SHRI BRAHMAGUPTA VIRACITA

BRĀHMA-SPHUṬA SIDDHĀNTA

WITH

Vāsanā, Vijñāna and Hindi Commentaries

Vol. I

FOREWORD

By

DR. SAMPURNANANAD

Governor-Rajasthan

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Shri S. K. Patil

Union Minister for Railways

श्रीब्रह्मगुप्ताचार्य-विरचित

ब्राह्मस्फुटसिद्धान्तः

(संस्कृत-हिन्दी-भाषायां वासनाविज्ञानभाष्याभ्यां समलंकृतः सोपपत्तिकः)

प्रथमो भागः

प्राक्कथन :

डा० सम्पूर्णानन्द-राज्यपाल-राजस्थान

प्रधानसम्पादक :

आचार्यवर पंडित रामस्वरूप शर्मा

(सञ्चालक-इण्डियन इंस्टीट्यूट आफ् ऐस्ट्रानौमिकल एण्ड संस्कृत रिसर्च)

प्रकाशक :

इण्डियन इंस्टीट्यूट आफ़ ऐस्ट्रानौमिकल एण्ड संस्कृत रिसर्च

२२३९, गुरुद्वारा रोड, क़रौलबाग़, न्यू देहली-५

प्रकाशक—
इंडियन इंस्टीट्यूट आफ़ ऐस्ट्रानौमिकल
एण्ड संस्कृत रिसर्च
२२३९, गुरुद्वारा रोड, क़रौल बाग़,
नई दिल्ली-५ (भारत)

⊙

भारत सरकार के शिक्षा मन्त्रालय द्वारा
प्रदत्त अनुदान से प्रकाशित ।

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प्रथम संस्करण
१९६६

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मूल्य रु० ८०.००

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मुद्रक :
पद्म श्री प्रकाशन एण्ड प्रिण्टर्स
१२ चमेलियन रोड,
दिल्ली ।

समर्पण :

श्रीयुत एस० के० पाटिल

यूनियन मिनिस्टर फ़ार रेल्वेज़

को

सादर समर्पित

Foreword

The Indian Institute of Astronomical & Sanskrit Research has done a very useful piece of work by publishing the Brāhma Sphuṭa Siddhānta. This is an original work on Astronomy written about twelve hundred years ago. Mainly devoting himself to Astronomy as was natural, the author, Brahma Gupta. has also given considerable space to such branches of Mathematics as in his opinion are particularly applicable to Astronomy. Brahma Gupta is not a mere theoriser. His work bears ample evidence of close observation of astronomical phenomena, though he did not have at his disposal any large and well equipped Vedhālaya or Observatory. He has had to find fault with some of his predecessors. The main reason for his criticism was as stated by him:

ब्रह्मोक्तं ग्रहगणितं महता कालेन यत् श्लथीभूतम् ।
अभिधीयते स्फुटं तज्जिष्णुसुतब्रह्मगुप्तेन ॥

The creator Brāhma himself had given certain calculations in his book namely Brahma Siddhānta. But in the course of many years these calculations have been found to have bocome inaccurate. Of course, in referring to calculations, the author is referring to the bases of these calculations, the main data of astronomy. The excellent and fairly exhaustive introduction by Dr. Satya Parkash is of very great help in understending the book because it brings out clearly the various points on which Brahma Gupta has laid stress, particularly those on which he differs from other great astronomers.

A great controversy still rages between two schools of Indian astronomers which for want of better names may be called the schools of Arya Bhata and Brahma Gupta. Some years ago the Indian Institute of Astronomical & Sanskrit Research published the Vateshwar Siddhānta which is supposed to be associated with the Arya Bhata School. It is, therefore. in the fitness of things that it should now publish the present standard volume of the other school.

To my mind the Publication of such books is of great value from two points of view. It helps to remove the ignorance of average educated Indian of today about the achievements of his ancestors. In the field of two important branches of science, Mathematics and Astronomy, it is really surprising how those ancient astronomers could reach such heigts of accuracy with the help of instruments which seem to be laughably crude compared to those that modern astronomers have at their disposal. At the same time a study of such literature is a very salutary corrective

to the vanity of those who feel that in astronomy as in certain other subjects the last word was said by those writers who have written in Sanskrit. We learn how far behind we are in certain very important directions in the field of knowledge.

It is interesting by the way to find that the author of this great work was a Vaishya. This shows how diffused knowledge even of the most abstract subjects was in those days and how Scholarship was honoured irrespective of caste. Not one the critics of Brahma Gupta has taunted him on the ground of his not being a Brahmana.

Sampurnanand
Governor-Rajasthan

Raj Bhavan,
Jaipur,
Dated May 4, 1966.

—:o:—

Observations

of

Dr. K. M. Munshi

President of the Reception Committee

The Author Shri Ram Swaroop Sharma has given to the world of scholars an excellent and valuable treatise on the famous Astronomer Brahma-Gupta, son of Jiṣṇugupta, born in 589 A. D. in Bhillamala or Srimala now in Southern Marwad close to the northern frontier of modern Gujarat. The work is divided into 13 chapters and at the end of each, the learned author has given reference to other works and treatises for further study as also in support of his various conclusions. He has described Astronomy in Ancient India in the light of the knowledge of the subject available in different countries in his time.

After giving personal details of Brahma-gupta, the author starts on a critical study of the works of that Astronomer-particularly his *Brahma-sphuta-siddhānta* and *Khandana-Khādya*. The author has also discussed the Indian Luni-solar Astronomy, the Greek and Hindu methods in spherical Astronomy and the Epicyclic theory of ancient Indians. Discussing in detail the contribution of Brahma Gupta in Arithmetic, Algebra, in Astronomy and the Astronomical instruments that he used, the author has brought out the various highlights of his work and achievements in comparison with those of his predecessors, successors and contemporaries in other countries.

The author deserves to be congratulated for this scholarly contribution on the subject of Ancient Indian mathematics and Astronomy.

—*K.M. Munshi*

Bhartiya Vidya Bhawan
Bombay

Publisher's Note

It is with pride and pleasure that the Indian Institute of Astronomical & Sanskrit Research brings out its second monumental work 'Brāhma Sphuṭa Siddhānta'. The Institute, set up on the 23rd November, 1957, with the object of promoting research into ancient Indian manuscripts on Astronomy and allied Sciences, started its programme of publication with the preparation of a critical edition of Vateshwara Siddhānta running into more than 700 pages. It was far back in early forties that the idea of reviving the treasures of knowledge hidden in ancient manuscripts came to my mind. In 1945 I could succeed in editing and publishing 'Trailokya Prakāśa' of Acharya Hema Prabha Sūri.

Ālbruni's Travel Accounts of India contain a reference to Vateshwara Siddhānta and this fact was responsible for prompting me to arrange publication of Vateshwar Siddhanta. It was rather difficult to search out this manuscript and the clue given by Mahamahopadhyaya Sudhākar Dwivedi (a great Mathematician and Astronomer of 19th century) that the manuscript was available in Gwalior did not lead me to any results. I kept my search on and found a copy of this text in the collection of manuscripts inherited by a Brahman widow of Gujranwala District in west Pakistan. The same style of copy was later seen by me in the Panjab University Library at Lahore.

Vateshwarāchārya, the great writer of Vateshwara Siddhānta, has criticised Brāhma Sphuṭa Siddhānta of Brahma Gupta, in his work. This naturally aroused my curiosity to procure and publish Brahma Sphuṭa Siddhānta so as to provide right perspective to the students of ancient Indian Scientific literature. Moreover, in one of my discussions with the late Dr. K. S. Krishnan, Director, National Physical Laboratories, New Delhi, he referred to Dr. Colebrook (a German Writer) as having translated into English two chapters of 'Brāhma Sphuṭa Siddhānta', namely, Vyakta (Arithmetic)and Ayakta(Algebra). The late Dr. Krishnan showed keen interest in this manuscript and encouraged me in taking up preparation of a critical edition of this text. The Institute is grateful to the Govt. of India (Department of cultural Affairs) for meeting part of the expenditure on this publication and thereby enabling us to complete our task.

I shall be failing in my duty if I do not mention the great and invaluable contribution made for the success of the Institute by its founder President the late Shri Brijlal Nehru. It was under his able guidance that the Institute started functioning and its various programmes were finalised. His passing away has been a big and irreparable loss to us The Institute will keep his memories always alive by following his ideals and by executing with zeal the programmes inspired by him.

I must take this opportunity to express my heartfelt gratitudes to Shri B. B. Varma, Member Parliament, who has never shirked in shouldering the responsibilities of managing the affairs of the Institute first as a member of its Executive Council and now as its President. I am also thankful to Dewan Hari Krishan Das, Chairman of the Executive Council and Shri F.C. Bedi Treasurer of the Institute for their ungrudging support to the cause of the Institute.

My thanks are also due to Dr. Sampurnanand, Governor Rajasthan, who has blessed the Institute by inaugurating it and has now been kind to write a foreword for the present book. I am also indebted to Dr. Satya Prakash, Head of the Deptt. of Chemistry, Allahabad University for his having spared time to write an introduction in English for this publication. He has always been cheerfully allowing us to draw on his rich experience and wealth of knowledge. I am also grateful to Pt. Mukund Mishra, Pt. Vishwa Nath Jha, Shri Daya Shankar Dixit and Pt. Om Datt Sharma, the learned scholars who helped me in preparing this work.

The book has been published in four volumes. Volume I includes introduction in English by Dr. Satya Prakash followed by the text as given in the copy of the manuscript obtained from the Bhandarkar Research Institute, Poona, with footnotes to collate the various versions found in the copies of the manuscripts procured from the Royal Asiatic Society, Bombay, the Oriental Research Institute, Baroda and the Vishweshwaranand Vedic Research Institute, Hoshiarpur. The volume also contains a Sanskrit Bhumika from the Chief Editor and an Index of Shlokas. Volume II comprises of the first nine chapters of Brāhma Sphuṭa Siddhānta containing only those readings which we have considered as correct. It also includes Vāsanā commentary of Pṛthūdaka Swāmi and Vigyān Bhashya in Sanskrit with Hindi translation. Volume III includes chapters 10 to 16. This volume also contains Nutan Tilak commentary of Sudhakar Dwivedi and Vigyan Bhashya in Sanskrit with Hindi translation. Volume IV comprises of chapters 17 to 24 and also an Index of Shlokas contained in Volumes II. III and IV. It also includes an appendix on Dhayāna Grhaopadeshādadhyāya. Another appendix in this volume contains Vāsanā commentary on Golādhyāya.

The Institute has planned to add to its list of publications, shortly, Samrāṭ Siddhānta (3000 pages and already in press). Bṛhad Yavan Jātaka (2000 pages) and Panch Siddhāntikā (1600 pages).

The Indian Institute of Astronomical & Sanskrit Research considers it a proud priviledge to dedicate Brāhma Sphuṭa Sidhānta to Shri S. K. Patil, Union Minister for Railways. I am highly grateful to him for his having consented to this dedication. I am also grateful to Shri K. M. Munshi and Shri Wadilal Chaturbhuj Gandhi for their kindly agreeing to my request to be President and Chairman respectively of the Reception Committee. My heart felt thanks are also due to Shri Kanti Lal H. Shah. Hony. Secy. of the Organising Committee and to all the members of the organising and the Reception Committees for their help and cooperation in my work. I also owe a debt of grati-

tude to the Patrons of the Institute : His Majesty the King of Nepal, Abhinaya Samrat. Shri Prithvi Raj Kapoor, Shri Dhairyasinh, R. Morarji, Chairman Dharamsi Morarji & Co., Bombay, Shri Pranlal Bhogilal, Patel Bombay for their invaluable help. I am also grateful to the life members of the Institute : H.H. Maharaja Manabendra Shah of Tehri Garhwal, Yuvraj P.C Dev, Shri B.N. Bhaskar, Shri R.K. Batra, Shri Sada Jivatlal Chandulal, Shri Shiv Kumar Bhuvalka, Shri Jamna Das H. Moorjani, Shri Shantilal K. Somaiya, Shri Kisonlal M. Diwanji, Solicitor, Shri N. K. Jalan, Shri D. R. Nayar, Shri Vadilal C. Gandhi, Shri Devi Prasad Khandelval, Shri Ram Prasad Khandelval, Shri B. K. Jalan, Shri Amir Chand T. Gupta, Shri Laxman Vaman Apte, Smt. Padma Koregaonkar, Shri Yodh Raj Bhalla for their support to the Institute.

I must make a special mention here of shri A. N. Jha, Chief Commissioner, Delhi, who has greatly encouraged me in my task of publishing old manuscripts. His help in solving the various problems faced by me, has been invaluable. I am highly grateful to him for his support in my cause. I am also grateful to H. H. Maharaja Manabedra Shah of Tehri Garhwal, Seth Sadajivat Lal, Smti. Padma Koregaonkar, Lala Yodh Raj Bhalla, Shri F.A Fazalbhai, Shri Morar J. Vaidya, Shri N. J. Aggarwal, Shri P. S. Naulakha, Shri R. L. Maheshwari, Shri D. N. Bhattacharjee, Shri P. A. Narialwala, Shri P. M. Aggrawal, Shri Shiv Kumar Bhuvalka, Shri Navin Bhai Khandwala and Smti. Nirmala Gomte, Lala Jagan Nath Ji, Shri L.S. Aggarwal, Shri B.N. Saxena, Shri R.B. Shah, Shri L.O. Joshi, Shri T.S. Krishnamurti, Shri R. S. Chitkara, Dr. Ram Karan Sharma, Shri V.P. Agnihotri, Shri K.L. Handa and Shri K.G. Somayya for their help and advice at various occasions.

Ram Swarup Sharma

Bombay
17-5-1966.

—:o:—

विषयानुक्रमणिका

—:o:—

भूमिका

ब्रह्मगुप्तकृतो ब्राह्मस्फुटसिद्धान्तः

श्रीचापवंशतिलके श्रीव्याघ्रमुखे नृपे शकनृपाणाम् ।
पञ्चाशत्संयुक्तैर्वर्षशतैः पञ्चभिरतीतैः ।।
ब्राह्मः स्फुटसिद्धान्तः सज्जनगणितज्ञगोलवित्प्रीत्यै ।
त्रिंशद्वर्षेण कृतो जिष्णुसुतब्रह्मगुप्तेन ।।

इति ब्राह्मस्फुटसिद्धान्तीयसंज्ञाध्याये आचार्योक्त्या ५२० शाकवर्षे-आचार्यस्य (ब्रह्मगुप्तस्य) जन्म समयस्ततः परं त्रिंशति वर्षेषु गतेषु तेन ब्राह्मस्फुटसिद्धान्तसंज्ञको ज्यौतिषसिद्धान्तग्रन्थो विरचितः[1]। गुर्जरदेशमध्ये भिनमाल नाम ग्राम एवास्य जन्मस्थानं बहूनां पाश्चात्यानां गवेषणया सिध्यति। गुर्जरदेशीयज्योतिर्विदां मुखकथातोऽपि भिल्लमालकोऽधुना भिनमालनाम्ना प्रसिद्धो ग्राम एवाऽऽचार्यस्य जन्मस्थानं सिध्यति। गुर्जरदेशोत्तरसीमायां मालव (माड़वार) देशतो दक्षिणस्यां दिशि आबूपर्वतलूणीनद्योर्मध्ये तत्पर्वताद्वायुकोणेऽयं भिनमालनामा ग्रामोऽधुना प्रसिद्धोऽस्ति।

विष्णुधर्मोत्तरपुराणान्तर्गतं ब्रह्मसिद्धान्तमागमीकृत्य ब्राह्मस्फुट सिद्धान्तो ब्रह्मगुप्तेन विरचितः। नलिकादिवेधद्वारेण दृग्गणितैक्यकारि—ग्रहादि साधनकारणात्प्राचीनं ब्रह्मसिद्धान्तं संशोध्य नवीनं ब्राह्मस्फुटसिद्धान्तं रचितवान् ब्रह्मगुप्तः।

ब्रह्मोक्तं ग्रहगणितं महता कालेन यत् खिलीभूतम् ।
अभिधीयते स्फुटं तज्जिष्णुसुतब्रह्मगुप्तेन ।।
संसाध्य स्पष्टतरं बीजं नलिकादियन्त्रेभ्यः ।
तत्संस्कृतग्रहेभ्यः कर्त्तव्यौ निर्णयादेशौ ।।

इत्याद्युक्त्या स्फुटं ज्ञायते। अस्य चतुर्वेदाचार्यपृथूदककृता तिलकसंज्ञिका टीका प्रसिद्धाऽऽसीत् साऽधुना सम्पूर्णा सम्प्रति नोपलभ्यते। 'कोलब्रूक' साहेबमहोदयैः सम्पूर्णा सा टीको (पृथूदक कृता) पलब्धा तद्बलेनास्य ग्रन्थस्य द्वादशाष्टादशाध्याययोर्व्यक्ताव्यक्तगणितसंज्ञयोराङ्गलभाषायामनुवादः १७३९ शाकवर्षे

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१. गुप्तपदान्ताद्वैश्यकुलोत्पन्नो रीवांनरेशस्य व्याघ्रभटेश्वरस्य प्रधानज्योतिषिक आसीदयमिति बहूनां मतमस्ति ।

(१८१७ खीष्टाब्दे) कृत इत्युपलभ्यते । अत्र ब्राह्मस्फुटसिद्धान्तेऽष्टाधिक सहस्र-१००८मिता आर्याः सन्ति, तथा पूर्वार्धे १. मध्यगतिः । २. स्पष्टगतिः । ३. त्रिप्रश्ना-ध्यायः । ४. चन्द्रग्रहणाध्यायः । ५. सूर्यग्रहणाध्यायः । ६. उदयास्तमयाध्यायः । ७. चन्द्रशृङ्गोन्नत्यध्यायः । ८. चन्द्रच्छायाध्यायः । ९. ग्रहयुत्यध्यायः, १० भग्रह-युत्यध्यायः, इति दशाध्यायाः सन्ति । परार्धे च १. तन्त्रपरीक्षाध्यायः । २. गणिताध्यायः । ३. मध्यगत्युत्तराध्यायः । ४. स्फुटगत्युत्तराध्यायः । ५. त्रिप्रश्नोत्तरध्यायः । ६. ग्रहणोत्तराध्यायः । ७. छेद्यकाध्यायः । ८. शृङ्गोन्न-त्युत्तराध्यायः । ९. कुट्टाकाराध्यायः । १०. छन्दश्चित्युत्तराध्यायः । ११. गोला-ध्यायः । १२. यन्त्राध्यायः । १३. मानाध्यायः । १४. संज्ञाध्यायः । इति चतुर्दशा-ध्यायाः सन्ति, पूर्वार्धपरार्धध्याययोर्योगेन चतुर्विंशतिरध्याया अत्र ग्रन्थे सन्ति । तेषु तन्त्रपरीक्षाध्यायो विचारार्हः । अत्र बहूनामाचार्याणां नामानि मतानि चाचार्येणोल्लिखितानि । यथा—

लाटात् सूर्यशशाङ्कौ मध्याविन्दूच्च चन्द्रपातौ च ।
कुजबुध शीघ्रबृहस्पति सितशीघ्र शनैश्चरान् मध्यान् ॥

युगयातवर्षभगणान् वासिष्ठाद्विजयनन्दिकृतपादात् ।
मन्दोच्चपरिधि-पात-स्पष्टीकरणाद्यमार्यभटात् ॥

श्रीषेणेन गृहीत्वा रत्नोच्चयरोमकः कृतः कन्था ।
एतानेव गृहीत्वा वासिष्ठो विष्णुचन्द्रेण ॥

अनयोर्न कदाचिदपि ग्रहणादिषु भवति दृग्गणितैक्यम् ।
यद्भवति तद्घुणाक्षरमतोऽस्फुटाभ्यां किमेताभ्याम् ॥

एभिः श्लोकैः श्रीषेणाचार्यकृतो रोमकसिद्धान्तः, विष्णुचन्द्रकृतश्च यो वासिष्टसिद्धान्तस्तयोर्दूषणमाहेति टीकाकृतश्चतुर्वेदाचार्यस्य कथनमस्ति । पञ्च-सिद्धान्तिकायां श्रीषेण विष्णुचन्द्रयोरनुल्लेखात् वराहमिहिराचार्यानन्तरं ब्रह्म-गुप्ततः पूर्वमेतौ ज्यौतिषसिद्धान्तग्रन्थरचयितारावास्ताम् ४२७ शाकवर्षात् पश्चात् ५५० शाकवर्षात्पूर्वं तयोः (श्रीषेण विष्णुचन्द्रयोः) रोमकसिद्धान्तो वासिष्ठ-सिद्धान्तश्चातिगणितस्थौल्यमापन्नाविति स्वयं वेधद्वारा स्थिरीकृत्यैवाऽऽचार्येण (ब्रह्मगुप्तेन) प्रौढोक्त्या 'यद्भवति तद्घुणाक्षर'मित्यादि कथ्यते । अत्रार्यभटस्य सिद्धान्तः सर्वत्रैव दोषावह एवेति वदन्नप्याचार्यो (ब्रह्मगुप्तः) बहुधैव तदुक्तीरेव खण्डयितुं ग्रन्थमरचयत् । यथा भूभ्रमणं खण्डयति—

प्राणेनैति कलां भूर्यदि तर्हि कुतो व्रजेत् कमध्वानम् ।
आवर्तनमुर्व्याश्चेन्न पतन्ति समुच्छ्रयाः कस्मात् ॥

पृथिव्याश्चलत्वं भगणानां स्थिरत्वं स्वीकृत्य—अहोरात्रासुभिः स्वाक्षोपरि पृथिव्या भ्रमणं मन्यते आर्यभटेनेति—आवर्त्तनमुर्व्याश्चेदित्याद्युक्तिः। अन्यत्रानेका अत्युक्तयो दुराग्रहवशात् कुत्रचिद्वाग्बलेन कथिता ब्रह्मगुप्तेन यथा—

स्वयमेव नाम यत्कृतमार्यभटेन स्फुटं स्वगणितस्य ।
सिद्धं तदस्फुटत्वं ग्रहणादीनां विसंवादात् ॥

जानात्येकमपि यतो नार्यभटो गणितकालगोलानाम् ।
न मया प्रोक्तानि ततः पृथक् पृथक् दूषणान्येषाम् ॥

आर्यभटदूषणानां संख्या वक्तुं न शक्यते यस्मात् ।
तस्मादयमुद्देशो बुद्धिमताऽन्यानि योज्यानि ॥

स्वयं ग्रहग्रहणादिवेधकर्त्ता ब्रह्मगुप्तः प्राचीनाचार्येभ्योऽनेकान् विशिष्टान् ग्रहादिसाधनविधीन् गणितसत्यासत्यपरीक्षार्थं वेधविधींश्च स्वग्रन्थे प्रौढोक्त्या प्रतिपादयति—

ज्ञातं कृत्वा मध्यं भूयोऽन्यदिने तदन्तरं भुक्तिः ।
त्रैराशिकेन भुक्त्या कल्पग्रहमण्डलानयनम् ॥

यदि भिन्नाः सिद्धान्ता भास्करसंक्रान्तयोऽपि भेदसमाः ।
स स्पष्टः पूर्वस्यां विषुवत्यर्कोदयो यस्य ॥

इत्यादिना वास्तवविचारासक्तः सर्वप्रथमं सर्वतो विशिष्टं विवेचनाबहुलं सिद्धान्तग्रन्थं ब्रह्मगुप्त एव रचितवानित्युपलब्धज्यौतिषसिद्धान्तग्रन्थेभ्यो ज्ञायते। 'कृती जयति जिष्णुजो गणकचक्रचूडामणि' रितिस्वसिद्धान्तशिरोमणेर्गणिताध्यायारम्भे भास्कराचार्येण ब्रह्मगुप्तमभिवन्द्य तत्परमपि बहुत्रस्थले ब्रह्मगुप्तमतोल्लेखं कुर्वताऽपि 'यथाऽत्रग्रन्थे ब्रह्मगुप्तस्वीकृतागमोऽङ्गीकृत' इत्युक्त्या तद्ग्रन्थानुसारी ग्रन्थो रचित इति प्रतीयते। ब्रह्मगुप्तेनायनचलनं नोपलब्धमिति ब्रह्मस्फुटसिद्धान्ततो ज्ञायते । अयनचलनोपलब्धिः प्रत्युत खण्डितेति दृश्यते यथा—

परमल्पामिथुनान्ते द्युरात्रिनाड्योऽर्कगतिवशादृतवः ।
नायनयुगमयनवशात् स्थिरमयनद्वितयमपि तस्मात् ॥

वराहमिहिरोऽयनचलनसम्बन्धे सन्दिहान आसीदिति 'नूनं कदाचिदासीद्येनोक्तं पूर्वशास्त्रेषु' इति तत्कथनेन ज्ञायते । तत्समयेऽश्विन्यादौ क्रान्तिपात आसीदित्यश्विन्यादि नक्षत्रगणना प्रवृत्ता सैव ब्रह्मगुप्तात्परमद्यावधि प्रचलति ।

पञ्चषष्टया वर्षैः क्रान्तिपातः प्राय एकमंशं पश्चिमदिश्यपसरति तज्ज्ञानं स्वल्प-कालेनासम्भव इवेति वेधविज्ञेनापि ब्रह्मगुप्तेनायनचलनं नोपलब्धमिति । आर्य-भटविरोधी भूत्वापि ब्रह्मगुप्तो ब्राह्मस्फुटसिद्धान्तरचनानन्तरं सप्तत्रिंशत्तमे वर्षे खण्डखाद्यकं नामकरणग्रन्थं रचितवान् यथा तत्प्रारम्भे—

प्रणिपत्य महादेवं जगदुत्पत्तिस्थितिप्रलयहेतुम् ।
वक्ष्यामि खण्डखाद्यकमाचार्यार्यभटतुल्यफलम् ॥

प्रायेणार्यभटेन व्यवहारः प्रतिदिनं यतोऽशक्यः ।
उद्वाहजातकादिषु तत्समफललघुतरोक्तिरतः ॥

इति तदुक्तग्रन्थपर्यालोचनया ज्ञायते यत्सर्वत्र व्यवहारकर्तां मानवानां मध्ये प्रचरितार्यभटमत निराकरणमतीव कठिनमासीदिति—'आर्यभटमतानुसारि-व्यवहरतां तात्कालिकजनानामुपकारायैव व्यावहारिकः करणग्रन्थः खण्डखाद्यक-नामको रचितो ब्रह्मगुप्तेन। यथोपलब्धेषु प्राचीनज्यौतिषसिद्धान्तग्रन्थेषु ब्राह्म-स्फुटसिद्धान्त आदर्शरूपो ग्रन्थस्तथैव सर्वेषां करणग्रन्थानामादर्शरूपमादिमं वा इतस्त्रयोदशशतवर्षैः प्राचीनं खण्डखाद्यकं करणम् । अथ 'ब्रह्माह्वयश्रीधरपद्म-नाभबीजानि यस्मादति विस्तृतानि' इति बीजगणिते भास्करोक्त्या ज्ञायते यद्ब्रह्मगुप्तस्य विपुलो बीजगणित ग्रन्थ आसीत्परमयं ग्रन्थः कुत्रापि नोपलभ्यते न वा श्रूयते । ब्रह्मगुप्त एव सर्वापेक्षया श्रीपतेरादर्शभूतः । ब्राह्मस्फुटसिद्धान्त-सिद्धान्तशेखरयोः पर्यालोचनया ज्ञायते यद् ब्रह्मगुप्तोक्ताः संक्षिप्ता बहुलार्थयुक्ता आर्या एव बृहदाकारैश्छन्दोभिरनूदिताः श्रीपतिना। वस्तुतो ब्रह्मगुप्तोक्तं ग्रह-गणितं सूक्ष्मं ज्ञात्वा सत्यमिव तदेव स्वीकुर्वन् श्रीपतिस्तदुक्तिवैषम्यं स्वसुन्दर-रचनाभिरपहरन् सुगमतरं ग्रन्थांतरं (सिद्धान्त शेखरं) चकार, नात्र केषामपि विप्रतिपत्तिः। ग्रन्थरचनासम्बन्धे श्रीपतेर्विशेषतो लल्लाचार्य एवादर्शः । ये केचन विषया ब्रह्मगुप्तेन न कथिता अथ लल्लेन कथितास्तान् सर्वानिव नियतमेव श्रीपतिः श्लोकान्तरेण तथैव कथितवान् । वस्तुतो द्वयोर्ग्रन्थयोः (ब्राह्मस्फुट सिद्धान्तशिष्यधीवृद्धिदयोः) परिशीलनं कृत्वा श्रीपतिना सिद्धान्तशेखरो रचितः । ब्राह्मस्फुट सिद्धान्ते येषामाचार्याणां नामानि समागतानि सन्ति तेषां सम्बन्धे किञ्चिद्विविच्यते। सर्वेषां सिद्धान्तानामादिमः सर्वेभ्यः प्राचीनो वा ब्रह्मसिद्धान्त एव, स एव कैश्चित् पितामहसिद्धान्तनाम्नाप्युच्यते । पञ्चसिद्धान्तिकायां वराहमिहिरेण द्वादशोऽध्याय आर्यापञ्चात्मकः पैतामहसिद्धान्तः कथितो यथा—

रविशशिनोः पञ्चयुगं वर्षाणि पितामहोपदिष्टानि ।
अधिमासस्त्रिंशद्भिर्मासैरवमस्त्रिषष्ट्याऽह्नाम् ॥

द्व्यूनं शकेन्द्रकालं पञ्चभिरुद्धृत्य शेषवर्षाणाम् ।
द्विगुणं माघसिताद्यं कुर्याद् द्युगणं तदन्ह्यु दयात् ॥२॥
सैक षष्ट्यंशे गणे तिथिर्भमार्कं नवाहतेऽक्ष्यर्कैः ।
दिग्रसभागैः सप्तभिरूनं शशिभं धनिष्ठाद्यम् ॥३॥
प्रागर्धे पर्व यदा तदोत्तराऽतोऽन्यथा तिथिः पूर्वा ।
अर्कघ्ने व्यतिपाता द्युगणे पञ्चाम्बरहुताशैः ॥४॥
द्व्यग्निनगेषूत्तरतः स्वमितमेष्य दिनमपि याम्यायनस्य ।
द्विघ्नं शशिरसभक्तं द्वादशहीनं दिवसमानम् ॥५॥

एतदनुसारेणैकस्मिन् युगे सौरवर्षाणि=५, सौरमासाः=५×१२=६० । अधिमासौ=२ । चान्द्रमासाः=६२ एते त्रिंशद्गुणितास्तिथयः=१८६०, अवमानि=३०, एभी रहितास्तिथयोऽहर्गणः=१८३० इति ॥

पञ्च सिद्धान्तिकायां 'पौलिश सिद्धान्तः' इति नाम्ना एकोऽध्यायो वर्त्तते, ब्राह्मस्फुट सिद्धान्तटीकायां पृथूदकेन बहून्येव पौलिशसिद्धान्तवचनानि प्रमाणत्वेनोद्धृतानि सन्ति । अस्य सिद्धान्तरचयितुः सम्बन्धे बहूनि मतान्तराणि सन्ति । वराहोक्तपौलिशसिद्धान्ते यवनपुरात् उज्जयिन्या वाराणस्याश्च देशान्तरमुल्लिखितमस्ति । यथा—

यवनाच्चरजा नाड्यः सप्तावन्त्यां त्रिभागसंमिश्राः ।
वाराणस्यां त्रिकृतिः साधनमन्यत्र वक्ष्यामि ॥

शाकल्यसंहितोक्त ब्रह्मसिद्धान्ते पुलिशसिद्धान्तोल्लेखो वर्त्तते । ब्राह्मस्फुटसिद्धान्तटीकायां पृथूदकेन 'देशान्तर रेखा च पौलिशे पठ्यते' इत्युक्तम् । तथा च पुलिशाचार्यः—

उज्जयिनी रोहीतककुरुयमुनाहिमनिवासमेरूणाम् ।
देशान्तरं न कार्यं तल्लेखामध्यसंस्थदेशेषु ॥'

इत्यादि विचारेण पौलिशसिद्धान्तः सर्वमान्य आसीदिति प्रतिभाति । परमयं सिद्धान्तः साम्प्रतं नोपलभ्यते इति ।

सूर्य सिद्धान्त एव प्राचीनतमः सर्वप्रथमः सिद्धान्तग्रन्थ इति बहूनां विदुषां मतम् ।

'केचित्प्रत्यक्षसूर्याच्च भिन्नोऽयमिति यद्बलात् ।
वदन्ति मूढवादस्याप्रामाण्यात्तदसद्ध्रुवम् ॥'

इति कमलाकरोक्तया स्वयं भगवान् सूर्य एवास्य रचयिता। आश्चर्य्यस्य विषयोऽयमस्ति यदत्रा (सूर्यसिद्धान्ते) यनांशानयनम्।

'त्रिंशत्कृत्यो युगे भानां चक्रं प्राक् परिलम्बते।
तद्गुणाद्भूदिनैर्भक्ताद् द्युगणाद्यदवाप्यते ॥'
'तद्दोस्त्रिघ्ना दशाप्तांशा विज्ञेया अयनाभिधाः।
तत्संस्कृताद् ग्रहात् क्रान्तिच्छाया चरदलादिकम् ॥'

इत्यनेन कृतमस्ति। परं ब्राह्मस्फुटसिद्धान्तनिर्मात्रा ब्रह्मगुप्तेन तस्य (अयनांशस्य) चर्चाऽपि न कृता। कथं ब्रह्मगुप्तेन तच्चर्चा न कृतेति न ज्ञायते। सूर्य सिद्धान्तस्योदयास्ताधिकारे 'अभिजिद् ब्रह्महृदयं स्वातीवैष्णव वासवाः' इत्यादिना सदोदित नक्षत्राणि भगवता सूर्येण कथितानि सन्ति, अस्य श्लोकस्य सुधावर्षिणी टीकायां 'देशज्ञानं विना सदोदित नक्षत्राणां ज्ञानं न भवति निरक्षे च सौम्यध्रुवोऽप्यदृश्योऽतः केनचिद्गोलानभिज्ञेनायं श्लोकः प्रक्षिप्त, इति यल्लिखितमस्ति तत्समीचीनं नास्ति। पाताधिकारे पातस्थितिकालस्य फलं—

आद्यन्तकालयोर्मध्यः कालो ज्ञेयोऽतिदारुणः।
प्रज्वलज्ज्वलनाकारः सर्वकर्मसु गर्हितः ॥
एकायनगतं यावदर्केन्द्वोर्मण्डलान्तरम्।
सम्भवस्तावदेवास्य सर्वकर्मविनाशकृत् ॥
स्नानदानजपश्राद्धव्रतहोमादिकर्मभिः।
प्राप्यते सुमहच्छ्रेयस्तत्कालज्ञानतस्तथा ॥

इत्यनेन पातस्थितिकालः सर्वकर्मविनाशकृदुक्तः। पातकाले स्नानदानजपश्राद्धव्रतहोमादिकर्मभिर्महत्कल्याणं प्राप्यते लोकैरिति। तथा च—

रवीन्द्वोस्तुल्यता क्रान्त्योर्विषुवत्सन्निधौ यदा।
द्विर्भवेद्धि तदा पातः स्यादभावो विपर्ययात् ॥

इत्यनेनापूर्वविषयः कथितोऽर्थाद्रविगोलसन्धिसमीपे यदा रविचन्द्रयोः क्रान्तिसाम्यं भवेत्तदाऽल्पेनैव कालेन द्विवारः पातः स्यात्। यदा रव्ययनसन्धिसमीपे क्रान्तिसाम्याभावस्तदा वहुकालपर्यन्तं क्रान्ति साम्याभावः स्यादिति।

ब्राह्मस्फुटसिद्धान्तेऽपि पातस्थितिकालफलं सूर्यसिद्धान्तोक्तवत्कथितम्। सिद्धान्तशेखरे कियत्कालपर्यन्तं पातफलमिति 'भानोर्बिम्बं तुहिनकिरणापक्रमेणैकमार्गे यावत्तावन्मुनिभिरुदितसंभवस्तत्फलस्य। तस्याभावे भवति नियतं

तत्फलस्याप्यभावो यात्रोद्वाहादिषु पुनरिह द्युत्रयं नैव दुष्टम् ॥' अनेन कथितम्, अर्थात्सूर्यविम्बं तुहिनकिरणापक्रमेण (चन्द्रस्य स्पष्टक्रान्त्या सह) यावत्कालपर्यन्तमेकमार्गे (एकस्मिन्नहोरात्रवृत्तेऽर्थाद्यावत् क्रान्त्योर्विवरं मानैक्यार्धादल्पं भवति यथा बिम्बैकदेशजक्रान्त्योः साम्यं भवतीत्यर्थः।) तावत् मुनिभिः फलादेशकृद्भिः पातसंजातफलस्य संभवः कथितः। तस्य सूर्यस्य चन्द्रस्य स्पष्टक्रान्त्या सहैकमार्गावस्थानाभावे तत्फलस्याप्यभावो भवति। इह पुनः पातस्थितिकाले यात्रोद्वाहादिषु मङ्गलकार्येषु दिनत्रयं दुष्टं नैव। केषुचित्फलग्रन्थेषु व्यतीपातवैधृतयोः सतोस्तद्दिनं तत्पूर्वदिनमपरदिनं चेति दिनत्रयं शुभकार्ये निषिद्धमिति कैश्चिदुक्तं तत्परिहारार्थमाह—द्युत्रयं नैव दुष्टम्। सूर्यसिद्धान्तादिषु पातकाल एव शुभकार्येषु दोषभाक् गते पातकाले च दोषो न भवतीति। प्रसङ्गादत्र सिद्धान्तशेखरवचनोल्लेखः कृतः। यतः श्रीपतिराचार्या(ब्रह्मगुप्तात्) दर्वाचीनोऽस्ति। ब्राह्मस्फुट सिद्धान्ते तन्नामोल्लेखो नास्ति।

भारतीयानां ज्योतिर्विदां मध्ये आर्यभट एव सर्वप्रथमं दिनरात्र्योः कारणस्वरूपं पृथिव्या आवर्त्तनं कथयति। यथा गीतिकापादस्य प्रथमश्लोके एकस्मिन् महायुगे ४३२०००० भूमेर्भगणाः १५८२२३७५०० एतावन्तो भवन्तीति प्रथमं कथयित्वा दृष्टान्तद्वारेण भूभ्रमणं—

अनुलोमगतिर्नौस्थः पश्यत्यचलं विलोमगं यद्वत्।
अचलानि भानि तद्वत् समपश्चिमगानि लङ्कायाम्॥

अनेन दृढीकरोति। परमत्र विचित्रमेतदवलोक्यते यदार्यभटीय टीकाकारेण परमेश्वरेणैतत्-श्लोकस्यावतरणं 'भूमेः प्राग्गमनं नक्षत्राणां गत्यभावञ्चेच्छन्ति केचित्तन्मिथ्याज्ञानवशादुत्पन्नां प्रत्यग्गमन प्रतीतिमङ्गीकृत्य भूमेः प्राग्गतिरभिधीयते। परमार्थतस्तु स्थिरैवभूमिः' इत्युक्तम्। स्वयमप्यार्यभटः—

उदयास्तमय निमित्तं नित्यं प्रवहेण वायुना क्षिप्तः।
लङ्कासमपश्चिमगो भपञ्जरः सग्रहो भ्रमति॥

इत्यनेन भूभ्रमणमस्वीकरोतीति दृश्यन्ते। आर्यभटस्य मनसि निश्चयो नासीद्यत् पृथिवी चलति-नवा चलति। ब्रह्मगुप्तेनैकमपूर्वं वस्तु 'नतकर्म' प्रतिपादितम्। मन्दफल-शीघ्रफल-भुजान्तरादि संस्कारेण यो हि स्पष्टग्रहः समागच्छति स स्वगोलीयः (ग्रहगोलीयः) स ग्रहोऽस्माकं यत्र प्रत्यक्षीभूतो भवति स एवास्माकं स्पष्टग्रहो भवितुमर्हति। स्वगोलीयस्पष्टग्रहे यावता संस्कारेणास्माकं स्पष्टग्रहो भवति तस्यैव संस्कारस्य नाम 'नतकर्म' ब्रह्मगुप्ततः केऽपि प्राचीना आचार्या एतस्य (नतकर्मणः) नामोल्लेखं न कृतवन्तः। भास्कराचार्येण सिद्धान्त-

शिरोमणेर्गणिताध्यायस्य स्पष्टाधिकारे-एतस्याऽनयन प्रकारोऽभिहितः । 'मुहुः स्फुटातो ग्रहणे रवीन्द्वोस्तिथिस्त्विदं जिष्णुसुतो जगाद' इति भास्करोक्तेर्ज्ञायते यदेतस्याविष्कर्त्ता ब्रह्मगुप्त एवास्ति । भास्कराचार्येण भोग्यखण्डस्पष्टीकरणं यदभिहितं तन्मूलमपि ब्राह्मस्फुटसिद्धान्तस्य ध्यानग्रहोपदेशाध्याये ब्रह्मगुप्तोक्तमेव, न ह्यन्यैराचार्यैस्तत्सम्बन्धे किमपि लिखितम् । कमलाकरेण तु सिद्धान्ततत्वविवेके भास्करोक्तभोग्यखण्डस्पष्टीकरणस्य खण्डनमेव कृतम् । वस्तुतः कमलाकरोक्तं खण्डनं न समीचीनम् । ब्राह्मस्फुटसिद्धान्ते त्रिप्रश्नाधिकारे दिक्साधने 'पूर्वापरयोर्बिन्दू तुल्यच्छायाग्रयोर्दिगपराद्यः । पूर्वान्यः क्रान्तिवशात् तन्मध्याच्छङ्कुतल मितरे' इत्यत्र क्रान्तिवशाद्दिक्साधने कथं भेद उत्पद्यते तदर्थं चतुर्वेदाचार्येण कर्णवृत्ताग्रान्तरं यत्साधितं तदेव 'छायानिर्गमनप्रवेशसमयार्कक्रान्तिजीवान्तरमि' त्याद्युक्त्या श्रीपतिना, तदनु 'तत्कालापम जीवयोस्तुविवराद्दि' त्यादिना भास्करेण च गृहीतम् । मन्दफलानयने वस्तुतो मन्दकर्णानुपातेनैव मन्दफलं सिध्यति । यद्यप्यत्र भास्करेण स्वमतं न प्रतिपादितं तथापि चन्द्रग्रहणे स्फुटरविचन्द्रकर्णसाधने 'मन्दश्रुतिर्द्राक्श्रुतिवत् प्रसाध्या' इत्यादिना ब्रह्मगुप्तस्यैव मतं स्वीकृतमित्यपि ब्रह्मगुप्तोक्तेर्वैलक्षण्यमस्ति । लल्लाचार्येण वलनदृक्कर्मणोरानयनमुत्क्रमज्ययाकृतमिति ब्रह्मगुप्तोक्तौ 'अत्र ज्याशब्देनोत्क्रमज्या ग्राह्येति' चतुर्वेदाचार्यव्याख्यानमेव लक्ष्यीकृत्य भास्करेण 'ब्रह्मगुप्तकृतिरत्रसुन्दरी साऽन्यथा तदनुगैर्विचार्यते' इत्युक्तम् ।

'युगमन्वन्तरकल्पाः कालपरिच्छेदकाः स्मृतावुक्ताः ।
यस्मान्न रोमके ते स्मृतिवाह्यो रोमकस्तस्मात् ॥'

(ब्राह्मस्फुट सिद्धान्त अध्याय १)

इति ब्रह्मगुप्तोक्त्या 'रोमक' इति नाम्ना चायं कस्यचित्पाश्चात्यज्योतिर्विदो मूलमादाय रोमकसिद्धान्तो रचित इति स्फुटं भवति । प्राचीनाचार्याणां मध्ये केवलं ब्रह्मगुप्त एव रोमकमतं खण्डयति । वराहमिहिरस्तु रोमक सिद्धान्तमतेनाहर्गणादीनां बहूनामेव सिद्धान्तोक्तविषयाणां साधनं स्वीकरोति । ब्रह्मगुप्तः—

ब्रह्मोक्तं ग्रहगणितं महता कालेन यत् खिलीभूतम् ।
अभिधीयते स्फुटं तज्जिष्णुसुतब्रह्मगुप्तेन ॥

इत्युक्त्वा ब्रह्मसिद्धान्तमेव संस्कृतवानिति स्फुटमेव । तदेतेषां मूलरूप एको ब्रह्मसिद्धान्तोऽतिप्राचीन आसीदिति सिद्धयति । ब्रह्मगुप्तस्तु—

'येऽज्ञानपटलरुद्धदृशोऽन्यं ब्राह्माद्वदन्ति सिद्धान्तम् ।
तेषां युगादिभेदे ये दोषास्तान् प्रवक्ष्यामि ॥'

इत्युक्त्याऽन्यान् सर्वान् सिद्धान्तान्निन्दन्ति । ब्राह्मस्फुटसिद्धान्ते बहुषु स्थलेषु स्थौल्यं त्वस्त्येव तथापि बहवो विषया अत्र निवेशिताः सन्ति, तस्मात्सर्वश्रेष्ठो ब्राह्मस्फुटसिद्धान्तोऽस्तीतिकथने न काचिद्विप्रतिपत्तिः प्रतिभाति । अत्रैकोऽध्यायो 'छन्दश्चित्युत्तराध्यायः' अस्ति, यत्र लिखितानां श्लोकानां व्याख्योपपत्तिश्चाद्यावधि केनापि न कृता तेषु तादृशं काठिन्यमस्ति यदर्थो न मनसि समागच्छति, उपपत्तेश्च कथैव का ?, प्रश्नाध्यायो यादृशोऽत्र ग्रन्थेऽस्ति न तादृशोऽन्येषु सिद्धान्तग्रन्थेषु । अत्र ग्रन्थे मध्यगत्यादीनां पञ्चाध्यायानां प्रश्नाः सोत्तराः पृथक् पृथक् लिखिताः सन्ति । येषामभ्यासेन पाठका अतीव सिद्धान्तग्रन्थे निपुणा भवितुमर्हन्ति । सिद्धान्तशिरोमणेर्भूमिकायां 'जीवासाधनं विनैव यद्भुजज्यानयनं कृतवान् श्रीपतिस्तत्त्वपूर्वमेव स्यात् । यथा तत्प्रकारो विदां विनोदाय प्रदर्श्यते –

दोः कोटिभागरहिताभिहताः खनागचन्द्रास्तदीयचरणेन शरार्कदिग्भिः ।
ते व्यासखण्डगुणिता विहृताः फलं तु ज्याभिर्विनापि भवतो भुजकोटिजीवे ॥

इति केनापि लिखितमस्ति तन्नैव युक्तियुक्तं यतो ज्याभिर्विना भुजकोटिज्ययोरानयनं ज्यातश्चापानयनं च सर्वप्रथमं ब्रह्मगुप्तेनैव कृतम् यथा तदुक्तप्रकारः –

भुजकोट्यंशोनगुणा भार्धांशास्तच्चतुर्थभागोनैः ।
पञ्चद्वीन्दुखचन्द्रैर्विभाजिता व्यासदलगुणिता ॥
तज्ज्ये परमफलज्या सङ्गुणिता तत्फले विना ज्याभिः ।
इष्टोच्चनीचवृत्तव्यासार्धं परमफलजीवा ॥[1]

इष्टज्यातश्चापानयनञ्च

इष्टज्यासङ्गुणिताः पञ्चकयमलैकशून्यचन्द्रमसः ।
इष्टज्यापादयुतव्यासार्धं विभाजिता लब्धम् ॥
नवतिकृतेः प्रोह्यपदं नवतेः संशोध्य शेषभागकलाः ।
एवं धनुरिष्टाया भवति ज्याया विना ज्याभिः ॥

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१. चिरादेव प्रकारोऽयं श्रीपत्युक्तोऽस्तीति ज्योतिर्विदां मध्ये प्रसिद्धोऽस्ति । तथैव ज्यातश्चापानयनमपि । एतदवलम्ब्यैव ग्रहलाघवे करणग्रन्थे गणेशदैवज्ञेन बहवः प्रकारा विलिखिताः ।

एतदनुरूप एव बटेश्वरसिद्धान्ते बटेश्वरेण स्वीयप्रकारोऽभिहितः। सिद्धान्तशेखरे सर्वत्र श्रीपतेः स्वकीयः प्रकारोऽल्पीयानेवास्ति, ब्रह्मगुप्तोक्त-प्रकारा एव छन्दोऽन्तरेण लिखिताः सन्ति[1] वराहोक्त पञ्चसिद्धान्तिकायां त्रयोदशभिरार्याभिरुक्तो वासिष्ठसिद्धान्तः पैतामहसिद्धान्तश्च वराहोक्त्यैव दूरभ्रष्टाविति तत्रापि ब्रह्मसिद्धान्तापेक्षया यत्किञ्चित् वासिष्ठसिद्धान्तः सूक्ष्मताभियायि। तन्त्रपरीक्षाध्याये—

लाटात् सूर्यशशाङ्कौ मध्याविन्दूच्च चन्द्रपातौ च।
कुजबुधशीघ्रबृहस्पति सितशीघ्रशनैश्चरान् मध्यान्॥
युगजातवर्ष भगणान् वासिष्ठाद्विजयनन्दिकृत पादात्।
मन्दोच्चपरिधिपातस्पष्टीकरणाद्यमार्यभटात्॥
श्रीषेणेन गृहीत्वा रत्नोच्चयरोमकः कृतः पन्थाः।
एतानेव गृहीत्वा वसिष्ठो विष्णुचन्द्रेण॥

इति ब्रह्मगुप्तोक्त्या वसिष्ठसिद्धान्तरचयिता विष्णुचन्द्रनामकः कश्चिदासीत्। सम्भवतोऽयं विष्णुचन्द्रः प्राचीनं वसिष्ठसिद्धान्तं संस्कृतवानिति 'एतानेव गृहीत्वा वासिष्ठो विष्णुचन्द्रेण' इत्युक्त्या स्फुटं भवति। परमयं ग्रन्थोऽधुना कुत्रापि नोपलभ्यते। एतस्यैव विष्णुचन्द्रस्य मतं यत्र तत्र श्रीषेणार्यभटाभ्यां सह ब्रह्मगुप्तेन खण्डितम्।

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१. यथोदाहरणार्थं किञ्चित्प्रोच्यते। सिद्धान्तशेखरस्य सूर्यग्रहणाधिकारे।

तिथ्यन्तात् स्थितिखण्डहीन सहितात् प्राग्वत्ततो लम्बनं
कुर्यात् प्रग्रहमोक्षयोः स्थितिदलं युक्तं विधायासकृत्।
तन्मध्यग्रहणोत्थलम्बनभुवा विश्लेषणानेहसा
मर्दार्धोनयुताथितेरपि तथा संमीलनोन्मीलने॥
अधिकमृणयोराद्यं मध्यात्तथाऽन्त्यमिहाल्पकं भवति
धनयोश्चाद्यं हीनं यदाऽधिकमन्तिमम्।
नमनविवरेणैवं कुर्याद्विहीनमतोऽन्यथा स्थितिदल-
मृणस्वस्थे भेदे तदैक्ययुतं पुनः॥

इति ब्रह्मगुप्तोक्तस्या—

प्राग्वल्लम्बनमसकृत् तिथ्यन्तात् स्थितिदलेन हीनयुतात्।
अधिकोनं तन्मध्याद्दणयोरूनाधिकं धनयोः॥
यद्यधिकं स्थित्यर्धं तदाऽन्तरेणान्यथोनमृणमेकम्।
अन्यद्धनं तदैक्येनाधिकमेवं विमर्दार्धे॥

(शेष पृष्ठ ११ पर)

न च श्रीपतिरेव निजपूर्ववर्त्तिनां ग्रन्थकाराणां ग्रन्थेभ्यस्तदुक्तविषयान् छन्दोऽन्तरेण तथैव निबध्य स्वग्रन्थे स्वोक्त्या लिखितवानपितु तत्पूर्ववर्तिनां ग्रन्थकाराणामपि सैव रीतिः। परवर्त्तिनो भास्कराचार्यादयोऽपि न तां रीतिममुञ्चन्निति प्रत्यक्षदर्शनादेव स्फुटीभवति।

यथा भास्कराचार्यः—गणिताध्यायस्य मध्यमाधिकारे सिद्धान्तग्रन्थलक्षणं ज्योतिः शास्त्रस्य वेदाङ्गत्व निरूपणं वेदाङ्गानां नामानि वेदाङ्गेषु ज्योतिः शास्त्रस्य प्राधान्यं तच्च द्विजैरेव पठनीयमिति सर्वं परतोऽपि भचक्रचलनं काल-

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ऽस्य सर्वथा सदृशमेव तथा च प्रकारान्तरेण स्फुट स्थिति दल साधनं श्रीपत्युक्तम्।

स्पित्यर्धोनयुतात् परिस्फुटतिथेः स्याल्लम्बनं पूर्ववत्
तन्मध्यग्रहवेच मध्यमतिथो ततस्तु तिथौ।
स्थित्यर्धेन परिस्फुटेषु जनितेनोनाधिकाद्वाऽसकृत्
तत्तिथ्यन्तर नाडिकाः स्थितिदले स्तः स्पर्शमुक्त्योः स्फुटे॥

अस्य श्लोकस्य द्वितीयं चरणं शुद्धं नास्ति। प्रकारोऽयं ब्रह्मगुप्तोक्तस्या—

स्फुटतिथ्यन्ताल्लम्बनमसकृत् स्थित्यर्धहीनयुक्ताद्वा।
तत्स्फुट विक्षेपकृत स्थित्यर्धोनयुततिथ्यन्तात्॥
तत्स्पष्टतिथिच्छेदान्तरे स्फुटे दिनदले विहीनयुतात्।
स्व विमर्दार्धेनासकृदेवं स्पष्टे विमर्दार्धे॥

ऽस्य पुनरुक्तिरेव। सिद्धान्तशिरोमणौ—

तिथ्यन्ताद्गणितागतात् स्थितिदलेनोनाधिकाल्लम्बनं
तत्कालोत्थनतींषु संस्कृति भव स्थित्यर्धहीनाधिके।
दर्शान्ते गणितागते धनमृणं वा तद्विधायासकृज्
ज्ञेयौ प्रग्रहमोक्ष संज्ञसमयावेवं क्रमात् प्रस्फुटौ॥

भास्करोक्तमपि सर्वथैव तदनुरूपमेवास्ति। एवं सिद्धान्तशेखरस्य सूर्यग्रहणाध्यायोपसंहारे स्फुटं भवति पञ्चजीवया लम्बनं नहि यतस्ततः कृतम्। युक्तमुक्तमिति जिष्णुसूनुना तन्मयाऽपि कथितं परिस्फुटम् इति ब्रह्मगुप्तोक्तस्या—

दृग्गणितैक्यं न भवति यस्मात् पञ्चज्यया रविग्रहणे।
तस्माद्यथा तदैक्यं तथा प्रवक्ष्यामि तिथ्यन्ते॥

ऽस्य सदृशमेव। मध्यगत्यध्यायतो ग्रन्थ समाप्ति यावत्साहृश्यस्यैवमेव स्थितिरिति द्वयोर्ग्रन्थयो 'ब्राह्मस्फुट सिद्धान्त सिद्धान्तशेखरयोः' रवलोकनेन स्फुटं भवतीति।

प्रवृत्तिः। कालमानानां परिभाषाः सर्वाः, ग्रहाणां भगणाः, युगानां मन्वादीनां नामानि मानानि च ब्रह्मणो गतवर्षादिः प्रयोजनाभाव इत्यादि सर्वमपि मध्यमाधिकारोक्तं श्रीपतेः साधनाध्यायोक्तश्लोकानां श्लोकान्तरमात्रमेवाकरोत्। सुधियो ग्रन्थाभ्यन्तरे ग्रन्थकारयोरानुरूप्यमवलोकयन्तु। एवं प्राचीनकृतेरनेकान् विशेषान् प्रवक्तुमेव श्रीपतिः प्रथमं (साधनाध्यायं) ग्रहभगणाध्यायं वा कृतवान्। तत्परं मध्यमाध्यायेसप्तभिः प्रकारैरहर्गणानयनं, कदा प्रभृति वारप्रवृत्तिरित्यत्र बहूनामाचार्याणां मतानि, तद्दूषणपुरःसरस्वाभिमतवारप्रवृत्तिकथनं, मध्यमग्रहसाधनार्थं बहून्येव नूतनानि प्रकारान्तराणि, रव्यादीनां सर्वेषामपि ग्रहाणां राश्यादिमन्दोच्चकथनमित्यादयो वहवोऽपि श्रीपतिकृताप्राचीनकृतेर्विशेषा वर्त्तन्ते।

ब्राह्मस्फुट सिद्धान्ते बहुभिरेव प्रकारैरहर्गणानयनं लघ्वहर्गणानयनं ब्रह्मगुप्तेन कृतं, आचार्योक्ताहर्गणानयनस्यानुकरणमेव श्रीपतिना कृतम्। परं सिद्धान्तशेखरे लघ्वहर्गणानयनस्य चर्चा ग्रन्थकृता न कृता। अहर्गणाद्वारज्ञानार्थमहर्गणः सैकः कार्य इति ब्रह्मगुप्तेन श्रीपतिना च कथितः। परमहर्गणो निरेकोऽपि कर्त्तव्यो वारज्ञानार्थमिति सिद्धान्तशिरोमणौ 'अभीष्टवारार्थमहर्गणश्चेत्सैको निरेकस्तिथयोऽपि तद्वदि'त्यनेन भास्कराचार्यः कथयति। वटेश्वरसिद्धान्तेऽपि बहुभिः प्रकारैरहर्गणानयनं लघ्वहर्गणानयनं च तद्ग्रन्थकृता कृतमस्ति। भास्कराचार्यस्तु महदहर्गणानयनं 'कथितकल्पगतोऽर्कसमागण' इत्यादिना, लघ्वहर्गणानयनं च 'चैत्र सितादिगतस्थिति संघ' इत्यादिना कृतम्। यद्यपि लघ्वहर्गणानयने स्थौल्यं वर्त्तते तथाप्येकमपूर्वं वस्तु प्रतिपादितम्। वटेश्वरकृतं लघ्वहर्गणानयनं स्थौल्यरहितं नास्ति, एतदतिरिक्तैः प्राचीनाचार्यैर्नवीनैश्च लघ्वहर्गणानयनं न कृतं प्रत्युत कमलाकरेण भास्करकृतलघ्वहर्गणानयनस्य खण्डनमेव कृतम्। स्फुटगत्यध्याये सर्वैरेवार्यभटब्रह्मगुप्त लल्लाचार्यादिभिर्वृत्तचतुर्थांशे चतुर्विंशतिः क्रमज्या उत्क्रमज्याश्च तत्त्वाश्वि २२५ कलावृद्ध्या साधितास्तत्र आर्यभटस्य लल्लस्य च त्रिज्या=३४३८, ब्रह्मगुप्तस्य खमुनिरद ३२७०मिता त्रिज्या, श्रीपतिना चैतद्भिन्ना ३४१५ त्रिज्या गृहीता ब्रह्मगुप्तोक्तभूपरिधिः=५०००, भास्कराचार्यमतेन पादोनगोक्षधृतिभूमितयोजनानीत्यनेन ग्रहाणां योजनगतिः=११८५८।४५। गतियोजनतिथ्यंशः कुदलस्य यतोमितिरित्यनेन भूव्यासः=१५८१, भूपरिधिः=४९६७ ग्रहाणां भुजान्तरकर्म प्रतिपादितमस्ति, सूर्यसिद्धान्तोक्त भुजान्तरकर्मवदेवास्ति, सिद्धान्तशेखरे, सिद्धान्तशिरोमणावपि भुजान्तरकर्मण उपपादनमाचार्योक्तवदेवास्ति, अन्येऽपि बहवो विषयादर्शनीयाः पठनयोग्याश्चेति।

त्रिप्रश्नाधिकारे रवेर्मध्यान्हकालिकनतांशान् ज्ञात्वा तद्वशतो रव्यानयनार्थं प्रथमतः क्रान्तिज्यासमागच्छति। ततोऽनुपातेन रवेर्भुजांशज्ञानं भवति।

भुजांशतो राश्यादिरवेर्ज्ञानं पदाधीनं तत्र पदज्ञानोपायः प्राचीनैः कैश्चिन्न कृतः, यथाऽत्राचार्येण—

'क्रान्तिर्व्यासार्धगुणा जिनभागज्याहृता धनुरजादौ।
कर्क्यादौ चक्रार्धात्प्रोह्य तुलादौ सचक्रार्धम् ॥

चक्रार्धात्प्रोह्यमृगादौ स्फुटो सकृत् व्यस्तमृणं धनं मध्यम्। अर्कोऽस्मादिति' एतेन रवेरानयनं कृतम्। श्रीपतिना 'अजतुलादिगतस्य विवस्वतो दिनदलप्रभयो-र्युतिरर्धिता। भवति वैषुवती निजदेशजे' त्यनेन पलभामानं ज्ञात्वा—
'आद्येपदेऽपचयिनी पलभाऽल्पिका स्यात् छायाल्पिका भवति वृद्धिमती द्वितीये।
छायाधिका भवति वृद्धिमती तृतीये तुर्येपुनः क्षयवती तदनल्पिका च ॥
वृद्धिं प्रयान्ती यदि दक्षिणाग्रच्छाया तथापि प्रथमं पदं स्यात्।
ह्रासं व्रजन्तीमथ तां विलोक्य रवेर्विजानीहि पदं द्वितीयम् ॥'

इत्यनेन गोलयुक्तिसिद्धं पदज्ञानं कृतम्। अत्र भास्कराचार्यः—

क्रान्तिज्या त्रिज्याघ्नी जिनभागज्योद्धृता दोर्ज्या।
तद्धनुराद्ये चरणे वर्षस्यार्कः प्रजायतेऽन्येषु ॥
भाधाच्च्युतः सभार्धो भगणात्पतितोऽब्द चरणानाम्।
ऋतुचिन्हैर्ज्ञानं स्यादृतुचिन्हान्यग्रतस्ततो वक्ष्ये ॥'

इत्यनेनाचार्योक्तवदेव कथितवान् केवलं 'ऋतुचिन्हैर्ज्ञानं स्यादिति' विशेषं कथितवान्। पदज्ञानार्थमृतुवर्णननामकमेकमधिकारं सिद्धान्तशिरोमणेर्गोला-ध्यायेऽभिहितम्। भास्करतो नवीनाः कमलाकरतः प्राचीनाः सर्वेऽपि सिद्धान्त-ग्रन्थकर्तारो ज्यौतिषसिद्धान्तस्यैकमङ्गं ज्ञात्वा स्वस्वसिद्धान्तग्रन्थे निश्चितरूपेण 'ऋतुवर्णनाध्यायं,' प्रोक्त'वन्तः। सिद्धान्ततत्त्वविवेके आद्ये पदेऽपचयिनी पलभाऽल्पिका स्या' दित्यादि श्रीपत्युक्त पदज्ञानबोधक श्लोकद्वयं लिखित्वा कमलाकरेण—

'ऋतुचिह्नैरिदं पूर्वैरुक्तं सर्वत्र तन्न हि।
केवलं कुकविप्रीत्यै पदज्ञप्तयै न तद्रवेः ॥'

इत्यनेन भास्करोक्त ऋतुवर्णनं निन्दितम्। वस्तुतः 'सर्वत्र तन्नही'ति कमलाकरोक्तं यथार्थमेव। परं पदज्ञान प्रकारोऽयं श्रीपत्युक्त इति कमलाकरेण नोक्तः। सिद्धान्तशेखरस्याप्राप्तौ प्रकारोऽयं कमलाकरस्यैवेत्याधुनिका ज्योतिर्विदो जानन्त आसन्। यदि रवेः पदज्ञानार्थं कोऽपि प्रकारः प्राचीनैर्यथार्थतो नोक्तस्तदा प्रकारस्यास्य रचयिता श्रीपतिरवश्यमेव सर्वेषां ज्योतिर्विदां प्रशंसापात्रमित्यत्र न कोऽपि सन्देहः। महदाश्चर्यं चैतद्यत् श्रीपतिकृतमिदं गोलयुक्तियुक्तं पदज्ञानं

त्यक्त्वा भास्कराचार्येण ऋतुवर्णनद्वारा पदज्ञानं समीचीनं ज्ञात्वा कृतमिति। चन्द्रग्रहणाध्याये रविचन्द्रभुवां योजनबिम्बानि, रविचन्द्रयोर्योजनात्मककर्ण-स्पष्टीकरणं, भूभा बिम्बानयनं, ग्रासमानाद्यानयनं, परिलेखप्रकारश्चाचार्येरुक्तः, श्रीपतिना भास्कराचार्येण च कथनक्रममादाय विशेषतया तथैवानूदितः। ब्रह्म-गुप्तकृत एव सूर्यग्रहणाधिकारः श्रीपतिना प्रायः श्लोकान्तरैरुक्तः। उदयास्तमया-ध्याये आयनदृक्कर्मसाधनं कृतं परं तन्न समीचीनं श्रीपतिनाऽपि प्राचीनोक्तं तदानयनं कृत्वा—

खनभोधृतिभिः समाहतं प्रथमं दृक्फलमायनाह्वयम्।
द्युचराश्रितभोदयासुभिर्विहृतं स्पष्टमिह प्रजायते॥

इत्यनेन तत्स्फुटीकरणं कृतं, एतदवलोक्य भास्कराचार्येण 'आयनं वल-नमस्फुटेषुणा सङ्गुणमि' त्यादिना तदेवोक्तम्। चन्द्राध्याये ब्रह्मगुप्तेन बहवो-विषयाः प्रतिपादिताः सन्ति, श्रीपतिना तु वराहब्रह्मगुप्तलल्लाचार्याणां बहवः श्लोका अनूदिताः। वस्तुतो नास्ति कश्चिद्विशेषः। केवलं चन्द्रस्य स्पष्टचरा-नयने परिलेखसूत्रप्रमाणानयने च बहून्येव प्रकारान्तराणि स्फुटोक्त्या लिखि-तानि सन्ति। वराहब्रह्मगुप्तलल्लाचार्यैरुदयान्तरकर्म नोक्तं ग्रहयुत्यध्याये (ग्रह-युद्धाध्याये-ग्रहयोगाध्याये वा)—

अन्त्यभ्रमेणगुणिता रविबाहुजीवाऽभीष्टभ्रमेण विहृता फलकार्मुकेण।
बाहोः कलासु रहितास्ववशेषकं ते यातासवो युगयुजोः पदयोर्धनर्णम्॥

इत्यनेन श्रीपत्युक्तं दृग्गणितैक्यकृत् कर्मैव भास्कराचार्येण उदयान्तर-कर्मेति नाम्नोक्तम्। सिद्धान्तशेखरस्याप्राप्तौ भास्कराचार्येणैवानुभूतमिदं कर्मे-त्याधुनिकानां गणकानां प्रतीतिरासीत्। इदमुदयान्तरकर्म प्रथमं श्रीपतिरेव स्वकीय विचारेण कथयामासेति ज्ञायते। तथा च—

त्रिभविरहितचन्द्रोच्चोनभास्वद्भुजज्या गगननृपविनिघ्नी भत्रयज्या विभक्ता।
भवति चरफलाख्यं तत्पृथक्स्थं शरघ्नं हृतमुडुपतिकर्णत्रिज्ययोरन्तरेण॥१॥
परमफलमवाप्तं तद्धनर्णं पृथक्स्थे तुहिन किरणकर्णे त्रिज्यकोनाधिकेऽथ। स्फुट-दिनकर हीनादिन्दुतो या भुजज्या-स्फुटपरमफलघ्नी भाजिता त्रिज्ययाऽऽप्तम्॥२॥
शशिनिचरफलाख्यं सूर्यहीनेन्दुगोलात् तद्दृणमुतधनं चेन्दूच्चहीनार्कगोलम्।
यदि भवति हि साम्यं व्यस्तमेतद्विधेयं स्फुटगणितदृगैक्यं कर्त्तुमिच्छद्भिरत्र॥३॥

श्लोकत्रयेणानेन दृग्गणितैक्यार्थं श्रीपतिना चन्द्रे संस्कारविशेषो दत्तः। कस्मिन्नपि प्राचीनग्रन्थे नायं संस्कारो लिखितो वर्त्तते। यद्यपि—

इन्दूच्चोनार्ककोटिघ्ना गत्यंशा विभवा विधोः ।
गुणो व्यर्केन्दुदोः कोटचोरूपपञ्चाप्तयोः क्रमात् ॥
फले शशाङ्कतद्गत्योर्लिप्ताद्ये स्वर्णयोर्वधे ।
ऋणं चन्द्रे धनं भुक्तौ स्वर्णसाम्यवधेऽन्यथा ॥

इत्यनेनैतादृश एव चन्द्रसंस्कारो मुञ्जालाचार्येण 'लघुमानस'नामके करणग्रन्थे कथितः । परमेतयोः सदृशत्वाभावात्—श्रीपतिना वेधेन दृष्ट्वा ततो भिन्नोऽयं कथित इति प्रतिभाति । श्रीपत्युक्तोऽयं संस्कारो भास्कराचार्येणासकृद्-दृष्ट्वा विवेचितस्तत्र स्वोपलब्धेर्विस्तारपूर्वकं प्रतिपादनार्थमेको 'बीजोपनय' नामको ग्रन्थः ५९ श्लोकात्मकः सिद्धान्तशिरोमणि रचनैकवर्षानन्तरं—

मयाय बीजोपनये यदन्ते सूर्योक्तमाद्यं परमं रहस्यम् ।
प्रकाशये गोप्यमपीह देवं प्रणम्य बीजं जगतां हितार्थम् ॥१॥
यद्यपि पूर्वमपीदं संक्षेपादुक्तमागमोक्तदिशा ।
नैतावतैव कश्चित् दृक्करणैक्याय कल्पते गणकः ॥२॥
दृक्करणैक्यविहीनाः खेटाः स्थूला न कर्मणामर्हाः ।
अत इह तदर्हतायै तात्कालिकबीजविस्तरं वक्ष्ये ॥३॥
पाता रवेस्तामसकीलकाख्यास्तेषां समाकर्षणतः शशाङ्कः ।
तत्तुङ्गशक्तिश्च निजस्वभावं विहाय नित्यं विषमत्वमेति ॥४॥
चन्द्राच्च तद्योगवियोगतश्च साध्यं हि भाद्यं विषमं यतः स्यात् ।
तस्माद्विधोरत्र विशुद्धिशुद्ध्यै विस्तार्यते बीजफलक्रियेयम् ॥५॥
एकेन पुंसा निखिलग्रहाणामन्तं प्रबोधो नहि शक्यतेऽतः ।
व्यासात्समासाच्च यथोपलब्धं प्रोक्तं मयेत्यादरणीयमेतत् ॥६॥

इत्यादिना सिद्धान्तशिरोमणिवद्वासनाभाष्यसहितो विरचित इति । भग्रहयोगाध्याये—

कृत्वापि दृष्टिकर्म श्रीषेणार्यभटविष्णुचन्द्रोक्तम् ।
प्रतिदिनमुदयेऽस्ते वा न भवति दृग्गणितयोरैक्यम् ॥१॥
भमुनिमृगव्याधानां यतस्ततो दृष्टिकर्म वक्ष्यामि ।
दृग्गणितसमं देयं शिष्याय त्रिरोषितादेयम् ॥२॥

इति ब्रह्मगुप्तेन पाण्डित्यपूर्णमुक्तम् । एतदेव यथार्थं बुध्वा तदुक्तो (ब्रह्म-गुप्तोक्तः) भग्रहयुत्यध्यायः सम्पूर्णोऽपि स्फुटोक्त्याऽनूदितः श्रीपतिनेति ।

ब्राह्मस्फुटसिद्धान्तोत्तरार्धे परिकर्मविंशतिः (सङ्कलितम्, व्यवकलितम्, प्रत्युत्पन्नो गुणनम् । भागहारः, वर्गः, वर्गमूलम्, घनः, घनमूलम् । पञ्चजातयः, त्रैराशिकम्, व्यस्तत्रैराशिकम्, पञ्चराशिकम्, सप्तराशिकम्, नवराशिकम्, एकादशराशिकम्, भाण्डप्रति भाण्डं चेति) कथिताऽस्ति, सर्वत्रैव चतुर्वेदाचार्योक्ता उद्देशकाः (उदाहरणानि) सन्ति । सिद्धान्तशेखरेऽपि परिकर्मविंशतिः (अभिन्नाङ्कानां गुणन-भजन-वर्ग-वर्गमूल-घन-घनमूलानीति षट् ६, भिन्नाङ्कानां योगान्तर-गुणन-भजन-वर्ग-वर्गमूलानीति षट् ६, भाग प्रभाग-भागानुबन्ध-भागापवाहाख्य-जाति चतुष्टयम् ४, विलोमकर्म १, त्रैराशिकम् १, व्यस्त त्रैराशिकम् १, पञ्चराशिकम् १, इति) ब्रह्मगुप्तश्रीपत्युक्त विंशत्यां परिकर्मसु विषयवर्णने महानेव भेदोऽस्ति तद्विंशतेः परिकर्मणां नामानि बहुधा भिन्नानि सन्ति । भास्करोक्त-प्रकीर्णविषयाः (सङ्कलिततो भाण्डप्रतिभाण्डं यावत्) यादृशाः स्फुटरूपेण वर्णिताः सन्ति न तादृशा ब्रह्मगुप्तश्रीपत्योः परिकर्मविंशत्युक्तविषयाः । विषयास्तु ब्रह्मगुप्तौ-श्रीपत्युक्तौ-भास्करोक्तौ-समाना एव किन्तु तत्प्रति पादनरीतयो भिन्ना भिन्नाः सन्ति । एवमष्टौ व्यवहाराः (मिश्रक व्यवहारः, श्रेढी व्यवहारः, क्षेत्रव्यवहारः, खातव्यवहारः, चिति व्यवहारः, क्राकचिक व्यवहारः, राशिव्यवहारः, छायाव्यवहारः) ब्राह्मस्फुटसिद्धान्ते, सिद्धान्तशेखरे भास्करीय लीलावत्यां च सन्ति, एतेष्वष्टसु व्यवहारेष्वपि बहुधैवान्यादृशत्वमस्ति, सर्वेषु व्यवहारेषु ब्रह्मगुप्तोक्तश्रीपत्युक्तव्यवहाराभ्यां भास्करोक्तव्यवहारेषु-विषयाधिक्यं-विषय-प्रतिपादन स्फुटत्वं चास्ति, ग्रन्थत्रया (ब्राह्मस्फुटसिद्धान्तः, सिद्धान्तशेखरः, लीलावती च) वलोकनेनेति स्फुटं भवति, एतत्परं प्रश्नाध्यायोऽस्ति यत्र मध्यगत्युत्तराध्यायः, स्फुटगत्युत्तराध्यायः । त्रिप्रश्नोत्तराध्यायः । ग्रहणोत्तराध्यायः । शृङ्गोन्नत्युत्तराध्यायः । एतेषु पञ्चसूत्तराध्यायेषु सोत्तराः प्रश्नाः सन्ति, प्रश्नाश्चातीव विलक्षणाः सन्ति, येषामभ्यासेन पाठका अतीव ज्यौतिषसिद्धान्तविषयेषु-निपुणा भवितुमर्हन्ति प्रत्यध्यायमीदृशः सोत्तरप्रश्नक्रमलेखः किञ्चित् किञ्चिद्वटेश्वर-सिद्धान्ते-सिद्धान्तशेखरे चावलोक्यते । सिद्धान्तशिरोमण्यादौ नायं क्रमोऽस्ति । एतत्परं प्रश्नसहितः कुट्टकाध्यायोऽस्ति, ब्रह्मगुप्तोक्तकुट्टकाध्याये[1] श्रीपत्युक्त-भास्करोक्ताभ्यां विषयाधिक्यमस्ति किन्तु विषयकथनस्फुटता भास्करोक्तावेवास्ति, धनर्णादीनां सङ्कलितव्यवकलितादि-भास्करोक्तवदेवास्ति-सिद्धान्त-शेखरेऽपि, ततः परमेकवर्णसमीकरणं बीजमस्ति, भास्करोक्तैकवर्ण समीकरण-बीजतोऽल्पमेवास्ति । ततः परमनेकवर्णसमीकरणबीजमस्ति, ब्रह्मगुप्तमिदमपूर्व-

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१. ब्रह्मगुप्तोक्त कुट्टकाध्याये बहवः प्रश्नास्तादृशाः सन्ति येषामुत्तरमतीवाऽऽनन्द-जनकमस्ति, येषामभ्यासेन पाठकास्तत्सम्बन्धिविषयाणामतिज्ञातारो भवितु-मर्हन्तीति ।

मस्ति, अत्र विषयाश्चाप्यधिकाः सन्ति, भास्करोक्तमप्यनेकवर्णसमीकरणबीजं विषयाधिक्येन सहितं विद्यते। किन्तु सिद्धान्तशेखरेऽतीव स्वल्पं तद्विद्यते। भावित-बीजं ब्रह्मगुप्तोक्ताच्छ्रीपत्युक्तं स्वल्प भास्करोक्तं चाधिकं विद्यते, सर्वत्रैव भास्क-रोक्तौ वैशद्यं वर्त्तते। एतत्परं वर्गप्रकृतिरस्ति, कनिष्ठे ज्येष्ठक्षेपाणां योगभावना-ऽन्तरभावना च ब्रह्मगुप्तोक्तादेवाऽऽदाय श्रीपतिना भास्करेण च विलिखिता, परं श्रीपतिना भावनास्वरूपं न प्रतिपादितम्। वर्गात्मकप्रकृतौ कनिष्ठज्येष्ठयो-रानयनं ब्रह्मगुप्तोक्तमेव बीजगणिते भास्करेण लिखितम्। परं श्रीपतिना तत्स-म्बन्धे किमपि न लिखितम्। शङ्कुच्छायादिज्ञानाध्यायो ब्रह्मगुप्तस्यापूर्वं वस्तु वर्त्तते सिद्धान्तशेखरे भास्करीय ग्रन्थे चैतदध्यायोक्ता विषया न सन्ति, वस्तुतो दर्शनीयोऽयमध्यायः। छन्दश्चित्युत्तराध्यायस्त्वेतादृशोऽस्ति, यत्रस्थश्लोकोपप-त्तीनां का कथा तद्व्याख्याऽप्यतिकठिना तेनैव हेतुनाऽद्यावधि तद्व्याख्योपपत्तिश्च कैरपि न लिखिता। गोलाध्याये-भूगोलसंस्थानं-देवासुरसंस्थानं-चक्रभ्रमण-व्यवस्थादेवादीनां रविभ्रमणस्थितिः, देवदैत्यानां राशिसंस्थानं-देवादीनां रवि-दर्शनकालः, भूगोले लङ्कावन्तीसंस्थानमित्यादयो विषयाः सन्ति—

भूपरिधितुर्यभागे लङ्काभूमस्तकात् क्षितितलाच्च।
लङ्कोत्तरतोऽवन्ती भूपरिधेः पञ्चदशभागे॥

इत्यनेन लङ्कोत्तरतो भूपरिधिपञ्चदशभागेऽवन्ती वर्त्तत इत्याचार्येण कथ्यते, आचार्यानुयायी भास्कराचार्यः सिद्धान्तशिरोमणेर्गोलाध्याये 'निरक्षदेशात् क्षितिषोडशांशे भवेदवन्ती' इति कथितवान्, चतुर्वेदाचार्यसम्मतः पाठश्च 'पञ्च-दशभागे, अयमेव, अत्राध्याये-आचार्योक्ता बहवो विषयाः सूर्यसिद्धान्तीयभूगोला-ध्याये तथैव सन्ति, मध्ये मध्ये उभयत्र (आचार्योक्ताध्याये-सूर्यसिद्धान्तीय-भूगोलाध्याये) विषयान्तराण्यपि सन्ति, सिद्धान्तशेखरस्य गोलाध्याये श्रीपति-नाऽपि कियन्तो विषया आचार्योक्तसदृशा एव कथिताः। 'यन्मूले तद्व्यासो मण्डललिप्ताकृतेर्दशहृतायाः' इत्यनेन परिधितो व्यासानयनं सूर्यसिद्धान्तोक्त 'तद्वर्गतो दशगुणात्पदं परिधिरि'त्यादेर्विलोमेन परिधितो व्यासानयनवदस्ति, श्रीपतिनापि 'कालः स्यात्परिधेर्वर्गाद्दिग्भक्ताच्च पदं त्विहे'ति प्रकारानुकूलैव त्रिज्या-तिथियुगाग्नि ३४१५ मिताऽस्तीति स्वीकृता भास्कराचार्येण 'व्यासे भनन्दाग्नि-हते विभक्ते खबाणसूर्यैः परिधिः सुसूक्ष्मः' इत्यनेन व्यासात्परिध्यानयनं कथ्यते। एतद्विलोमेन परिधितो व्यासानयनं भवेत्। परं केषामपि व्यासात्परिध्यानयनं परिधितो व्यासानयनं वा न समीचीनं तयोः (परिधव्यासयोः) सम्बन्धस्या-स्थिरत्वादिति।

ज्याप्रकरणे—आचार्येण यथा चापार्धांशज्याद्यानयनं कृतं तथैव सिद्धान्त-शेखरे श्रीपतिना सिद्धान्तशिरोमणेर्गोलाध्याये भास्करेण च कृतमिति तद्ग्रन्था-

वलोकनात्स्फुटमस्ति । भास्करेण 'अन्त्यज्योत्पत्त्यौ' बहवो विशेषाः प्रतिपादिताः सन्ति ।

स्फुटगतिवासनायां—मन्दफलसाधनेऽपि कर्णानुपातेन यत्फलं तदेव समीचीनमिति कर्णः कथं न कृत इत्यस्य कारणम्—

त्रिज्याभक्तः परिधिः कर्णगुणो बाहुकोटिगुणकारः ।
असकृन्मान्दे तत्फलमाद्यसमं नात्रकर्णोऽस्मात् ॥

कथितम् । सिद्धान्तशेखरे—

त्रिज्याहृतः श्रुतिगुणः परिधिर्यतोदोः कोटयोर्गुणो मृदुफलानयनेऽसकृत्स्यात् ।
स्यान्मान्दमाद्यसममेव फलं ततश्च कर्णः कृतो न मृदुकर्मणि तन्त्रकारैः ॥

इति श्रीपत्युक्तश्लोक आचार्यो (ब्रह्मगुप्तो)क्त श्लोकस्यानुवादरूप एव, भास्कराचार्येणापि—

स्वल्पान्तरत्वान्मृदुकर्मणीह कर्णः कृतो नेति वदन्ति केचित् ।
त्रिज्योद्धृतः कर्णगुणः कृतेऽपि कर्णे स्फुटः स्यात्परिधिर्यतोऽत्र ॥
तेनाद्यतुल्यं फलमेति तस्मात् कर्णः कृतो नेति च केचिदूचुः ।
नाशङ्कनीयं न चले किमित्थं यतो विचित्रा फलवासनाऽत्र ॥

इह कर्णेन यत्फलमानीयते तदेव समीचीनम् । यन्मन्दकर्मणि कर्णो न कृतस्तत्स्वल्पान्तरादिति कथ्यते । मन्दकर्मणि मन्दकर्णतुल्येन व्यासार्धेन यद्वृत्तं तत्कक्षावृत्तम् । तेन ग्रहो गच्छति । यो मन्दपरिधिः पाठपठितः स त्रिज्यापरिणतः । अतोऽसौ कर्णव्यासार्धे परिणाम्यते । यदि त्रिज्यावृत्तेऽयं परिधिस्तदा कर्णवृत्ते क इति स्फुटपरिधिः । ततः स्वेनाहते परिधिना भुजकोटिजीवे भांशैरित्यादिना यत्फलमागच्छति तत्त्रिज्यया गुणितं कर्णेनभक्तं यल्लब्धं तत्पूर्वफलतुल्यमेव फलमागच्छतीति ब्रह्मगुप्तमतम् । अथ यद्येवं परिधेः कर्णेन स्फुटत्वं तर्हि किं शीघ्रकर्मणि न कृतमित्याशङ्क्य चतुर्वेदः कथयति—ब्रह्मगुप्तेनान्येषां प्रतारणपरमिदमुक्तमिति । तदसत् । चले कर्मणीत्थं किं न कृतमिति नाशङ्कनीयम् । यतः फलवासना विचित्राऽस्तीति । अन्यत्सर्वं पूर्वकथितमेवेति ।

ग्रहणवासनायां—छादकनिर्णयं कृत्वा राहुकृतं ग्रहणं न भवतीति वराहमिहिरादीनां मतं प्रतिपाद्य संहितामतमवलम्ब्य तन्निराकृतम् ।

राहुकृतं ग्रहणद्वयमागोपालाङ्गनादि सिद्धमिदम् ।
बहुफलमिदमपि सिद्धं जपहोमस्नानफलमत्र ॥

लोक प्रथेयमिति कथयित्वा राहुकृतं ग्रहणं भवतीत्यत्र स्मृति वाक्यं वेदवाक्यं च प्रतिपादितम्। युक्त्या राहुकृतं ग्रहणं न भवति। परन्तु स्मृतिषु-पुराणेषु वेदेषु च राहुकृतं ग्रहणं प्रतिपादितमस्त्यतोऽत्र द्वयोर्मतयोः समन्वयः—

राहुस्तच्छादयति प्रविशति यच्छुक्लपञ्चदश्यन्ते।
भूछाया तमसीन्दोर्वरप्रदानात् कमलयोनेः॥
चन्द्रोऽम्बुमयोऽधःस्थो यदग्निमयभास्करस्य मासान्ते।
छादयति शमिततापो राहुश्छादयति तत् सवितुः॥

आचार्येण कृतः। सिद्धान्तशिरोमणेर्गोलाध्याये भास्कराचार्येण भूभाकृतं चन्द्रग्रहणम्। चन्द्रकृतं सूर्यग्रहणं प्रतिपाद्य स्मृतिपुराणादिमतेन साकं समन्वयार्थं—

राहुः कुभामण्डलगः शशाङ्कं शशाङ्कगश्छादयतीव बिम्बम्।
तमोमयः शम्भुवरप्रदानात्सर्वागमानामविरुद्धमेतत्॥

इति कथितम्। सिद्धान्तशेखरे राहुकृतग्रहणखण्डनार्थमेको 'राहुनिराकरणाध्यायः' नामकोऽध्यायोऽस्ति।[1] गोलबन्धाधिकारे महद्वृत्तानां (पूर्वापरवृत्त-याम्योत्तरवृत्त क्षितिजवृत्तादीनां) लघुवृत्तानां (मेषादिद्वादशराशीनामहोरात्र-वृत्तानि) रचनां बिधाय परमलम्बनावनत्योः स्वरूपं प्रतिपाद्य दृक्कर्मानयनं कृतमाचार्येण, यथाऽत्र ब्राह्मस्फुटसिद्धान्ते ब्रह्मगुप्तेन गोलबन्धः प्रतिपादितस्तथैव सिद्धान्तशिरोमणौ चास्ति। ग्रहर्क्ष गोलयोः पञ्च स्थिरवृत्तानि (पूर्वापरम्, याम्योत्तरम्, क्षितिजम्, उन्मण्डलम्, बिषुवन्मण्डलम्) इति प्रतिपादितानि, एतानि कक्षामण्डलतुल्यानि महद्वृत्तानि ज्ञेयानि। ग्रहाणां चलवृत्तानि च—

मन्दनीचोच्चवृत्तानि = ७, भौमादीनां शीघ्रनीचोच्चवृत्तानि = ५। मन्द-प्रतिवृत्तानि—७, शीघ्रप्रतिवृत्तानि = ५ दृग्मण्डलं, दृक्क्षेपमण्डलं कक्षामण्डलं

१. शिद्धान्तशेखरे सूर्यचन्द्रयोर्ग्रहणयोराहोरकारणत्वेऽपि लोकमतश्रुति स्मृति संहितानां यथैक्यं भवति तथा तत्प्रतिपादनाय राहोरेव ग्राहकत्वं कथ्यते यथा—

विष्णुलूनशिरसः किल पङ्गोर्दत्तवान् वरमिमं परमेष्ठी।
होमदानविधिना तव तृप्तिस्तिग्मशीतमहसोरुपरागे॥
भूमेश्छायां प्रविष्टः स्थगयति शशिनं शुक्लपक्षावसाने।
राहुर्ब्रह्मप्रसादात् समधिगतवरस्तत्तमो व्यासतुल्यः॥
ऊर्ध्वस्थं भानुबिम्बं सलिलमयतनोरप्यधोवर्त्ति बिम्बं
संसृत्यैवं च मासव्युपरतिसमये स्वस्य साहित्यहेतोः।

चेति सप्तानां ग्रहाणाम्=२१, चन्द्रादीनां विमण्डलानि=६ सर्वेषां योगश्चल-वृत्तान्येक पञ्चाशत् सन्तीति, सिद्धान्त शेखरेऽप्येवमेवास्ति यथा—

मन्दोच्चनीचवलयानि भवन्ति सप्त शैघ्र्याणि पञ्च च तथा प्रतिमण्डलानि ।
दृक्क्षेप दृष्टचपमजानि च खेचराणामर्कं विनैव खलु षट् च विमण्डलानि ॥
पञ्चाशदेकसहितानि च मण्डलानि पूर्वापरं वलयमुत्तरदक्षिणं च ।
क्ष्माजं तथा विषुवदुद्वलयाभिधाने पञ्च स्थिराणि कथितान्युडु खेचराणाम् ॥

इति यन्त्राध्याये—

सप्तदश कालयन्त्राण्यतो धनुस्तुर्यगोलकं चक्रम् ।
यष्टिः शङ्कुर्घटिका कपालकं कर्त्तरी पीठम् ॥
सलिलं भ्रमोऽवलम्बः कर्णश्छाया दिनार्धमर्कोऽक्षः ।
नतकालज्ञानार्थं तेषां संसाधनान्यष्टौ ॥

इत्यने धनुर्यन्त्रम् । तुरीयम् । चक्रयन्त्रम् । यष्टिः, शङ्कुः, घटीयन्त्रम् । कपालयन्त्रम् । कर्त्तरीयन्त्रम् । पीठसंज्ञं यन्त्रम् । सलिलं (जलम्), भ्रमः (शाणः), अवलम्बसूत्रम्, छायाकर्णः, शङ्कुच्छाया, दिनार्धमानम्, सूर्यः, अक्षः (पलांशाः) नतकालज्ञानार्थं सप्तदश काल यन्त्राणि सन्ति, तेषां यन्त्राणां मध्ये सलिलादीन्यष्टौ यन्त्ररचना मूलकानि सन्ति, सिद्धान्तशेखरे 'गोलश्चक्रं कार्मुकं कर्त्तरी च कालज्ञाने यन्त्रमन्यत् कपालम् । पीठं शङ्कुः स्याद् घटी यष्टिसंज्ञं गन्त्री यन्त्राण्यत्र दिक् सम्मितानी' त्युक्त्य १ गोलयन्त्रम्, २ चक्रयन्त्रम्, ३ धनुर्यन्त्रम् । ४ कर्त्तरी नामक-यन्त्रम् । ५ कपाल यन्त्रम् । ६ पीठ (फलक) यन्त्रम्, ७ शङ्कुनामकयन्त्रम् । ८ घटीनामक यन्त्रम्, ९ यष्टि यन्त्रम् । १० गन्त्री (शकट) यन्त्रम् । इति दश-मितानि यन्त्राणि श्रीपत्युक्तानि सन्तीति । शिष्यधीवृद्धिद तन्त्रे द्वादश यन्त्रा-ण्युक्तानि यथा—

गोलो भगणश्चक्रं धनुर्घटी शङ्कुशकटकर्त्तर्यः ।
पीठकपालशलाका द्वादश यन्त्राणि सह यष्टया ॥
कर्णच्छाया द्युदलं रविरक्षो लम्बको भ्रमः सलिलम् ।
स्युर्यन्त्रसाधनानि प्रज्ञा च समुद्यमाश्चैवम् ॥

भास्कराचार्येण सिद्धान्त शिरोमणौ दशैव यन्त्राण्युक्तानि । यथा—

गोलो नाडीवलयं यष्टिः शङ्कुर्घटी चक्रम् ।
चापं तुर्यं फलकं धीरेकं पारमार्थिकं यन्त्रम् ॥ इति ।

सूर्य सिद्धान्तोक्त यन्त्राणि—

तुङ्गबीजसमायुक्तं गोलयन्त्रं प्रसाधयेत् ।
गोप्यमेतत्प्रकाशोक्तं सर्वगम्यं भवेदिह ॥

कालसंसाधनार्थाय तथा यन्त्राणि साधयेत् ।
एकाकी योजयेद्बीजं यन्त्रे विस्मयकारिणि ॥

शङ्कुयष्टिधनुश्चक्रैश्छायायन्त्रैरनेकधा ।
गुरूपदेशाद्विज्ञेयं कालज्ञानमतन्द्रितैः ॥

तोययन्त्रकपालाद्यैर्मयूरनरवानरैः ।
ससूत्ररेणुगर्भैश्च सम्यक् कालं प्रसाधयेत् ॥

पारदाराम्बुसूत्राणि शुल्वतैलजलानि च ।
बीजानि पांसवस्तेषु प्रयोगास्तेऽपि दुर्लभाः ॥

ताम्रपात्रमधश्छिद्रं न्यस्तं कुण्डेऽमलाम्भसि ।
षष्टिर्मज्जत्यहोरात्रे स्फुटं यन्त्रं कपालकम् ॥

नरयन्त्रं तथा साधु दिवा च विमले रवौ ।
छाया संसाधनैः प्रोक्तं कालसाधनमुत्तमम् ॥

मानाध्याये—

मानानि सौरचान्द्रार्क्षसावनानि ग्रहानयनमेभिः ।
मानैः पृथक् चतुर्भिः संव्यवहारोऽत्र लोकस्य ॥

इत्यनेन सौरचान्द्रनाक्षत्रसावनमानानि कथितानि, एभिरेव चतुर्भिर्मानैर्लौकिकानां व्यवहारा भवन्ति। केन केन मानेन के के पदार्था गृह्यन्ते इति सर्वे प्रतिपादिताः सन्ति, ब्राह्मं, दिव्यं, पित्र्यं, प्राजापत्यं, बार्हस्पत्यं, सौरं, सावनं, चान्द्रं, नाक्षत्रमिति नव मानानि सन्ति, एतेषु नवमानेष मनुष्यलोके मानचतुष्टयानां (सौर चान्द्रार्क्ष सावनानां) प्राधान्यम्, यतस्तैरेव तेषां व्यवहारा दृश्यन्ते । सूर्यसिद्धान्त-सिद्धान्तशेखर-सिद्धान्तशिरोमण्यादिषु सर्वेषु ग्रन्थेषु-मानानां सम्बन्धे समानरूपेणैव सर्वं प्रतिपादितमस्ति। ब्राह्मस्फुटसिद्धान्तेऽ-त्राध्याये भूभादैर्घ्यं भूभामानञ्चापि प्रतिपादितमस्ति ।

संज्ञाध्याये—संज्ञाकथनकारणम्। सिद्धान्त एक एवास्ति, कस्मिन्नंशे सूर्यसिद्धान्तादयो भिन्नाः सन्तीति प्रतिपाद्य स्वसिद्धान्तोत्तरार्धेऽनुक्रमणिकाः कथिता आचार्येण, नान्येषु-सूर्यसिद्धान्त-सिद्धान्तशेखरादिसिद्धान्तग्रन्थेषु संज्ञाध्यायः। अध्यायोपसंहारात्पूर्वमेकः प्रश्न विशेषः—

आग्नेये नैर्ऋत्ये वेष्टदिने संस्थितस्य योऽर्कस्य ।
शङ्कुच्छाये कथयति वर्षादपि वेत्ति सूर्यं सः ॥

कथितोऽस्ति यदुत्तरं कोणाशङ्कोरानयनेत स्फुटमस्ति ।
संज्ञाध्यायकथनस्य किमपि प्रयोजनं नासीत् ॥

आचार्येण कथमेतस्याध्यायस्योल्लेखः कृत इति न जानीमः ।

ध्यानग्रहोपदेशाध्याये—चैत्रादौ मासगणानयनम् । चैत्रादौ दिनादिकं तिथि ध्रुवसाधनम् । इष्टमासादौ रव्यानयनम् । प्रतिमासं शशिकेन्द्रतिथिध्रुवक्षेपयोगानयनम् । प्रतिदिनचालनम् । चन्द्रसाधनमौदयिकरविसाधनञ्च । ज्याखण्डकानि केन्द्रज्या साधनञ्च यथा —

त्रिंशत् सनवरसेन्दुर्जिनतिथिविषया गृहार्धचापानाम् ।
अर्धज्याखण्डानि ज्याभुक्तैक्यं स भोग्य फलम् ॥
गतभोग्यखण्डकान्तरदलविकलवधाच्छतैर्नवभिराप्तैः ।
तद्युतिदलं युतोनं भोग्यादूनाधिकं भोग्यम् ॥

इत्याचार्योक्तभोग्यखण्डस्पष्टीकरणमेव सिद्धान्तशिरोमणेर्ग्रहगणिताध्यायस्य स्पष्टाधिकारे 'यातैष्ययोः खण्डकयोर्विशेषः शेषांशनिघ्नः' इत्यादिना भास्कराचार्येण कथितम् । भास्कराचार्येण खार्क-१२० मिता त्रिज्या गृहीता, अत्राचार्येण खतिथि १५० मिता त्रिज्या गृहीता । इत्यतीववैचित्र्यं यत्सर्वत्रैव श्रीपतिनाऽऽचार्यश्लोकोक्तविषया एव छन्दोन्तरेण लिखिताः परं किं कारणं यदपूर्वं भोग्यखण्डस्पष्टीकरणं न लिखितम् । चन्द्रे भुजफलसंस्कारः, तिथौ फलसंस्कारश्च । इत्यादयः सर्वे विषया अपूर्वाः सन्ति । अत्राध्याये ये केचन विषया लिखिताः सन्ति ते सूर्यसिद्धान्ते सिद्धान्तशेखरे, सिद्धान्तशिरोमणौ न सन्ति ।

अनुगृहीतोऽस्म्यहं श्रीडाक्टर सत्यप्रकाश डी० एस० सी० महोदयानां यैराङ्गलभाषायां कृपया ग्रन्थस्यास्य प्रस्तावना समरचि ।

सम्पादकमण्डलस्यान्ये सहयोगिनः ज्योतिषाचार्याः श्रीमुकुन्दमिश्राः, श्रीविश्वनाथ झा, श्रीदयाशंकरदीक्षिताः, शास्त्रिणः श्रीओंदत्तशर्माणश्च सर्वे एव मम धन्यवादस्य पात्रतामर्हन्ति । एतेषाममूल्यसहयोगेनैवायं महान् ग्रन्थः सुचारुरूपेण सम्पूर्णतामगच्छत् ।

'पद्मश्रीप्रकाशनालयस्य' स्वामिने रमेशचन्द्रशर्मणेऽपि धन्याञ्जलिर्भवतु यस्य महता परिश्रमेण ग्रन्थस्य प्रकाशनं कालेनैवाभवत् ।

अन्येभ्यः सर्वेभ्योऽपि धन्यवादान् प्रददे, यैरल्पमपि साहाय्यं विधायाहं कृतार्थीकृतोऽस्मि, इति शम् ।

भृगु-आश्रमः
३०-३-६६

विदुषामनुचरः
रामस्वरूप शर्मा

श्रीब्रह्मगुप्ताचार्यं विरचितः

विभिन्नपाठान्तरसहितो

ब्राह्मस्फुटसिद्धान्तः

७

CHAPTER I

Astronomy in Ancient Nations

Brahmagupta's great works like the *Khaṇḍakhādyaka* and *the Brāhma-sphuṭa-siddhānta* took astronomy to Arabs through whom it spread to many countries of Europe. Al Beruni records this testimony in his great book on India. It is doubtful that astronomy had its birth in Greece and China. From remote ages China, India, Greece, Arabia and Egypt developed the entire system in close cooperation. This knowledge must have spread from their common cradle home where man for the first time developed his culture and civilisation. In this chapter we propose to give a review of astronomy as developed in many of these ancient lands, especially Arabia, people of which land came in close contacts with India much before any recorded time.

Dawn of Astronomy

The earliest man must have been the primitive astronomer. The striking spectacles presented to him by the varied appearances of a sky covered with thousands of twinkling and non-twinkling objects of different degrees of brightness, apparently revolving round the Earth, and the daily changing phases of the Moon must have raised strange feelings of the most primitive man also. Then he must have in course of time observed the bright morning and evening stars, and at a considerably late stage the comets and shooting stars and then on occasions eclipses of the Sun and the Moon. These phenomena not only raised feelings of admiration, but in different sections of human society often feelings of superstitious alarm. By and by stars became guides for the traveller by land and sea. In the midst of these observations, one discovered various cycles : cycle of day and night, cycle of seasons and cycle of other details. Then there was a striking observation of the tides in a sea changing with the phases of the Moon.

Earliest Discoveries

We shall briefly sketch out the order of astronomical discoveries. The first phenomena to be noted must have been the regularly recurring dawn (for this one may refer to the Uṣā Sūkta of the *Ṛgveda*), the sunrise and sunset (which led to *prātaḥ* and *sāyam*, *i.e.* morning and evening prayers of the Vedic times), daylight, twilight and night concerning which we have numerous Vedic hymns. Next it led to the measurement of a day (which was of a short duration in winters and of a long duration in summers). The Vedic Aryans also discovered the variations in the duration of the day along different latitudes, and the time of sunrise in places of different longitudes. In fact the idea of longitudes and latitudes came sufficiently afterwards. Man discovered month as related to the variation of light with the Moon's phases. In temperate regions, where probably the first astronomical observations were systematically made, the changing length of the day or the direction of the Sun at rising or setting or the lengths of shadows cast at midday, would show that the Sun's daily path in the sky altered throughout the year, a time interval which was already marked by the changing vegetation. According to Sir W.C. Dampier, "attempts were made to determine the number of months in the cycle of the seasons in Babylonia about 4000 B. C. and in the China soon after. About 2000 B. C. the Babylonian year settled down to one of 360 days or twelve months, the necessary adjustments being made from time to time by the interposition of extra-months." In India, this concept is of even much earlier origin. The old inspired sages like Dīrghatamas discovered for the observing man the Vedic Era and intercalation. I have described this discovery in a special chapter on the subject in my book the *Founders of Sciences in Ancient India* and a reference may be made to the *Asya Vāmasya Sūktam* of the *Ṛgveda*. It is impossible to assign an age to these old traditions. Round the *Yajña*, developed the science of astronomy, mathematics, anatomy and medicine in this ancient land of ours, which in fact was the common heritage of a large number of people of the modern world.

One might also say that a considerable period might have well elapsed before it was noticed that at a particular season of

the year, the same stars are seen at corresponding hours of the night. Of course this circumstance was less conspicuous than the regular variation of the Sun's altitude in the sky as the year progresses. It is the surmise that the striking naked-eye cluster, the Pleiades, must have been one of the earliest noted star-groups, and it became the first star-group for providing the first fairly close determination of the length of the year as approximately 365 days. The rising of this cluster in the evening was a mark of the coming winter to primitive man; and the husbandman judged the time of reaping by its rising, and of ploughing by its setting in very ancient times; Sirius, Arcturus, the Hyades and Orion were similarly equally useful to him. The passages in the *Taittirīya Saṁhitā* and in the *Śatapatha Brāhmaṇa* clearly indicate the confusion once created by following the concept of lunar months without further adjustments:

> "Now the seasons were desirous to have a share in the sacrifice among the gods and said, 'Let us share in the sacrifice. Do not exclude us from the sacrifice! Let us have a share in the sacrifice!' The gods, however, did not approve of this. The gods, not approving, the seasons went to the Asuras, the malignant, spiteful enemies of the gods. Those (Asuras) then throve in such a manner that they (the gods) heard of it, for even while the foremost (of the Asuras) were still ploughing and sowing, those behind them were already engaged in reaping and threshing: indeed even without tilling, the plants ripened forthwith for them. (*ŚBr.* I.6.1.1-3)

The Zodiac

It is difficult to say how much time it must have taken, but in fact, it was eventually noted that the Sun and Moon travel over very similar paths among the stars during their circuit of the sky. This led to the formation of the Zodiac and its constellations, the centre of this zone, a belt about 16° broad, being the annual path of the Sun or Ecliptic. The division into twelve parts, each corresponding to a month of the Sun's movement, was made; and their connection with the solar course during the year was found by observations of heliacal risings or settings. These were the times of the year when certain bright stars would first be seen to rise before the Sun, or when

they were last seen to set after sunset. In the case of Ṣirius, the brightest fixed star, these would happen when the Sun was about ten degrees below the horizon. For the less bright stars the angle would be a larger one.

It must have been almost simultaneously observed that the Moon in going like the Sun round the heavens always in the same direction from west to east (i. e., opposite to the diurnal motion which she shares with the other bodies), kept in general to the same track in the sky. After a time, however, it must have been noted by careful observers that this path was not constant, but deviated from the centre line of the Zodiac, getting away from that line up to a maximum deviation on either side but slowly returning to it. In the course of a number of years, it must have become evident that the Moon's path among the stars does not lie always in the same line on the celestial sphere, but in a zone or band about twenty moon breadths (10°) wide, occupying the middle of the Zodiacal zone itself.

Among the bright stars Mercury, Venus, Mars, Jupiter and Saturn (the first two of which are never seen very far from the Sun in the sky) soon must have been noted to be moving in the Zodiac with varying periods. The English name *planet* is derived from Greek *planetes,* meaning a wanderer, since the planets change their positions among the Zodiacal stars.

There is a word *Stṛ* which in the *Ṛgveda* always occurs in the instrumental plural, *Stṛbhiḥ.* The English word star is derived from this word. Parāśara and Gṛtsamada, I have shown elsewhere, were the first amongst the great observers, inspired by the Ṛgvedic hymns, and Vāmadeva identified Bṛhaspati or the Jupiter planet and Vena Bhārgava discovered tht planet Venus which still bears the name of its discoverer.

Constellations

Long before the Zodiacal belt was divided into "signs" (700 B. C.), a number of asterisms, or the configuration of stars in the sky had been arranged, the brighter stars of these configurations, thus identified, proved very useful in indicating the seasons of the year by the times of their rising or setting, and also in locating the positions on the celestial vault of such moving objects as planets, comets and shooting stars and in helping the traveller by land or sea to determine direction.

These named constellations date back to very early period. In India, Gārgya is the name of an astronomer who is associated with a hymn of the *Atharvaveda* which for the first time enumerates constellations. In many of these constellations, the stars form a well marked group, clearly separated from other groups, and the names given to these formations are supposed to have been suggested by a resemblance to the shapes of certain familiar objects. Of course, the resemblance is usually very slight, and depended merely on a fancy.

It is remarkable that different countries devloped almost similar notions regarding these constellations. The late Dr. A. C. D. Crommelin considered that there is a reason to believe that the stars may have been grouped to some extent by the Egyptians as early as 4000 B. C., and he remarked on their use of the then Pole Star for orienting the Great pyramid, Again, Chinese are said to have mapped out the sky into many divisions of stars by 2500 B. C., if one can rely on their records.

The idea of constellations takes us to a date much earlier than 2500 B. C. even. In total forty-eight have come down from extremely ancient times, but these do not cover the entire extent of the sky. The part not occupied by any of them evidently did not rise above the horizon where the early astronomers to whom we owe their naming lived; and the stars concerned were therefore not included in their constellation schemes. The centre of this part (near the bright star Achernar) must have been near the South Pole of the heavens of the time, and its angular radius from the Pole gives us roughly the latitude of their homes. The date appears to have been about 2800 B. C., when, owing to the precession of the equinoxes, the South celestial pole was in the position indicated. The latitude seems to have been about 38° North. These are the findings of E. W. Maunder (*Astronomy without a Telescope*, p.5, 1902); but from the same considerations Dr. Crommelin assigns a latitude of 36° and a date 2460 B.C, and Proctor 2200 B. C. Maunder also suggested that the presence of the Lion and Bear among the stellar configurations and the absence of Elephant, Tiger, Camel and Crocodile seem to exclude India towards the East and the countries towards the West, the latitude and the longitude indicated being those of Asia Minor or Armenia. The suggestion that the blank area in

the sky referred to gave an approximate date for the formation of the constellations appears to have beeen first put forward in 1807 by Carl Schwartz, for some time Swedish Consul at Baku.[1]

Indo-Greek Contacts

It is highly improbable that before Alexander, there had been absolutly no contacts between India and the distant nations. Even in pre-Alexandrian era, there had been such migration is clearly evinced by the philological and mythological studies. But we do not pcssess historic record of it.

The conquests of Alexander the Great made the Greeks acquainted with the Eastern world, which had up to that time been visited probably by very few Europeans, and it likewise spread Greek culture to all the countries which the victorious Macedonian had been able to reach. The Indian province of his Empire became independent soon after Alxander's death and though the spread of Buddhism in the third century B. C. checked the progress of Hellenism in Northern India, the rise of the Greek kingdom of Bactria and its gradual extension south and east continued for a long time to keep alive the connection between India and the West. Not only (as has beeen asserted) the Greek and Indian drama and architecture have been strongly influenced by Hellenistic and Indian contacts, it is beyond a doubt that the entire astronomy of the two great nations is the offspring of these mutual contacts.

In earliest times astronomy had only been cultivated in India and in no other country. Some idea had been acquired during those days of the periods of the Sun and Moon and the planet Venus and Bṛhaspati (Jupiter), which were used for chronological purposes, the lunar motions being specially connected with the proper times for sacrificial acts. The Vedic era was discovered during this period by Viśvāmitra, and Gārgya enumerated the Nakṣatras. Lagadha composed his *Vedāṅga Jyotiṣa*, which is the *first* book on astronomy written in human literature. India developed her geometry in connection with the construction of sacrificial altars, and its account is found in the *Śulba Sūtras* of Baudhāyana, Āśvalāyana and Kātyāyana. Āryabhaṭa laid the foundations of algebra. One might still say that there is no sign of

1. See, Peter Doig: *A concise History of Astronomy*. London, 1950.

accurate knowledge of the planetary motions earlier than about the century of the Christian era. From thenceforth astronomy, hitherto confined to rituals, appears as a science, treated in the course of the next thousand years in a series of text-books, the *Siddhāntas*,[1] the contents of which, though supposed to be derived from divine sources are strongly influenced by Greek authors. Prior to the Greek influence, we had ceremonies like dvādaśāha (lasting for twelve days), ṣaḍaha (lasting for six days), tryaha (lasting for three days) besides darśa-pūrṇamāsa ceremonies connected with the New Moon and Full Moon. But the week of seven days (*Saptāha*) was unknown in India. This concept of week and the dedication of each day to the deity of one of the seven planets, now appears for the first time. It is difficult to say whether names of the planets were borrowed by Greeks from India or vice versa, but they became common, e.g., Aśvajit or *Asphudit* (Aphrodite). *Dyugatiḥ* or *dyaus* or *Jīva* (Zeus), Heli (Helios), &c., while the zodiacal signs have superseded the earlier but totally different twelve star-groups connected with the Sun's motion, and proclaim their origin by their names:

Kriya, Tāvuri, Jituma, Karkin, Leya, Pāthena, Jūka, Kaurpya, Taukshika, Ākokera, Hridroga, Ittha,

corresponding to *Κριός, Ταῦρος, Δίδυμος, Καρκίνος, Λέων, Παρθένος, Ζυγόν, Σκορπίος, Τοξότης, Αἰγόκερως, Ὑδροχόος, Ἰχθύς*[2].

A great many other Greek terms connected with geometry, astronomy and astrology have also been transferred from Sanskrit works to Greek and vice versa. This conclusively shows the mutual influence on astronomy. Indian authors never failed to acknowledge the ideas they borrowed from Greeks, e.g. Varāhamihira quotes the Yavanas or peoples of the west as authorities for some of the scientific statements he makes. The name of the Romaka Siddhānta (which is at least as old as A.D. 400) also points in an unmistakable manner to its origin in one of the provinces of the Roman Empire.

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1. The *Romaka* or *Pauliśa Siddhānta* (before 400 A. D.), See Varāhamihira's the *Pañcasiddhāntikā* (about 570 A.D., Varāhamihira died in 587 A.D.). The original *Sūrya-siddhānta* was prior to Varāhamihira, the modern edition is perhaps of the 13th century. See J. Burgess "*Notes on Hindu Astronomy*" J. R. A. S., October 1893, p. 742.

Earth as a Sphere

The astronomers of the *Siddhāntas* taught that the Earth is a sphere, unsupported in space, and they reject the ancient mythological notion that it is supported by some animal like Śeṣanāga (serpent), kacchapa (tortoise), or diggajas (elephants) which in turn rest on another, and so on, until the support of the last one after all has to be left unexplained. Bhāskara II, about A.D. 1150, who comments on the absurdity of this, also rejects the idea that the Earth is perpetually falling, since it would fall faster than an arrow shot upwards, on account of being heavier, so that an arrow could never again reach the Earth.[1] Round the Earth the planets are moving, all with the same linear velocity. The diameter of the Earth is 1600 yojanas, the distance of the Moon is 51,570 yojanas (or 64.5 times the radius of the Earth, nearly equal to Ptolemy's greatest distance, 64⅙), while the distances of the other planets result from the assumption of equal velocities.[2] The equation of centre of the planets is found by an epicycle and to this arrangment the Hindus add one of their own invention, by assuming that the epicycle had a variable circumference, greatest when the planet is at apogee or perigee and least at 90° from these, when the equation reaches its maximum. This contrivance of an oval epicycle was by some astronomers applied to all the planets, by others (Brahmagupta and Bhāskara) only to Mars and Venus, by others it was altogether rejected.[3] Why they complicated the calculation in this way is not clear. Āryabhaṭa I of Kusumapura or Pāṭaliputra, born A.D. 476, made another deviation from the Alexandrian doctrines, as appears in the *Brāhma-sphuṭa-siddhānta* of Brahmagupta, wherein he quotes the following from Āryabhaṭa: "The sphere of the stars is stationary, and the Earth, making a revolution, produces the daily rising and setting of stars and planets." Brahmagupta rejects this idea, saying: "If the Earth moves a minute in a prāṇa, then whence and what route does it proceed? If it revolves, why do not lofty objects fall?" But his commentator Caturveda Pṛthūdaka Svāmī replies: "Āryabhaṭa's

1. *As. Res.* XII. p. 229 (*Essays*, II, p. 394).
2. The distances are proportional to the orbital periods of revolution, but for Mercury and Venus to the periods in the epicycles.
3. For further details see *As. Res.* II. p. 251 (Davis) and XII. p. 236 (Colebrooke, also *Essays*, II. p. 401).

opinion appears nevertheless satisfactory, since planets cannot have two motions at once : and the objection, that lofty things would fall, is contradicted; for every way the under part of the Earth is also the upper; since wherever the spectator stands on the Earth's surface, even that spot is the uppermost spot.[1]

Earth rotation by a current of aerial fluid

It is very interesting to see the theory once advocated by Herakleides of Pontus transplanted on Indian soil, especially when we remember that Seleukus, the Babylonian, had adopted that theory. From Babylon the theory might easily find its way to India, though it is of course equally possible that Āryabhaṭa, quite independently of his Greek precursors, hit on the same idea. He appears to have accounted for the Earth's rotation by a wind or current of aerial fluid, the extent of which, according to the orbit assigned to it by him, corresponds to an elevation of little more than a hundred miles (114) from the surface of the Earth, or fifteen yojana's while he put the diameter of the Earth equal to 1050 yojanas (of 7.6.miles each[2]). This was in accordance with the general opinion of the Indians, that the planets are carried along their orbits by mighty winds with the same velocity and parallel to the ecliptic (while one great vortex carries all stars round the Earth in twenty-four hours, but that the planets are deflected from these courses by certain invisible powers having hands and reins, with which they draw the planets out of their uniform progress. The power at the apogee, for instance constantly attracts the planet towards itself, alternately with the right and left hand (like Lachesis in Plato's *Republic*), while the deity at the node diverts the planet from the ecliptic first to one side and then to the other. And lastly the deity at the conjunction causes the planet to move with variable velocity and to become occasionally stationary and even retrograde. This is gravely set forth in the *Sūrya-śiddhānta* ,and even Bhāskara gives the theory in his notes, though he omits it from his text. Similarly Brahmagupta, although he gives the theory of eclipses, affirms the existence of an eighth planet, Rāhu, which is the immediate cause of eclipses; and he blames Varāhamihira,

1. *Asiat. Res*, XII. p. 227; Colebrooke's *Essays*, II. p. 392.

2. Colebrooke, *Notes and Illustrations to the Algebra of Brahmagupta*. p. xxxviii.' *Essays*. II. p. 467.

Āryabhaṭa and others for rejecting this orthodox explanation of the phenomenon.[1]

Indian astronomy some times appears to be a curious mixture of old fantastic ideas and sober geometrical methods of calculation. But it is wrong to presume that these geometric calculations were derived from froeign contacts. Indians have always been fond of geometry (from the earliest times of the Vedic rituals), and they from the very beginning realised the importance of applying geometry to astronomy, Side by side we find Greek contacts also. As remarked by Colebrooke, the absence of the most characteristic parts of Ptolemy's system, the equant and the details of the theories of the Moon and Mercury seems to indicate that Greek planetary theory must have been introduced in India between the times of Hipparchus and Ptolemy; and with the exception of the epicycle from the circular form, the Hindus did not modify the theory or perfect it in any way. The precession of the equinoxes they held to consist in a liberation within the limits of 27° (Āryabhaṭa says 24°) east and west of its mean position, but they came much nearer to the truth than Ptolemy did as regards the annual amount, as they supposed the space travelled over in a century to be $1\frac{1}{2}$°.

Contacts with Arabs

Notwithstanding some isolation of India from Europe during the Middle Ages, her astronomy was destined to exercise an indirect influence on the progress of astronomy. Through the conquest of Persia in the seventh century, the Arabs, like the Greeks a thousand years earlier, came in contact with India, from whence physicians and astrologers found their way to the court of the Caliph already before the reign of Harun al Rashid. We possess a detailed account of the manner in which the Indian astronomy was introduced at Baghdad, from the pen of the astronomer Ibn al Adami (who died before 920), confirmed by the celebrated memoir on India by Al Beruni, written in 1031[2]. In the year 156 of the Hijra (A. D. 773), there appeared before the Caliph Al Mansur a man who had come from India; he was skilled in

1. *Asiat. Res.* XII, pp. 233, 241; *Essays*, II. pp. 398, 407.
2. Hankel, *Zur Geschichte der Mathematik im Alterthum* and *Mittelalter*, Leipzig, 1874, p. 229; Cantor, *Gesch. d, Math.* I. p. 656.

the calculus of the stars known as the Sindhind (i. e. Siddhānta), and possessed methods for solving equations founded on the kardagas (i. e. kramajyā, sines) calculated for every half degree, also methods for computing eclipses and other things. Al Mansur ordered the book in which all this was contained to be translated into Arabic, and that a work should be prepared from it which might serve as a foundation for computing the motions of the planets. This was accordingly done by Muhammed ben Ibrahim Al Fazari, whose works the Arabs call the great *Sindhind*, and from it an abstract was afterwards made for Al Mamun by Abu Giafar Muhammed ibn Musa al Kwarizmi, who made use of it to prepare his tables, which obtained great renown in the lands of Islam. But when Al Mamun became Caliph, he promoted these noble studies and called in the most learned men in order to examine the *Almagest* and make instruments for new observations.

Arabs and Greeks

The account of which the above is an abstract shows us clearly the origin of the study of astronomy and mathematics under the Abbasid Caliphs. But though the first impulse came from India the further development of Arabian science was to a considerable extent founded on that of Greece and Alexandria. It was through the court physicians from the flourishing medical school kept up by Nestorian Christians of Khusistan that a knowledge of Greek Philosophy and science was first spread among the subjects of the Caliphs; and by degrees the works of Aristotle, Archimedes, Euclid, Apollonius, Ptolemy, and other mathematicians were translated into Arabic. Fresh translations of Ptolemy were made from time to time in the various kingdoms into which the vast empire of the Caliph was soon split up,[1] and a thorough knowledge of Ptolemaic astronomy was thus spread from the Indus to the Ebro. There were several special inducements for Muhamedans to pay attention to astronomy, such as the necessity of determining the direction in which the

1. The earliest is probably that of Al Hajgag ben Jusuf ben Matar early in the ninth century. See Suter, *Die Mathematiker und Astronomen der Araber und ihre Werke*, Leipzig, 1900 (p. 9), which valuable bibliograpical summary has been follwed by J. L. E. Dreyer as regards names and dates (J. L. E. Dreyer's *A History of Astronomy*, 1953; we have reproduced this account from his chapter XI.)

faithful had to turn during prayers, also the importance of the lunar motions for the calendar, and the respect in which judicial astrology was held all over the East. The Caliph Al Mamun, son of Harun Al Rashid (813-833) is the first great patron of science, although the Omayyad Caliphs had much earlier an observatory near Damascus, and the Jew Mashallah (who died about 815) had already before the reign of Al Mamun won a name as an observer and astrologer. But the Damascus observatory became quite eclipsed by that erected at Baghdad in 829 where continuous observations were made and tables of the planetary motions constructed while an important attempt was made to determine the size of the Earth. Among the astronomers of Al Mamun and his successors one of the greatest was Ahmed ben Muhammed Al Fargani (afterwards known in the West as Alfraganus), whose *Elements of Astronomy* were translated into Latin in the twelfth century and contributed greatly to the revival of science in Europe.[1] Tabit ben Korra (826–901) was a most prolific writer and translator, but is chiefly known in the history of astronomy as a supporter of the erroneous idea of the oscillatory motion of the equinoxes. A younger contemporary of his, Muhammed Al Battani (died 929), was the most renowned of all the Arabian astronomers and became known in the West in the twelfth century (under the name of Albategnius) by the translation of the introduction to his tables.[2] Already in his time the power of the Caliphs had commenced to decline, and they soon lost all temporal power. The study of astronomy was, however, not influenced by this loss of patronage, as the Persian family of the Buyids, who in 946 obtained possession of the post of Amir-al-Omara (corresponding to the Frankish Major Domus) took over the *role* of patrons of science, so long and so honourably carried on by the Abbasid Caliphs. Sharaf al Daula built in 988 a new observatory in the garden of his palace, and among the astronomers who worked there was Muhammed Abu 'l Wefa al Buzjani (959-998), who wrote an *Almagest* in order to

1. First printed at Ferrara in 1493. See the edition of Golius, Amsterdam, 1669.

2. Translated by Plato of Tivoli. First Printed in 1537 after the book of Alfargani. Dreyer has used the edition of Bologna, 1645, and a new edition which is now being published by C. A. Nallino, of which the Arabic and a Latin translation of the text have already appeared (*Pubbl. d. R. Osservatorio di Brera in Milano*, No. 40, 1899-1903).

make the contents of Ptolemy's work accessible to the less learned. In the nineteenth century this book gave rise to a long controversy, which we shall presently consider somewhat in detail.

Western Countries under Islam

In the eleventh and twelfth centuries we do not find any names of conspicuous astronomers in Muhammedan Asia. But the western countries under Islam had in the meantime become ready to do their share of the work of keeping the mathematical sciences alive. In the Fatimite kingdom of Egypt Ali ben Abi Said Abderrahman ben Ahmed ben Jūnis, generally called Ibn Jūnis (died 1009), was distinguished both as an astronomer and a poet. At Cairo a liberally equipped observatory enabled him to verify the planetary theories which had once been developed in the neighbouring Alexandria. and in token of his gratitude to the reigning sovereign, Al Hakim, he named his work the Hakemite Tables.[1] We have to pass to the farthest west to find the next astronomer of mark in the person of Ibrahim Abu Ishak, known as Al Zarkali (in Europe afterwards called Arzachel). He was a native of Cordova, lived about 1029-1087, and edited planetary tables called the Toledo Tables.[2] In the following century we find two celebrated astronomers of Seville, Gabir ben Aflah, known as Geber (died 1145, often mistaken for the great alchemist, Gabir ben Haijan, in the eighth century),[3] and Nur ed-din al Betrūgi (Alpetragius), both of whom raised objections to the planetary theories of Ptolemy, though they failed to produce anything better of their own. Spanish astronomy continued to flourish for a while, although the power of the Arabs in the Peninsula was rapidly declining, and it produced in the thirteenth century a very remarkable man, who, although a Christian king, must be included in this account of Arabian astronomy,

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1. Caussin has published an extract in vol. *vii* of the *Notices et Extraits des manuscrits (Le livre de la grande table Hakemite)*. Other Chapters, translated by the elder Sedillot but never published, are reviewed by Delambre, *Hist, de l'astr. du Moyen Age*, p. 95 sqq.
2. Never published. Delambre, l. c. p 176, and Steinschneider, *Etudes sur Zarkali. Bullettino Boncompagni* T. *xx*. p. 1.
3 The word algebra has also sometimes erroneously been connected with his name.

as he owed all he knew about the science to the example and the teaching of Muhammedans and Jews. King Alfonso X, of Castille named el Sabio (1252-1284), followed the example of the Caliphs and called astronomers to his court to assist in the preparation of the renowned Alfonsine Tables.

With Alfonso the study of astronomy disappeared from Spain, but not before it had been revived in the East. In 1258 the still existing but shadowy Caliphate of Baghdad was swept away by the Mongol conqueror Hulagu Khan, grandson of Genghis Khan; but already in the following year this great warrior listened to the advice of his new vazier, Nasir ed-din al Tūsi (born at Tūs in Khorasan in 1201, died in 1274), and founded a great and magnificient observatory at Merāgha, in the north-west of Persia. In this observatory, which was furnished with a large number of instruments, partly of novel construction, Nasir ed-din and his assistants observed the planets diligently and produced after twelve years labour, the "Ilokhanic Tables," Among the astronomers of Merāgha seems to have been Juhanna Abu 'l Faraj, called Bar Hebrāyā, or the son of a Jew. He was a Christian, born in 1226 and from 1264, till his death in 1286 Maphrian or Primate of the Eastern Jacobites. He left a well-known chronicle and an astronomical work, both written in Syriac, as well as other writings.[1] The observatory at Merāgha had not a long life, and Asiatic astronomy had to wait a century and a half, until the grandson of another terrible conqueror erected another observatory. Ulug Begh, grandson of Tamerlan, drew learned men to Samarkand and built an observatory there about the year 1420, where new planetary tables and a new star catalogue, the first since Ptolemy's, were prepared. Ulug Begh died in 1449, he was the last great Asiatic protector of astronomy; but just as the Eastern countries saw the star of Urania setting, it was rising again for Europe.

In this review of Arabian astronomers we have only mentioned a few, omitting several names of distinction, whose

1 *Le livre de l' ascension de l' esprit sur la forme du ciel et de la terre.* Cours d' Astronomie redige en 1279 par Gregoire Aboulfarag, dit Bar Hebraeus. Publie par F. Nau, Paris, 1899-1900 (2 parts, Syriac and French). His chronicle is the chief authority for the fable about the burning of the Alexandrian Library by order of the Caliph Omar. For a very thorough refutation of this see Butler, *The Arab Conquest of Egypt*, Oxford, 1902 pp 401-426.

owners devoted themselves to other branches of astronomy. Though Europe owes a debt of gratitude to the Arabs for keeping alive the flame of science for many centuries and for taking observations, some of which are still of value, it cannot be denied that they left astronomy pretty much as they found it. They determined several important constants anew, but they did not make a single improvement in the planetary theories. It will therefore be sufficient to enumerate the improvements attempted and the opinions held by Arabian astronomers without keeping strictly to the chronological order, although we are here dealing with a period of about six hundred years and men belonging to very different nations, who had little in common except their religion and the language in which they wrote.

Figure of Earth

Turning first to the question of the figure of the Earth, we find a remarkable contrast between Europe and Asia. In the world under Islam there was an entire absence of that hostility to science which distinguished Europe during the first half of the Middle Ages. Though we learn from Kazwini's *Cosmography*[1] that some of the earlier Arabs believed the Earth to be shaped like a shield or a drum, still there is no record of any Arabian having been persecuted for asserting that the Earth is a sphere capable of being inhabited all over. Whether this was in consequence of the warriors of the Caliphs having carried their arms to the centre of France on one side and to the borders of China on the other while their merchants travelled southward to Mazambique and northward to the centre of Asia, is another question : anyhow, the fact of the Earth being a sphere of very small dimensions in comparison to the size of the universe was accepted without opposition by every Arabian scholar, and the very first scientific work undertaken after the rise of astronomy among them was a determination of the size of the Earth. It was carried out by order of the Caliph Al Mamun in the plain of Palmyra. According to the account given by Ibn Jūnis, the length of a degree was measured by two observers between Wamia and Tadmor and by two others in another locality, we are not told where. The first measure gave a degree

1. *Zakarija Ben Muhammed Ben Mahmūd El Kazwini's Kosmographie*, deutsch von H. Ethe, Leipzig, 1868, p. 295.

equal to 57, the second one equal to $56\frac{1}{4}$ Arabian miles of 4000 black cubits, and the approximate mean, $56\frac{2}{3}$ miles, was adopted as the final result, the circumference of the Earth being 20,400 miles and the diameter 6500 miles. Another report, by Ahmed ben Abdallah, called Habash, an astronomer under Al Mamun (quoted by Ibn Jūnis), states that a party of observers (no names given) proceeded along the plain of Sinjar until they found a difference in meridian altitudes, measured the same day, equal to one degree, while the distance travelled over was found to be $56\frac{1}{4}$ miles[1]. Probably two different determinations were made. If the "black cubit" is the Egyptian and Babylonian cubit of 525 mm.[2], the mile would be=2100 m. and $56\frac{2}{3}$ miles=119,000 meters, rather a large result.

The doctrine of the spherical earth remained undisputed in the Muhammedan learned world, though the curious error of assuming that the level of the sea was higher on some parts of the Earth than on others appears to have found some adherents among Arabian writers as well as in Europe.[3] We may, therefore, at once pass on to the motions of the heavenly bodies. Al Battani determined the longitude of the Sun's apogee and found it=82° or $16^\circ\ 47'$ more than Ptolemy had given. As he believed

1. Caussin, *Not. et Extraits.* vii. pp. 94-96; Delambre, *Hist. de l'astr du Moyen Age.* pp. 78 and 97; Shems ed-din, *Manuel de la cosmographie*, traduit par Mehren, Copenhague. 1874 p. 6. Suter, p. 209, mentions a third report (from Ibn Challikān's *Biographical Dictionary*), according to which the sons of Musa first measured in the plain of Sinjar and afterwards as a test at Kūfa, by order of Al Mamun. The eldest of the sons of Musa died 41 years after Al Mamun, and the names of the observers in the first report are different, so that the third report is not to be relied on. Al Fargani merely gives $56\frac{2}{3}$ miles as the result of Al Mamun. According to Shah Cholgii *Astronomica . . . . studio et opera Ioh. Gravii*, London, 1652, p. 95, Ala ed-din Al Kūsgi (one of the Ulug Begh's astronomers) gives the circumference of the earth=8000 parasangs. As a persian parasang =30 stadia (Hultsch; *Griech u. Rom. Metrologie.* p. 476) this would seem to be the value of Posidonius, 240,000 stadia. Kazwini (p. 298) gives the circumference=6800 parasangs on the authority of Al Berūni.
2. Hultsch p. 390.
3. It deserves to be mentioned that Shems ed-din of Damascus (1256-1327) explains the great Preponderance of dry land in the northern hemisphere by the attraction of the Sun on the water, which is the greatest when the Sun is in perigee, at which time it is nearly at its greatest south declination. That this accumulation of water would not be a permanent one does not occur to him (*Cosmographie*, p. 4).

that Ptolemy's value had been found by himself,[1] and as he adopted 54″ (or 1° in 66 years) as the annual amount of precession, there remained (assuming that 760 years had passed since the time of Ptolemy) an outstanding error of 79″—54″=25″ per annum. In reality the annual motion of the solar apsides is 11½″; still we may say that the discovery of this motion is due to Al Battani, though he did not announce it as such; in fact he merely gives his own value as an improvement on that of Ptolemy. Even Ibn Jūnis (who found 86° 10′) did not suspect that the apogee was steadily moving but merely says that it must be corrected for precession (1° in 70 years), and remarks that the longitude of the apogee is very difficult to determine accurately.[2] On the other hand, Al Zarkali found a smaller value, 77° 50′ and as he also found a smaller value of the eccentricity he thought it necessary to let the centre of the Sun's eccentric orbit describe a smaller circle, after the example set by Ptolemy in the case of Mercury.[3] The inclination of the ecliptic which the Greeks had found—23° 51 20″ was by the astronomers of Al Mamun found—23° 33′ (in 830), by Al Battani (in 879), and by Ibn Jūnis 23° 35′[4]. When Al Zarkali found 23° 33',he, and afterwards Abu 'l Hassan Ali of Morocco, concluded that the obliquity oscillated between 23° 53 and 23° 33', an idea to which the prevailing belief in the "trepidation" of the equinoxes lent countenance.[5]

Moon and its orbit

If we now turn to the Moon, we do not find that the Arabs made any advance on Ptolemy. Several of them noticed that the inclination of the lunar orbit was not exactly 5°, as stated by Hipparchus. Thus, Abu 'l Hassan Ali ben Amagiur early in the tenth century says that he had often measured the greatest latitude of the Moon and found results greater than that

1. *Scient. Stell.* Cap. xxviii. Bologna, 1645, p. 72; Nallino. p. 44. At the end of Cap. xlv. he says the apogees of the Sun and Venus are both in 82° 14,′ and Ibn Jūnis also gives 82° 14′ as the value found by Al Battani (Caussin, p. 154).
2. Caussin, pp. 232 and 238. Abu'l Faraj gives 89° 28′ for the year 1279 (p. 22).
3. Sedillot, *Prolegomenes aux tables astron. d' Olough Beg* (1847), pp. lxxx-lxxxii. Riccioli, *Almag. Novum*, I. p. 157.
4. Caussin. p. 56. For A.D. 900 Newcomb gives 23° 34′ 54″, with a diminution of 46″ per century, so that the Arabian astronomers erred less then 1′.
5. Aboul Hassan Ali, *Traite des Instruments astron. des Arabes*; T.I.p. 175; Sedillot, *Memoire sur les instr. astr. des Arabes*, p. 32.

of Hipparchus, but varying considerably and irregularly. Ibn Jūnis, who quotes this, adds that he has himself found 5° 3′ or 5° 8′, while other observers are said to have found from 4° 58′ to 4° 45′.[1] Want of perseverance and of accurate instruments caused them to miss a remarkable discovery, that of the variation of the lunar inclination.

Abu 'l Wefa and his Almagest

But an even more remarkable discovery has been claimed for an Arabian astronomer. In 1836 the younger Sedillot announced that he had found the third inequality, the variation, distinctly announced in Abu 'l Wefa's *Almagest.* A fierce controversy raged for a number of years as to the reality of this discovery, Sedillot alone defending his hero with desperate energy and refusing to listen to any arguments, while Biot, Libri and others as strenuously maintained that Abu 'l Wefa simply spoke of the second part of the evection, the prosneusis of Ptolemy. The fight had died out when, in 1892, Chasles suddenly took up the cudgels for Sedillot and pointed out what seemed to him to be some contradictions in Ptolemy's statement.[2] Nobody answered this until Bertrand did so in 1871; he called attention to several inaccuracies in the text of Abu 'l Wefa as we possess it now, and also showed that Abu 'l Wefa did not add his "mohazat" to the prosneusis, the latter not being included in his "second anomaly."[3] It is unnecessary to enter into a more detailed account of the controversy; but to show that any weapon was considered good enough with which to defend Abu 'l Wefa, it may be mentioned that Sedillot and Chasles tried to prove that Tycho Brahe must have copied his discovery from Abu 'l Wefa, because he calls it *hypothesis redintegrata.* Tycho used this same phrase in speaking of his own planetary system, which he most emphatically claimed as

1. Sedillot, *Prolegomenes*, p. *xxxviii. Materiaux pour servir a l' hist. des sciences chez les Grecs et les Orientaux*, T. I. p. 283. The sons of Mūsā ben Sakir (about 850) seem to have been the first to find a value differing from that of the ancients. Abraham ben Chija, a Jewish writer who lived about A. D. 1100 says that Ptolemy found 5°, but that according to the opinion of the Ishmaelites it is 4½° (*Sphaera mundi.* Basle. 1546 p. 102).
2. *Lettre a M. Sedillot sur la question de la variation lunaire.* Paris, 1862, 15 pp. 4° and *Comptes Rendus*, vol. 54, p. 1002.
3. *Comptes Rendus.* vol. 73, pp. 581, 756, 889 ; *Journal des Savants.* 11 Oct. 1871.

an original discovery, and which he vigorously defended against other claimants. In future it will be hopeless for anybody to claim the discovery for Abu 'l Wefa as the matter has now been thoroughly sifted, both by mathematicians and orientalists.

The *Almagest* of Abu 'l Wefa has never been published in full, but there are three translations of the chapters in question,[1] which only differ in some trivial points. In no part of the book does he make any advance on Ptolemy or claim to have made any new discovery, and in speaking of three inequalities he merely does what the other Arabian astronomers do.[2] He begins by describing the first (equation of the centre) and the second (evection) and states when they reach their maxima. He then says that we have found[3] a third inequality, which takes place when the centre of the epicycle is between the apogee and the perigee of the eccentric, and which reaches its maximum when the Moon is about a *tathlith* or a *tasdis* from the Sun, while it is insensible in syzygy and quadrature. The maximum is $\frac{3}{4}°$. He explains that this is caused by a deviation of the line or apsides of the epicycle, and he describes quite correctly the construction adopted by Ptolemy (whose name he does not mention), letting the line of apsides be directed, not to the Earth but to another point on the line of apsides of the eccentric. It is difficult for an unbiassed reader to understand how anyone could fail to see that Abu 'l Wefa is simply copying Ptolemy. Sedillot maintained that the words *tathlith* and *tasdis* mean the octants (where the variation reaches its maximum); but every other orientalist who has expressed an opinion, states that by their roots the words correspond to the numbers 6 and 3, in other words, to elongations 60° and 120° from the Sun. This is in accordance with

1. By Reinaud, Munk, and de Slane(for Biot)in the *Journal des Savants*, March, 1845 (14 pp. the whole section on the Moon) ; by Sedillot, *Materiaux*, i. pp. 45--49 ; and by Carra de Vaux, "L' almageste d' Abū 'l Wefa Albūzdjani," *Journal asiatique*, 8° Serie, T. *xix.* (1892), pp. 408--471 (translation on pp. 443-44). Most of the chapters on the planets are lost.

2. The unknown author of a short resume of astronomy (in the *Bibl. Nationale*) even calls the inequality of prosneusis the first equation (Carra de Vaux, l.c. p. 460). This is not unreasonable, since the equation of the centre must be taken from the lunar tables, using as argument not the mean anomaly but the latter corrected for the effect of the prosneusis.

3. He uses exactly the same expression when speaking of the first and second inequalities.

facts, as Biot has shown from the Ptolemy's numerical data that the deviation of the line of apsides reaches its maximum value of $\pm$ 13° 8′.9 in elongations 90° $\mp$ 32° 57′.5.[1] But it must be acknowledged that the words in question are also used very vaguely, e. g. by Abu 'l Wefa himself, who says that the velocity of the superior planets after emerging from the Sun's rays diminishes gradually till their distance from the Sun is about a *tathlith*, when they become stationary. It looks almost as if these words might be used to denote any elongation outside syzygy and quadrature.[2]

If Abu 'l Wefa had made a new discovery, we should have expected later Arabian astronomers to have alluded to it. But not one of them gives anything but interpretations of the lunar theory of Ptolemy, and in expressions very similar to those employed by Abu 'l Wefa. Attention was at once called to this fact, and Isaac Israeli of Toledo (about 1310) and Geber of Seville were quoted as examples,[3] though it would, of course, have been quite possible for these two writers to have remained ignorant of whatever progress astronomy might have made in the school of Baghdad. But this objection does not apply to Nasir ed-din al Tūsi, in whose review of the Almagest and Memorial of Astronomy the inequalities known to Ptolemy and no others, are described and credited to Ptolemy[4]; not to Mahamud al Jagmini (about 1300), who wrote a compendium (*mulachchas*)

1. *Journal des Savants*, 1843, p. 701 ("Sur un traite arabe relatif a l' astronomie," Reprint, p. 47). This deviation does not represent the amount of the correction to the Moon's place as seen from the Earth, so that there is not any contradiction in Ptolemy's account.

2. Carra de Vaux, l. c. p. 466. The Arabs had no word for "octants." Nasir-ed-din on one occasion wants to mention them, and has to call them "the points midway between syzygy and quadrature."

3. Isaac Israeli repeatedly speaks of these inequalities discovered by Ptolemy, two of which are not found at conjunction and opposition. *Liber Jesod, Olam seu Fundamentum Mundi auctore R. Isaac Israeli Hispano*, section III. ch. 8 and sect. v. ch. 16, Part I. p. xxiv Part II. p. xxxi (Berlin, 1848 and 1846; this publication is not mentioned by Carra de Vaux).

4. C. de Vaux, "Les spheres celestes selon Nasir Eddin Attusi", Appendix to P. Tannery's *Recherches sur l' astr. anc.* p. 342, and *Journ. asiat.* 1892, p. 459: "The third anomaly is that of the prosneusis; it is called the equation of the proper motion" (i.e. of the motion on the epicycle).

of astronomy.[1] Nor can any objection be raised to Abu'l Faraj (Bar Hebraeus), and it would be impossible to explain more clearly than he does the effect of the prosneusis. He says: " The third inequality is the angle formed at the centre of the epicycle by two lines which are drawn, one from the centre of the universe and the other from the point called the prosneusis, at the end of which is the apogee of the epicycle, at which commences the proper motion, and which is called the mean apogee. The apogee which is at the end of the line drawn from the centre of the universe is called the apparent one. The point proseneusis is on the side of the perigee of the eccentric, 10 parts 17 minutes from the centre of the world[2] which is itself at the same distance from the centre of eccentric. The maximum value of this angle is 13 parts 9 minutes when the Moon is a crescent or $\frac{3}{4}$ gibbous, that is, near the hexagon or trigon with the Sun. In fact, when the epicycle is four or eight signs distant from the apogee of the eccentric, the Sun is itself two or four signs distant from [the centre of the epicycle] because it is half way between this centre and the apogee. In the tables, this inequality of the two apogees is called the first angle and is included in the motion of the centre."[3] While this describes the construction of Ptolemy as clrealy as possible, at the same time the agreement of the account with that of Abu' l Wefa is perfect. Abu'l Faraj even (like Nasir ed-din) describes as a fourth inequality in longitude that caused by the motion along an orbit inclined to the ecliptic, so that he would not have neglected to describe the variation, if it had been found by an astronomer of Baghdad. We may add that the Jewish writer Abraham ben Chija (A. D. 1100), in his *Sphaera Mundi*, also describes the "aberration" of the apside of the epicycle, chiefly "in sexta et tertia parte mensis."[4]

1. Translated by Rudloff and Hochheim, *Zeitschrift der Deutschen Morgenland Ges.* XLVII pp. 213—275. He describes (p. 249) how the line of apsides is directed to a point called "the corresponding point," and gives its position correctly. The inequality he calls the deviation.
2. Nasir ed-din gives $10^p\ 9^r$.
3. *Le livre de l' ascension*, & c. T. II. PP. 29-30. Two codices add after the word prosneusis : "This is the point mohazat."
4. *Sphaera Mundi* (1546, ed. Schreckenfuchs), p. 75. Munster's commentary to the Hebrew text (p. 116) has "cum centrum est in sextili aut trino aspectu [id est, quando abest a sole duobus signis aut quatuor]" ; the words in brackets are not in the Hebrew original. The words "sixth" and "third" are unmistakable (shithith and shelishith). Apparently no one has hitherto thought of consulting Abraham ben Chija.

Abu 'l Wefa and Ptolemy

Therefore, Abu 'l Wefa did not know a single thing about the motion of the Moon which he had not borrowed from Ptolemy. But the prosneusis of Ptolemy is not the variation discovered by Tycho Brahe. The latter depends solely on the elongation of the Moon from the Sun, as it is $= +39'.5 \sin 2\varepsilon$, while it is beyond the power of mortal man to express the effect of the prosneusis without the anomaly. Ptolemy's exprssion for all the inequalities in longitude assumed by him, when developed analytically, found to contain, in addition to terms represening the equation of the centre and the evection, the latter being

$$+1^\circ 19'.5 \sin\ (2\varepsilon - m),$$

a very considerable term

$$+17.8 \sin 2\varepsilon\ [\cos (2\varepsilon + m) + 2 \cos (2\varepsilon - m)],$$

where ε is the elongation and m the mean anomaly.[1]

Obviously this term has nothing in common with the variation, except that it disappears in the syzygies and quadratures. Tycho Brahe did not hang his new term on to the unaltered lunar theory of Ptolemy, and by doing that we should in fact only spoil the latter and make its maximum error rise to more than a degree.[2] Owing to the insufficiency of the observations at his disposal, Ptolemy could only perceive that there was some outstanding inequality after allowing for the evection, only appearing outside the syzygies and quadratures, but he was neither able to find the law which governed the phenomenon, nor was he aware what a large quantity it represented; he could only tinker up his constructions a little, and in this he was most faithfully followed by the Arabs, who added nothing to what he had done and left it to the reviver of practical astronomy to discover the third lunar inequality.

Al Fargani and others on Planets

Passing to the five planets, we find that, generally speaking, very few attempts were made to improve the work of Ptolemy. But the Arabs were not content to consider the Ptolemaic system

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P. Tannery, *Recherches*, p. 213. Another expansion of Ptolemy's lunar inequalities in a series was given by Biot, *Journal des Savants*, 1843, p. 703 (Reprint, p. 49).

P. Kempf, *Untersuchungen uber die Ptolemaische Theorie der Mondbewegung*, Berlin, 1878 (Inaug. Diss.), p. 37.

merely as a geometrical aid to computation; they required a real and physically true system of the world, and had therefore to assume solid crystal spheres after the manner of Aristotle. Above the Moon is the Alacir, the fifth essence, which is devoid of lightness and heaviness, and is not perceptible to the human senses; of this substance the spheres and planets are formed.[1] Already in the book of Al Fargani we find the principle adopted which we have seen dates from the fifth century (Proklus) and which became universally accepted in the Middle Ages, that the greatest distance of a planet is equal to the smallest of the planet immediately above it, so that there are no empty spaces between the spheres.[2] The semidiameter of the Earth is by Al Fargani given as 3250 miles, which corresponds very nearly to Al Mamun's $56\frac{2}{3}$ miles to a degree, if we put $\pi = \frac{22}{7}$. Starting from Ptolemy's distances of

Greatest Distance of	Al Fargani	Al Battani	Abu 'l Faraj[3]
Moon	$64\frac{1}{6}$	$64\frac{1}{6}$	$64\frac{1}{6}$
Mercury	167	166	174
Venus	1,120	1,079	1,160
Sun	1,220	1,146[4]	1,260
Mars	8,876	8,022	8,820
Jupiter	14,405	12,924[5]	14,259
Saturn	20,110	18,094	19,963

the Moon and the Sun, it was easy to express the other distances in semidiameters of the Earth, the ratios between the greatest and

1. Al Battani, cap. 50 (p. 195).
2. Al Fargani, cap. 21 (ed. Golius, p. 80). Much later, Maurolycus in his *Cosmographia* (Venice, 1543, f, 20a) proves that Mercury and Venus must be below the Sun, by pointing out that there would otherwise be a large vacant space between the Sun and the Moon.
3. pp. 189-191.
4. So in Nallino's ed. (Milan, 1903 p. 121) the ed. of 1645 has 1176.
5. The ed. of 1645 has 12, 420; obviously an error, as the ratio of greatest to smallest distance is given as 37:23 for Saturn 7:5 (misprinted 7:2), or "quantitas unius et duarum quintarum ad unum" (p. 199). Nallino's ed (Milan 1903) has 12,924. Abraham ben Chija has 12,400.

smallest distances being in substantial agreement with the theory of Ptolemy. Al Battani also gives a similar set of figures, though with some slight differences. He does not mention peculiar treatment given by Ptolemy to the theory of Mercury. The above table gives the distance expressed in semidiameters of the Earth.

Al Kusgi and diameters of planets

Al Kūsgi, one of the astronomers of Ulug Begh, gives a list of the semidiameters of the "concavities" of the planetary spheres (i.e. the smallest distances of the spheres) expressed in parasangs, the diameter of the Earth being 2,545 parasangs.[1] Expressed in semidiameters of the Earth, the figures turn out somewhat different from those given above, e.g. the smallest distance of the Sun being 1,452 and the greatest of Saturn 26,332, but he does not supply any means of making out how these figures were found.

Before leaving this subject, we shall also give the diameters of the planets according to Al Fargani, as they became known in Europe at an early date and were quoted by Roger Bacon and others.[2] With trifling variations the same values are given by Al Battani, Abu 'l Faraj, and Abraham ben Chija.

	Apparent Diameter	True Diameter (Earth's=1)
Moon in apogee	$31\frac{2}{5}'$ ...	1 : $3\frac{2}{5}$
Mercury, mean dist.	$\frac{1}{15}$ of Sun's ...	$\frac{1}{28}$
Venus „ „	$\frac{1}{10}$ „ ...	1 : $3\frac{1}{3}$
Sun „ „	$31\frac{2}{5}'$ ...	$5\frac{1}{2}$
Mars „ „	$\frac{1}{20}$ of Sun's ...	$1\frac{1}{6}$
Jupiter „ „	$\frac{1}{12}$ of Sun's ...	$4\frac{1}{2} + \frac{1}{16}$
Saturn „ „	$\frac{1}{18}$ „ ...	$4\frac{1}{2}$

Al Kazwini, Abu'l Faraj and Al-Jagmini on Excentric Spheres of the Sun

The system of the spheres is set forth in greatest detail in three treatises of later date, the cosmograpy of Zakarija ben Muhammed ben Mahmud al Kazwini (about 1275), the astronomy

1. *Astronomica Shah Cholgii*, pp. 95-97.
2. There are some slight differences between the figures given in the various editions (J.L.E. Dreyer has compared those of 1493, 1546, and 1669), but those given above agree with the cubic contents according to Al Fargani. The figures of Kazwini seem to have been greatly corrupted.

of Abu 'l Faraj, written in 1279, and that of Mahmud ibn Muhammed ibn Omar al Jagmini, whose date and nationality are equally uncertain, but who probably wrote in the thirteenth or fourteenth century. We find in these text-books an elaborate system of spheres designed to account for every particular of planetary motion, in perfect agreement with each other as to the general arrangement of the spheres, and offering nothing new as to lunar or planetary theory. The accompanying figures (taken from Jagmini) will illustrate the ideas better than a lengthy description.[1] The Sun is a solid sperical body, fitting between two excentric spherical surfaces, which touch two other surfaces, in the

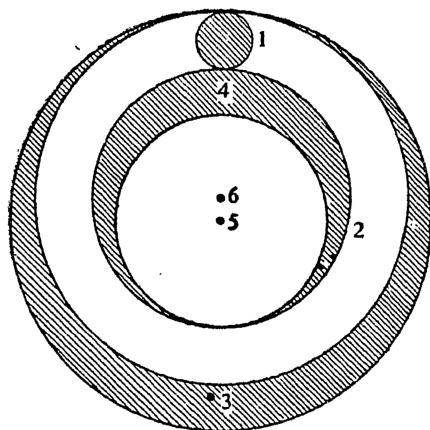


Fig. 1.—Planetary motions and system of spheres.

1. The Sun. 2. Excentric sphere. 3. The surrounding spheres. 4. The complement of the surrounding sphere. 5. Centre of the world. 6. Centre of the excentric sphere.

common centre of which the Earth is situated, and which between them enclose a space (or intersphere, as Abu 'l Faraj calls it), named by Jagmini al-mumaṭṭal, or the equably turning sphere, which has the same motion from west to east as the fixed stars, i.e. precession. The spheres of the three outer planets and Venus are arranged on the same plan, except that the place of the body of the Sun is taken hy the epicycle-sphere of each planet, to the inner surface of which the planet (a solid spherical body) is attached or (as Abu 'l Faraj says[2]) "fixed like a pearl on a ring, touching the

1. Al Kusgi gives very similar diagrams of the spheres of the Saturn, Mercury, and the Moon.

2. Precession is supposed to be included in this, "the first motion." The second

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surface in one point." The axis of the excentric sphere is inclined to that of the mumaṭṭal sphere, which causes the motion in latitude. The lunar system comprises an additional sphere outside the others, the centre of which coincides with the centre of the world, and which is called *al-gauzahar*, signifying the cosntella-

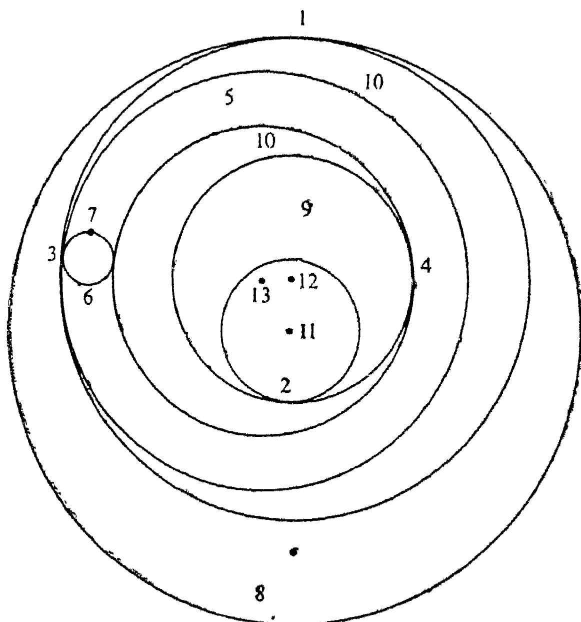


Fig. 2.—Spheres of Mercury

1. Upper Apsis. 2. Lower Apsis. Upper Apsis of deferent sphere. 5. Deferent sphere. 4 Lower Apsis of deferent sphere. 6. Epicycle. 7. Mercury. 8. Surrounding complement. 9. Surrounded part of Mumaṭṭal sphere. 10. Mūdir sphere. 11. Centre of the world. 12. Centre of Mūdir. 13. Centre of deferent sphere.

tion Draco, as this sphere provides for the revolution of the lunar nodes ("the head and tail of the dragon") round the zodiac. The inner one of the two concentric spherical surfaces, between which the excentric sphere lies, surrounds immediately the fire sphere of the Earth. The system of Mercury is more complicated, as a space had to be provided for the revolution of the centre of the

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one is that of the concentric oblique intersphere (called the mail sphere or the sphæra deflectens) round the centre of the world, 11°9′ per day, by which amount the lunar apogee moves towards the west. The third motion is that of the excentric, carrying the centre of the epicycle 24°22′ towards the east. The fourth is the motion on the epicycle. Abu 'l Faraj, p. 27.

excentric sphere. The figure shows the excentric sphere enclosed in a sphere, *al-mūdir* or the turning one, which allows the upper apsis or apogee of the excentric or deferent sphere (3 in the figure) to move right round the outer surface of the *mūdir*. The inner surface of the mumaṭtal sphere immediately surrounds the *gauzahar* sphere of the Moon.

It was a necessary consequence of the large solar parallax of 3' accepted by Ptolemy, that Mercury and Venus must be very near the Earth, since they are assumed to be nearer than the Sun. Thus Abraham ben Chija says that the shadow or the Earth extends beyond the orbit of Mercury but does not reach that of Venus.[1] Ptolemy never mentions the parallaxes of Mercury and Venus, as to which nothing was known, though they ought, of course, to be greater than 3'. But on the assumption that the smallest distance of Mercury is equal to the distance of the Moon at apogee, the parallax of Mercury ought to rise to 54', which must have been felt to be too large a quantity, though it does not seem to have struck Al Battani as anything surprising, perhaps because Mercury cannot be seen when in inferior conjunction. It may have been this necessarily large parallax of Mercury, which induced Ibn Jūnis (without any explanation) to reduce the solar parallax from 3 to 2', or rather to 1' 57".[2] Geber[3] blames Ptolemy for having said that the parallaxes of the planets are insensible, and remarks that he ought, therefore, logically to have placed Venus and Mercury above the Sun. He takes great pains to show that Venus may be exactly on the line joining the Sun and the Earth. Indeed, Geber neglects no opportunity of criticising Ptolemy's methods of finding the elements of the orbits,[4] and he is generally very unjust to him but he does not venture to

1. *Sphaera mundi*, ed. Osw. Schreckenfuchs, Basle, 1546 pp. 84, 86.

2. Unpublished chapters of Ibn Jūnis, reviewed by Delambre, *Hist. de l'astr. du Moyen Age*. p. 101.

3. *Instrumentum primi mobilis a P. Apiano. Accedunt ijs Gebri filii Affla Hispalensis... libri* IX. *de astronomia*, Norimbergæ, 1534, fol. (Introd. p. 3 and lib. VII. p. 104).

4. See the long indictment on pp. 2-3 of his introduction. He blames Ptolemy among other things for assuming that the centre of the deferent is half-way between the centres of the zodiac and of the equant, while he himself deduces this from the movements.

substitute any other system and does not object to the general principles of the Ptolemaic system.[1]

Three great names :
Ibn Badja, Ibn Tofeil (Abubacer) and Abu Welid (Averroes)

Geber's attempts to pick holes in the work of Ptolemy were, perhaps, not unconnected with the rapid rise of Aristotelean philosophy in Spain in the twelfth century, which, though not destined to last long, nevertheless exercised a considerable influence on the spread of knowledge of Aristotle in the Christian world, while it cast a halo round the Caliphate of Cordova, which at that time, under the enlightened rule of the Almohades, seemed to have reestablished the glory of the best days of the Moslem world. Three names are specially associated with this movement :

(i) Abu Bekr Muhammed Ibn Jahya al Sayeg, called Ibn Badja (of Saragossa, died 1139), known as Avempace among the Scholastics ;

(ii) his pupil Muhammed ben Abdelmelik Ibn Tofeil (of Granada, died 1185-1186), called Abubacer by the Scholastics ;

(iii) and finally the greatest philosopher of Islam, Ibn Rosd Abu Welid, known as Averroes (1126-1198).

In studying Aristotle they laid special stress on his scientific works, and did not, like their Christian successors, think of little but dialectics. The acceptance of the system of homocentric spheres or some modification of it must, therefore, have seemed a necessity to the Arabian philosophers and this, of course, led them to reject the theory of epicycles.. The little we know of the opinions of Ibn Badja on this subject is found in the famous work *The Guide of the Perplexed* of the great Jewish scholar Moses ben Maimun of Cordova, better known as Maimonides, who tells us that he had his information from a pupil of Ibn Badja. Like Geber (with whose son he had been familiar), Maimonides doubted that Mercury and Venus were nearer than

1. Copernicus possessed a copy of Geber's book; which is now in the University library at Upsala. On the title page, after the author's name, he has written : "Egregii, Calumiatoris Ptolemaei," while a number of marginal notes show that he has read the book carefully. Curtze, *Mittheilungen des Coppernicus Vereins*, I, p. 37.

the Sun, though he would not venture to say how they actually moved.[1] But what is more important, he declared the motion of a planet on an epicycle to be contrary to physical principles, because there are only three motions possible in this world : around its centre, or towards it, or away from it; while he also maintained that according to Aristotle circular motion can only take place round a real, central body.[2] Though Aristotle in reality did not object to epicyclic motion with a mathematical point as centre, for the simple reason that it had not been proposed when he wrote, while, as we have seen, his moving principle had nothing to do with the centre of motion, it is easy to see that Ibn Badja's real difficulty was the same which afterwards produced so many obstacles to the advance of science in Europe : whatever could not be found in Aristotle's book must be unworthy of notice. According to Maimonides (who, however, makes the reservation that he had not heard it from disciples), Ibn Badja constructed a system of his own, in which he only admitted excentric circles but no epicycles. We are not given any particulars as to this system but there can hardly be any doubt that its author confined himself to generalities and did not attempt to represent phenomena like the lunar inequalities by it. Maimonides remarks that there is nothing gained by Ibn Badja's reform, since the excentric hypothesis is as objectionable as the epicyclic one, as it also supposes motion round an imaginary point outside the centre of the Earth. The centre of the excentric, on which the Sun is supposed to move, is outside the convexity of the lunar sphere and inside the concavity of that of Saturn's excentric is between the spheres of Mars and Jupiter. He adds that the revolution of a number of concentric spheres around a common axis is conceivable, but not the revolution round different axes inclined to each other, as the spheres would disturb each other unless there are other spherical bodies between them. This attempt to revive and modify the system of (movable ?) excentrics did, therefore, not mend matters.[3]

1. *Rabbi Mosis Majemonidis Liber . . . . Doctor Perplexorum.* Basileæ, 1629, Pars II. cap. IX.

2. Ibid., Pars II. cap. XXIV.

3. Maimonides also remarks (in the same chapter) that the supposed inclinations of Mercury and Venus in the Ptolemaic system are difficult or impossible to comprehend or imagine as really existing. Therefore, if what

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Ibn Tofeil

Ibn Tofeil, the second of the three Moslem philosophers of Spain, vizier and physician at the court of Jusuf ben Abd el Mumin of Morocco, seems to have walked in the footsteps of his master; but the only extant work of his, a kind of religious mystic romance about the emancipation of a soul from the trammels of this material world, does not give any clue to his ideas as to the planetary system. But Averroes, who also objected to the excentrics and epicycles says in his commentary to Aristotle's *Metaphysics* that Ibn Tofeil possessed on this subject excellent theories [2], and Ibn Tofeil's pupil, the astronomer Al Betrugi, in the introduction to his theory of the planets, says of him : "You know that the illustrious judge Abu Bekar Ibn Tofeil told us that he had found an astronomical system and principles of the various movements different from those laid down by Ptolemy and without admitting either excentrics or epicycles, and with this system all the motions are represented without error." Ibn Tofeil was therefore probably the real author of the fairly elaborate system, which his pupil worked out and handed down to us in a work on the planets, which was translated into Hebrew in the following century and from that again into Latin, and published in 1531 [3].

The object of this system was to explain the constitution of the universe as it really is, and not merely to represent the motions of the planets geometrically, so as to be able to foretell their places in the heavens at any time; and the author (be he Ibn Tofeil or Al Betrugi alias Alpetragius) specially disclaims any intention of testing the theory by comparing it with observations

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Aristotle says is true, there is neither epicycle nor excentric, and everything turns round the centre of the Earth.

2. Munk ; *Melanges de philosophie juive et arabe*. Paris, 1859, p. 412.

3. *Alpetragii Arabi Planetarum theorica phisicis rationibus probata, nuperrime latinis litteris mandata a Calo Calonymos, Hebreo Neapolitano*, Venice 1531, 28 ff. folio (published with Sacrobosco's *Sphaera*). A translation by the famous Micheal Scot has never been printed, but is still extant in Paris (Munk, *Melanges*, p. 519). The principle of the system is described by Isaac Israeli, who, however, does not mention the author's name (*Liber Jesod Olam*, II. 9. Part I. p. XI

or of accounting for minor details of the motions.[1] The leading idea is that of the homocentric spheres, each star being attached to a sphere, and the motive power is the ninth sphere, the sphere outside that of the fixed stars. The Spanish philosopher ought, therefore, to have been content with the system of Eudoxus or its modification by Aristotle (whom he never mentions by name, but only as "the sage"), but unfortunately he became possessed with the notion that the prime mover must everywhere produce only a motion from east to west, and he had, therefore, to reject the independent motion of the planets from west to east, and revert to the old Ionian idea that the seven planets merely perform the daily revolution with a speed slightly slower than that of the fixed stars. The true speed of the *primum mobile* is a little faster than this ; the eighth sphere performs a revolution in a slightly longer period (24 hours), and the effect of the prime mover is gradually weakened more and more, with increasing distance, until we find the sphere of the Moon, being furthest from the prime mover, taking nearly twenty-five hours to complete a revolution. This was the old primitive Ionian idea, but Al Betrugi (or his teacher) saw that this was not sufficient, as not only is the pole of the ecliptic different from that of the equator, which prevents the planets from moving in closed orbits, but the planets do not even keep at the same distance from the pole of the ecliptic but have each their motion in latitude, as well as variable velocity in longitude ; and all this had yet to be accounted for. The ninth sphere has but one motion, but the eighth has two, that in longitude (precession) and another which is caused by the pole of the ecliptic describing a small circle round a mean position, thereby producing the supposed oscillation or trepidation of the equinoxes.[2] Similarly, the pole of each planet describes a small circle round a mean position (i. e. the pole of the ecliptic), thereby producing inequalities in longitude and motion in laritude[3] Whenever the actual orbit-pole of a planet is on the parallel of the mean pole, it is obvious that the planet will perform its daily revolution with its mean velocity, while the velocity is increased or lessened when the actual pole is respectively at ts minimum or maximum distance from the pole of the heavens

1. Fol. 8 b. 2. Fol. 9 b.

3. Fol. 14 b;. sq.

(the motion of the pole of the orbit being added to or subtracted from the motion of the planet), so that the epicycle is hereby rendered superfluous. The lengths of the radii of these small circles are not given, except in the case of Saturn, where the radius is 3° 3′,[1] while the mean pole of the moon is 5° (the inclination of the lunar orbit) distant from the pole of the ecliptic,[2] and the small circle is so exceedingly small as to produce no retrograde motion, which is also the case with the Sun. The periods of the poles of the outer planets are given by the following figures Saturn makes 57 revolutions in 59 years and $1\frac{1}{2}+\frac{1}{4}$ days, in which period the mean pole lags behind 2 revolutions $1\frac{4}{5}°+\frac{3}{5}°$. Jupiter makes 65 revolutions in 71 years, the mean pole lagging behind 6 revolutions. Mars makes 37 revolutions in 79 years and $3\frac{1}{6}+\frac{1}{15}$ days, the pole lagging behind 42 revolutions and $3\frac{1}{7}°$[3].

In other words, the motion on these small circles are completed in the synodic periods of planets. Similarly, the pole of Venus makes 5 revolutions in the 8 years less $2\frac{1}{4}d+\frac{1}{30}$, lagging $1\frac{3}{5}$ revolutions in one year ; and Mercury 145 revolutions in 46 years and $1\frac{1}{30}d$[4]. It is curious that Alpetragius alters the order of the planets, placing Venus between Mars and the Sun, because the defectus (lagging) of Venus smaller than that of the Sun.[5] He also says that nobody has given any valid reason for accepting the usually assumed order of the planets, and that Ptolemy is wrong in stating that Mercury and Venus are never exactly in a line with the Sun (a remark already made by Geber) ; and as they shine by their own light they would not appear as dark spots, if passing between us and the Sun. That they do not receive their light from the Sun is proved, he thinks, by the fact that they never appear crescent-shaped.[6]

There is no need to dwell any longer on this quaint theory

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1. Fol. 16 a.

2. Fol. 25 a.

3. Fol. 16 a, 18 a, 19 b.

4. Fol. 21 b, 24 b.

5. "Nam reperimus defectum eius primum minorem defectu orbis solis et maiorem defectu orbis martis, et sequitur juxta radices nostras ut sit inter eos ambos."

6. Fol 21 a

of spiral motion, as it has been rather improperly called.[1] It represented a retrograde step of exceedingly great magnitude, totally unjustified as the theory could not seriously pretend to be superior to the Ptolemaic system, which had only become so very simple if one was content with representing only the principal phenomena. We are told by the Jewish astronomer Isaac Israeli of Toledo, that the new system made a great sensation, but that it was not sufficiently worked out to be taken seriously, and that the system of Ptolemy, founded on the most rigorous calculations, could not be superseded by it.[2] Another Jewish author, Levi ben Gerson, in a work written in 1328, entered into a lengthy refutation of the hypotheses of Al Betrugi.[3] But the latter certainly represented a general desire on the part of the Spanish Aristoteleans to overcome the physical difficulties in accepting the Ptolemaic system; thus Averroes says that the astronomy of Ptolemy is merely a convenient means of computing, and that he himself in his youth had hoped to prepare a work on the subject.

Nasir ed-din Al Tūsi

While ineffectual attempts were being made in the far west. to devise a new astronomical theory, the astronomers of the east did not remain blind to the desirability of finding a system, in which the planets were not supposed to move unsupported in space in such a wonderfully complicated manner; and in the thirteenth century we find one of the greatest astronomers, Nasir ed-din Al Tūsi, advocating a system of spheres which he supposed to be more acceptable than excentrics and epicycles.[4] In addition to a review or digest of the *Syntaxis* of Ptolemy he wrote a shorter work entitled *Memorial of Astronomy*, in various

1. e.g. by Riccioli, *Almag. Nov.* T. I. p. 504, where Kepler's figure of the real motion of Mars in space from 1580 to 1596 (supposing the earth to be at rest) is copied, as if that had anything to do with the "*Spirals*" of Alpetragius.

2. He adds that he was not qualified himself to sit in judgment on the proposed system (*Liber Jesod Olam*, II. 9, p. XI.)

3. Munk, *Melanges* pp. 500 and 521.

4. "*Less spheres celestes selon Nasir-Eddin Al tūsi. Par M. Carra de Vaux.*" Appendix VI. *to Tannery's Recherches sur l'astr. anc.* pp. 337—360. Includes a translation of the chapter in which the new theory is set forth.

passages of which he shows his dissatisfaction with the Ptolemaic system. In the chapter on the Moon (to which we have already alluded) he counts up the various anomalies, among which he mentions the anomaly of illumination, that is, the spots on the Moon, which he believes to be caused by other bodies moving in the lunar epicycle and unequally exposed to the Moon's light. He then says that we should expect in a simple theory to find the centre of the epicycle in equal times describing equal arcs on the deferent, and the diameter of the epicycle joining the pericentre and the apocentre pointing to the centre of the deferent. But neither of these conditions is fulfilled. In the theories of the planets he makes the same objections, which it must be said are very just, since the introduction of the equant was a very unnatural arrangement. But this is nothing to the artificial machinery designed by Ptolemy to account for the motion in latitude of the five planets, especially of Mercury and Venus. Nasir ed-din describes the marvellously complicated movements of the deferents and epicycles of these planets, and remarks that "these motions require the introduction of a system of guiding spheres, about which the ancients have not said anything". He next proceeds in the following chapter to explain a system of his own which allows us to discard these combinations.

First he proves that if there are two circles in one plane, one touching the other internally and of a diameter equal to half that of the other, and if the greater one rotates, and a point moves along the circumference of the smaller one in the opposite direction with twice the velocity and starting from the point of contact, then that point will move along a diameter of the greater circle.[1] These two circles may now be assumed to be the equators of two spheres, and for the point we may substitute a sphere representing the Moon's epicycle (1 in the figure), Nasir ed-din assumes another sphere (2) surrounding the epicycle and destined to keep the diameter from apogee to perigee in its place always coinciding with the diameter of the sphere (4) "let us give it a suitable thickness, but not too great, so as not to take up too much space." He next assumes two more spheres, one (3) which corresponds to the smaller sphere in the distance of the centre of the deferent in the Ptolemaic system from the

1. Compare Copernicus, *De revolutionibus*, III. 4 (Secular ed. 1873, p. 166).

centre of the Earth; and another sphere (4) with a diameter twice as great. Finally (4) is placed in the interior of a carrying sphere (5) concentric with the world and occupying the concavity of the

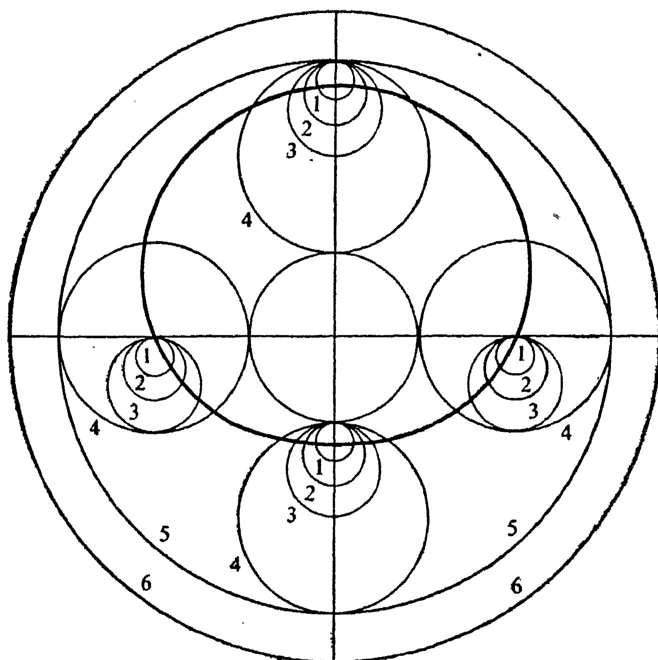


Fig. 3.—Movements of deferents and epicycles of planets.
The thickline is *not* a circle. All others are circles.

sphere (6), the equator of which is in the plane of the lunar orbit. (2) and (4) and (5) revolve in the same period, that in which the centre of the epicycle performs a revolution; (3) revolves in half that time, while (6) revolves in the opposite direction with the same speed as the apogee of the excentric. The figure now shows how the epicycle moves to and fro along the diameter of (4) and during the revolution of the circle (5) describes a closed curve, about which Nasir ed-din justly says that it is somewhat like a circle but is not really one, for which reason it is not a perfect substitute for the eccentric circle of Ptolemy. He estimates the greatest difference between the lunar places given by the two theories as one-sixth of a degree, half-way between syzygy and quadrature. Except for the action of the guiding sphere (2), it would not be the centre of the epicycle but the point of contact of circles (3) and (4), which describes the curve resemblng a circle. The same

method may be adopted for Venus and the three outer planets, and Nasir ed-din promises to explain the new theory of Mercury in an appendix, but this appears to have been lost.

Nasir ed-din also endeavours to improve on the machinery proposed by Ptolemy to illustrate the manner in which the epicycle remains parallel to the plane of the ecliptic. He mentions that the celebrated Ibn al Haitham (afterwards known in the west as Alhazen, author of a well-known book on optics) had written a chapter on this subject, adding to each epicycle two spheres to account for the inclination of the diameter perigee-apogee, and two additional ones for the inferior planets for the diameter at right angles thereto.[1] Nasir ed-din makes use of the same principle which guided him in his demonstration about the motion in longitude, and he shows how in this way we may by means of two spheres make the extremities of the diameter of the epicycle move backwards and forwards along an arc of a sphere.[2] He claims that this arrangement is superior to that of Ptolemy by not introducing any error in longitude,[3] but he acknowledges that he has not been able to get rid of the strong objection to Ptolemy's auxiliary circle, viz. that the irregular motion in longitude with regard to the centre of the deferent necessitates the introduction of a corresponding irregularity in the motion on the auxiliary circle by letting the motion be uniform with regard to an equant. It baffled Nasir ed-din's ingenuity to find an arrangement of spheres which could obviate the necessity of having recourse to this expedient.

All the attempts at rebellion against the Ptolemaic system had thus turned out failures. And they deserved nothing else, since it was impossible to find anything better than what Ptolemy had produced, until it was perceived that where Ptolemy was wrong was not in his mathematical methods, which were perfect, but in the fundamantal idea of the Earth being at rest. The time

1. Ibn al Haitham said that by using discs instead of spheres one might complete the demonstration; but Nasir ed-din objects to the arrangement (about which he gives no details) that a non-spherical system is not in accordance with the principles of astronomy.

2. It is not quite clear whether this plan is his own or is the same as Ibn al Haitham's.

3. Due to disturbance of the position of the diameter from perigee to apogee, from which the anomaly is counted.

was apparently not ripe for a radical change with regard to this idea. Though the doctrine of the Earth's motion does not seem to have been mentioned by Arabian writers, we have evidence that the hypothesis of the daily rotation of the Earth was not unknown among them, a natural consequence of their familiarity with the writers of antiquity. One of Nasir ed-din's fellow-workers at the Meragha observatory, Ali Negm ed-din al Katibi, who died in 1277, wrote a book, the *Hikmat al-ain*, on philosophy, in which he combats this opinion, which he attributes to "some philosphers." "I do not," he says, "advance as an argument against it that, if this were the case, a bird flying in the direction of the motion of the Earth would not be able to keep up with it, because the motion of the Earth would be much faster than that of a bird, inasmuch as it returns to its place in a day and a night. Such an argument is not conclusive, because it may be urged that the atmosphere which is close to the Earth partakes of its motion as the ether partakes of the motion of the heavenly sphere. But I reject this theory, because all terrestrial motions take place in a straight line, and therefore we cannot admit that the Earth should move in a circle."[1]

What reformation of astronomy could be hoped for, as long as this kind of argument could be used ? We cannot see from this remark of Katibi's whether there really were any Arabian philosophers who believed in the rotation of the Earth. It is, however, stated in the *Zohar*, the great Kabbalistic work attributed to Mosheh ben Shemtob of Leon (died 1305), that a certain Rabbi Hamnuna the Elder (otherwise unknown) taught that "the Earth turns like a sphere in a circle and that some people are above and others below."[2] Though this passage as well as others in the Zohar may have been interpolated much later, it would

1. A. Sprenger, "The Copernican System of Astronomy among the Arabs." *Journ. Asiat. Society of Bengal*, Vol. XXV. (1857), p. 189. Katibi's contemporary, Abu 'l Faraj (II. p. 10) deems it necessary to prove that the Earth cannot be in motion, neither rectilinear nor circular, but his arguments (about birds and stones flung upwards) seem merely taken from Ptolemy, lib, 1. cap. 6, Kazwini (*Kosmographie*, p. 296) says that among the ancients there were some adherents of Pythagoras who maintained that the Earth continually moves round in a circle ; but whether these adherents were Greeks or Arabians cannot be seen from the context.
2. *Sohar*, Amsterdam, 1718, T. III. f. 10a ; Gunther, *Studien Z. Gesch, d. math, Geogr.*, p. 113.

after all not be very surprising if some learned Jews had been influenced by the opinion of Herakleides, since it is an established fact that the doctrines of the Kabbalists were intimately connected with the later Greek philosophy. But any how nothing came of this isolated case, and the daily rotation of the heavens continued to be universally accepted as a self-evident fact.

Arabian astronomers and Ptolemaic system—

Arabian astronomers who really wished to follow in detail the celestial motion were therefore obliged to adopt the Ptolemaic system altogether. New planetary tables had long been found to be a necessity, and this important work was at last undertaken by King Alfonso X. of Castille and several Jewish and Christian astronomers working under him at Toledo, who prepared the celebrated Alfonsine Tables, Apparently the King must have had his doubts about the physical truth of the system, judging from his well-known saying that if God had consulted him when creating the world, he would have given Him good advice. The tables were prepared under the direction of the Jew Ishak ben Said, called Hasan, and a physician, Jehuda ben Mose Cohen, and were finished in 1252, the year in which Alfonso ascended the throne of Castille. They continued in great repute for three hundred years as the best planetary tables; they were first printed in 1483, but had been spread all over Europe long before that time in numerous MS copies, many of which are still in existence, Twenty-six codices are counted up in the *Libros del Saber de Astronomia del Rey D. Alfonso X.de Castella*, Madrid, 1863-67 (5 vols. fol.). This compilation, a series of chapters on spherical and theoretical astronomy followed by tables, must have been made up from several codices, as there are numerous repetitions even of very elementary matters. In the third volume the theories of the planets are dealt with, but one looks in vain for any improvement on Ptolemy; on the contrary, the low state of astronomy in the Middle Ages is nowhere better illustrated. In general the elements of the orbits are those of Ptolemy, though sometimes only approximations are given, while different values are given in different chapters, though Ptolemy places the centre of the deferent midway between the centre of the equant and the Earth, the *Libros del Saber* places the centre of the equant (*cerco del alaux.*[1]) midway between the Earth and the centre of the deferent

1. *al* is the Arbic article, *aux* (apside) is a corruption of the Arabic *Oudj* (Abu 'l Faraj, II. p. 25). The equant is called the *cerco del Y guador.*

(*cerco del levador*[1]), as in Ptolemy's theory of Mercury, which the authors would seem to have extended to the planets, omitting the motion of the centre of the deferent on a small circle; this, they have, however, correctly given in the case of Mercury.[2] There is a very curious figure[3] of the deferent of Mercury in the form of an ellipse (the axes being as 6 to 5 nearly), with what looks like the Sun in the centre. This curve has been constructed from a number of small circular arcs,[4] and it is obviously nothing but the curve described by the centre of the epicycle of Mercury in Ptolemy's theory. For according to the latter the centre of the deferent describes a small circle with radius$=\frac{1}{21}$ of that of the deferent, in direction from east to west, in the same time which the centre of the epicycle takes to pass round the circumference of the deferent from west to east. This makes the centre of the epicycle describe a closed curve resembling an ellipse, the axes of which are in the ratio 11: 10, almost exactly the same as in the Spanish diagram, and there is therefore in the latter no anticipation whatever of Kepler's great discovery, since in the case of the inferior planets it is the epicycle which is the real orbit.[5] The small sun-like object in the centre of the ellipse represents the centre of Ptolemy's small circle, and it has either been inserted in the manuscript centuries after the essay had been written, or, more likely, it has been caused by a small blot on the place in the parchment where the stationary leg of the draughtsman's compasses had made a small hole. An oval deferent of Mercury occurs in several books published in the sixteenth and seventeenth centuries.[6]

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1. Vol. III. pp. 246—253.
2. Vol. III, pp. 253 and 278. In the the latter place the radius of the small circle is $\frac{1}{21}$, as in the "*Hypotheses*" of Ptolemy.
3. Vol. III. p. 282.
4. See the lengthy description on pp, 278—280.
5. The editor, Don Manuel Rice y Sinobas, on p. xxxiii. of his preface, even goes so far as to suggest that Kepler may have known of this great discovery of Alfonso's or rather of Arzachel's, as the text attributes the construction to him. This and other similar diagrams were intended to be used instead of planetary tables in the manner afterwards adopted by Apianus.
6. First (about 1460) in Purbach's *Theoricae novae Planetarum* (ed. of Basle, 1573, p. 82): "Ex dictis apparet manifeste, centrum epicycle Mercurij,

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Though the somewhat confused collection of essays entitled the *Libros del Saber* would not, if published in the thirteenth century, have advanced astronomical science, it cannot be denied that the Alfonsine Tables were very useful in their day. The actual elements are not given, nor is any thing said about any observations by which somewhat more correct values of the mean motions must have been found.[1]

Arabs on motions of fixed stars.

Thus we finish our review of the planetary theories of the Arabs. Now we shall say a few words about their ideas as to the nature and motion of the fixed stars. The exaggerated notion which prevailed before the invention of the telescope with regard to the apparent angular diameters of the stars naturally, led to erroneous estimates of their actual size, founded on the assumption that the sphere of the fixed stars (the eighth sphere) was immediately outside that of Saturn.[2] The stars of the first magnitude were supposed to have an apparent diameter equal to $\frac{1}{20}$ of that of the Sun, from which it followed that their actual diameters were about $4\frac{3}{4}$ times that of the Earth, or about

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propter motus supradictos non (ut in alijs planetis fit) circumferentiam deferentis circularem, sed potius figuræ, habentis similitudinem cumplana ovali peripheriam describere." Next by Albert of Brudzew in 1482 in his *Commentariolum super theoricas novas*, printed at Milan in 1495 (ed. Cracow, 1900, p. 124), where it is remarked that the centre of the lunar epicycle describes a similar figure. This is also stated by E. Reinhold in his commentary to *Purbach*, 1542, fol. p. 7 verso (ed. of Paris, 1558, fol. 78.) by Vurstisius in his *Questiones novae in theoricas*, & c., Basle, 1573, p. 233 ; and in Riccioli's *Almagestum novum* T. I. p. 564. The last three writers (who give a figure) also take the equable angular motion round the centre of the equant into account, which centre lies on the point of the circumference of the small circle nearest the Earth. The curve described by the centre of the epicycle thus becomes egg-shaped, and not like an ellipse.

1. The tables in vol. v. of the *Libros del Saber* are quite different from the Alfonsine Tables, and are apparently only intended for astrological purposes.
2. Al Battani (cap. 50) gives the greatest distance of Saturn=18,094. and the distance of the fixed stars=19,000 semidiameters of the Earth. Al Fargani (p. 82) puts them exactly equal. Al Kusgi gives the diameters in parasangs, of the concavity of the stellar sphere=33,509,180 of the ninth sphere 33,524,309, of its convexity "no one but God knows" (Shah Cholgi, p. 97).

twice that of Mars.[1] As to the nature of the stars, they seem generally to have been assumed self-luminous, being condensed parts of the sphere, though Abraham ben Chija says that the eighth sphere does not shine with a uniform light, but has denser spots, which are illuminated by the Sun and appear to us as the fixed stars.[2]

To account for the apparent slow motion of the stars paralleled to the ecliptic, from west to east, whereby their longitudes increase while their latitudes remain unaltered, it became necessary to inroduce a ninth sphere (*primum mobile*), turning in twenty-four hours and communicating this motion to the eighth sphere, while the latter moved extremely slowly round its own axis forming an angle of 23° 35′ with that of the ninth.[3] But the simple phenomenon of precession was by many Arabian astronomers complicated by being assumed variable. It may be mentioned that according to Theon and Proklus it had been assumed by some astronomers apparently before the time of Ptolemy, that the precessional motion of the stars was not progressive, but was confined to an oscillation along an arc of 8°, along which the equinoctial points moved backwards and forwards on the ecliptic, always at the same rate of 1° in 80 years. The absurdity of the sudden change of direction must have become obvious as soon as astronomy began to be cultivated among the Arabs, for we find that one of the earliest astronomers, Tābit ben Korra, substituted a physically less objectionable theory.[4]

1. Al Fargani (p. 85, Golius) gives the cubic contents of the six spheres as 107, 90, 72, 54, 36, 18 times that of the Earth. Abu 'l Faraj, p. 199, gives a similar series from 93 to 15¼ for the average star of each class. Shems ed-din of Damascus in his *Cosmography* (p. 3) merely says that the smallest fixed star is much larger than the Earth.

2. According to Suter, p. 77. a writer called Ibn Zura wrote a treatise "On the cause of the light of the stars, though they and the spheres consist of one single substance."

3. The outermost sphere is by the philosopher Ibn Sina (Avicenna) defined as a spherical, single (not composite) body, emanating directly from GOD and subject to dissolution, endowed innately with circular motion as an expression of its praise of the Creator (Mehren in *Oversigt, K. Danske Vid. Selskab*, 1883, p. 70).

4. The treatise "*On the motion of the 8th sphere*" has never been printed; an abstract is given in Delambre's *Hist. de l'astr. du Moyen Age.* p. 73. Compare a quotation by Ibn Junis, Caussin, *Notices et Extraits*. VII. p. 116.

He imagines a fixed ecliptic (in the ninth sphere) which intersects the equator in two points (the mean equinoxes) under an angle of 23° 33′ 30″, and a movable ecliptic (in the eighth sphere), attached at two diametrically opposite points to two small circles, the centres of which are in the mean equinoxes and the radii of which are=4° 18′ 43″. The movable tropical points of Cancer and Capricorn never leave the fixed ecliptic, but move to and fro to the extent of 8° 37′ 26″, while two points on the movable ecliptic 90° from the tropical points move on the circumferences of the small circles, so that the movable ecliptic rises and falls on the fixed one, while the points of intersection of the equator and the movable ecliptic advance and recede to the extent of 10° 45′ either way, This is a motoin of the eighth sphere, common to all stars, and the Sun will, therefore, sometimes reach its greatest declination in Cancer, sometimes in Gemini. Tabit does not say that the obliquity of the ecliptic is variable, and perhaps it did not occur to him that this would be a necessary consequence of his theory; he only notices the change in direction and amount of the motion of the equinoxes, which, he says, has increased since the days of Ptolemy, when it was only 1° in 100 years, while later observers have found 1° in 66 years. The erroneous value given by Ptolemy was, therefore, mainly responsible for the continuance of the imaginary theory. It is to be observed that Tabit expresses himself with a certain reservation, and seems to think that further observations are necessary to decide if the theory is true or not. His younger and greater contemporary Al Battani was even more cautious, for though he repeats the account of the trepidation given by Theon (which he says that Ptolemy *manifeste in suo libro declarat*[1]) he does not make use of it, but simply adopts 1° in 66 years (or 54″.5 a year), which he finds by a comparison between his own observations and some made by Menelaus. In rejecting the erroneous value of Ptolemy, which Al Fargani alone had accepted,[2] Al Battani was followed by Ibn Jūnis, who came still nearer to the truth by adopting 1° in 70 years or 51″.2 a year, and who does not allude to trepidation. It is greatly to the credit of several other Arabian writers that they were not led astray by this imaginary phe-

1. Cap. 52, (205). Plato's translation gives the period as 84 years, but Nallino's ed. has 80 (p. 127).

2. c. 13, p. 49.

3. Schjellerup, *Descr. des etoiles fixes*, p. 43,

nomenon; among them are Al Sūfi, the author of the only uranometry of the Middle Ages[3], who followed Al Battani, also Abu 'l Faraj and Jagmini,[1] while Nasir ed-din mentions it but seems to doubt its reality.[2] By others it was willingly accepted, for instance by Al Zarkali, who made the period of oscillation of 10° either way equal to 2000 Muhammedan years (or 1940 Gregorian years, i.e. 1° in 97 years or 37″ a year). The motion is in a circle of 10° radius; at the Hijra the movable equinox was it 40′ in increasing precession, and in A: D. 1080 at 7° 25′.[3]. The diminution of the inclination of the ecliptic, which the astronomers of Al Mamun had found=23° 33′, no doubt lent countenance to the idea of trepidation, and the next step in the development of this curious theory was the combination of progressive and oscillatory motion. Al Betrugi, who gives a sort of history of the theory, beginning with a mythical H mes, makes out that Theon (or Taun Alexandrinus as he calls him) combined the motion of 1° in 100 years with the oscillation[3]. A century later this was actually done, and the theory received its last development by King Alfonso or his astronomers, who[4] perceived that the equinoxes had receded much further than Tabit's theory allowed. The equioxes were now supposed to pass right round the heavens in 49,000 years (annual motion=26″.45), while the period of the inequality of trepidation was 7000 years, so that in a sort of Great Jubilee year everything was again as it had been in the beginning.[5] The progressive motion belongs to

1. Abu 'l Faraj, p. 12, simply says that the motion is 1° in 100 years according to Ptolemy, or 1° in 66 years according to others. But on p. 18 he says that if the ancient Chaldeans gave the tropical points a motion backwards and and forwards, and if ancient astrologers adopted this, then the motion of the fixed stars must have been unknown to them. Jagmini (p. 229) says that most people adopt 1° in 66 solar years.
2. *Spheres celestes*, p. 347.
3. Sedillot, *Memoire sur les instr. astr. des Arabes*, pp. 31, 32. Abraham ben Chija (p. 196 of Munster's *Sphaera mundi*. Basle, 1546) gives the period as 1600 years without quoting any authority. He adds that the ancient Indians, Egyptians, Chaldeans, Greeks, and Latins first proposed the theory—Ptolemy neither approved nor disapproved of it, but Al Battani confuted it.
4. Alpetragius, f. 12a. He says that Al Zarkali did the same.
5. A later writer, Augustinus Ricius, *De motu octave sphaere*, Paris, 1521, who traces the theory back to Hermes, 1985 years before Ptolemy (!) credits

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the ninth sphere; the annual precession varies between 26″.45± 28″.96, or from + 55″.41 to −2″.51.[1] It was now necessary to assume the existence of a tenth sphere, which as primum mobile communicated the daily rotation to all the others, while the ninth produced the progressive and the eighth periodical motion on the small circles, which are situated "in the concavity of the ninth sphere." This was a nice and comfortable theory on account of the long periods involved and the slow changes it produced in the amount of annual precession; and oblivious of the fact that the theory had no foundation except the circumstance that the obiquity of the ecliptic was now about 20′ less than it had been stated to be by Ptolemy, and that he had given the amount of precession as 36″ a year instead of about 50″, and often shutting their eyes to several of the necessary consequences of it, such as the changes in the latitudes of stars which it ought to produce[2], astronomers continued to accept the theory until at last a real observer of the stars arose and wiped it out by showing that the obliquity of the ecliptic had steadily diminished, and that the amount of annual precession had never varied. We have in this place only alluded to it because it involved some rearrangement of the spheres and because it is eminently characteristic of the period during which no persistent observations were taken, and hardly an attempt was made to improve the theories of Ptolemy. The theory of *trepidatio* or *titubatio*, as it was sometimes called, was one attempt and it would have been better left alone. But it forms a not uninteresting chapter in the history of astronomy.

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this development to a Jew of Toledo, Isaac Hassan (see above. p. 38), adding that Alfonso four years after the completion of the tables became convinced of the futility of the theory by reading the book on the fixed stars by Al Sufi. Riccioli, *Almag. novum*, I. p. 166.

1. In the Alfonsine Tables the maximum took place at the birth of Christ. In Essler's *Speculum astrologicum*, p. 224 (appended to Purbach's *Theoricae novae*, Basle, 1573) the epoch is A.D. 15, diebus 137 completis. Reinhold in his commentary to Purbach (Paris, 1558, f. 163b) explains that 26″.45 is the space passed over by the Sun in 10 mins. 44 secs., by which amount the Alfonsine Tables made the tropical year smaller than 365¼ days.
2. Abraham ben Chija (p. 103, *Schrackenfuchs*) says that trepidation does not change the latitudes. Perhaps he refers to the earliest form of the notion, that described by Theon of Alexandria.

Here we finish our review of ancient astronomy. We have omitted as not coming within our province several valuable contributions to science which did not deal with cosmology or planetary theory. But even with this limitation enough has been said to show that when Europeans again began to occupy themselves with science they found astronomy practically in the same state in which Ptolemy had left it in the second century. But the Arabs had put a powerful tool into their hands by altering the calculus of chords of Ptolemy into the calculus of sines or trigonometry, and hereby they influenced the advancement of astronomy in a most important manner.

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CHAPTER II

Personal References of Brahmagupta

Sudhākara Dvivedī in his *Gaṇaka Taraṅgiṇī*, a small book on biographical skethes of astronomers and astrologers of this country gives a brief account of Brahmagupta thus :

Brahmagupta was born in 520 Śaka (655 Vikramī or 589 A.D.) in the reign of King Vyāghramukha, belonging to the *Cāpa* family ; his father was Jiṣṇugupta ; and at the age of 30, he wrote in 550 Śaka (628 A. D.) his well known treatise on Astronomy known as the *Brāhmasphuṭasiddhānta*, which is corroborated by the statement in the *Viṣṇudharmottara Purāṇa*, (Chapter on the *Brahma-siddhānta*), His other treatise, entitled the *Khaṇḍa-Khādyaka*, which is a *karaṇa* book, was completed in 587 Śaka (665 A. D.). According to some authorities, Brahmagupta was the grandson of Viṣṇugupta, and the family suffix (*Gupta*) indicated that he belonged to the Vaiśya family, and he was in the service of the King of Rewah, known as Vyāghrabhaṭa.

Brahmagupta was a great critic ; he did not spare any of his predecessors like Āryabhata, Varāhamihira, Śrīṣeṇa, Viṣṇucandra and others. Later on, his influence on the writing of the succeeding generations has been immense. Bhāskarācārya II in his *Bījagaṇita* has acknowledged him as a great authority on algebra and has given him as the first place amongst the galaxy consisting of Brahmagupta, Śrīdhara, Padmanābha etc. The Eighteenth Chapter of the *Brāhmasphuṭasiddhānta*, known as Kuṭṭaka Chapter (on Pulveriser) has been translated by H. T. Colebrooke in English in 1817. The English translation of the Twelfth Chapter on Gaṇita or Calculations from the *Brāhmasphuṭasiddhānta* is also available in English. (See Colebrook's *Algebra with Arithmetic and Mensuration from the Sanskrit of Brahmagupta and Bhāskara*, London, 1817).

The *Vāsanā Commentary* on the Brāhmasphuṭasiddhānta by Pṛthūdakasvāmī (860 A. D.) is also available though with difficulty (as indicated by Sudhākara Dvivedi) ; its incorrect manus-

cript is available in the Library of the King of Banaras (Kāśirāja) which has the colophony at the end as :

श्री चापवंशतिलके श्री व्याघ्रमुखे नृपे शकनृपालात् ,
पञ्चाशत्संयुक्तै र्वर्षशतैः पञ्चभिरतीतैः ।
ब्राह्मस्फुटसिद्धान्तः सज्जनगणितज्ञगोलवित्प्रीत्यै,
त्रिंशद्वर्षेण कृतो जिष्णुसुतब्रह्मगुप्तेन ॥

Bhāskara II has written the famous treatise *Siddhāntaśiromaṇi* (1150), which is almost based on the *Brāhmasphuṭasiddhānta.* It has been edited by the author's own gloss (*Vāsanābhāṣya*) by Bāpu Deva Śāstrī (Vārāṇasī) ; by Murlīdhar Jha with the commentaries, *Vāsanāvārttika* of Nṛsiṁha (1621) and Marīci of Munīśvara (1635), vol. I (containing chapter 1 of the *Gaṇitādhyāya*) (Vārāṇasī, 1917); by Girija Prasad Dvivedi with original commentaries in Sanskrit and Hindi, vols. I and II (Lucknow, 1911, 1926) ; English translation of the text only by Bāpu Deva Śāstrī and Wilkinson (Calcutta, 1861).

In the very first Chapter (verse 2), Brahmagupta writes : The old calculations dealing with planets (i.e. the old astronomy), based on the system of Brahmā have become erroneous in course of past ages and therefore, I, the son of Jiṣṇugupta would like to clarify them.

Brahmagupta was not a mere theorist, he based his calculations on direct observations with the help of instruments or devices (*nālikādi yantra*) ; he was in favour of making corrections on the basis of these observations. He was himself an expert *observer*. In his *Khaṇḍakhādyaka* also he has emphasised the need of direct observation.

At many places, Brahmagupta has severely criticised the Romaka and Pauliśa systems of astronomy which were introduced in this country by Lāṭadeva and Śrīṣeṇa, There are many passages where this criticism would be available with vehemance.

Brhamagupta was opposed to the system of Āryabhaṭa I. He never spares the school of Āryabhaṭa which was regarded as the most authoritative then. Sudhākara Dvivedi says that as Brahmagupta was opposed to the system of Āryabhaṭa, so the Vaṭeśvara Siddhānta was opposed to that of Brahmagupta. The Institute has already published the *Vaṭeśvara Siddhānta* and now it has the privilege of publishing the *Brāhmasphuṭasiddhānta.*

A Note on Bhillamāla

It is said that Brahmagupta completed his *Brāhmasphuṭa-siddhānta* in Śaka 550, and he has come to be known as Bhillamālakācārya or a teacher residing in "Bhillamālaka." In this connection, therefore, it would be interesting to reproduce a note on *Bhillamāla* from G. Bhūler's article on *Gurjara Inscriptions*, No. III, published in the *Indian Antiquary*, July 1888, vol. 17, p. 192 :

With a single exception all the complete inscriptions call the princes enumerated above, scions of the Gurjara race; and *Khe* I. and II. highly extol the greatness and wide extent of this family. *Na.* alone names the Mahārāja Karṇa as their ancestor. With respect to this personage it is for the present impossible to say whether the famous hero of the *Mahābhārata* may be meant, or some real historical king. But the name *Gurjara* makes it evident that this dynasty belonged to the great tribe which is still found in Northern and Western India and after which two provinces, one in the Bombay Presidency and one in the Pañjāba, have been named. The Gurjaras or *Gūjars* are at present pretty numerous in the western Himālaya, in the Pañjāba and in Eastern Rājpūtānā. In Kachh and Gujarāt their number is much smaller. It would, therefore, seem that they came into Western India from the north. Their immigration must have taken place in early times, about the beginning of our era or shortly afterwards. In Western India they founded, besides the kingdom of Broach, another larger state which lay some hundred miles further north. Hiuen Tsiang mentions in his travels[1] the kingdom of *Kiu-che-lo* and its capital *Pi-lo-mi-lo.* It has been long known that the former word corresponds to Gurjara.

But the name of the town has been incorrectly connected by the French scholars with Bālmer in the Jēsalmīr territory, and this identification has been accepted in Mr. Beal's new translation of *Siyuki.* As I have stated already formerly[2] following Colonel. J. Watson, *Pilomilo* corresponds exactly to Bhillamāla

1. Beal, *Siyuki,* Vol. II, p. 269f. Hiuen Tsiang assigns to the northern Gurjara State an extent about double of that given for the kingdom of Broach.

9. *Ante.* Vol. VI. P. 63.

one of the old names of the modern Bhīnmāl or Śrīmāl[1] in southern Mārvāḍ close to the northern frontier of Gujarāt. Another work, which was composed a few years before Hiuen Tsiang's visit to Gujarāt, contains likewise a notice of this northern kingdom of the Gurjaras. The astronomer, Brahmagupta, who completed his *Siddhānta* in Śaka-Samvat 550 or 628 A.D. calls himself Bhillamālakakācārya[2], "the teacher residing in Bhillamālaka and is called so by his commentator Pṛthūdakasvāmin. He further states that he wrote under king Vyāghramukha who was 'an ornament of the Cāpa race.' This family, whose name recurs in the Haḍḍāla grant of Dharaṇivarāha[3] prince of Vadhvān, thus seems to have been the reigning house of Bhillamāla. It is most probably identical with the Cāuḍās, Cāvóṭakas[4] or Chāpótkaṭas, who from 756 to 941 A.D. held Aṇhilvāḍ and still possess various small districts in northern Gujarāt. The Gurjara kingdom of Broach was without a doubt an offshoot of the larger State in the north, and it may be that its rulers, too, belonged to the Cāpa family.

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1. Bhillamāla means etymologically 'the field of the Bhil' and Śrīmāla 'the field of Sri'. The latter name must also be ancient, as the Śrīmāli Brāhmaṇ as are called after it. The Jainas narrate various, of course incredible, legends, which explain how Śrimāla came to be called Bhillamāla. Merutuṅga says that king Bhoja invented the latter name, because the people of Śrimāla let the poet Māgha die of starvation. According to another authority, the town had a different name in each Yuga. It is in India very common for ancient towns to have two or even more names. Thus Kanauj was called, Kānyakubja, Gādhipura, and Mahodaya.

2. See Professor A. Weber. *Die Sanskrit und Prakrit Handschriften der Berliner Bibliothek* Vol. II. pp. 297-298. In the first passage the MSS. offers incorrectly Bhilamācārya; in the second which occurs in the commentary on the Khaṇḍakhādyaka, we have Bhillamālavakācārya, a slightly corrupt reading. This latter varia lectio occurs also in other MSS., see Weber, *Indische Streifen.* Vol. III, p. 90, and has given rise to erroneous suppositions regarding Brahmagupta's home, The Gujarāti Joshis still preserve the tradition that Brahmagupta was a native of Bhinmāla.

3. Ante, Vol. XII. p. 190ff. The remark which I have made there that the Cāpas are not named elsewhere, of course requires correction.

4. The form Cāvoṭaka, which occurs in Dr. Bhagavanlal's grant of the Gujarāt Cālukya king Pulakeśin of Samvat 490, is the immediate predecessor of the word Cāuḍā. Its Sanskrit original is certainly not cāpotkaṭa which probably has been coined in comparatively speaking modern times, in order to explain the difficult Prakrit word, just as the bards of Rajputana have invented Rāṣṭrauḍha as etymon for Rāthoḍ.

Brahmagupta's own References

In the Twenty-fourth Chapter (*Sañjñādhyāya*), of the *Brāhmasphuṭasiddhānta*, Brahmagupta has made a reference to his own biography : In the reign of Vyāghramukha belonging to the family of Cāpa, in the year 550 Śaka the treatise *Brāhmasphuṭasiddhānta* was composed for the benefit of benevolent astronomers by Brahmagupta, son of Jiṣṇugupta at the age of 30. (*BrSpSi.* XXIV. 7. 8)

Then again he says : The *Brāhmasphuṭasiddhānta* has been written by Brahmagupta, son of Jiṣṇu, in 1008 verses of Āryāchanda. (ibid 10)

In the beginning of this Sañjñādhyāya, he refers to the differences in fundamental notions created by the various existing systems of astronomy as the *Sūrya-siddhānta, Puliśa-siddhānta. Romaka-siddhānta, Vasiṣṭha-siddhānta* and other *Yavana-siddhāntas,* which have caused anomalies in the calculations of eclipses. He also refers to the anomalies due to the calculations based on midnight day-reckoning and sunrise day-reckoning.

From the point of view of own references, the following would be of interest :

Brahmagupta, son of Jiṣṇugupta (Jiṣṇusuta-Brahmagupta) :
BrSpSi. I. 2; XVI. 35. 37; XXIV. 8. 10; XXV. 73.

It is strange that in the *Khaṇḍakhāḍyaka*, Brahmagupta has not given his name nor his father's name anywhere. At least the reading of the *Khaṇḍakhāḍyaka* as given by Pṛthūdakasvāmī does not contain this name. In the edition of Bhaṭṭotpala, there are three more chapters in the *Khaṇḍakhādyaka* (Chapters IX, X and XI). In the Chapter XI (known as *Pātādhikāra*), we have 21 verses and in the last 21st verse we find the name of Brahmagupta,[1] son of Jiṣṇu mentioned :

> Those who are eager to have the knowledge of the motion of stars and planets, for them and for the benefit of disciples in this field, Brahmagupta son of Jiṣṇu has composed this *Khaṇḍakhādyaka.*

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1. खण्डखाद्यकमिदं तृप्त्यर्थं ग्रहगतिबुभुत्सूनाम् ।
शिष्याणां हितार्थं प्रोक्तं जिष्णुसुतब्रह्मगुप्तेन ॥ —*KK. XI. 21*

Reference to Āryabhaṭa

We have said that it appears that Brahmagupta was a bitter opponent of Āryabhaṭa in his younger days (628 A. D.), but later on (in 665 A. D.), he climbed down to describe and teach one of the Āryabhaṭa's system of astronomy. Āryabhaṭa was universally revered. and it was difficult for Brahmagupta to have ignored him and thus he has to refer to this great authority some times to oppose some of his views and some times to expound his views. The following are the pasages in the *Brāhmasphuṭasiddhānta*, where the author has referred to the name of Āryabhaṭa. There are many other passages where the name "Āryabhaṭa" does not occur but where Brahmagupta indirectly means to quote the views of this great master.

BrSpSi. I. 9. 12. 28. 32. 60. 61 ; II. 33. 46; V. 21.25; VI. 13; IX.10; XI. 4. 9. 10. 12. 25. 29. 33. 41. 42. 43. 44, 46, 47. 49, 62; XIII, 27; XIV. 45; XVI. 37. 46; XXI. 39.

The largest references are in Chapter XI, where Brahmagupta has made an attempt to show the discrepancies of the Āryabhatiaya system of reckoning astronomical observations and constants.

In the *Khaṇḍakhādyaka* also there is a reference to the name of Āryabhaṭa but on very few occasions. In Chapter I, we have this reference at three places-

> Having made obeisance to God Mahādeva, who is the great cause of this world's rise (i.e. creation), existence and destruction, I shall declare the *Khaṇḍakhādyaka* (i.e. a short treatise on astronomy, which is as pleasant as food prepared with sugarcandy), which will yield the same results as the great astronomical treatise of Āryabhaṭa. As in most cases calculation by the great work of Āryabhata, for (the knowlege of time and longitude of planets etc. at) marriage, nativity and the like, is impracticable for common use every day, this smaller treatise is made so as to yield the same results as that. [1]

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1. प्रणिपत्य महादेवं जगदुत्पत्तिस्थितिप्रलयहेतुम् ।
वक्ष्यामि खण्डखाद्यकमाचार्य्यार्य्यभट तुल्यफलम् ॥
प्रायेणार्य्यभटेन व्यवहारः प्रतिदिनं यतोऽशक्यः ।
उद्वाहजातकादिषु तत्समफललघुतरोक्तिरतः ॥ —*KK. I, 1-2*

These two verses show that Brahmagupta was not hostile to Āryabhaṭa when he wrote this *Khaṇḍakhādyaka* ; he merely intends presenting the subject matter on simple lines and furnishing the results obtained by Āryabhaṭa in a simpler way.

In the following verse of the same chapter, he refers to Āryabhaṭa's midnight day-reckoning system :

> The mean Saturn diminished by 3 seconds, the Śighrocca of Mercury diminished by 22 seconds, the mean Mars increased by 2 seconds and the mean Jupiter increased by 4 seconds are equal to the respective mean planets of Āryabhaṭa's "midnight-system".[1]

In the Appendix of the *Khaṇḍakhādyaka* known as *Khaṇḍakhādyakottara,* we again find a few verses where the name of Āryabhaṭa occurs; Three of these verses have been reproduced from the *Brāhmasphuṭasiddhānta (BrSpSi* I. 62, 63; II.47*)* :

> Āryabhaṭa made the apogee of the Moon as moving more quickly and the node as moving more slowly than their actual motions ; if his constants give correct results in relation to the end of *tithis* [i. e. conjunction etc.] or eclipses, they must be considered as accidental as are the letters cut into wood by weevils. (*KK*. IX.1; *BrSpSi*. I. 62)
>
> On seeing me, who possess the most accurate knowledge of mean motions, men who have learnt from the works of Śrīṣena, Viṣṇucandra and Āryabhaṭa, cannot face me in any meeting just like deer on seeing a lion (*KK*. IX. 2; *BrSpSi*. I. 63)
>
> As the apparent planets beginning with Mars as derived from the works of Śriṣeṇa, Āryabhaṭa and Viṣṇucandra, are far deviated from their true places, the works of these authors are therefore not valued among the learned.[2] (*KK*. IX. 3; *BrSpSi*. II. 47)

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1. तिसृभिः शनिर्ज्ञशीघ्रं द्वाविंशत्या कुजोऽधिको द्वाभ्याम् ।
चतसृभिरधिको जीवोऽर्द्धरात्रिकार्य्यभटमध्यसमाः ॥ —*KK.I.7*

2. अकृतार्य्यभटः शीघ्रगमिन्दूच्चं पातमल्पगं स्वगतेः ।
तिथ्यन्त ग्रहणानां घुणाक्षरं तस्य संवादः ॥१॥
मध्यगतिज्ञं वीक्ष्य श्रीषेणार्य्यभट विष्णुचन्द्रज्ञाः ।
सदसि न भवन्त्यभिमुखाः सिंहं दृष्ट्वा यथा हरिणाः ॥२॥
दूरभ्रष्टाः स्पष्टाः श्रीषेणार्य्यभटविष्णुचन्द्रेषु ।
यस्मात् कुजादयस्ते विदुषां नैवादरस्तस्मात् ॥३॥ —*KK. IX. 1-3*

In the Appendix of the *Khaṇḍakhādyaka*, there is another verse which also speaks in the same strain against Āryabhaṭa (this verse does not occur in the *Brāhmasphuṭasiddhānta*) :

> As the process of finding the apparent places of planets as given by Āryabhaṭa does not make them agree with observation, I shall, therefore, speak of this process. Of the Sun the apogee is at two signs and seventeen degrees (*KK*. IX. 4)[1]

Brahmagupta opposed to Śrīṣeṇa—
Viṣṇucandra, Lāṭa, Vijayanandī and others

Brahmagupta was a great critic; he did not spare Āryabhaṭa, and along with him he was vehemently opposed to the doctrine of Śrīṣeṇa, Viṣṇucandra, Lāṭadeva, Vijayanandī and Pradyumna also. He was opposed to the *Romaka* and *Pauliśa Siddhāntas*, which were the systems of foreign astronomy, derived from Greece, Babylonia and other centres of learning. He did his best to resist the foreign influences on astronomy.

The following are the verses in the *Brāhmasphuṭasiddhānta*, where Brahmagupta expressed his note of discord against the systems or notions of Āryabhaṭa, Śrīṣeṇa and Viṣṇucandra :

> *BrSpSi*. I.60; II 46, 47; X 13, 62; XI.31, 46, 47, 48-50, 55, XVI. 36, 46; XXI.39; XXII. 2.

In two of the verses, he refers to Lāṭasiṃha :

> *BrSpSi*. XI. 46, 48.

In the following verse, he refers to Aṅkaciti, Vijayanandī, Pradyumna and others: *BrSpSi*.XI. 58.

In the *Khaṇḍakhādyaka* we do not find the names of these adversaries of Brahmagupta ; we, however, have a reference of Śrīṣeṇa, Āryabhaṭa and Viṣṇucandra in the verses already quoted, occurring in the Appendix of the *Khaṇḍakhādyaka* (*Khaṇḍakhādyakottara*), Chapter IX. 2 and 3. As we have said before, these verses of the Appendix have been reproduced from the *Brāhmasphuṭasiddhānta*. (I.62 and II.47).

Reference to Romaka and Pauliśa systems

Brahmagupta speaks of his system as if expounded by Brahmā himself for the first time, later on deteriorated, and then revived by Brahmagupta himself. The very second verse of the *Brāhma-*

1. न स्फुटमार्यभटोक्तं स्पष्टीकरणं यतस्ततो वक्ष्ये ।
भानुमतो मन्दोच्चं राशिद्वयमंशकाश्च सप्तदश ॥ —*KK. IX. 4.*

sphuṭasiddhānta (I. 2) substantiates this view :

The science of astronomy (or the calculations of heavenly bodies) in course of long duration became ineffective or erroneous; this was revived by Brahmagupta, son of Jiṣṇu.[1] (*BrSpSi.* I.2).

The system of astronomy which goes by the name Brahma (*Brahmasiddhānta*) has been handed down to us in three forms : (i) one is as treated by the *Śākalya Saṃhitā*, (ii) one as described in prose in the *Viṣṇudharmottara Purāṇa*, and (iii) the one described by Varāhamihira in the *Pañcasiddhāntikā*, which recognises the *yuga* of the duration of five years. Which of these three was accepted by Brahmagupta is not clear. But from the measures of the number of revolutions performed by a planet in a given period (*graha-bhagaṇa*) etc., it is clear that Brahmagupta acknowledges the system as propounded in the *Viṣṇudharmottara Purāṇa*. In his chapter "*Tantra-parīkṣādhyāya* or *Dūṣaṇādhyāya*, he contradicts the notions of the *Vedāṅga Jyotiṣa* which accepts the *yuga* of five years.

We may further emphasize the fact that Brahmagupta has not clearly detailed out the errors to which the Brahma-siddhānta succombed in course of time, and how these errors were eradicated by him. During the days of Brahmagupta, Romaka and Pauliśa systems were getting currency in this country. Reference to these two are found in the *Brāhmasphuṭasiddhānta* at several places as follows :

ROMAK : I.13; XI.50; XXIV.3
PAULIŚA : XIV.45; XXIV.3

In fact, *BrSpSi.* XXIV.3, we find the line "*Sūryendu-Puliśa-Romaka-Vaśiṣṭha-Yavanādyaiḥ*", where we have a reference to all the then existing systems : *Sūrya-siddhānta*, *Indu-siddhānta*, *Puliśa-siddhānta*, *Vasiṣṭha-siddhanta*, and other *Yavana-siddhāntas*. Just as the Sun is one, so the astronomical system is also one ; this is a different thing that calculations in different systems may vary according to different sunrises in different places.

Brahmagupta refers at one place to Varāhamihira in *BrSpSi.* XXI.39, where he has been spoken of in connection with a list of

१. ब्रह्मणोक्तं ग्रहगणितं महता कालेन यत् खिलीभूतम् ।
अभिधीयते स्फुटं तज्जिष्णुसुतब्रह्मगुप्तेन ॥ —*BrSpSi. I. 2.*

anti-authoritative versions of astronomical systems :

Evam Varāhamihira-Śrīṣenācāryabhaṭa-Viṣṇucandrādyaiḥ

Lokaviruddhamabhihitam Veda-smṛtisaṃhitābāhyam.

At one place, he mentions the difference between the calculations based on the system of Āryabhaṭa and the Pañca-siddhāntas (Five systems) : Pauliśa, Romaka, Vasiṣṭha, Saura, and Paitāmaha. (*BrSpSi*. XIV.46).

Brahmagupta was also familiar with the Jaina systems of astronomy; for example, at one place he uses the term "Jinoktam" (i.e., one propounded by the Jainas) : He repudiates the concept of *two Suns and two Moons* "*Dvāvarkaindavau*"(do canda do sujja) (*BrSpSi*. XI.3) as enunciated by the Jainas.

At several places we find a reference to the *Vaśiṣṭha-siddhānta* (*BrSpSi*. XI.49, 50; XXIV.3)

Wherever, Brahmagupta has to press for his views in preference to the views of others, he uses the words *Brāhma* or *Brahmokta* : *BrSpSi*.

Brāhma : I.32; X.62; XI, 61; XVI.37

Brahmokta : II.31, 33; X.63, 69; XV.59; XVI.38

Reference

Sudhākara Dvivedī : *Gaṇaka Taraṅgiṇī*

G. Būhler : Gurjara Inscriptions, *Indian Antiquary*, 1888.

P. C. Sengupta : *Khaṇḍakhādyaka*, Calcutta, 1934.

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CHAPTER III

Manuscripts of the Brāhmasphuta Siddhānta

Sudhākara Dvivedī has given an account of some of the manuscripts of the *Brāhmasphuṭasiddhānta* in his *Bhūmikā* or Introduction appended to the edition published in the PAṆḌITA, Vol.XXIV, 1902 (New Series) : (i) available in the Library of the Government College, Kashi (Vārāṇasī) i. e. Kāśika-Rājakīya-Pāṭhālaya,(ii) Dr.Thibaut's Manuscript,(iii) the Manuscript in possession with Yajñadatta Sharmā, the Chief Astronomer attached to the Prince of Ayodhyā. It is further mentioned that Dr. Thibaut's Manuscript was a copy of a Manuscript available in the Deccan College, Poona. The Manuscripts (ii) and (iii) were identical. The Manuscripts (iii) was very faulty and incorrect.

The Manuscript from which Colebrooke translated out in English the Twelfth and the Eighteenth Chapters on *Gaṇita* or Mathematics and *Kuṭṭaka* (the Chapter on Pulveriser) respectively, appeared to be different from the three Manuscripts described above. The readings differed considerably. The *Kuṭṭaka*-Chapter of that book is, writes Sudhākara Dvivedī, still available in the India Office Library. (See Catalogue of the Sanskrit[1] Manuscripts in the Library of India Office, Part V.p. 995).[1]

1. एतत्कृतस्यास्य सिद्धान्तग्रन्थस्यैका प्रतिः काशिकराजकीय पाठालयतो द्वितीया डा० थिबौ साहिब महाशयतस्तृतीया चायोध्यानरेशप्रधानज्योतिर्विच्छ्री यज्ञदत्तशर्मणो मया लब्धा । डा० थिबौमहाशयस्य पुस्तकं कस्यचिद्दक्षिणदेशीय (Deccan College, Poona) ङेका पुस्तकस्य प्रत्यन्तरम् । इदं पुस्तकं तथा पं० श्री यज्ञदत्त पुस्तकं चैकमातृकमेव । इदं पुस्तकत्रयमतीवाशुद्धं बहु च स्खलितं चास्ति ।

यत्पुस्तकानुसारेण व्यक्ताध्याययोर्द्वादशाष्टादशसंख्ययोरंगलभाषायामनुवादः कोलब्रूकसाहिबेन कृतस्तत्पुस्तकमेतत्त्रयतो भिन्नमित्यसंशयं विभाति पाठविभेदात् । तत्पुस्तकस्य कुट्टकाध्यायः संप्रति इण्डिया-आफ़िस-सरस्वती भवने वर्त्तते (See Catalogue of the Sanskrit Manuscripts in the Library of India Office, Part V, Page 995)

पृथूदककृताऽस्य सिद्धान्तस्य टीका या कोलब्रूकसाहिबेन भारतवर्षे ह्युपलब्धा सा च संप्रति लण्डननगरे इण्डिया-आफिस-सरस्वती भवने वर्त्तते । तस्या एका प्रतिर्मद्द्वारेण श्री डा० थिबौ साहिबमहाशयेनोत्पादिता सापि संप्रति मन्निकटेऽस्ति । अहो इण्डिया-आफिस-सरस्वती

(Continued on next page)

Colebroke procured a Manuscript of the Pṛthūdaka Svāmī's Annotation on the *Brāhmasphuṭasiddhānta* from somewhere in India. This is also available in the India office Library, London. Undoubtedly it appears that this Manuscript is a copy from one written in the *Maithila* script. Dvivedī describes a few characteristics of this Manuscript. For example, on the Folio 11. 7 (७) is written instead of 9 (९). At a few other places also, the same has happened. Following a visarga, (*kva* क्व) is inscribed instead of '*ka*' (क), for example refer to Folio 12, line 6. At some places instead of *visarga* (:) we find ṣa (ष) inscribed, for example on Folio 12, line 1. Sometimes we find a *sandhi* at the *virāma* or end of a sententence; e. g. in the Golādhyāya, Folio 21, line 2: *sarvamupapannamuktamakhaṇḍena* (सर्वमुपपन्नमुक्तमखण्डेन). At some places we find *nū* (नू) written in place of *nta* (न्त). In one of the Folios, *Śri Gaṇeśāya namaḥ.* श्रीगणेशायनमः is written in Maithila script.[1] Sudhākara Dvivedī prepared a copy of this Manuscript for Dr. Thibaut, and this copy was available with Sudhākara Dvivedī when he published his commentary with Text in the *Paṇḍita*. During the course of binding, on account of carelessness, many of the Folios got misarranged, and many of them got fragmented. Sudhākara Dvivedī emphasises in his Introduction the need of careful research on the arrangement of these Folios and their readings. (See *Catalogue of the Sanskrit Manuscripts* in the Library of India Office, Part V, p. 993–995).

Sudhākara Dvivedī with considerable efforts could rearrange the Text:

Golādhyāya-Bhāṣyam 1 to 45, mutilated at the beginning
Madhyamādhikāra-Bhāṣyam 45 to 59

(Continued from previous page)

भवने अस्य पुस्तकस्य पुटकवन्धनकालेऽनवधानतया पत्राण्यसंगतानि जातानि, बहुत्र खण्डितानि च सन्ति । तानि कदाचिदनुपयुक्तपत्राणां मध्ये स्युरिति तेषां सम्यगन्वेषणं समुचितम् । (See Catalogue of the Sanskrit Manuscripts in the Library of India Office Part, V, Page 993-995)

1. इदं पुस्तक कस्यचिन्मिथिलाक्षरैर्लिखितस्य पुस्तकस्य प्रत्यन्तरमिति निःसंशयं प्रतिभाति । ११ पत्रे, ९ इत्यस्य स्थाने ७ इति लेखात् । एवमन्यत्रापि । विसर्गात् परतः 'क' स्थाने 'क्व' इति लेखात् । यथा १२ पत्रे, ६ पंक्तौ । तथा विसर्गस्थाने 'ष' इति लेखात्, यथा १२ पत्रे, १ पंक्तौ । वाक्यविरामेपि सन्धिकरणात् । यथा गोलाध्यायस्य २१ पत्रे, २ पंक्तौ सर्वमुपपन्नमुक्तमखण्डेन । कुत्रचित् 'न्त' स्थाने 'नू' इति लेखात् । एकस्मिन् पत्रे मैथिलाक्षरैः श्री गणेशायनमः इति लेखाच्च ।

In this, the commentary is up to verse 31. In the *Spaṣṭādhikāra*, the commentary begins from verse 29, Folio 60. At the top of the Folio, we have the old numbering 1 and 115.

After this, 68 folios are mis-arranged, and there the old numbering is marked 9.

After that, up to 87 folio, we have in the bound volume a commentary up to the verse 6 of *Tripraśnādhikāra*. Here the old numbering is marked 28. Then we have the commentary up to verse 27 of the *Tripraśnādhikāra*. Here the numbering of folios is marked 1 and 159 (old numbering) and 218 new. After this, then we have in the bound volume, commentary up to verse 33 of the Tripraśnādhikāra. On the last folio, the old numbering is marked 5 and 163, the new numbering 222. After this begins the commentary on the *Candragrahaṇādhikāra* from verse 4, old numbering 1 and 297 and new numbering 257. Then follows the commentary on *Sūryagrahaṇa* up to verse 23. The last old folio numbering is 36 and 232, the new numbering 292. This is the last folio-numbering of the volume in the India Office Library. After this, begins the commentary on *Grahayutyadhikāra*, verse 11, old numbering 1 and 164 and the new numbering 223.

Then follows the *Madhyagatyuttarādhyāya* up to verse 40, old folio numbering 119, and new numbering 178. Then we have the commentary of the *Madhyagatyuttarādhyāya* beginning from the verse 45; the old folio numbering 120 and the new numbering 179. Then we have the commentary on *Tripraśnottarādhyāya* up to verse 56. Here the last old folio number is 48 and 158, and the new numbering 217.

In this way, we have the commentary on : the multilated *Golādhyāya*, mutilated *Madhyamādhikāra*, mutilated *Spaṣṭādhikāra*, mutilated *Tripraśnādhikāra*, mutilated *Candra-grahaṇādhikāra*, mutilated *Sūrya-grahaṇādhikāra*, mutilated *Grahayūtyadhikāra*, *Bhagrahayutyadhikāra*, *Tantra-parīkṣādhyāya* (also known as *Dūsaṇādhikāra*), *Gaṇitādhyāya* (Arithmetic), mutilated *Madhyagatyuttarādhyāya*, *Sphuṭagatyuttarādhyāya*, mutilated *Tripraśnottarādhyāya*.[1]

1. मया महताऽऽयासेन तत्प्रति-पाठक्रम एवं नियोजितः ।
गोलाध्यायभाष्यम् १-४५ आदौ खण्डितम् ।
मध्यमाधिकारभाष्यम् ४५-५६ ।

(Continued on next page)

Sudhākara Dvivedī says that nowhere in the *Brāhma-Sphuṭasiddhānta, Madhyamādhikāra,* is found the verse:

Saṁsādhya spaṣṭataram bījam nalikādiyantreṇa.

Tat-saṅsṛtagrahebhyaḥ kartavyau nirṇayādeśau.

(This verse has been quoted by Dvivedī in the *Gaṇaka-Taraṅgiṇī,* page 19).[1]

This verse has been quoted by Dvivedī from the Translation of *Grahalāghava* by Mallāri.

· Dvivedi further says that in the Manuscripts available, there is mentioned a Twenty-fifth Chapter under the title "*Dhyānagrahopadeśādhyāya*". Dvivedi thinks that this Chapter does not constitute the *Brāhmasphuṭasiddhānta* proper, which ends in fact with twenty-four chapters.[2] In his commentary and Edition in the *Paṇḍita,* he has published it as a separate treatise of Brahmagupta. Thus he has named his Edition as:

अत्र मध्यमाधिकारे ३१ श्लोकपर्यन्तमेव भाष्यम् ।

अतः स्पष्टाधिकारस्य २९ श्लोकतष्टीकाऽऽरब्धा ५० पत्रतोऽत्र प्राचीन संख्या पत्रोपरि १, तथा ११५ ।

अग्रेऽत्र ६८ पत्रमसंगतम् , यत्र प्राचीन संख्या ९ ।

ततः ८७ पत्रपर्यन्त संलग्नग्रन्थस्त्रिप्रश्नाधिकारस्य ६ श्लोकपर्यन्तं टीका । अत्र प्राचीनपत्रसंख्या २८। ततस्त्रिप्रश्नाधिकारस्य २७ श्लोकतष्टीका, पत्रसंख्या प्राचीना १ तथा १५९, नवीना २१८ । अग्रे संलग्न ग्रंथस्य त्रिप्रश्नाधिकारस्य ३३ श्लोकपर्यन्तं टीकान्तिमपत्रप्राचीनसंख्या ५ तथा १६३, नवीना संख्या च २२२। ततश्चन्द्रग्रहणाधिकारस्य ४ श्लोक टीकारब्धा प्राचीनपत्रसंख्या १ तथा २९७ । नवीना संख्या च २५७ । ततः सूर्यग्रहणस्य २३ श्लोकपर्यन्तं टीका । अन्तिम प्राचीन पत्र-संख्या ३६ तथा २३२, नवीना संख्या च २९२ । इण्डिया-आफिस पुस्तकपुटके चेयमन्तिमपत्रसंख्या । ततो ग्रहयुत्यधिकारस्य ११ श्लोकतष्टीकारब्धा यत्र प्राचीनपत्रसंख्या १ तथा १६४, नवीना संख्या २२३ । ततो मध्यमगत्युत्तराध्यायस्य ।

४० श्लोकपर्यन्तं संलग्नग्रन्थौ यत्रान्तिमप्राचीनपत्र संख्या ११९ नवीना संख्या च १७८ । ततो मध्यगत्युत्तराध्यायस्य ४५ श्लोकतष्टीकारब्धा । अत्र प्राचीनपत्रसंख्या १२० नवीनासंख्या च १७९ । ततस्त्रिप्रश्नोत्तराध्यायस्य ५६ श्लोकपर्यन्तं टीका । अत्रान्तिमप्राचीनपत्रसंख्या ४६ तथा १५८, नवीना संख्या च २१७ ।

खण्डितगोलाध्यायस्य । खण्डितमध्यमाधिकारस्य । खण्डितस्पष्टाधिकारस्य । खण्डितत्रिप्रश्नाधिकारस्य । खण्डितचन्द्रग्रहणाधिकारस्य । खण्डितसूर्यग्रहणाधिकारस्य । खण्डितग्रहयुत्यधिकारस्य । भग्रहयुत्यधिकारस्य । तन्त्रपरीक्षाध्यायस्य (दूषणाधिकारस्य) । गणिताध्यायस्य पाटीम-गणितस्य) । खण्डितमध्यगत्युत्तराध्यायस्य । स्फुटगत्युत्तराध्यायस्य । खण्डितत्रिप्रश्नोत्तराध्यायस्य च टीका वर्त्तते ।

1. सर्वेष्वपि पुस्तकेषु 'संसाध्य स्पष्टतरं बीजं नलिकादियंत्रेण' इत्यादिश्लोको मध्यमाधिकारे नास्ति । मया गणकतरंगिण्यां मल्लारिकृतग्रहलाघवटीकातो व्यलेखि (द्रष्टव्या गणकतरंगिणी पृ० -१८१९) ।

Brāhmasphuṭasiddhānto Dhyānagrahopadeśādhyāyaśca or *Brāhmaphuṭasiddhānta* and *Dhyānagrahopadeśādhyāya by* Brahmagupta (1902)[1]

The manuscript of this small treatise was also mutilated, and Dvivedī took special pains in editing it, and he revised the calculations also incorporated in this treatise.

The small treatise, *Dhyānagrahopadeśādhyāya* must have been composed prior to the *Brāhmasphuṭasiddhānta*, since we find a verse in the last Chapter (the 24th Chapter also known as the *Sañjñādhyāya* of the *Brāhmasphuṭasiddhānta*), verse 9, a reference to this book :

How could this result be obtained in a simple way has been shown by me in the *Dhyānagrahopadeśādhyāya* of 72 Āryā verses, and therefore, it is not repeated here. *BrSpSi*. XXIV. 9)

In the *Dhyānagrahopadeśādhyāya*, we have a verse 61, which is also found in the *Khaṇḍakhādyaka* (KK. I. 21) :

Navatithayaḥ (159) divided by *aṣṭi* (16), pañcarasāḥ (65) divided by *vasu* (8), 10 divided by 3, each multiplied by the equinoctial shadow are the (tabular differences of) ascensional difference expressed in *vināḍīs*. (*KK*. I. 21; *DhGr*. 61)

This verse then indicates that the *Dhyānagrahopadeśādhyāya* has been composed after the *Khaṇḍakhādyaka*. It may also be possible that the *Brāhmasphuṭasiddhānta* and the *Dhyānagrahopadeśādhyāya* were simultaneously written, and the above verse (*DhGr*. 61) was repeated again in the *Khaṇḍakhādyaka*.

Sudhākara Dvivedī has taken the help from the commentary of Pṛthūdaka Svāmī in the Chapters on *Pāṭigaṇita* (Arithmetic), and has quoted the examples from this commentary. At many places he has corrected the readings which were mutilated in manuscripts.

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1. उपलब्धमूलपुस्तकत्रये पंचविंशतितमेऽध्याये वस्तुतो ब्रह्मगुप्तकृतो ध्यानग्रहोपदेशाध्यायो वर्त्ततेऽतो मयायं पृथक्त्वेन तन्नाम्ना मुद्रितः। अत्र बहुत्र स्खलितानि पदानि तानि गणितेन संशोध्य मुद्रितान्यपि सुधीभिर्भृशं विचिन्त्यानि।

अस्य सिद्धान्तस्य चतुर्विंशतितमेऽन्तिमे संज्ञाध्याये (पृ० ४०८)
गणितेन फले सिद्धिर्ब्राह्मे ध्यानग्रहे यतोऽध्याये।
ध्यानग्रहो द्विसप्ततिरार्याणां न लिखितोऽत्र मया॥

इति नवमश्लोकेन ध्यानग्रहोपदेशाध्यायस्य रचनेतत्सिद्धान्तरचनातः पूर्वं विभाति परन्तु तत्राहर्गणसाधनप्रकारेण सिद्धान्तरचनाकाल एवास्य रचना सिध्यति तथा 'नवतिथयोष्टिविभक्ता' इत्यादिगद्येन खण्डखाद्यरचनातः पश्चात् सिध्यति।

Reference

Sudhākara Dvivedī : His *Bhūmikā* on *BrSpSi.*, *Paṇḍita*, Vol. XXIV, 1902 (New Series)

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Chapter IV

Subject Matter Classified in the Brāhmasphuṭasiddhānta & Khaṇḍakhādyaka

It needs no emphasis that Āryabhaṭa commanded a great influence as an astronomer not only prior to Brahmagupta but during his days also, and we have seen how Brahmagupta quoted this great authority in his writings, sometimes borrowing from him and sometimes contradicting him or improving upon his calculations. Āryabhaṭa's great work is known as the *Aryabhaṭīyam* written in 499 A. D. Āryabhaṭa was born in 476 A. D. (Kaliyuga Saṃvat 3577). The *Aryabhaṭīyam* is also known as the *Aryasiddhānta*. For details about Āryabhaṭa the reader is referred to the Chapter entitled" *Aryabhaṭa lays Foundations of Algebra*" (*Founders of Sciences in Ancient India*, 1965, Chapter X) . This great work was written in Kusumapura, (modern Patna, Bihar).

Divisions of Āryabhaṭīyam

The *Aryabhaṭīyam* is divided into four chapters called *Pāda*: (i) the *Gītikā Pāda*, with ten verses; (ii) the *Gaṇita Pāda* with 33 verses; (iii) the *Kālakriyā Pāda* with 25 verses and (vi) the *Gola Pāda* with 50 verses.

In the *Gaṇita Pāda*, a chapter on mathematics, we have such subjects : squares (*varga*), cubes (*ghana*) (verse 3), square-root (*vargamūla*) (4), cube-root (*ghanamūla*) (5) ; area of a triangle, volume of a prism (6), area of a circle, volume of a sphere (7), area of a quadrilateral (*viṣamacaturasra*) (8); circumference of a circle (10), Rsine (radius x sine) (*Jīvā*) (11); determination of the Rsine of the zenith distance, the base (*bāhu*) of a right-angled triangle, and the upright (*koṭi*) of a right-angled triangle (16) ; hypotenuse (*karṇa*) of a right-angled triangle and *ardhajyā* (17), Reversed-sine (*śara*) (18), areas of series-figures (*śreḍhīphala*) (19), rule of three (*trairāśika*) (23), reduction of fractions (*savarṇīkaraṇa* of *bhinna*) (27) ; inverse-rule of three (*vyasta*) (28) ;

evaluation of unknown values (*mūlya-pradarśana* of *avyakta mūlya* (30) ; and the theory of pulveriser (*Kuṭṭaka*) (32, 33). In this chapter, Āryabhaṭa gives the solutions of quadratic equations, and thus he earns for himself the credit of founding the science of algebra.

(iii) The *Kālakriyā Pāda* with 25 verses, which enumerates the units of time [1 year (*varṣa*)=12 months (*māsa*) ; 1 month= 30 days (*divasa*) ; 1 day =60 *nāḍīs* ; 1 *nāḍī*=60 *vināḍī* ; *vināḍī* or *vināḍikā* is the same as *vighaṭikā* equivalent to our 24 seconds ; *nāḍī* or *nāḍikā* or *ghaṭī* is equal to 24 minutes][1] ; correlation of time division with the *kṣetra*—division or angular division,[2] Twelve signs of Zodiac or *rāśis* go to constitute a *bhagaṇa*[3] ; solar day (*ravimāsa*), lunar day (*śaśi māsa*) ; additional month or intercalary month (*adhimāsa*) ; various kinds of years : the solar year is human or *manuṣya* year ; 30 human years=1 *pitṛ* year ; 12 *pitṛ* years=1 *divya* year (divine year) ; 12,000 *divya* years constitute a *yuga* (6, 7, 8) ; the first half of the *yuga* is *utsarpiṇī kāla*, and the latter half is *avasarpiṇī kāla* and they are calculated from the apex of the Moon (*candrocca*) (this is not very clear) (9) ; a *yuga* is of 60 years, and such 60 *yugas*, that is 3,600 years had passed away since the *kaliyuga*, when the author was of 23 years of age, (10) ; the count of a *yuga*, year, month and

१. वर्षं द्वादशमासास्त्रिंशद्दिवसो भवेत् स मासस्तु ।
षष्टिर्नाड्यो दिवसष् षष्टिस्तु विनाडिका नाडी ॥

—*Ārya. III. 1.*

२. गुर्वक्षराणि षष्टिर्विनाडिकार्क्षी षडेव वा प्राणाः ।
एवं कालविभागः क्षेत्रविभागस्तथा भगणात् ॥

—*Ārya. III. 2.*

यावता कालेन षष्टिगुर्वक्षराण्युच्चरति मध्यमया वृत्या पुरुषः ।
तावान्काल आर्क्षी विनाडिका । ...यावता कालेन पुरुषः
षडुच्छ्वासान् करोति, तावान्कालश्चार्क्षी विनाडिका स्यात् ।
(परमादीश्वर)

Just as we have the time division, similarly we have the kṣetra division or the circular angular division. A year has twelve months, so do we have 12 *rāśi* in a *bhagaṇa*. One-thirtieth of a *rāśi* is one *bhāga* ; one-sixtieth of a *bhāga* is one *liptā* ; one-sixtieth of a *liptā* in one *viliptā* : and one-sixtieth of a *viliptā* is one *tatparā*.

३. चन्द्रोऽंशैर्द्वादशभिरविक्षिप्तोऽर्कान्तरस्थितैर्दृश्यः ।
नवभिर्भृगुर्भृगोस्तैर्द्व्यधिकैर्यथाश्लक्ष्णाः ॥

—*Ārya. IV. 4.*

day should begin from the month *Caitra*, *Śukla Pratipadā* (the first day of the brighter half of the month *Caitra*) (11) ; *mandocca* (apex of slowest motion) and *śīghrocca* (apex of fastest motion) (17—24).

(iv) The *Gola Pāda* with 50 verses. In Verse 1, there is a reference to a point in the Sun's path, the commencement of *meṣa* (*meṣādi*) ; this must have been *vasanta*-equinox. The ascending nodes (*pāta*) of planets and the shadow of the Earth move on the path of the Sun (*arka-apamaṇḍala*) (2-3) ; the angular difference in relation to the Sun at the appearance of Moon (12 degree or *aṁśa*), of the Venus (9 degrees or 9 *vināḍikā*) ; of the Jupiter (2 more than the Venus, i.e. 11 *vināḍikās*) ; the Mercury or *Budha* (13 *vināḍikās*), of the Saturn or *Śani* (15 *vināḍikās*) ; and of Mars or *kuja* (17 *vināḍikās*).

The half of the Earth, Moon, planets and stars is dark, since those parts happen to be under their own shadow ; the other half is bright as it faces the Sun (this is not true with respect to stars—author) (5). The Earth is surrounded with an atmosphere of air and water (6, 7). In the *Brahma-Divasa* (Brahma's day), the sphere of the Earth is increased by one yojana and decreased by this amount during the Brahmā's night (8). Just as a person sitting on a moving boat sees the stationary trees etc. on the bank of a river moving in the opposite direction, similarly the stationary stars are seen moving from Laṅkā (or equator) moving towards the West(9). On account of *pravahavāyu* (air) the *nakṣatra* system and planets rise and set receding towards the West (10). The dimensions of *Sumeru Parvata* (North pole) is given to be one *yojana*, and it shines like a jewel (11) and in the next verse is given the position of Sumeru and the *Bāḍavamukha* (South pole) (12). The four cities situated at a difference of 90° each on the equator are given (13). The distance of Ujjayinī from Laṅkā (thus giving the latitude of Ujjayinī) is given (14).

On account of the thickness of the Earth-sphere, the *Khagola* (celestial sphere) is seen less than the hemisphere (15). The next verse describes how moving appears the Khagola on the North and South poles (16). Then is given the measure of day and night of *devas* (gods), *pitar* (fathers), *asura* (demons) and *manuja* (men) (17). Then are given a few technical definitions

of celestial mathematics (18—21) like *dṛṣṭi-sthāna* (intersection of horizontal and vertical axis--*pūrvapardiggatā rekhā* and *adha-ūrdhva-diggatā rekhā*). *Dṛṅ-maṇḍala*, *dṛgkṣepamaṇḍala* (*dṛgkṣepa* is the zenith distance of that point of a planet's orbit which is at the shortest distance from the zenith). Then the *Bhubhagola* instrument is described (22, 23). Then follow the formulæ for calculating *lagna* (the horizon ecliptic point in the East), *kala* etc. comprising the *Tripraśnādhikāra* (24—33). In the next verses, we have *lambaka* or Rsine of colatitude (34) ; *dṛk-karma* (35) and *ayana-dṛk-karma* (36). Then follow the calculations of lunar and solar eclipses (37—47). Verse 48 describes the coordinates of the Sun which are determined by the conjunction of horizon with the Sun, of the Moon by the conjunction of the Sun and the Moon, of planets by the conjunction of the Moon and planets or stars. Verse 49 describes how this jewel treatise has been procured out of an ocean of true and untrue knowledge with the help of a boat of intellect. This means that the author has taken special pains in discriminating true knowledge from falsehood with respect to the prevalent notions of astronomy. In the last verse he says, that he has not given anything new ; he has given that very knowledge which was imparted by the *Svayambhu* in the earliest times (50).

The *Pañchāṅgas* prepared according to the rules and formulæ of the *Āryabhaṭīyam* are still regarded with reverence by the *Vaiṣṇavas* in the South. Brahmagupta was a great critic of Āryabhaṭa, but finally he wrote his treatise, the *Khaṇḍakhādyaka*, on the basis of this very *Āryabhaṭīya* (this treatise is a *karaṇagrantha* i.e. one containing a principal element of the Indian Calendar). The four commentaries of the *Āryabhaṭīya* available in Sanskrit are of Bhāskara I, Sūryadeva Yajvā, Parameśvara and Nīlakaṇṭha. Two English translations by P.C. Senagupta (1927) and W.E. Clark (1930) are also available.

Major Landmarks

Indian astronomy which reached its zenith in the times of Āryabhaṭa and Brahmagupta shows its evolution in the following stages :

1. Rudiments of astronomy in the *Vedas* and *Brāhmaṇa* Books like the *Taittirīya Saṁhitā* and the *Śatapatha Brāhmaṇa*. This period is associated with the dis-

covery of the Vedic era, some of the planets, the twenty-four *nakṣatras*, cycle of seasons, concept of leap year, the dimensions of a yuga, solar and lunar years and the like.

II. Astronomy of the *Vedāṅga*, also known as the *Vedāṅga Jyotiṣ*. Lagadha is the most prominent figure of this period (1400 B.C. to 850 B.C.) ; he is the first compiler of a text on astronomy. In his work, we for the first time in history find a reference to the *Jñeya Rāśi* (the knowable or the unknown quantity) and the *Jñāna-Rāśi* (known quantity). He lays the foundations of astronomical calculations. In his treatise we find a mention of such subjects as : Solstices (northern and southern journey of the Sun), increase in days and nights in the *ayanas* or solstices, solstitial *tithis* omission of *tithis*, *parva rāśi* , acceptable and non-acceptable *parvas*, addition of day, acceptable *parvas*, concept of *yoga* (a term applied to the joint space which would be travelled by the Sun and the Moon in a given period of time on the presumption that these two bodies have travelled in directions opposite to each other), method of finding out a *nakṣatra* on any *parva* day, distinction between *parva-nakṣatra* and *tithi-nakṣatra*, correlation of solar and lunar dates, measure of a *nāḍikā* (unit of time), *nakṣatra* of the Sun, *yoga* and its *nakṣatra*, *parva-bhaśeṣa* and equivalent *kalās*, solar year, lunar revolutions (risings of *nakṣatras*) deities of *nakṣtras*, lunar and *sāvana day* differences (*ahika māsa*), divisions of a *sāvana day* and length of day in two *ayanas*. This author probably belonged to Kashmir.

III. The period of *Siddhāntas* : Varāhamihira in his well known treatise, the *Pañcasiddhāntikā*, refers to five *Siddhāntas* or systems of Astronomy : Paitāmaha, Vasiṣṭha, Romaka, Pauliśa and Sūrya (Saura). As regards its importance, he gives the first place to the Sūryasiddhānta, places next the Romaka and Pauliśa, and declares the remaining two to be definitely inferior to the former. We do not possess the full treatise of these Siddhāntas, except the *Sūryasiddhānta*. Here too,

we have difficulty. The *Sūryasiddhānta*, as summarised by Varāhamihira in his *Pañcasiddhāntika*, in many essential features differs from the system prescribed by the Text of the *Sūryasiddhānta* now available. So we have two versions, the one with which Varāhmihira was familiar and the modern one.

The present *Sūryasiddhānta* comprises of fourteen chapters called *adhyāyas*. We have an authentic commetary on it by Parameśvara. The first two chapters of the *Sūryasiddhānta* have no special name. The classification of chapters is as follows :

Modern Sūrya Siddhānta

Chapter	Name of the Chapter	Number of verses	Subject
I	—	69	Mean longitude of planets.
II	—	68	True motion and true longitude of planet ; and elements of *Pañcāṅga.*
III	Tripraśnādhyāya	50	Directions, place and time.
IV	Candra-grahaṇādhyāya	29	Lunar eclipse.
V	Sūrya-grahaṇādhyāya	17	Solar eclipse.
VI	Chedyakādhyāya	24	Projection of eclipse on a plane surface.
VII	Graha-samāgama-yuddhādhyāya	24	Conjunction of one planet with another.
VIII	Tārāviṣayodhyāya	21	Conjunction of a Planet with the junction star of a nakṣatra.
IX	Udayāstamaya-viṣayodhyāya	18	Heliacal rising and setting of planets.
X	Candrāstamayādi viṣayāḥ	16	Moon rise and elevation of Moon-horn.
XI	Vyatipāta-viṣayāh	23	Pāta (*vyatipāta*)
XII	—	87	Cosmogony and geography

Chapter	Name of the Chapter	Number of verses	Subject
XIII	Vyatipāta-viṣayāh	26	Armillary sphere and astronomical instruments
XIV	—	28	Modes of reckoning time
	Total	500	

From the contents of the Modern *Sūryasiddhānta*, it appears that its great author (or rather *compiler*, since this *Siddhānta* has been existing much before he compiled this treatise) intends giving a complete but brief account of the entire Indian astronomy. He has been careful enough to avoid controversies, and he has omitted the methods occurring in other *Siddhāntas* and *Mahā-tantras* as alternative rules. He describes only those which are most important and of general nature. Part II of the book dealing with cosmogony and geography etc.. is very brief , a nd the entire subject has been summarised in three chapters (Chapters XII to XIV). The Chapter on Astronomical instruments (XIII) is sketchy and rather incomplete; the author has given the names only of the instruments, as if the purpose was to keep the details secret and guarded. The whole text of the *Sūryasiddhānta* is finished in 500 verses (compare this with the length of other Indian books on Astronomy: the *Brāhmasphuṭasiddhānta* 1008 verses, the *Siddhānta-śekhara* 890 verses and *Siddhānta-śiromaṇi* proper 962 verses).

The Modern *Sūryasiddhānta* is a composition or compilation of a period when the *Āryabhaṭīyam* and the *Brāhmasphuṭasiddhānta* had already become popular. This *Sūryasiddhānta* is indebted to both these systems, though it has nowhere acknowleged them in the Text. We shall refer to this matter later at an appropriate stage of our discussion.

It may casually be mentioned here that Alberuni has ascribed the authorship of the *Sūryasiddhānta* to Lāṭadeva while Munīśvara (603 A. D.) has ascribed it to Āryabhaṭa I. Though there is little or no support to these views, it is not improbable, that the works of Āryabhaṭa I and Lāṭadeva which followed midnight-day-reckoning were based on the *Sūryasiddhānta* prevalent at the time. P. C. Senagupta on the other hand is of the opinion that " the old *Sūryasiddhānta* was made up-to-date by Varāhamihira by replacing the old constants in it by new ones from Ārya-

bhaṭa I's midnight system. " In this connection, it must be remembered that Varāhamihira nowhere expresses his indebtedness to Āryabhaṭa I.

The *Sūryasiddhānta* undoubtedly is the most popular book on Astronomy in this country. It has been so for the last 1000 years as is seen from the list of commentators on its text (K. S. Sukla has given a list of 28 commentators including those who wrote commentaries in the South Indian languges like Telugu and Kannaḍa.) :

Allanarya Suri
Amaredya
Bhaṭṭotpala (966 A. D.)
Bhūdhara (1572 A. D.)
Bhūti viṣṇu
Caṅḍeśvara (1178)
Cola
Dādābhai (1719 A. D.)
Devīdāsa
Kamala Kara Daneśvarah (1618 A. D.)
Kāmabhaṭṭa
Kṛṣṇa Daivajña
Madanapāla
Mādhavācārya
Maheśvara
Mallikārjuna Sūri (1178 A. D.)
Nārāyaṇa
Nrsinha Daivajña (b. 1586 A.)
Nṛsiṃhadeva
Parameśvara (1432 A. D.)
Rāghava Śarmā (1592 A. D.)
Ṛamakṛṣṇa Ārādhya (1472 A. D.)
Raṅganātha (1603 A. D.)
Sārvabhauma
Tamma Yajva (1599 A. D.)
Yallaya (1472 A. D.)
Viśvanātha (1628 A. D.)

A large number of astronomical books in this country were written on the basis of the *Sūryasiddhānta*, as the *Gaṇakānanda* by Sūrya (1387-1447 A. D.), *Gaṇitādarśa* by Dharmapathin, *Makaranda Sāriṇi* by Makaranda (1478 A D.), *Grahacakra* by Kucanācārya (1299 A.D.), *Viṣṇukaraṇa* by Viśṇu (1556 A.D.) besides many others with indefinite dates such as the *Sūryasiddhānta nayana-prakārah*, *Sūryasiddhānta-gaṇita Sūryasiddhānta-saṁgraha* by Viśvanātha Sūri, and Sūryasiddhānta Sāriṇi by Rāmadatta Daivajña. K. S. Sukla has given a list of this literature in his Introduction to the *Sūryasiddhānta*.

(iv) *Period of Bhāskara* I : The author or the compiler of the *Sūryasiddhānta* is not known nor its date of composition. Bhāskara and Brahmagupta are the brilliant names of a contemporary period. Bhāskara I lived in the seventh century of the Christian era and was a contemporary of Brahmagupta (628

A.D.). He wrote three works on Astronomy which were most likely composed in the following order : (i) the *Mahā-Bhāskarīya*. (ii) a commentary on the *Āryabhāṭiya*, and (iii) the *Laghu-Bhāskarīya*, His commentary on the *Āryabhātīya* was written in 629, i.e., only one year after the *Brāhmasphuṭasiddhānta*. His commentary on the *Āryabhatīya* was written in 629 A.D., i.e, one year after the completion of the *Brāhmasphuṭasiddhānta*. Undoubtedly Bhāskara was the follower of Āryabhaṭa I. Shukla says, that his works provide us with a detailed exposition of the astronomical methods taught by Āryabhaṭa I and throw light on the development of Astronomy in India during the sixth and early seventh centuries A. D. which was the most brilliant period in the history of Indian Astonomy-Shukla has brought a critical edition with English translation of the *Mahābhāskarīya* and the *Laghu-Bhāskarīya* and he proposes to bring out a volume on the life and works of this great astronomer,

Division of Mahābhāskarīya

The *Mahābhāskarīya* is divided into Chapters called the *adhyāyas*. The *adhyāyas* have not been named as some of the Chapters of the *Sūryasiddhānta* or the *Brāhmaspuhṭasiddhānta*. The number of verses in the *Mahābhāskarīya* is as follows :

	Subject	*Number of verses*
Adhyāya I	Mean Longitude of a Planet and Planetary Pulveriser	52
Adhyāya II	The Longitude Correction	10
Adhyāya III	Direction, Place and Time. Junction-stars of the Zodiacal Asterisms and conjunction of Planets with them.	75
Adhyāya IV	The Longitude of a Planet	64
Adhyāya V	Eclipses	78
Adhyāya VI	Rising, Setting and Conjunction of Planets	62
Adhyāya VII	Astronomical Constants	35
Adhyāya VIII	Examples	27

These titles to the subject-matter given in the above table have been assigned by Dr. Kripa Shanker Shukla in his critical

edition. The total mumber of verses in this work is 403. The Sūryasiddhānta has, as stated above, 500 verses in all.

Laghu-bhāskarīya

The *Laghu-Bhāskarīya* is also divided into eight chapters, each chapter is known as *Adhyāya.* The subject matter in the book has been dealt with as follows :

Subject			*Number of verses*
Adhyāya	I	Mean longitudes of the Planets	37
Adhyāya	II	True Longitudes of the Planets	41
Adhyāya	III	Direction, Place and Time from Shadow	35
Adhyāya	IV	The Lunar Eclipse	32
Ādhyāya	V	The Solar Eclipse	15
Adhyāya	VI	Visibility, Phases and Rising and Setting of the Moon	25
Adhyāya	VII	Visibility and Conjunction of the Planets	10
Ādhyāya	VIII	Conjunction of a Planet and a Star	19

The total number of verses in this text is 214. The *Laghu-Bhāskarīyam* is thus an abridged edition of the *Mahā-Bhāskarīyam.* From the closing stanza of this work, it is clear that the author wrote this work for the benefit of young students with immature mind by condensing and simplifying the contents of his larger work, the *Mahā-Bhāsarīyam* (also known as *Karma-nibandha).* Thus we have a little of the parallelism: Brahmagupta, after finishing his bigger treatise, the *Brāhma-sphuṭasiddhānta,* wrote a minor abridged work, the *Khaṇḍa-khādyaka,* as a *karaṇa grantha.* This latter work of Brahmagupta, however, incorporates some original ideas not included in the earlier work. Shukla has given an analytical table indicating the rules of the *Mahā-Bhāskarīyam* incorporated in the *Laghu-Bhāskarīyam* also in an abridged or modified form, and also a list of the rules which have been omitted in the *Laghu-Bhāsakrīya.* There are a few rules in the *Laghu-Bhāskarīya* also which have no counterpart in the

Mahā-Bhāskarīya. Shukla further says that the arrangement of the contents of the *Laghu-Bhāskarīya* is more systematic and logical than that of the *Mahā-Bhāskarīya*, and is, at the same time, in keeping with the general practice followed by the other Hindu astronomers. Numerous quotations of this work occur in the annotative works of Sūryadeva (b. 1191 A.D.), Yallaya (1480 A.D.), Nīlakaṇṭha (1500 A.D.), Raghunātha Rāja (1597 A.D.), Govinda Somayāji and Viṣṇu Śarmā and in the *Prayoga-racanā*, an anonymous commentary on the *Mahā-Bhāskarīyam*. We find the commentaries of this abridged work in Malayalam and Tamil also. All this speaks of the great popularity of this work.

There are circumstantial evidences to show that Bhāskara I had associations with the countries of Aśmaka and Surāṣṭra. His commentary on the *Āryabhaṭīya* was probably written in the city of Valabhī in Surāṣṭra. Perhaps Bhāskara I was born and educated in Aśmaka and later on he migrated to Valabhī, where he wrote his commentary on the *Āryabhaṭīya* or that he was a native of Valabhī and got his education in the Aśmaka country. Perhaps there was a strong school of Astronomy in the Aśmaka country, which was founded by the followers of Āryabhaṭa, so much so that at places, Bhāskara I has also called Āryabhaṭa as Āśmaka, his *Āryabhaṭīyam* by the name *Aśmaka-Tantra* or the *Āśmakīya* and the followers of Āryabhaṭa as Āśmakīyāḥ. This Aśmaka country or Aśmaka Janapada is mentioned in the Buddhist literature also. It was somewhere either in the north-west of India, or was situated between the rivers Narmadā and Godāvarī. Bhāskara I was evidently a resident of the latter Aśmaka (which was between the Narmadā and Godāvarī).

Brahamagupta and Bhāskara I were contemporaries. Both of them developed their systems in the earlier part of the seventh century A.D. (3700 years of *Kaliyuga*). *Brahāmasphuṭasiddhānta* was written in 628 A.D. and the commentary on the Āryabhaṭīyam by Bhāskara I was composed in 629 A. D. Bhāskara closely followed Āryabhaṭa, but Brahmagupta had the guts to oppose the views expressed by this great master and he not only contradicted him at places, but also propounded many new ideas, methods of calculation and constants of greater accuracy.

The classification of the contents of Astronomy in *adhikāras* appears to be the original concept of *Brahmagupta* ; this system was to some extent adopted in the modern *Sūrya-Siddhānta* in the case of a few chapters. The *Vaṭeśvara-Siddhānta* by Vaṭeśvarācārya (born 802 Śaka or 880 A.D. in Ānandapura city, Punjab, son of Mahādatta) also adopts the terminology: *Madhyamādhikāra, Spaṣṭādhikāra* and *Tripraśnādhikāra.* We owe this type of caption-nomenclature to Brahmagupta.

Contents of the Brahmasphuṭasiddhānta

Now we shall summarise the contents of the Chapters of this great treatise and also enumerate the number of verses in each chapter. The author has himself given the total number of verses in the Chapter in the ending verse of each chapter. Sometimes, the verse specifying this number itself is not taken into account while giving the total number of verses in that chapter, and therefore, there occurs a minor discrepancy in the actual number and the number specified by the author himself. The following table records both these numbers separately :

Chapter	Title	Number of verses indicated by the author	Actual number of verses
PŪRVA-DAŚĀDHYĀYI (First Ten Chapters)			
I	Madhyāmadhikāraḥ (Madhyamagati-radhyāyaḥ)	63	63
II	Spaṣṭādhikāraḥ (Sphuṭagati-radhyāyaḥ)	67	68
III	Tripraśnādhikāraḥ (Tripraśnādhyāyaḥ)	66	66
IV	Candragrahaṇādhikāraḥ (Candragrahaṇādhyāyaḥ)	20	20
V	Sūryagrahaṇādhikāraḥ (Ārka-grahaṇam or Ravigrahaṇādhyāyaḥ)	26	27
VI	Udayāstādhikāraḥ (Udayāstamayādhyāyaḥ)	12	13

	bījam	51—59		
	Bhāvita-bījam	60—63		
	Varga-prakṛtiḥ	64—74		
	Udāharaṇāni	75—102		
XIX	Śaṅkucchāyādijñānādhyāyaḥ		20	20
XX	Chandaścityuttarādhyāyaḥ		20	19
XXI	Golādhyāyaḥ		70	70
	Sāmānya-golaprakaraṇam	1—16		
	Jyā-prakaraṇam	17—23		
	Sphuṭagati-vāsanā	24—30		
	Bimba-sādhanam	31—35		
	Grahaṇa-vāsanā	36—48		
	Golabandhādhikāraḥ	49—70		
XXII	Yantrādhyāyaḥ		53	57
XXIII	Mānādhyāyaḥ		12	12
XXIV	Sañjnādhyāyaḥ		13	13
		Total	1016	1022

In one of the verses, Brahmagupta states that he has composed the treatise containing 1008 verses. Sudhākara Dvivedī has given the total as 1021, whereas he says, this number according to Brahmagupta's own statement should be 1020. If one deducts the concluding 12 verses of the *Sañjñanādhyāya*, the number should be 1008.

Sudhākara Dvivedī, in his addition of the *Brāhma-sphuṭa-siddhānta* (published in the *Paṇḍita*, 1901 and 1902) gives as a supplement a small treatise of Brahmagupta known as *Dhyāna-grahaṇopadeśādhyāya* or *Dhyānagrahaṇādhikāraḥ* which has 72 verses.

It would be worthwhile to give here the details of the *Khaṇḍakhādyaka* also, a book of Brahmagupta about which we have spoken so much. The titles to the chapters have not been indicated in the Text ; most likely they have been assigned by the commentator, Pṛthūdaka Svāmi known as the *Khaṇḍakhādyaka-vivaraṇam.*

Chapter	Title	Number of verses
I	Tithi-nakṣatrādhikārādhyāyaḥ (On tithīs, nakṣatras etc.)	32
II	Grahagatyadhyāyaḥ (On the mean and true places of 'star' planets)	19
III	Tripraśnādhyāyaḥ (On the three problems relating to diurnal motion)	16
IV	Candragrahaṇādhyāyaḥ (On lunar eclipses)	7
V	Sūryagrahaṇādhyāyaḥ (On solar eclipses)	6
VI	Udayāstādhikāraḥ (On the rising and setting of planets)	7
VII	Candrasṛṅgonnatyadhāyaḥ (On the position of the Moon's cusps)	4
VIII	Samāgamādhyāyaḥ (On conjunction of planets)	6
	UTTARA KHAṆḌAKHĀDYAKA—APPENDIX	
IX	Corrections and new methods	14
X	On conjunction of stars and planets	16
	Total	127

Bhaṭṭotpala, in his commentary on the *Khaṇḍakhādyaka* has given several additional verses in the main or proper treatise and also in its Uttara portion or the Appendix. P.C. Sengupta's edition (Sanskrit Text 1941) has given at the end of this publication the account of these additional verses. The English

edition (1934) classifies the *Uttara-Khaṇḍakhādyaka* into two chapters (which the author calls as Chapters IX and X), the Sanskrit edition gives 3 verses in Chapter IX, 21 verses in Chapter X and 24½ verses in Chapter XI. Of these three chapters, the Chapter X has been given the title "*Patādhikāra*" and Chapter XI the title "*Parilekhādhyāya*" by Bhaṭṭotpala.

TABLE

Arrangement of contents in different treatises

Topic	*BrSpSi*	*SūSi*	*MBh*	*MSi*	*SiŚe*	*SiŚi*
Mean longitudes of the planets	I,XIII	I	I	I,II	I,II	I
True longitudes of the planets	II,XIV	II	IV	III	III	II
Direction, place and time	III,XV	III	III	IV	IV	III
Computation of a lunar eclipse	IV,XVI	IV	V	V	V,VII	IV,V
Computation of a solar eclipse	V,XVI	V	V	VI	VI	VI
Projection of an eclipse	XVI	VI	V	VIII		V
Conjunction of a planet with another planet	IX	VII	VI	XI	XI	X
Conjunction of a planet with a star	X	VIII		XII	XII	XI
Heliacal rising of planets	VI	IX	VI	IX,X	IX	VII, VIII

Topic	*BrŚpSi*	*SūSi*	*MBh*	*MSi*	*SiŚe*	*SiŚi*
Moonrise and elevation of lunar horns	VII,XVII	X	VI	VII, VIII	X	IX
Pāta	XIV	XI	VII	XIII	VIII	XII
Cosmogony and geography	XXII	XII		XVI		II.iii
Astrono. instruments	XXIII	XIII	III		XIX	II.xi
Time reckoning	XXIV	XIV				I.i

Āryabhaṭa and Brahmagupta Controversy

The scientific Indian astronomy was more or less created by Āryabhaṭa I (476 A. D.). It is said that he was the teacher of two distinct systems of astronomy, one of which is called the *audayika* system, and the other the *ardharātrika* system. In the first, the astronomical day is taken to begin at *sunrise* at Laṅkā, and in the other, the same begins at the *midnight* of the same place. In the *Khaṇḍakhādyaka* Brahmagupta gives compendious rules for the calculation of longitudes, etc, of planets according to the *ardharātrika* system of Āryabhaṭa I. In this connection, he refers to Āryabhaṭa in the following words in his *Khaṇḍakhādyaka :*

> Having made obeisance to God Mahādeva, who is the great cause of this world's rise (i. e. creation), existence, and destruction, I shall declare the *Khaṇḍakhādyaka* which will yield the same results as the great astronomical treatise of Āryabhaṭa.[1]

> As in most cases calculation by the great work of Āryabhaṭa, for (the knowledge of time and longitude of planets etc. at) marriage, nativity and the like is impracticable for common use every day, this smaller

1. प्रणिपत्य महादेवं जगदुत्पत्तिस्थितिप्रलयहेतुम् ।
वक्ष्यामि खण्डखाद्यकमाचार्य्यार्य्यभटतुल्यफलम् ॥

treatise (i.e. *Khaṇḍakhādyaka*, literally meaning food prepared from sugar-candy) is made so as to yield the same results as that.[1]

The mean saturn diminished by 3 seconds, the *Śīghrocca* of Mercury diminished by 22 seconds, the mean Mars increased by 2 seconds and the mean Jupiter increased by 4 seconds are equal to the respective mean planets of Āryabhaṭa's *midnight* system.[2]

In the *Brāhmasphuṭasiddhānta*, Brahmagupta accepts the astronomical day to begin with the sunrise at Laṅkā, and the calculations of days, months, years, Yugas, and Kalpas all begin from Caitra Śukla Pratipadā (the first *tithi* of the month Caitra in the bright-half of the Moon) and the first day is regarded as Sunday.[3]

Varāhamihira in his epicyclic cast to the *Sūryasiddhānta* in his *Pañcasiddhāntikā* adopts the *ardharātrika* system or the system of reckoning days from midnight. The question why Brahmagupta who was so bitter an opponent of Āryabhaṭa I in his younger days (628 A.D.) claimbed down to describe and teach one of the systems of Āryabhaṭa's astronomy in his sixty-seventh year (665 A.D.) is difficult to explain. In fact so great was Āryabhaṭa's reputation and fame that in spite of Brahmagupta's severe ricticisms of the former in Chapter XI of the *Brāhmasphuṭasiddhānta*, it perhaps was undiminished and it was Āryabhaṭa who continued to be universally followed.

Some authorities have thus expressed the view that to meet the popular demand Brahmagupta in the *Khaṇḍakhādyaka* took upon himself the task of simplifying Āryabhaṭa's *ardharātrika* system and in this task he became eminently successful. But it has been supposed that in this task he could not be a mere simplifier or expounder.

प्रायेणार्य्यभटेन व्यवहारः प्रतिदिनं यतोऽशक्यः ।
उद्वाहजातकादिषु तत्समफल लघुतरोक्ति रतः ॥
त्रिसृभिः शनिर्बुधशीघ्रं द्वाविंशत्या कुजोऽधिको द्वाभ्याम् ।
चतसृभिरधिको जीवोऽर्द्धरात्रिकार्य्यभट मध्य समाः ॥

—*KK*. I. 1,2,7

1. चैत्रसितादेरुदयाद्भानोर्दिनमासवर्षयुगकल्पाः ।
सृष्ट्यादौ लंकायां समं प्रवृत्तः दिनेऽर्कस्य ॥

—*BrSpSi I.4*

The minor work of Brahmagupta known as *Khaṇḍakhādyaka* has two distinct parts : *Khaṇḍakhādyaka* proper and the *Uttara Khaṇḍakhādyaka*. In the first part the astronomical constants are the same as those of Āryabhaṭa's *ardharātrika* system, but the methods of spherical astronomy, calculation of eclipses and other topics are almost the same as in the *Brāhmasphuṭasiddhānta*. The corrections for parallax in calculating a solar eclipse is here an important illustration.[1]

In the *Uttarakhaṇḍakhādyaka*, Brahmagupta gives corrections to the *Khaṇḍakhādyaka* proper. In it are to be found the neat and original methods of interpolation and correction to the longitudes of the aphelia, as also to the dimensions to the epicycles of apsis of the Sun and the Moon.[2] while a few additional chapters supply what else is necessary to the first seven chapters of the first part, to make the whole a complete treatise on Indian scientific astronomy. It was perhaps through the influence of this supplementary part of the *Khaṇḍakhādyaka* that Brahmagupta's great work, the *Brāhmasphuṭasiddhānta* came to be valued among a distinct school of Indian astronomers. For long in this country India, this *Siddhānta* of Brahmagupta has been forming the basis for the calculation of almanacs by astronomers of the orthodox school of Rājasthān, Bombay and others.

We might at this stage take up the question : Was Āryabhaṭa the author of two distinct systems of astronomy ? Undoubtedly he was. Several authors have written on this subject. I may specially mention the name of Prabodha Chandra Sengupta (*Journal of the Department of Letters*, Calcutta University, vol. XVIII; *Bulletin, Calcutta Mathematical Society*, vol. XXII. Nos. 2 and 3). The reasons advanced by him may be restated in slight details thus. In his *Brāhma-*

1. व्यासार्धेन विभक्ता दृग्गतिजीवा चतुर्गुणा लब्धम् ।
लम्बननाड्यः पञ्चदश गुणितया त्रिज्यया भक्ता ॥
दृक्क्षेपज्या भुक्त्यन्तरा हता लब्धमवनतिर्भवति ।
स्फुटयोजनकर्णाभ्यां भूव्यासेन च विना स्पष्टे ॥
आर्यभटेनास्मिन् सति लघुनि किमर्थं महत् कृतं कर्म ।
गणिताज्ञानाज् जाड्यं विजानता यदि ततः सुतराम् ॥

—*BrSpSi*. XI. 23-25, also *KK*. V.

2. See UKK. 9.

sphuṭasiddhānta, Brahmagupta thus speaks of the two works of Āryabhaṭa:

> As in both the works the number of the Sun's revolutions is spoken of as 432,000 years, their planetary cycle is clear, i. e., of 4,320,000 years. Why then is there difference of 300 civil days in the same cycle of the two books ?[1]

Again, he says :

> In 14,400 years elapsed of the *Mahāyuga*, there is produced a difference of one day in the *audayika* and *ardharātrika* systems.[2]

Varāhamihira in the *Pañcasiddhāntikā* writes ·

> Āryabhaṭa maintains that the beginning of the day is to be reckoned from midnight at Laṅkā; and the *same* teacher again says that the day begins from sunrise at Laṅkā. [3]

Thus from the writings of Brahmagupta and Varāhamihira, it is clear that Āryabhaṭa I was the author of both the *audayika* and *ardharātrīka* systems of astronomy. In Varāhamihira's verse the phrase *sa eva* (स एव), meaning "he undoubtedly" is of speeial significance. It removes the least doubt as to Āryabhaṭa's authorship of both these systems. The *audayika* and *ardharātrika* astronomical constants are respectively to be found from the Āryabhatīya and may be deduced from the *Khaṇḍakhādyaka* as well. The following is the comparative view of the constants of Varāhamihira and of the present day *Sūryasiddhānta*.

TABLE I

Planetary revolutions in a mahāyuga of 4,320,000 years, according to various authorities.

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1. युगरविभगणाः रव्युघ्नति यत् प्रोक्तं तत् तयोर्युगं स्पष्टम् ।
त्रिशती रव्युदयानां तदन्तरं हेतुना केन ॥
—*BrSpSi XI. 5*

2. अधिकैः शतैश्चतुर्भिर्वर्षं सहस्रैश्चतुर्दशभिरेकः ।
युगयातैर्दिनवारान्तर मौदयिकार्धं रात्रिकयोः ॥
—*BrSpSi XI. 13*

3. लङ्कार्द्धरात्रसमये दिनप्रवृत्तिं जगाद चार्यभटः ।
भूयः स एव सूर्योदयात् प्रभृत्याह लङ्कायाम् ॥
—*PSi. XV. 20*

Planet	*BrSpSi*	*Āryabhaṭīya*	*Khaṇḍa-khādyaka*	Varāha-*Sūrya-siddhānta* (PSi.)	Later or modern *Sūrya-siddhānta*
Moon	57,753,300	57,753,336	57,753,336	57,753,336	57,753,336
Sun	4,320,000	4,320,000	4,320,000	4,320,000	3,320,000
Mars	2,296,828.522	2,296,824	2,296,824	2,296,824	2,296,832
Jupiter	364,226.455	364,224	364,220	364,220	364,220
Saturn	146,567.298	146,564	146,564	146,564	145,568
Moon's apogee	—	488,219	488,219	488,219	488,203
Venus	7,022,389.492	7,022,338	7,022,388	7,022,388	7,022,376
Mercury	17,936,998.984	17,937,020	17937,000	17,937,000	17,937.060
Moon's nodes	232,311.168	232,226	232,226	232,226	232,238

TABLE II

Longitudes of the apogees of the orbits of Planets.

Planets	*Āryabhaṭīya*	*Khaṇḍa-khādyaka*	Varāha *Sūrya-siddhānta.*	Modern *Surya-siddhānta*
Sun	78°	80°	80°	77° 07·
Mercury	210°	220°	220°	220° 26′
Venus	90°	80°	80°	79° 49′
Mars	118°	110°	110°	130° 00′
Jupiter	180°	160°	160°	171° 16′
Saturn	236°	240°	240°	236° 37′

TABLE III

Dimensions of the epicycles of Apsis

Planets	*Ārybhaṭīya*	*Khaṇḍa-khādyaka*	Varāha. *Sūrya-siddhānta*	Modern *Sūrya-siddhānta*
Sun	13°-30′	14°	14°	13$\frac{2}{3}$°-14°
Moon	31°-30′	31°	31°	31$\frac{2}{3}$°-32°
Mercury	22$\frac{1}{2}$°-31$\frac{1}{2}$°	28°	28°	28°-30°
Venus	9°-18′°	14°	14°	11°-12°
Mars	63°-81°	70°	70°	72°-75°
Jupiter	31$\frac{1}{2}$-36$\frac{1}{2}$°	32°	32°	32°-33°
Saturn	40$\frac{1}{2}$-58$\frac{1}{2}$	60°	60°	48°-49°

Table IV

Dimensions of the Sīghra epicycles (i.e. conjunctions)

Planet	*Āryabhaṭīya*	*Khaṇḍa-Khādyaka*	Varāha *Sūrya-siddhānta*	Modern *Sūrya-siddhānta*
Saturn	36½°- 40°	40°	40°	39°- 40°
Jupiter	67½°- 72°	72°	72°	70°- 72°
Mars	229½°-239½°	234°	234°	232°-235°
Venus	256½°-265½°	260°	260°	262°-262°
Mercury	130½°-139½°	132°	132°	132°-133°

Table V

Longitudes of the nodes of the orbits of planets

Planets	*Āryabhaṭīya*	*Khaṇḍa-khādyaka siddhānta*	Varāha *Sūrya-siddhānta*	Modern *Sūrya-siddhānta*
Saturn	40°	40°	Not stated in the Text	Have to be calculated from the data of the text
Jupiter	20°	20°		
Mars	80°	80°		
Venus	60°	60°		
Mercury	100°	100°		

Table VI

Orbital inclinations (geocentric) to the ecliptic

Planets	*Āryabhaṭīya*	*Khaṇḍa-khādyaka*	Varāha *Sūrya-siddhānta*	Modern *Sūrya-siddhānta*
Mars	90′	90′	10′	90′
Mercury	120′	120′	135′	120′
Jupiter	60′	60′	101′	60′
Venus	120′	120′	101′	120′
Saturn	120′	120′	135′	100′

The *Mahābhāskarīya* of Bhāskara I (522 A. D.) contains a passage which corroborates the fact that Āryabhaṭa I was the author of both the *audayika* and the *ardharātrika* systems of Indian Astronomy. According to Pṛthūdakasvāmin, whose

commentary on the *Brāhmasphuṭasiddhānta* we have the privilege of presenting to the public, it is clear that in certain respects Bhāskara and others may be wrong but the Āryabhaṭa's authenticity cannot be questioned. Pṛthūdakasvāmin while commenting on the *Brāhmasphuṭasiddhānta*, XI. 26 writes:

> Such a mistake may have been made by Bhāskara and others; they have not understood his (Āryabhaṭa's) intention.

The passage in the *Mahābhāskarīya* giving constants of the *ardharātrika* system runs as follows (we are giving the translation from Kripa Shankar Shukla's edition on the *Mahābhāskarīya*) :

> The astronomical processes which have been set forth above come under the sunrise day - reckoning (*audayika* system). In the midnight day-reckoning (*ardharātrika* system) too, all this is found to occur: the difference that exists is being stated (below). [1]

The next fourteen stanzas relate to the midnight day-reckoning of Āryabhaṭa I.

(i) Civil days and omitted lunar days in a *yuga* and revolution numbers of Mercury and Jupiter are thus given :

(To get the corresponding elements of the midnight day-reckoning) add 300 to the number of civil days (in a *yuga*) and subtract the same (number) from the number of omitted lunar days (in a *yuga*); and from the revolution numbers of (the *śighrocca* of) Mercury and Jupiter subtract 20 and 4 respectively. [2]

Thus according to the midnight day-reckoning, we get

civil days in a *yuga*	=	1,577,917,800
omitted lunar days in a *yuga*	=	25,082,280
revolution number of the *śighrocca* of Mercury	=	17,937,000
revolution number of Jupiter	=	364,220

1. निबन्धः कर्मणां प्रोक्तो योऽसावौदयिको विधिः ।
अर्धरात्रे त्वयं सर्वो यो विशेषः स कथ्यते ॥ —*MBh. VII. 21*

2. त्रिशती भूदिने क्षेप्या ह्यवमेभ्यो विशोध्यते ।
ज्ञ गुर्वोर्भगणेभ्योऽपि विंशतिश्च ततोऽब्धयः ॥ —*MBh. VII. 22*

(ii) Diameters of the Earth, the Sun and the Moon are thus given :

(In the midnight day-reckoning) the diameter of the Earth is (stated to be) 1,600 *yojanas;* of the Sun 6,480 (*yojanas*) and of the Moon, 480 (*yojanas*)[1].

(iii) Mean distances of the Sun and the Moon are as follows :

The (mean) distance of the Sun is stated to be 689,358 (*yojanas*), and of the Moon 51,566 (*yojanas*).[2]

(iv) Longitudes of the apogees of the planets are as follows: 160, 80, 240, 110, and 220 are in degrees the longitudes of the apogees of Jupiter, Venus, Saturn, Mars and Mercury respectively.[3]

(v) *Manda* and *Śighra* epicycles of the planets are as follows :

The *Manda* epicycles (of the same planets) are 32, 14, 60, 70, and 28 (degrees) respectively; and the *Śighra* epicycles are 72, 260, 40, 234, and 132 (degrees) respectively. The Sun's apogee and epicycle are the same as those of Venus (i. e. 80° and 14° respectively).

The Moon's epicycle in the midnight day-reckoning is stated to be 31 (degrees). [4]

(vi) The positions of the so called *manda* and *śighra pātas* of the planets are given below:

(The following directions for) the degrees of the (*manda* and *śighra*) *pātas* of the planets as devised

1. अष्टिश्शतगुणा व्यासो योजनानां भुवो रवेः ।
खाष्टाब्ध्यङ्गानि शीतांशोः शून्यवस्वब्धयस्तथा ॥ —23

2. वस्विन्द्रिय गुणच्छिद्रवस्वङ्गानि विभास्वतोः ।
अङ्गाङ्गेष्वेक भूतानि चन्द्रकर्णः प्रकीर्तितः ॥ —24

3. अष्टिरष्टौ जिनारुद्रा विंशतिर्द्व्यधिकाः क्रमात् ।
दशघ्ना गुरुशुक्रार्कि भौमज्ञांशाः स्वमन्दजाः ॥ —25

4. मन्दवृत्तानि द्वात्रिंशन्मनवः षष्टिरेव च ।
खाद्रयो वसुदस्राः स्युः शीघ्रवृत्तान्यथ क्रमात् ॥ —26
द्व्यद्रयः खाङ्गनेत्राणि खाब्धयोऽब्ध्यग्निदस्रकाः ।
द्व्यग्नीन्दवो रवेर्मन्दं शुक्रवद् वृत्तमेव च ॥ —27
एकत्रिंशत्क्षपाभर्तुरर्धरात्रे विधीयते । —MBh. VII 26-28 (i)

> (under the midnight day-reckoning) should be noted carefully by learned scholars :
>
> Add 180° to the longitudes of the *mandoccas* (apogees) apd *śīghroccas* of Mercury and Venus, and subtract 3 signs from the *mandoccas* (apogees) and *śīghroccas* of the remaining planets. Then are obtained the longitudes of the *manda* and *śīghra pātas* of the planets. (Also) add 2 degrees to the longitudes of the *manda pātas* and *śīghroccas* of Venus, Saturn and Jupiter, and $1\frac{1}{2}$ degrees to those of Mars and Mercury. (It should be noted that) the *śīghra pātas* have been stated for all the planets excepting Mercury. (Mercury does not have a *śīghra pāta*).[1]

That is to say, the longitudes of the *manda pātas* of Mars, Mercury, Jupiter, Venus, and Saturn are 21.5, 41.5, 72, 262 and 152 degrees respectively; and the longitudes of the *śīghra pātas* of Mars, Jupiter, Venus and Saturn are (*śīghrocca*−88.5°), (*śīghrocca* −88°), (*śīghrocca*+182°) and (*śīghrocca*−88°) respectively.

(vii) A rule for finding the celestial latitude of a planet is as follows :

> (From the longitude of a planet severally) subtract the longitudes of its (*manda* and *śīghra*) *pātas* and therefrom calculate (as usual) the corresponding celestial latitude of that planet. Add them or take their difference according as they are of like or unlike directions. Then is obtained the true celestial latitude of that particular planet. The true celestial latitude of any other planet is also obtained in the same way. The remaining (astronomical) determinations are the same as stated before. This all is in brief the difference of the other *tantra* (embodying the midnight day-reckon-

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1. पातभागाश्च विज्ञेयाः पण्डितैः परिकल्पिताः ॥ —*28*
मन्द शीघ्रोच्चयोः क्षेप्यं चक्रार्धं बुधशुक्रयोः ।
राशित्रयं तु शेषाणां पात्यते पातसिद्धये ॥ —*29*
शुक्रार्किदेव पूज्यानां भागौ द्वावेव संयुतौ ।
मन्दपाताच्च शीघ्रोच्चात् सार्धांशस्तु कुजज्ञयोः ॥ —*30*
विबुधानां च सर्वेषां शीघ्रपाताः प्रकीर्तिताः । *MBh. VII. 28 (ii) 31 (i)*

ing of Āryabhaṭa I).[1]

(viii) A rule for finding the longitude of the true mean planet according to midnight-day reckoning is as follows :

Apply half the *Sighraphala* and (then) half the *mandaphala* to the longitude of the planet's own *mandocca* (reversely).

From the resulting longitude of the planet's *mandocca* calculate the (*mandaphala* and apply it to mean longitude of the planet : the resulting longitude of planet is stated to be) the true-mean longitude of the planet. This is stated to be another difference (of the midnight day-reckoning) [2]

(ix) Length of the circle of the sky and derivation of the lengths of the orbits of the planets are given as follows :

Multiply the revolutions of the Moon (in a *yuga*) by 3, 240,000 and then discard the zero in the unit's place : (this is the length of the circle of the sky in terms of *yojanas*). (Severally) divide that by the revolutions of the planets (in a *yuga*): thus are obtained the lengths of the orbits of the respective planets in terms of *yojanas*.[3]

From these stanzas (from 20-35), it is evident that one *yojana* of the sunrise day-reckoning is one and a half times that of the midnight day-reckoning.

Now from stanza 22, it appears that 300 is to be added to the number of civil days in a *Mahāyuga*. According to the *Āryabhaṭīya*. the number of civil days in this cycle is 1,577,917, 500, which increased by 300, becomes 1,577,917,800, the number of

1. शोधयित्वा क्रमात् पातान् विक्षेपांशान् प्रसाधयेत् । —31
योगविश्लेषनिष्पत्तिरेकानेकस्वदिग्वशात् ।
विक्षेपः स स्फुटो ज्ञेयो ग्रहस्यैकस्य कीर्त्तितः ॥ —32
अन्यस्याप्येवमेव स्याच्छेषाः प्रागुक्त कल्पनाः ।
एतत्सर्वं समासेन तन्त्रान्तरमुदाहृतम् ॥ —*MBh. VII. 31 (ii)-33*

2. शीघ्रमन्दोच्चचापार्धसंस्कृतात् स्वीयमन्दतः ।
स्फुटमध्यग्रहाः स वै विशेषः परिकीर्तितः ॥ —*MBh. VII. 34*

3. वेदाश्विरामगुणितान्य युताहतानि ।
चन्द्रस्य शून्यरहितान्यथ मण्डलानि ॥
र ं :स्वैहृतानि भगणैः क्रमशो ग्रहाणां ।
कक्ष्या भवन्ति खलु योजमानदृष्ट्या ॥ —*MBh. VII. 35*

civil days in a *Mahāyuga* according to Brahmagupta as referred to in the *Khaṇḍakhādyaka*.

Again, the same stanza tells us to subtract 20 and 4 respectively from the revolutions of Mercury and Jupiter, and we arrive at the figures 17,937,000 and 364, 220, which are the revolutions of Mercury and Jupiter in a *Mahāyuga* according to Brahmagupta as given in the *Khaṇḍakhādyaka*.

Again we can compare the figures for the diameters of the Earth, the Sun and the Moon given in the *Mahābhāskarīya*, in the present day *Sūrya-siddhānta* and the *Āryabhaṭīya*.

Diameter of	*Mahābhāskarīya*	Modern *Sūrya-siddhānta*	*Āryabhaṭīya*
Earth	1,600 yojanas	1,600 yojanas	1,050, yojanas
Sun	6,480	6,500	4,410
Moon	480	480	315

Then in stanza 24, we are given the distances of the Sun and the Moon as 689, 358 and 51, 566 yojanas respectively. The same figures are worked out by Lalla according to the *Āryabhaṭīya* and quoted in the *Śiṣyadhīvṛddhida* (IV.3.4) and they come to be 459,585 and 34,377.

The stanza 25 states the longitudes of the aphelia of planets these figures tally with the corresponding figures given by Brahmagupta in the *Khaṇḍakhādyaka* :

> Longitude of aphelion of Jupiter 160°, of Venus 80°, of Saturn 240°, of Mars 110° and of Mercury 220°.

Similarly the stanza 26 gives the peripheries of planets' epicycle of apsis, which also is in concordance with the values given by Brahmagupta :

> Periphery of epicycle of apsis of Jupiter 32°, of Venus 14°, of Saturn 60°, of Mars 70° and of Merury 28°.

In the stanza 27 of the *Mahābhāskarīya*, we have the dimensions of the epicycles of conjunction for planets; these figures are also the same as given by Brahmagupta :

> Epicycles of con:uction for Jupiter 72°, for Venus 260°, for Saturn 40°, for Mars 234° and for Mercury 132°.

In the stanza 28, we have the Sun's epicycle having a periphery of 14° and the Moon's epicycle 31° ; the longitudes of

the nodes of the planets to be the same as in the *Āryabhaṭīya.* All these are the same as given by Brahmagupta in the *Khaṇḍa-khādyaka*.

In the stanza 33 we have rules for finding the geocentric longitudes of planets which may be taken to be the same as in the *Khaṇḍakhādyaka*[1]; compare these values with those in the *Sūryasiddhānta* of Varāhamihira in the Pañcasiddhāntikā, XVII. 6, but slight different from the *Āryabhaṭīya.*[2]

The last stanza of the *Mahābhāskarīya* (35) gives the dimensions in *yojanas* of the orbits of planets ; these are the same as in the modern *Sūryasiddhānta.*

Thus we find a great semblance in the constants as given by the *Mahābhāskarīya* of Bhāskara I, of the Sūryasiddhānta as given by the *Pañcasiddhāntikā* and understood by Varāhamihira, and also the constants as given by Brahmagupta in his treatises, specially the *Khaṇḍakhādyaka.* It must not be forgotten that the same Āryabhaṭa I who is the celeberated author of the *Āryabhaṭīya* is also the author of another treatise very often referred to as the *Tantra.*

I shall quote Prabodha Chandra Sengupta in connection with these similarities, and the great influence of Āryabhaṭa on Indian Astronomy. He writes in his Introduction to the *Khaṇḍakhādyaka* as follows :

> We have shown that there is much resemblance in the constants between the *Sūryasiddhānta* of Varāha and the *Khaṇḍakhādyaka* and for the matter of that with the *Tantrāntara* of Āryabhaṭa I. In my papers "Āryabhaṭa and Āryabhaṭa's Lost Work", I have established the fact that the *Sūryasiddhānta* as it existed before the time of Varāha, was made more accurate by him by borrowing the constants from Āryabhaṭa's *ardharātrika* system. That there was a *Sūryasiddhānta*

१. शीघ्रफलार्द्धं मध्ये मन्दफलार्द्धं च मन्दशीघ्रफले ।
सकले मध्ये स्पष्टः शीघ्रं मध्योनकं केन्द्रम् ॥ —*KK. II. 18*

२. मन्दोच्चाच्छीघ्रोच्चादर्धमृणधनं ग्रहेषु मन्देषु ।
मन्दोच्चात्स्फुट मध्याश्शीघ्रोच्चाच्च स्फुटा ज्ञेयाः ॥
शीघ्रोच्चादर्धोनं कर्तव्यमृणं धनं स्वमन्दोच्चे ।
स्फुटमध्यौ तु भृगुबुधौ सिद्धान्मन्दात्स्फुटौ भवतः ॥ —*Arya. III. 23–24*

before the time of Varāha, is seen from Section 6 of the Table on page xii given before. This point is made clear from another consideration, viz., the star table in the modern *Sūryasiddhānta*, which unmistakably points to the conclusion that the longitudes of some stars, e.g., Spica *etc.*, correspond to a time much anterior to that of Āryabhaṭa I. The great fame of Āryabhaṭa I induced Varāha, the first maker of a *neo-Sūryasiddhānta* to use the elements of Āryabhaṭa's *ardharātrika* system to supplant the older materials in it. No wonder, therefore, that there is an opinion in favour of the hypothesis that Āryabhaṭa I was the author of the *Sūryasiddhānta.* If there were a shadow of truth in it, Varāha would have admitted it. Alberuni indeed says that the *Sūryasiddhānta* was composed by *Lāṭa* (Alberuni's India, translated by Sachau, Vol. I.p. 153). We now know that this Lāṭa or Lāṭadeva was one of the first pupils of Āryabhaṭa I. He was the expounder of the Romaka and Paulīśa *Siddhāntas* as we learn from Varāhamihira's *Pañcasiddhāntikā*, (I.3). As Alberuni's statement is not corroborated by Varāha, we are not inclined to take it as correct. None of the earlier writers suggest that the *Sūryasiddhānta* was in any way modified or changed by Āryabhaṭa I.

It has now been established beyond doubt that the same Āryabhaṭa was the author of the *Aryabhaṭīya* and another *Tantra* which is now lost. There is reason in support of hypothesis that this *Tantra* itself was the first work of Āryabhaṭa I and that the *Aryabhaṭīya* was the second work from the order in which Varāha mentions them in the Stanza quoted earlier. If this hypothesis be true, the stanza in the *Aryabhaṭīya*[1], which was translated by me as :

"Now when sixty times sixty years and three quarter *yugas* also have elapsed, twenty increased by three years have elapsed since my birth."

1. षष्ट्यब्दानां षष्टिर्यदा व्यतीतास्त्रयश्च युगपादाः ।
त्र्यधिका विंशतिरब्दास्तदेह मम जन्मनोऽतीताः ॥ —*Arya. III. 10.*

should now be translated thus :

"In this *Mahāyuga* when sixty times sixty years and three quarter yugas also had passed, twenty increased by three years had elapsed since my birth."

Now Bhāskara I the author of the *Mahābhāskarīya* and the *Lagubhāskarīya*, wrote a commentary on the *Āryabhaṭīya*. The author commenting on this stanza observes that :

> "Or this was addressed by Āryabhaṭa when expounding the science to Pāṇḍuraṅgasvāmin, Lāṭadeva Niḥśanku and other pupils."[1]

This direct pupil of Āryabhaṭa I also says that this stanza does not show that the *Āryabhaṭīya* was composed when Āryabhata I was only 23 years old, but refers to the time when he probably began his career as a teacher of Astronomy.

Senagupta out of his discussion concludes that we are not justified in accepting that the Āryabhaṭīya was composed when Āryabhaṭa was only 23 years of age. This treatise as it exists in the present form must have been the composition of a mature age; it is a treatise highly finished in form; the date mentioned in this great work refers to a date when its author became a reputed *guru* or teacher.

Alberuni and Brahmagupta

Dr. E.C. Sachau in his translation of Alberuni's India (vol. II. p. 304) speaks of Brahmagupta in the following words :

> Brahmagupta holds a remarkable place in the history of Eastern civilization. It was he who taught the Arabs astronomy before they became acquainted with Ptolemy; for the famous *Sindhind* of Arabian literature, frequently mentioned but not yet brought to light, is a translation of his *Brāhmasiddhānta*; and the only other book on Indian astronomy, called Atarkand, which they knew, was a translation of his *Khaṇḍakhādyaka.*

Brahmagupta, the celebrated author of the *Brāhmasphuṭasiddhānta*, has another great work as we have said before to his credit which goes by the name *Khaṇḍakhādyaka*. This has

1. एतदेवाचार्य्यार्य्यभटस्य शास्त्रव्याख्यान समये वा पाण्डुरङ्गस्वामिलाटदेवनिःशङ्कुप्रभृतिभ्यः प्रोवाच ।

already been said that perhaps to meet the popular demand, Brahmagupta in this treatise took upon himself the task of simplifying Āryabhaṭa's *ardharātrika* system or the system of midnight day reckoning. Alberuni, the author of the *Indika* has made several references or quotations from the *Khaṇḍakhādyaka* proper and also its supplement, known as *Uttara-Khaṇḍakhādyaka.*

(a) There is a reference to the accepted circumference of the Earth, as given in the *Khaṇḍakhādyaka* (Sachau's *Alberuni*, Vol. I, p. 312)

Multiply the difference in longitude (from Ujjayinī) by the (mean) daily motion of a planet (in minutes) and divide by 4,800; apply the quotient taken as minutes negatively in places east of the meridian line of Ujjayinī and positively in places lying west.[1]

(b) The rules for finding the *ahargaṇa* as given in the *Khaṇḍakhādyaka* in I. 3-5 (Sachau's Alberuni, Vol. II, 46-47), to which Dr. Schram adds a valuable annotation, the constants being taken from the later Pauliśa Tantra as known to Bhaṭṭotpala. This Pauliśa astronomy is derived from Āryabhaṭa I's *ardharātrika* system.[2]

(c) A quotation from the Uttara *Khaṇḍakhādyaka* (Sachau's Alberuni, Vol. II, pp. 84-86) which Sengupta has given in his translation, Chapter X, pp. 148-152.

(d) A quotation also probably from the *Uttara Khaṇḍakhādyaka* (Sachau's Alberuni, Vol. II. p. 87). These stanzas are found in the *Brāhmasphuṭasiddhānta*, XIV, 47-52, also quoted by Bhaṭṭotpala as occurring in the *Brahma Siddhānta* in his commentary on the Bṛhat-Samhitā, IV, 7. The manuscripts which Sengupta used did not show them as occurring in the *Uttara Khaṇḍakhādyaka.* These relate to the dimensions of the *nakṣatras* as seen, as distinguished from the same as calculated.

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1. उज्जयिनी-याम्योत्तर-रेखायाः प्रागृणं धनं पश्चात् ।
देशान्तर भुक्तिवधात् ख खाष्टवेदैः कलाद्याप्तम् ॥
-KK. I. 15.

2. *-KK. Pt. B.* Misra's edition, *p. 145.*

(e) Two quotations from the *Uttara Khaṇḍakhādyaka* relating to the celestial co-ordinates of Canopus and Sirius (Sachau's Alberuni, Vol. II, p. 91). Present manuscripts do not show these stanzas, which are probably the same as stanzas 35-36 and 40 of Chapter X of the *Brāhmasphuṭasiddhānta.*

(f) Two quotations from the *Khaṇḍakhādyaka* proper as alleged by Alberuni (Sachau's Alberuni, Vol.II, p. 116). According to Āmarāja, the first is a couple of stanzas of which the author is Bhaṭṭotpala and not Brahmagupta. The second quotation cannot be traced. These relate to finding the possibility of an eclipse whether of the Sun or of the Moon.

(g) Two quotations from the *Khaṇḍakhādyaka* proper as asserted by Alberuni (Sachau's Alberuni, Vol. II, p. 119). These relate to finding the Lords of the year and of the month. According to Āmarāja the rules in question were given by Bhaṭṭotpala and not by Brahmagupta. Pṛthūdaka in his commentary on the first chapter at its concluding portion says ;

> "In this work the *Khaṇḍakhādyaka*, the teacher (Brahmagupta) has not given the rules for finding the Lords of the year and the month[1]."

1. अथाऽत्र खण्डखाद्यके वर्षाधिपमासाधिपा नयनमाचार्य्येण नाभिहितम् ।

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Reference

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Chapter IV

Brahmagupta's Originality in the Khaṇḍakhādyaka

Sengupta in his Indroduction to the Commentary of the *Khaṇḍakhādyaka* has discussed this point. We shall reproduce here some of the points mentioned by him.

Brahmagupta's Khaṇḍakhādyaka

(i) Brahmagupta does not accept the system of Āryabhaṭa but has simplified it in the *Khaṇḍakhādyaka* proper ; and here he has given the system which he thinks to be correct.

Uttar Khaṇḍa Khādyaka

(ii) In the *Uttara-Khaṇḍakhādyaka*, he has further corrected some of his results, given earlier in the *Khaṇḍakhādyaka* proper. In the proper *Khaṇḍakhādyaka*, Brahmagupta assignes to the longitude of the Sun's apogee the value 80^0, whereas in the *Uttara* text he corrects it to 77^0 (UKK. 4) :

> As the process of finding the apparent places of planets as given by Āryabhaṭa does not make them agree with observation, I shall, therefore, speak of this process. Of the Sun the apogee is at two signs and seventeen degrees (2 signs 17^0=60 plus 17 degrees=77^0).[1]

Compare this with the value given in the *Khaṇḍakhādyaka* proper (I.13)[2] :

The longitude of the Sun's apogee is 80^0 [KK.I,13] (The Sun's apogee is 80^0 or two signs plus 20 degrees) *inocco* means

1. न स्फुटमार्य्यभटोक्तं स्पष्टाकरणं यतस्ततो वक्ष्ये ।
भानुमती मन्दोच्चं राशिद्वयमंशकाश्च सप्तदश ॥ *UKK. IX 4*
2. भागाशीतिरिनोच्चं शशिनः पादोनकृत शरकृतोनाद् ।
भगणादि द्विन्त्रिरदैर्वसुनव यम नव गुणैः सकलम् ॥ *KK. I, 13*

mandocca of the Sun). The value given in the *Pañcasiddhāntikā*, IX.7-8) is also the same.

Let us compare it with the present value. According to the astronomical constants as given in the *Conn. des Temps.*, the longitude of the Sun's apogee in 499 A.D. (i.e. 1,400 years before 1900 A.D.) was

—77° 19′19.44″ according to *Conn.des Temps'* equation.

—76° 40′37.22″ according to Newcomb's equation.

The mean of these two values is very nearly 77° as given by Brahmagupta in the *Uttara* text. Thus the value given by Brahmagupta is more correct than the value given by Āryabhaṭa. The *Āryabhaṭīya* gives the value 78° which is less correct.

Brahmagupta more correct than Āryabhaṭa

(iii) Brahmagupta detected that Āryabhaṭa had made the Moon's apogee quicker and nodes slower, than they really are. In both the cases, Brahmagupta made rather an over-correction. We shall give the extract from *Uttara-Khaṇḍakhādyaka* in this connection :

> Multiply the *ahargaṇa* by 110, increase the product by 511 and divide by 30, 31; subtract the result taken as revolutions, etc., from the mean Moon; the final result is the Moon's apogee.[1]

Evidently Brahmagupta assumes that the anomalistic month=3031/110 days. This convergent to the anomalistic month was known to the author of the *Vasiṣṭha Siddhānta* as summarised in the *Pañcasiddhāntikā*[2] (II-2-6).

According to Brahmagupta, the length of the anomalistic month

$= \frac{1582236450000-4320000000}{57753300000-488105858}$ days. (*BrSpSi*. I.15,16,18, and 20)

= 27.55454641 days which is for 1900 A. D.

= 27.5545502 days according to Radau.

= 27.554602 according to the *Āryabhaṭīya*.

1. द्युगणात् ख रुद्र गुणिताद् भवशरयुक्ताच्छशित्रिखाग्नि हृतात् ।
भगणादि फलं शोध्यं मध्यमचन्द्राच्छशाङ्कोच्चम् ॥ (*UKK*. IX. 5)

Here also Brahmagupta is more accurate.

Again, the length of the sidereal period of the Moon's apogee

$$= \frac{1577918450000}{488105858} \text{ days}$$

$$= 3232.732048 \text{ days.}$$

Āryabhaṭa's value of the same is 3231.987844 days, and the modern value is 3232.3754 days. Hence Brahmagupta's result is by 0.3566 of a day out, while Āryabhaṭa's is by 0.3876 of a day in.

> Further in the *Uttara-Khaṇḍakhādyaka*(IX.10) we have : Deduct 354½ from the *ahargaṇa*, divide the remainder by 6792 ; subtract the quotient that is obtained in revolutions etc. from the circle : the result is the longitude of the ascending node.[1] (IX.10)

Here Brahmagupta gives the approximate period of the sidereal revolution of the Moon's node to be=6792 days. This according to his *Brāhmasphuṭasiddhānta* $= \frac{1577916450000}{232311168}$ days

= 6792.25396 days, which according to Lockyer would be 6793.39108 days and according to the *Khaṇḍakhādyaka* proper is 6794.75083 days. Hence Brahmagupta's attempt to correction makes the node quicker than it actually is.

Brahmagupta corrects Mars's Aphelion Point

(iv) Again Brahmagupta states that the longitude of Mars's aphelion should be increased by 17^0 and that of Jupiter by 10^0. Evidently here too, Brahmagupta is more correct than Āryabhaṭa. The passage in the *Uttara Khaṇḍakhādyaka* is as follows in this connection :

> Of Mars the apogee (the aphelion point) is to be increased by 17^0, that of Jupiter by 10° ; from the *śighra* of Venus 74′ are to be subtracted ; Saturn's equation of apsis should be decreased by its one-fifth ; the *śighra* equation of Mercury should be increased by

1. सार्द्धकृतेषु गुणोनादहर्गणाद् द्विनवमुनि-रसैर्भक्तात् ।
यन्मण्डलादि लब्धं चक्रात् संशोध्य तत् पातः ॥ —*UKK. IX 10*

one-sixteenth.[1]

This stanza says that in 499 A.D., Mars's aphelion point had a longitude of 127^0 ; of Jupiter the longitude of the aphelion was 170^0. (*KK.II.* 6[2])

According to Newcomb's rule, the longitude of the aphelion point of Mars in 499 A. D. works out to have been = 128°28'12''. According to the *Conn. des. Temps*' rule, the same was 128^{0}27'51''. Hence Brahmagupta's determination of Mars's aphelion is correct within 1^{0}30' and is therefore, quite satisfactory. According to the *Khaṇḍakhādyaka* proper it was 110^0, and according to the Āryabhaṭīya 118^0.

Of planets, beginning with Mars, the degrees of longitude of the apogees are respectively 11, 22, 16, 8 and 24, each multiplied by 10. (*KK .II. 6*)

Thus the longitudes of apogees of Mars = 110 (3 signs 20^0); of Mercury = 220^0 (7 signs 10^0) ; of Jupiter = 160^0 (5 signs 10^0); of Venus = 80^0 (2 signs 20^0) and of Saturn = 240^0 (8 signs). Compare these values with those given in the *Pañcasiddhāntikā* XVII. 2 (the *Sūrya-siddhānta)*.

Again according to this stanza Jupiter's aphelion had a longitude of 170° in 499 A.D.

According to *Conn. des. Temps*' rule the same was 170°25'. Thus here too, Brahmagupta is very accurate. According to the *Khaṇḍakhādyaka* proper, Jupiter's aphelion had a longitude of 160° (*KK*. II-6) and according to the *Āryabhaṭīya*, the value was 180°.

Brahmagupta First to Use Second Differences

All these illustrations reproduced here very well establish the point that the great Indian astronomers from Āryabhaṭa I to Brahmagupta were aware of the methods of separating the two distinct planetary inequalities, viz., that of the apsis and of conjunction in the cases of the five 'star' planets (*PSi*. Introduction Lii). In the *Khaṇḍakhādyaka*, Brahmagupta having given the "sines" and the equations of the Sun and the Moon

1. सप्तदशांशैरधिकं भौमस्योच्चं गुरोर्द्वाशभिरंशैः ।
सितशीघ्रात् कृतमुनयो लिप्ताः शोध्याः शनेः फलं मान्द्यम् ।।
पञ्चांशोनं शैघ्र्यं षोडशभागाधिकं बुधस्य फलम् ।। —*UKK*. IX. 11

2. मन्दांशा दशगुणिता रुद्रा द्वियमाश्च षोडशाष्टजिनाः । —*KK. II*. 6

at the interval of 15° of arc of the mean anomaly, in the *Uttara Khaṇḍakhādyaka* teaches, for the first time in the history of mathematics, the improved rules for interpolation by using the *second difference*. This very important feature I am reproducing here from the translation by Senagupta of the verse [1] (*UKK*. 8):

> Multiply the residual arc left after division by 900′ (i.e by 15°), by half the difference of the tabular difference passed over and that to be passed over and divide by 900′ (i. e. 15°) : by the result increase or decrease, as the case may be, half the sum of the same two tabular differences ; the result which, whether less or greater than the tabular difference to be passed, is the true tabular difference to be passed over. (*UKK*. 8)

The rule given here applies to the case of all functions hitherto considered in the *Khaṇḍakhādyaka*, which are tabulated at the difference of 15° of arc of the argument. They are :

(i) the tabular differences of the Sun's equation,

(ii) the tabular differences of the Moon's equation.

(iii) the tabular differences of the 'sines'.

Sengupta has illustrated the rule by an example belonging to the table of sines.

Illustration—To find the 'sine' of 57°.

Brahmagupta's table of sines in the *Khaṇḍakhādyaka* is as follows :

> Thirty increased severally by nine, six and one; twenty-four, fifteen and five, are the tabular differences of sines at intervals of half-a-sign. For any arc, the 'sine' is the sum of the parts passed over, increased by the proportional part of the tabular difference to be passed over.[2] (*KK*.I.30 ; also III.6)

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1. गतभोग्य खण्डकान्तरदलविकलवधात् शतैर्नवभिराप्त्या ।
तद्युतिदलं युतोनं भोग्यादूनाधिकं भोग्यम् ॥ —*UKK. IX. 8*

2. त्रिंशत् सनवरसेन्दुजिन (तिथि) विषयागृहार्द्ध चापानां ।
अर्द्धज्या खण्डानि ज्या भुक्तैक्यं सभोग्यफलम् ॥ —*KK. I. 30; also III. 6*

This can be shown in the tabular form thus :

Arc	'Sine'	Tabular difer-ence	Second difference
0°	0		
15°	39	39	
30°	75	36	—3
45°	106	31	—5
60°	130	24	—7
75°	145	15	—9
90°	150	5	—10

Now 57° = 3420 minutes=900′×3+720′. Thus three of the tabular differences are considered as passed over ; the last one being 31 and the one to be passed over is 24.

The true tabular difference by the rule, for arc 57°,

$$=\frac{31+24}{2}-\frac{720}{900}\times\frac{31-24}{2}$$

Hence the 'sine' of 57°

$$=39+36+31+\frac{720}{900}\left\{\frac{31+24}{2}-\frac{720}{900}\times\frac{31-24}{2}\right\}$$

$$=125.76$$

As worked out from the logarithm tables the same comes out to be 125.80.

Again 'sine' of 57° from Brahmagupta's formula

$$=106+\frac{720}{900}\times 24+\frac{31-24}{2}\times\frac{720}{900}-\left[\frac{720}{900}\right]\times\frac{31-24}{2}$$

$$=106+\frac{720}{900}\times 24+\frac{720}{900}\left[\frac{720}{900}-1\right]\times\frac{24-31}{2}$$

This in fact is the modern form the interpolation equation up to the term containing the second difference. Brahmagupta thus takes a decidedly improved step here and is undoubtedly the *first man in the history of mathematics* who has done this. One should also remember that in the case where the function is not tabulated at a constant interval, Brahmagupta's rule is remarkable.

Brahmagupta First to Introduce Sine Rule in Indian Plane Trigonometry

In this connection, we shall reproduce the following verse from the *Khaṇḍakhādyaka* :

> Multiply the 'sine' of the (*Śīghra*) anomaly by the 'sine' of the maximum Śīghra equation and divide by the 'sine' of the corresponding *Śīghra* equation, the result is the '*Śīghra* hypotenuse' when the (*Śīghra*) anomaly is half a circle, this śīghra hypotenuse is equal to the radius diminished by the 'sine' of the maximum equation ; when the anomaly is equal to the whole circle, the same is equal to the radius increased by the same 'sine' of the maximum equation.[1]

Let S, E and P be the positions of the Sun, the Earth and the planet, say Mars, respectively. Complete the parallelogram SEMP ; with M as centre and MP as radius, describe a circle. This circle is the epicycle of conjunction of Mars. Produce EM to cut this circle at K. The ∠PMK = ∠S'SP (the point S' is on ES produced), the angle gained by the Earth over Mars since the preceding conjunction. The ∠PMK is called the śīghra anomaly or ancmaly of conjunction. We take EM=360, and MP=234. The ∠PEM, which is equal to ∠PES, the annual parallax of Mars, is called the *śīghra* equation. The ∠MPE is equal to the ∠SEP, the elongation. The ∠PMK is given, and PM and ME are also given. Hence in the triangle MPE, we have

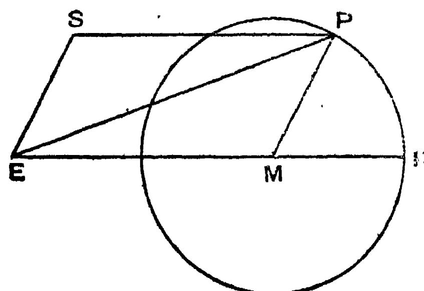


Fig. 4

$$\tan \tfrac{1}{2}(P-E) = \frac{EM-MP}{EM+MP} \tan \tfrac{1}{2} PMK$$

$$= \frac{126}{594} \tan \tfrac{1}{2} PMK$$

$$\therefore L \tan \tfrac{1}{2}(P-E) = \log \left\{\frac{126}{594}\right\} + L \tan \tfrac{1}{2} PMK$$

We have also $\tfrac{1}{2}(P+E) = \tfrac{1}{2}\angle PMK$

1. केन्द्रज्याऽन्त्यफलज्या गुणिता फलजीवया हृताकर्णः ।
त्रिज्यान्त्य फलज्योना चक्रार्द्धे संयुता चक्रे ॥ *KK. VI. 1.*

$$\text{Now } \log \left\{ \frac{126}{594} \right\} = 1.3265841.$$

The values of the ∠PMK and the ∠PEM and Brahmagupta's values as given in the verse[1] are presented below in a tabular form :

∠PMK=	28°	60°	90°	121°	135°	148°	164°	173°
∠PEM=	10°58′	23°1′	33°1′	39°56′	40°23′	37°31′	25°32′	12°35
Brahmagupta's ∠PEM=	11°	23°	33°	40°	40°30′	37°30′	25°30′	12°30′

It will be seen that Brahmagupta gives the values of the equation within 1/8th of a degree. It seems inexplicable why such discrepancies should remain in Brahmagupta's calculations. It is probable that he wanted to state his equations to the nearest half a degree.

Now we shall take up the Sīghra equations of Mars, and then revert to the Sine Rule. We have in the *Khaṇḍakhādyaka :*

Mars, by the degrees of *Śīghra* anomaly (i.e. anomaly of conjunction) of 28 getting at the corresponding equation of 11° rises (heliacally) in the east ; by the next 32° gets 12° more of the equation ; by the next 30°, 10° more ; by the next 31°,7°, more ; by next 14°, half a degree ; these are positive ; by the next 13°, negative 3° ; by the next 16° ; negative 12° after this he is retrograde ; by the next 9°, negative 13° ; by the next 7°, negative 12½°. After this the parts of the equations occur in the reverse order[1].

On the basis of this we have the following table of the *Śīghra* equations for Mars ;

Degrees of anomaly of conjunction	Equation of conjunction	Phenomena
0°	0°	Motion direct.
28°	+11°	Rises in the east.

1. भौमोऽष्टयमै रुद्रान् भुक्त्वा पूर्व्वोदितोरदैरर्कान् ।
ख॒ गैर्दशरूपगुणैः सप्तांशा मनुभिरर्द्धांशान् ॥
धनमृ मग्नि शशाङ्कै स्त्रीनष्ट्या भास्करानतो वक्री ।
नवभिर योदशानगैर्द्वादशासार्द्धान् विलोमोऽतः ॥

KK.II.8-9

Degrees of anomaly of conjunction	Equation of conjunction	Phenomena
60°	11+12=+23°	
90°	23+10=+33°	
121°	33+ 7=+40°	
135°	40+ ½=+40°30'	
148°	40°30'—3°=+37° 30'	
164°	37°30'−12°=+25°30'	Retrograde motion begins.
173°	25°30'—13°=+12°30'	
180°	12°30—12°30'=0°0'	
187°	—12°30'	
196°	—25°30'	Direct motion begins.
212°	—37°30'	
225°	—40°30'	
239°	—40°	
270°	—33°	
300°	—23°	
332°	—11°	Sets in the west.
360°	0°	

Now we come back to our discussion on the verse VI.1.

The *Śighra* hypotenuse spoken of here is EP, when SP or EM is taken to be R; when ∠PEM is a maximum, PM is its 'sine'.

It would be seen from the figure that

$$EP=\frac{R \sin PMK \times PM}{R\sin PEM}$$

This may again be written as

$$\frac{EP}{\sin PMK}=\frac{PM}{\sin PEM}$$

This is equivalent to the sine rule for a triangle in plane trigonometry. Brahmagupta is here seen to be the first person to give it in Indian mathematics, This expression reminds us of the famous relationship in respect to triangle ABC :

$$\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$$

Brahmagupta corrects
Dimensions of the Epicycle of Apsis

Brahmagupta corrects the dimensions of the epicycles of apsis of the Sun and Moon by—1/42 nd part and 1/48th parts respectively, The reference may be made to the following verse in the *Uttara Khaṇḍakhādyaka* :

> The Sun's equations are to be made less by *dvikṛtāṁśonam* (1/42nd) and the Moon's equations, increased by *vasuvedabhāgayutam* (1/48th). Multiply the Sun's equation a planet's daily motion in minutes and divide by the number of minutes of a whole circle and this is called *Bhujāntara* correction and applied in the same way to the planet as the equation is applied to the Sun.[1]

The Sun's epicycle of apsis has the dimension 14° in the *Khaṇḍakhādyaka* proper. With the correction introduced here, the value becomes $14^\circ \left\{1-\frac{1}{42}\right\} = 13^\circ\ 40'$.

The correction to the Moon's equations would make the epicycle's dimension changed from 31° to $31^\circ \left\{1+\frac{1}{48}\right\} = 31^\circ 38' 45''$.

Pṛthūdaka's commentary further corrects it to $31^\circ(1+\frac{1}{52}) = 31^\circ 35'$

Brahmagupta 's correction to Saturn's epicycle of apsis is—1/5th part and that to the *Śīghra* epicycle of Mercury 1/16th part as seen in the verse :

> Of Mars the apogee (the aphelion point) is to be increased by 17°, that of Jupiter by 10° ; from the *Śīghra* of Venus 74' are to be subtracted ; Saturn's equation of apsis should be decreased by its one-fifth and the *Śīghra* equation of Mercury should be increased by one-sixteenth.[2]

In the *Khaṇḍakhādyaka* proper (II.6), we have been given the longitudes of the apogee of planets : Mars 11°, Mercury 22°, Jupiter 160°, Venus 80° and Saturn 240°. Now with these corrections introduced in the *Uttara Khaṇḍakhādyaka* in the above

1. द्विकृतांशोनं रविफलमिन्दोर्वसुवेदभागयुतम् ।
अर्कफलभुक्तिघाताद् भगणकलाप्तं भुजान्तरं रविवत् ॥ *UKK. IX. 9*
2. सप्तदशांशैरधिकं भौमस्योच्चं गुरोर्दशभिरंशैः ।
सितशीघ्रात् कृतमुनयो लिप्ताः शोध्याः शनेः फलं मान्द्यम् ।
पञ्चांशोनं शैघ्र्यं षोडशभागाधिकं बुधस्य फलम् ॥ *UKK.IX.11*

verse, the aphelion point of Mars in 499 A.D. had a longitude of 110 plus 17=127°; of Jupiter 160 plus 10=170°.

According to Newcomb's rule, the longitude of the aphelion point of Mars in 499 A.D. works out to have been 128°28′12″. The same according to *Conn. des Temps* rule would be 128°27′51″. Hence Brahmgupta's determination of Mars's aphelion is correct within 1°30′, and may be, therefore, regarded as very satisfactory. According to the *Khaṇḍakhādyaka* proper this value was, as already said, 110°, while according to the *Āryabhaṭīya*, it was 118°.

The same may be said regarding Jupiter's aphelion. According to the *Khaṇḍakhādyaka* proper the value of its longitude is 160°, according to the *Āryabhaṭīya* it was 180°; according to *Conn. des. Temps'* rule, it would be in 499A. D, 170°25′, and the value given by Brahmagupta in the *Uttara Khaṇḍakhādyaka*, it is 170°.

We have thus shown by many illustrations the important corrections introduced by Brahmagupta in his *Khaṇḍakhādyaka* specially the *Uttara* part. Brahmagupta was highly original in his methods of calculations, accuracies and interpolations. He introduced new ideas in mathematics. He went much ahead Āryabhaṭa in many details. He so many times did not follow Āryabhaṭa in calculations. In the *Khaṇḍakhādyaka* proper, his treatment of parallax in the calculation of solar eclipses is different from that of Āryabhaṭa. The methods followed here are the same as propounded by him in the *Brāhmasphuṭasiddhānta*.[1]

Senagupta is right when he says : As has already been remarked, these corrections and innovations in the *Uttara Khaṇḍakhādyaka* paved the way for the acceptance of his great work the *Brāhmasphuṭasiddhānta* as a standard work on astronomy by the western Indian school of astronomers. The directness of the treatment of topics, and the simplicity of calculations taught in the *Khaṇḍakhādyaka* made it very neat handbook for the beginner. These two works of Brahmagupta were perhaps the only astronomical works in circulations in western India when the Arabs conquered Sind early in the eighth century

1. *On Parallax*—

नाडी चतुष्कविधिना सर्वत्र समो यतस्ततः स्थूलः ।
मानार्थं कर्म महत् कृतमार्यभटेन लघुनि सति ॥ *BrSpSi*. XI. 33

(712 A.D.) and the new conquerers learnt Indian astronomy and mathematics from these works as has been observed by Sachau. Alberuni who came to India early in the 11th centuty of the Christian era, learnt Indian astronomy chiefly by studying the *Khaṇḍakhādyaka* and the *Bṛhat-Saṁhitā* of Varāhamihira, and both of them with the help of commentary of Bhaṭṭotpala.

—:c:—

Reference

P.C. Sengupta : *The Khaṇḍakhādyaka, 1934.*

CHAPTER VI

Indian Luni–Solar Astronomy

In this chapter, it is proposed to give an account of astronomical constants and the equations in Indian luni-solar astronomy and to present a comparative view of these quantities with the corresponding ones in Greek and modern Astronomy. This account has been reproduced from P. C. Sengupta's. Appendix I of the *Khaṇḍakhādyaka* It has been shown that in many cases the Indian values of these constants are more accurate than the Greek values. and in Indian lunar astronomy the equations or inequalities discovered are the most startling.

Solar Astronomy

In solar astronomy the length of the year was determined by Āryabhaṭa[1] from the heliacal risings of some bright star at the intervals of 365 and 366 days.

(1) The year according to the Āryabhaṭīya

$$= \frac{1577917500}{4320000} \text{ days} = 365.2586805 \text{ days},$$

=365 da. 6 hrs. 12 mins. 29.64 secs.

(2) The same

$$= \frac{1577917800}{4320000} \text{ days} = 365.25875 \text{ days}.$$

=365 da. 6 hrs. 12 mins. 36 secs., according to the *Khaṇḍakhādyaka*, the *Sūryasiddhānta* of Varāha and the modern *Sūryasiddhānta*.

(3) It is

$$= \frac{1577916450}{4320000} \text{ days} = 365.2584375 \text{ days},$$

=365 da. 6 hrs. 12 mins. 9 secs., according to the

1, P. C. Sengupta, "Āryabhata's Method of determining the Mean Motions of Planets," *Bulletin of the Calcutta Mathematical Society*. Vol. XII, No. 3.

Brāhmasphuṭa Siddhānta of Brahmagupta.

Now the mean sidereal year

=365 da. 6 hrs. 9 mins. 9.3 secs. (Lockyer).

The mean anomalistic year

=365 da. 6 hrs. 13 mins. 49.3 secs. (Lockyer).

The mean tropical year

=365 da. 5 hrs. 48 mins. 46.054 secs. (Lockyer).

Though we take that Indian year was designed to be the sidereal year, it approached most closely the anomalistic year; and its excess over the sidereal year was about 3 minutes. From this consideration it appears that the Indian astronomers were justified in taking the Sun's apogee to be fixed.

Against the error of+3 min. in the Indian sidereal year, we may point out that—

(1) The Hipparchus-Ptolemy tropical year

=365 da. 14' 48" in sexagesimal units.[1]

=365 da. 5 hrs. 55 min. 12 secs., which has an error of about+6 min.

(2) Meton's sidereal year

$$= \left[365+\tfrac{1}{4}+\frac{1}{76}\right] \text{ days}^{2}$$

=365 da. 6 hrs. 18 min. 57 secs. which has an error of +9 min. 48 secs. nearly.

(3) The Babylonian sidereal-year was 4½ min. too long.[3]

Thus the Indian value of it is closer to the true value.

Again in 150 A.D. the longitude of the Sun's apogee according to the *Conn. des Temps* was

$$=101^\circ\,13'\,15''.17 - 6189''.03 \left[\frac{1900-150}{100}\right]$$

$$=1''.63 \times \left[\frac{1900-150}{100}\right]^{2}$$

=71° 16′ 26″. 37

while Ptolemy states it to be 65° 30′ which was wrong by—5° 36′ 27″:

1. *Syntaxis*, Karl Manitius's edition, Vol. I. p. 146.
2. Ibid, p. 145.
3. *Encyclopaedia Britannica*, History of Astronomy.
4. *Syntaxis*, Vol. I. p. 148. The Romaka Siddhānta of the *Pañca-siddhāntikā*, VIII. 2, indicates the Sun's apogee to be at longitude of 75°; this was perhaps a correction made by Lāṭadeva to the Greek constant.

In 500 A. D (Āryabhaṭa's time) the longitude of the Sun's apogee by the same rule works out to be=77°19′19.44″.

Āryabhaṭa states this to be 78° in the Āryabhaṭīya, Brahmagupta in the Uttarādhyāya of the *Khaṇḍakhādyaka* states the same to be 77°, while the Khaṇḍakhādyaka gives it as=80°. Hence the Indian findings of the longitude of the Sun's apogee were more accurate.

Again as to the Sun's equations of the centre we find that the *Āryabhaṭīya* states the periphery of the Sun's epicycle to be 13°30′, The *Khaṇḍakhādyaka* gives it as 14° ; while according to the Indian form, Ptolemy's value of the same is 15°. Hence according to these writers, the Sun's equations at 90° of the mean anomaly are :—

According to the *Āryabhaṭīya* =2° 8′ 54″.
" " *Khaṇḍakhādyaka*=2° 1′ 40″.
" " Brahmagupta=2° 7′ 20″.
" " Ptolemy=2° 23′ 3″.
The modern value =1° 55′ 97″.

Thus the Indian equations of the Sun are in general by more correct than the Greek ones. The Indian constants in solar astronomy are thus, generally, more accurate than the Greek ones. We now turn to the Indian Lunar astronomy.

Lunar Astronomy

Before discussing the constants in Indian lunar astronomy it is necessary to state something as to the time when the Moon was observed by our ancient astronomers and the astronomers from Āryabhaṭa I (499 A.D. to Pṛthūdaka Svāmī (864 A.D.). The months were reckoned from the first visibility of the crescent at the time of the *Mahābhārata* (1400 B. C.). We have a passage in the Bhīṣmaparva where Vyāsa speaks of the evil omens on the eve of the Kurukṣetra war thus—

चन्द्रसूर्य्यावुभौ ग्रस्तावेकामासीं त्रयोदशीम् ।

"That the Moon and the Sun have been both eclipsed on the 13th days of the light and dark halves of the same month."

The eclipses could not take place on the 13th days of the month unless the months were reckoned from the first visibility of the crescent. This was the custom in Babylonia and it has still survived in the Mahomedan world. Even in the *Pañca siddhāntikā* of Varāhamihira (540 A. D.), there is a special

chapter on शशि-दर्शनम् or the first visibility of the crescent. It is thus clear that the practice was to observe the Moon when very near the Sun.

Again Āryabhaṭa says that 'रवीन्दुयोगात् प्रसाधितश्चेन्दुः', "the Moon was determined from her conjunctions with the Sun." The Moon was observed by him at the time of solar eclipses, or at the time of the first visibility of the crescent.

Even up to the time of Pṛthūdaka, the accuracy in lunar astronomy was chiefly aimed at the time of eclipses. Thus in his commentary on the *Khaṇḍakhādyaka* IV, he makes the following introductory remarks :—

"All knowledge relating to (luni-solar) astronomy is desired by the wise (or cultured) specially for knowing the right instants of opposition or conjunction ; these instants are, however, not visible to the eye. Of other things such as *tithis*, *nakṣatras* and *Karaṇas*, as the planets, the Sun and the Moon, are not clearly observed, their beginnings and ends are not visible. Men see the agreement between calculation and observation at the times of solar and lunar eclipses. Hence the word of the astronomers is esteemed amongst men even in respect to such things as *tithis*, etc."[1]

Thus the chief aim of the ancient Indian astronomers was to calculate the eclipses accurately and the Moon was observed chiefly at lunar or solar eclipses, though the time for observation related also to the finding of the first visibility of the crescent. This latter phenomena did not perhaps lead them to directly observing the Moon's position at such times by using instruments.

Moon's Mean Motion

The practice of observing the Moon at the time of the eclipses alone led to the determination of the synodic month with the following results :—

(i) Mean synodic month according to the *Āryabhaṭīya*

$$= \frac{1577917500}{57753336-4320000} \text{ days},$$

$$= 29.530582 \text{ days}.$$

---

1. बाहुल्येन पर्व्वज्ञानार्थं सकलं ज्ञानमिष्यते शिष्टैः । तेषां च पर्व्वाणां दर्शनं नास्ति । अन्येषामपि तिथिनक्षत्रकरणानां तस्मात् तेषां शशिभास्करयोरव्यक्तित्वस्मात् । शशिभास्कर-ग्रहणयोर्दृग् गणितैक्यं लोकः पश्यति । तस्मात् तिथ्यादिष्वप्यर्थेषु दैवज्ञ वाक्यं लोके आद्रियते ।

(ii) The same according to the *Khaṇḍakhādyakā*
=29.5305874 days.

(iii) The same according to the *Brāhma-sphuṭa-siddhānta*
=29.530582 days.

(iv) The same according to Ptolemy=29 da. 31′ 50″ 8″ 20″
in sexagesimal units=29.5305927 days

The modern value according to Newcomb and Radau
=29.5305881 days.

Hence the *Khaṇḍakhādyaka* mean length appears to be the closest approximation.

The mean sidereal month must have been deduced from the mean synodic month and the year adopted. Hence no comparison need be made of this element here.

We will now consider the sidereal periods, the nodes and the apogee of the Moon. These are shown below :-

According to	Sid. Per. of Moon's Apogee	Sid. per. of the Ascending Node
Āryabhaṭīya	3231.987079 da.	6794.749511 da.
Khaṇḍakhādyaka	3231.987844 da.	6794.750834 da.
Brāhma-sphuṭa - Siddhānta	3232.73411 da.	6792.25396 da.
Ptolemy	3232.617656 da.	6796.45571 da.
Modern values (Lockyer)	3232.37543 da.	6793.39108 da.

Here also the Indian values show a closer approximation to the true values, Brahmagupta's figures representing the nearest approach.

Other Constants

So far the Indian values of the constants have been more accurate than the Greek ones ; but as to the inclination of the Moon's orbit the Greek value is more accurate than the Indian value.

Inclination of the lunar orbit
Indian value=4°30'.

Greek value=5°0'.

Modern mean value=5°8'43''.427 (Brown)

This discrepancy confirms the conclusion, that the observation of the Moon was restricted to the time when she was near a node, either at solar or lunar eclipses, where a small error of observation magnified itself into about half a degree.

We now turn to the parallaxes of the Sun and the Moon :-

	Sūn's Mean Hor. Parallax	*Moon's mean Hor. Parallax*
Āryabhaṭīya	3'55".62	52'30"
Kaṇḍakhādyaka	3'56"5.	52'42".3
Ptolemy	2'51"	53'34"
Modern values	0'8".806	57'2".79

As to the Sun's horizontal parallax, the ancients were of course totally wrong, but in respect to that of the Moon their values were fairly approximate.

We next consider the angular semi-diameters of the Sun and the Moon. These are :-

	Moon's Mean Semi-diameter	*Sun's Mean Semidiameter*
Āryabhaṭīya	15'45"	16'29".4
Khaṇḍakhādyaka (Brāhma-sphuṭa-siddhānta)	16'0".22	16'15"
Ptolemy	17'40"	15'40"
Modern values	15'33".60	16'1".8

Here also the Indian values are more accurate than the Greek values.

Moon's Equations. The First Equation.

It remains now to consider the Moon's equations in ancient Indian astronomy. As has been pointed out before, obser-

vation was up to the time of Brahmagupta, restricted to the time of eclipses perhaps also of syzygies.

The modern form of the Moon's equations is

$$=377' \sin (nt-\alpha)+13' \sin 2(nt-\alpha)+\ldots\ldots$$

$$+76' \sin [2(nt-\theta)-(nt-\alpha)]+40' \sin 2(nt-\theta)\ldots\ldots$$ [1]

where nt=mean longitude of the Moon, α the longitude of the perigee, θ=longitude of the Sun.

Here the first two terms, viz., $377' \sin (nt-\alpha) + 13' \sin 2(nt-\alpha)$, are due to elliptic motion about the Earth in one focus; the term $76' \sin [2(nt-\theta)-(nt-\alpha)]$ is known as the evection. We combine a part of the first term with the evection term and the expression for the equation of centre becomes $=301' \sin (nt-\alpha)+13' \sin 2(nt-\alpha)+\ldots\ldots+152 \sin (nt-\theta) \cos (\theta-\alpha)+40' \sin 2(nt-\theta)$.

Now at syzygies and eclipses $\sin (nt-\theta)$ and $\sin 2(nt-\theta)$ will very nearly vanish. Hence according to modern astronomy at the syzygies and eclipses, the chief term of the Moon's equation$=301' \sin(nt-\alpha)$.

This according to the *Āryabhaṭīya*

$=300' 15'' \sin (nt-\alpha)$

" " *Khaṇḍakhādyaka*

$=296' \sin (nt-\alpha)$

" " *Uttara Khaṇḍakhādyaka*

$=301'.7 \sin (nt-\alpha)$

" " *Brāhmasphuṭasiddhānta*

$=293' 31'' \sin (nt-\alpha)$

" " Greek astronomy

$=300' 15'' \sin (nt-\alpha)$

very nearly.

Hence both the Greek and the ancient Indian astronomers were very near the true value of the Moon's equation at the syzygies and eclipses. Godfray in his *Lunar Theory*, page 107, observes, "the hypothesis of an excentric, whose apse has a progressive motion as conceived by Hipparchus served to calculate with considerable accuracy the circumstances of eclipses; and observations of eclipses, requiring no instruments, were then the only ones which could be made with sufficient exactness to test

1. The accurate values of the coefficients appear to be 377′ 19″.06, 12′ 57″.11, 76′ 26″ and 39′ 30″.

the truth or fallacy of the supposition.'' We next consider the second inequality of the Moon.

Moon's Second Inequality or Equation

In ancient times it was Prolemy who first really found a second inequality of the Moon. According to Godfray (*Lunar Theory*, p. 107) "by dint of careful comparison of observations he (Ptolemy) found that the value of this second inequality in quadrature was always proportional to that of the first in the same place, and was additive or subtractive according as the first was so; and thus, when the first inequality was at its maximum or 5°1', the second increased it to 7° 40' which was the case when the apse line happened to be in syzygy at the same time.''

It is well known that though Ptolemy discovered the second inequality in the Moon's motion he was not able to ascertain its true nature. His corrections in this case are true when at the quadrature the Moon's apse line passes through the Sun or it is at right angles to the line joining the Earth and the Sun.[1] In the general case his construction does not lead to the clegant form of the evection term as we know it now, nor does it lead to the nice form in which it was given by later Indian astronomers from the time of Mañjula (or Muñjāla, 854 Śaka era = 932 A.D.).

As has already been pointed out, the early Indian astronomers from Āryabhaṭa to Brahmagupta aimed at accuracy in lunar calculation only for the eclipses and syzygies, and did not interest themselves about the Moon's longitude at the quadratures. Hence this second inequality is absent in the works of these makers of Indian astronomy, as also in the Pre-Ptolemaic Greek astronomy. This points to the conclusion that in both the earlier Indian and Greek systems of astronomy. the modes of observation of the Moon were copied from an earlier system of astronomy whether Babylonian or Chaldean. Even in the *Romaka Siddhānta* of the *Pañcasiddhāntikā*, there is no mention of evection.[2] Thus inspite of the transmission of a vague system of Greek astronomy, Indian astronomy as developed by Āryabhaṭa and Brahmagupta must be regarded as independent and

1. Godfray's *Lunar Theory*. pp. 108-110.

2. Vide the Summary in P.C. Sengupta's paper, "Āryabhaṭa the Father of Indian Epicyclic Astronomy." *Journal of the Department* of *letters*, vol. XVIII, Calcutta University Press.

original not only from this but also from other considerations. It sought to correct the constants as were obtained from the Babylonian and the Greek systems as has in some cases been shown already.

Mañjula's Second Equation of the Moon (932 A.D.)

We now take up in detail Mañjula's second equation of Moon. It is, however, necessary to say something about his first inequality.

This is given in the form

$$\frac{-488 \sin (nt-\alpha')}{96+\frac{488}{120} \cos (nt-\alpha')} \text{ degrees,}$$

where nt stands for the Moon's mean longitude, α''—that of the apogee.

Hence when $nt-\alpha'=90°$, the equation $= \frac{488°}{96} = 5°4' = 304'$ showing an excess of 4′ over the modern value.

It is further necessary to modify the expression for the Moon's modern form of the equation by changing α to $180°+\alpha$, as in ancient Indian astronomy anomaly is measured not from the perigee but from the apogee.

The modified form is

$$= -301' \sin (nt-\alpha) + 13 \sin 2(nt-\alpha)\ldots\ldots$$

$$-152' \sin (nt-\theta) \cos (\theta-\alpha) + 40' \sin 2(nt-\theta) + \ldots$$

Mañjula's lines giving the second equation are—

> The (mean) daily motion of the Moon diminished by 11° and multiplied by the "cosine" of the longitude of the Sun diminished by that of the Moon's apogee is the multiplier of the "sine" and the "cosine" of the longitude of the Moon diminished by that of the Sun, divided severally by 1 and 5. The results taken as minutes are to be applied negatively and positively to the Moon and to her daily motion if the quantities multiplied together are of opposite signs and in the reverse order if they are of the same sign.[1]

---

1. इन्दूच्चोनार्ककोटिघ्ना गत्यंशा विभवा विधोः ।
गुणो व्यर्केन्दुदोः कोट्योरूप पंचाप्तयोः क्रमात् ।।
फले शशाङ्क--तद्गत्योर्लिप्ताद्ये स्वर्णयोर्वधे ।
ऋणं चन्द्रे धनं भुक्तौ स्वर्णं साम्य वधेऽन्यथा ।। —11, 12

As to the positive or negative character of the "sine" and the "cosine" he gives the rule:—

> The mean planet diminished by its *ucca*, the apogee, aphelion or the Śīghra, is called *Kendra* or mean anomaly; its "sine" from above six signs (180°) arises from half circles and are respectively positive or negative, and its "cosine" in different quadrants are respectively positive, negative, negative, and positive.[1]

The convention followed is that the "sine" is negative from 0° to 180° and positive from 180° to 360° of the arc and that the cosine is positive betwen 0° and 90°, negative between 90° and 270° and positive between 270° and 360°.

We may now symbolically express Mañjula's second inequality thus :-

$-(13° 11' 35''-11°)\times 8^{P} 8' \cos(\theta-\alpha)\times 8^{P} 8' \sin(D-\theta)$ where D stands for the Moon as corrected by the 1st equation; we leave out the correction to the Moon's daily motion as given in the stanzas quoted above.

The moon's new equation comes out to be

$$=-143'58'' \cos(\theta-\alpha)\sin(D-\theta).$$

This, it will be seen, is exactly the modern form of the evection as combined with a part of the equation of apsis shown before. The difference in the main is that Mañjula's constant is 144', a quantity less by 8'. *In form the equation is most perfect, it is far superior to Ptolemy's, it is above all praise.* It is from this inequality, we trust, that Mañjula should have an abiding place in the history of astronomy. The next writer who gives the second equation is Śripati (1028 A.D.).

Śripati's Second Inequality of the Moon

The following stanzas from Śripati's *Siddhānta Śekhara,* it is said, were communicated to Sengupta by Pandit Babua Misra. Though they are probably not very correct still the general meaning is clear. They carry the following sense :

> "From the Moon's apogee subtract 90°, diminish the Sun by the remainder left; take the "sine" of the

1. ग्रहः स्वोच्चोनितः केन्द्रं षड्र्ध्वादर्द्धजो भुजः ।
धनर्णः पदशः कोटिर्धनर्णं धनात्मिका ॥

result; multiply it by 160′ and divide by the radius; the result is called *caraphala*. Put it down in another place, multiply it by *śara*(i.e., R vers $(D-\alpha)$ or versed sine of the Moon's distance from the apogee) and divide by the difference between the Moon's distance (hypotenuse) and the radius; the result is called *parama (cara) phala*, which is to be considered positive or negative according as the hypotenuse put down in another place is less or greater than the radius. Multiply the "sine" of the Moon which has been diminished by the apparent Sun, by the apparent *paramaphala* and divide by the radius; the final result is to be called *caraphala* to be applied to Moon negatively or positively as the Moon minus the Sun and the Sun minus the Moon's apogee (diminished by 90°) be of opposite signs; if these latter quantities be of the same signs, the new equation should be applied in the inverse order by those who want to make the calculation of the apparent Moon agree with observation.[1]

Symbolically :—

$$\frac{160' R \sin[\theta-(\alpha-90^\circ)]}{R} = caraphala$$

$$\mp \frac{160' R \sin[\theta-(\alpha-90^\circ)]}{R} \times \frac{R \text{ vers } (D-\alpha)}{H-R}$$

$= paramaphala$, according as H > or < R

The new equation

$$= \mp \frac{R \sin (D-\theta)}{R} \times paramaphala$$

1. त्रिभविरहितचन्द्रोच्चो नभास्त्रद् भुजज्या ।
गगननृपविनिघ्नी भत्रयज्या विभक्ता ।।
भवति चरफलाख्यं तत् पृथक् स्थं शरघ्नं ।
हृतमुडपतिकर्णत्रिज्ययोरन्तरेण ।।
परमफलमवाप्तंतद्धनर्णं पृथक्स्थे ।
तुहिनकिरणकर्णे त्रिज्यकोनाधिकेऽथ ।
स्फुटदिनकरहीनादिन्दुतो या भुजज्या ।
स्फुटपरमफलघ्नी भाजिता त्रिज्ययाप्तम् ।।
शशिनि चरफलाख्यं सूर्यहीनेन्दुगोलात् ।
तदृणमुतधनं चेन्दूच्चहीनार्कगोलम् ।।
यदि भवति हि साम्यं व्यस्तमेतद् विधेयम् ।
स्फुटगणितदृगैक्यं कर्त्तुमिच्छद्भिरत्र ।।

$$= \mp \frac{160' \, R \sin[\theta - (\alpha - 90^\circ)] \; R \text{ vers}(D-\alpha) \times R \sin(D-\theta)}{R\,(H-R) \times R}$$

$$= \mp \frac{160' \, R \cos(\theta-\alpha) \times R \sin(D-\theta)}{R \times R} \times \frac{R \text{ vers}(D-\alpha)}{H-R}$$[1]

This equation is a slightly modified one but practically the same in form as that of Mañjula, except that the constant here is 160′, greater than his by 16′. The constant is 160′ also in Candraśekhara's form as we shall see later on. We next consider the Moon's inequalities as given by Bhāskara II in his *Bijopanaya*,* a special work on these inequalities composed in the Saka year 1074 (=1152A.D.) two years after he had composed the *Siddhānta Śiromaṇi*.

Bhāskara II on Moon's Inequalities

His preliminary statement runs thus .—

> 112′ positive or negative representing the maximum difference. have been found by me in the daily observed Moon (as calculated and as observed) at that point of the ecliptic where the arc from the *kadamba* (i.e., its pole) passing through the zenith cuts it.[1]

Thus for observing the Moon he selected the nonagesimal as the suitable point where the uncertainty about her parallax is zero, and found ∓112′ of arc to be the maximum difference between her calculated and observed places.

Mallabhaṭṭa, perhaps a contemporary of Bhāskara II, ascribed this difference to a supposed *Śighrocca* of the Moon. Bhāskara in stanzas 9-13, refutes the existence of the Śighra in the case of the Moon, the substance of his argument begins (i) that it is against the teaching of the *Sūrya-siddhānta* and other accepted authorities, (ii) that there is no variation of the apparent angular diameter of the Moon corresponding to this alleged *Śighra*, and (iii) that planets having a *Śighra* have retrograde motion which is never the case with the Moon.

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*There is some uncertainty, about this new fraction introduced by Śripati.

1. लिप्ता विधोरर्कं मह्रीमिता मे दृग्गोचराः प्रत्यहमीक्षितस्य ।
कदम्ब गोलगत-सूत्रपाते क्रान्तौ धनर्णत्वजुषो भमध्यात् ॥

—*Bijopanaya*, stanza 8

The reasons for his new equations are stated as follows:—

> When the Moon is situated at a quadrant ahead of the apogee and with the Sun at half a quadrant ahead of her, the maximum discrepancy (of 112′) is seen in the negative character.
>
> When the Moon is situated at three quadrants ahead of the apogee and with the Sun at half a quadrant behind her, the maximum discrepancy (of 112′) is seen in the positive character.
>
> When the eclipses of the Sun and the Moon take place at the apogee or the perigee of the Moon, the Moon as corrected by the equation of apsis is seen to be without any new correction called *bīja.*
>
> When the eclipses of the Sun and the Moon take place at the ends of the odd quadrants of the Moon's anomaly (measured from the apogee), the discrepancy is seen to be less by 34′.
>
> When the Moon is at the apogee, whether the Sun be ahead or behind her by half a quadrant, the discrepancy amounts to be 34′.
>
> The same discrepancy of 34′ is observed when the Moon is at the perigee and the Sun is ahead or behind her by the same distance.
>
> Thus by analysis and synthesis, and by repeated observations, this variable correction has been devised by me; let it be seriously considered by the learned.[1]

Bhāskara here speaks of six cases and we consider them one after another :—

The Moon's equations as modified to suit *siddhāntas* are given by

$$-301' \sin(nt-\alpha)+13' \sin 2(nt-\alpha)\ldots\ldots$$

$$-152' \sin(nt-\theta) \cos(\theta-\alpha)-40' \sin 2(nt-\theta)+\ldots\ldots$$

According to Bhāskara's *Siddhānta - śiromaṇi.* the Moon's equation of apsis

$$=-\frac{31^\circ\ 36'}{360^\circ}\times 3438' \sin(nt-\alpha)$$

$$=-301'\ 46''.8 \sin(nt-\alpha),$$

this agrees well with the corresponding term of the modern equation. As Bhaskara takes in all the six cases, $nt-\alpha=90°$, $270°$, $0°$ or $180°$, the second term of the equation of apsis vanishes.

Case I.

$$nt-\alpha=90°,\ nt-\theta=-45°,\ \theta-\alpha=135°;$$

Here the total equation of the Moon

$$=-301'-(76'+40')=-301'-116'.$$

This fairly agrees with Bhāskara's observation, the difference being only of 4'.

Case II.

$$nt-\alpha=270°,\ nt-\theta=45°,\ \theta-\alpha=225°;$$

the total equation of the Moon

$$=301'+76'+40'=301'+116'.$$

This also agrees with Bhāskara's observation.

Case III.

$nt-\alpha=0°$ or $180°$, $nt-\theta=0°$ or $180°$, $\theta-\sigma=0°$ or $180°$, the total equation$=0'$, this also agrees with Bhāskara's observation.

Case IV,

$nt-\alpha=90°$ or $270°$, $nt-\theta=0°$ or $180°$, $\theta-\alpha=90°$ or $270°$,

---

1. तुङ्गादाद्यपदान्तस्थाद् विधोरर्के पदार्द्धतः ।
परमं चन्द्रवैषम्यं ऋणत्वेन समीक्ष्यते ॥ 20 ॥
तत् तृतीय पदान्तस्थात् पृष्ठगेऽर्के पदार्द्धतः ।
परमं चन्द्रवैषम्यं धनत्वेन समीक्ष्यते ॥ 21 ॥
चन्द्रतुङ्गे च नीचे च शशाङ्कार्कग्रहौ यदि ।
मन्दस्फुटगतश्चन्द्रो निर्वीजतुल्यमीक्ष्यते ॥ 22 ॥
ओजान्त्ययोर्विधोस्तुङ्गाच्छशाङ्कार्क ग्रहौ यदि ।
चतुस्त्रिंशत्-कलाहीनं वैषम्यं तु समीक्ष्यते ॥ 23 ॥
अग्रतः पृष्ठतो वाऽपि रवेश्चन्द्रे पदार्द्धगे ।
तुङ्गतुल्ये चतुस्त्रिंशत् कलावैषम्यमीक्ष्यते ॥ 24 ॥
एवं तन्नीचतुल्येऽपि वैषम्यं तावदेव हि ।
एवं व्यासात् समासाच्च पौनःपुन्येन वेधनात् ॥
चरवीजमिदं क्लृप्तं मया सद्भिः समीक्ष्यताम् ॥ 25 ॥

the total equation$=\mp 301'$. This does not agree with Bhāskara's statement that the total equation

$$=\mp(301'\pm 78').$$

Case V.

$$nt-\alpha=0,\ nt-\theta=\pm 45°,\ \theta-\alpha=\pm 45°,$$

the total equation

$$=0'-76'+40'=-36' \text{ or } 0'+76'-40'=+36'.$$

This fairly agrees with Bhāskara's observation.

Case VI.

$$nt-\alpha=180°,\ nt-\theta=\pm 45°,\ \theta-\alpha=180°\mp 45°$$

the total equation

$$=0'+76'+40'=0'+116', \text{ or } 0-76+40'=0'-36'.$$

This does not agree with Bhāskara's statement.

Bhāskara then states his first system of 24 equations corresponding to 24 sines in a quadrant to be 6', 13', 21', 27', 33', 39',45', 51', 56', 61', 65', 68', 70', 72', 74', 75', 75', 76', 76' 77', 77', 78', 78', 78'.[1]

These equations, he says—"are negatively added to the equation of apsis when that is negative and positively added to the same when that is positive"[2]. In other words his new equations are complements of the equation of apsis, the two together being represented by

$$-301'\ 46''.8 \sin(nt-\alpha)-78' \sin(nt-\alpha)$$

i.e., by $-379'\ 46''.8 \sin(nt-\alpha)$.

Hence next states his second set of equations depending on $\theta-D$, to be 6', 9', 13', 17', 22', 24', 27', 30', 32', 33', 34', 34', 34', 33', 31', 29', 26', 24', 20', 16', 11', 8', 3', 0'[3] and says :

"These minutes are negative in the odd quadrants of the argument and are positive in other quadrants.[4]"

When the value of the argument is 15°, the equation is 17',

,,	,,	,,	45°	,,	34',
,,	,,	,,	90°	,,	0',

1. *Bījopanaya*, 26-28.

2. ...फलं ऋणे ऋणं ।
धने धनं मन्दफलेन संयुतम् ॥ 28 ॥

3. *Bījopanaya*, 29-32.

4. एताः कला ओजपदे ऋणं स्युर्धनं तदन्यत्र भवन्ति भूयः ।

Hence the new equation $= -34' \sin 2 (\theta - D)$,
$= 34' \sin 2 (D - \theta)$.

Here the symbol D stands for the Moon as corrected by the ancient Indian equation of apsis and its complement as given by Bhāskara. It is readily seen that Bhāskara is the first of all the Indian astronomers to detect the equation known as "Variation" His constant, 34', is less than the modern value by about 6', and cannot be considered as a serious error.

We now see that the sum-total of the Moon's equation as given dy Bhāskara

$$= -379' \, 46''.8 \sin (nt - \alpha) + 34' \sin 2(D - \theta),$$

the evection term being totally absent. This is a serious defect, and Bhāskara's new equations would make the Moon generally more incorrect at the syzygies and eclipses than what the ancient Indian equation of apsis would do.

Perhaps late in life when he was 69 years old in 1105 of Śaka era (=1183 A.D.) he discovered the inapplicability of his new equations at the times of eclipses and in his *Karaṇa-kutū-hala* he altogether omitted these new equations which he had given in his *Bījopanaya*.

As to Bhāskara's second inequality which is really the complement of the equation of apsis without the evection term, it is far inferior to that of Mañjula and of Śrīpati; as we have seen their form of the second inequality combines the complement of the equation of apsis and evection in the mathematically correct form. For the discovery of such a form of the equation as of these authors, very patient, careful and frequent observation must have been coupled with very careful and nice comparison of observed facts.

As to "variation" it was first discovered by Abul-Wefa in 976 A.D.[1] which was quite forgotten when Tycho-Brahe re-discovered it in 1580 A.D. Hence Bhāskara, in 1152 A.D., re-discovered it in India four centuries before Tycho.

Candraśekhara of Orissa on the Moon's Inequalities

In connection with lunar inequalities it is nesefsary here to record what were the equations discovered or verified by M.M. Candraśekhara Siṁha of Orissā in the later half of the last century. He was educated in the orthodox Sanskrit fashion

1. Godfray's *Lunar Theory*, p. 114.

and had no acquaintance with English education. His work *Siddhānta-darpaṇa* was edited by Prof. Jogeschandra Ray, late of the Cuttack College, in 1899.[1] Candraśekhara in his work gives four equations of the Moon which are :-

(1) The equation of apsis.

(2) The Tungāntra equation or the complement of the equation of apsis in combination with evection.

(3) The fortnightly equation or variation.

(4) The Digaṁśa equation or the annual equation (i. e., $\frac{1}{10}$ of the Sun's equation).

(5) The first equation is of the form

$$= \frac{[31° \ 30' - 30' \cos(nt-\alpha)] 3438 \times \sin(nt-\alpha)}{360°}$$

$$= -300' \ 49''.5 \sin(nt-\alpha) + 4' \ 46''.5 \sin(nt-\alpha) \cos(nt-\alpha)$$

$$= -300' \ 49''.5 (\sin nt-\alpha) + 2' \ 23''.25 \sin 2(nt-\alpha)$$

It is seen that Candraśekhara wanted to correct the equation of apsis to the second order of small quantities as in all the Indian authors from Brahmagupta but Candraśekhara's form is correct though his contant is wrong.

(2) His second equation is of the form

$$\frac{160' \times 3438 \sin[\alpha-(\theta+90°)]}{3438} \times \frac{3438 \sin(D-\theta)}{3438}$$

$$\times \frac{\text{Moon's appt. daily motion}^2}{\text{Moon's mean motion}},$$

$$= -160' \cos(\theta-\alpha) \sin(D-\theta)$$

$$\times \frac{\text{Moon's appt. daily motion}}{\text{Moon's daily mean motion}}$$

Here the constant is the same as that of Śrīpati discussed before. The symbol means the Moon as corrected by the equation of apsis. It is readily seen that the constant of the first term of the equation of apsis is increased by 80'. and that the constant of evection is taken at 80'. In both the cases the error is about +4'.

(3) Candraśekhara's third equation or Variation

$$= \frac{3438' \sin 2(D'-\theta)}{90} = 38' \ 12'' \sin 2(D'-\theta).$$ [3]

1. *Siddhānta-darpaṇa*, V, 100-114.
2. Ibid, VI, 7-9
3. *Siddhānta-darpaṇa* VI. 11-12.

where D' means the Moon as corrected by the 1st and the 2nd equations. Here the constant is wrong by $-1' 18''$.

(4) His fourth equation or the annual equation $= \pm \frac{1}{10}$ of the Sun's equation of apsis,[1]

$$= \pm \frac{1}{10} \times \frac{12 \times 3438}{360} \sin \text{ (Sun's distance from the apogee).}$$

$= \pm 11' 27''.6 \sin$ (Sun's distance from the apogee).

The modern value of the constant is 11' 10″. Tycho found it to be 4′ 30″. Horrocks' (1639) co-efficient was 11' 51″.

As Candraśekhara was aware of Bhāskara's *Bijopanaya*, as also of the work of Śrīpati, his merit here lies in the discovery of the annual equation, and correction to the constant of variation.

Thus we have seen that so far as the luni-solar astronomy is concerned Indian astronomy is independent of Greek astronomy in respect of astronomical constants, that Indian astronomy is generally more accurate than Greek astronomy and that Indian astronomers were not mere "calculators"[2]. There were observers who verified and corrected the old astronomical constants as they came down from Āryabhaṭa and Brahmagupta, who also found independently all the principal equations of the Moon.

1. Siddhānta darpaṇa VI. 13.
2. G.R. Kaye *Hindu Astronomy*, p. 60

—: o :—

Reference

P.C. Sengupta : *The Khaṇḍakhādyaka*, 1934
Karl Manitius's edition : *Syntaxis.*
Godfray : *Lunar Theory.*

CHAPTER VII

Greek and Hindu Methods in Spherical Astronomy

Here we shall reproduce from Sengupta's paper a comparative account of the Greek and ancient Indian methods in Spherical Astronomy and to bring out the independence of the Indian Astronomers on this subject. The views on this subject would necessarily differ from those of many European scholars such as Colebrooke and Bentley (early 19th century) to Kaye (early 20th century). Kaye wrote as follows in the *Journal of Asiatic Society of Bengāl* 1919, No. 3.

> The methods by which (the rules) were obtained are buried in obscurity. Braunmühl[1] has stated "that the Indians were the first to utilise the method of projection in the Analemma of Ptolemy." It is intended to present the Hindu methods as clearly as possible and to show that Braunmühl has not done sufficient justice to the Indian astronomers.

As to Kaye, we shall show that his remark quoted above is due to the fact that he had to rely mostly on the English translation of the *Sūryasiddhānta* of Burgess, and perhaps he had no access to the works of Bhāskara II (1150 A.D.), who was the first to explain the ancient Indian methods clearly.

Greek and Hindu Methods in Spherical Astronomy

Of the Greek methods in Spherical Astronomy, the history begins with elementary principles only from Euclid (300 B.C.). Even in Theodosius' *Sphaerica*[2] (about 153 B. C.) "there is nothing that can be called trigonometrical." Heath again says,

1. Heath, *Greek Mathematics*, Vol. II. p. 291. Braunmuhl, *Geschichte der Trigonometrie*, pp. 38-42.
2. Heath, *Greek Mathematics*, Vol. II, p. 250.

"the early spheric did not deal with the geometry of the sphere as such, still less did it contain anything of the nature of the spherical trigonometry. (This deficiency was afterwards made good by Menelaus's *Sphaerica*).[1] Hence the Greek spherical trigonometry began with Menelaus (90 A.D.). His theorem in geometry is well-known—"If the sides of a plane triangle be cut by a transversal into six segments, the continued product of any three alternate segments, is equal to the continued product of the remaining three." From this proposition he deduced the so-called "*regula sex quantitatum*" or the theorem, if the sides of a spherical triangle be cut by an arc of a great circle into six segments, the continued product of the chords of the doubles of any three alternate segments is equal to the continued product of the chords of doubles of the remaining three segments." In plane geometry if the sides BC, CA, AB of a triangle be cut by any transversal at L, M, N, respectively, then we have

$$\frac{BL}{LC} \cdot \frac{CM}{MA} \cdot \frac{AN}{NB} = 1.$$

In spherics the theorem is :

$$\frac{\text{Chord } 2\,BL}{\text{Chord } 2\,LC} \cdot \frac{\text{Chord } 2\,CM}{\text{Chord } 2\,MA} \cdot \frac{\text{Chord } 2\,AN}{\text{Chord } 2\,NB} = 1$$

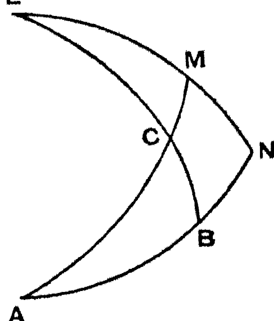


Fig. 5

Both these theorems are proved in Ptolemy's *Syntaxis* (Karl Manitius's edition, Vol. I, pp. 45-51).

If R be the radius of the sphere on which the spherical triangle ABC is constructed, then the chord of the arc 2 BL= 2 R sin BL. Hence Menelaus's theorem in spherics may be expressed as follows :

$$\frac{\text{Sin } BL}{\text{Sin } LC} \cdot \frac{\text{Sin } CM}{\text{Sin } MA} \cdot \frac{\text{Sin } AN}{\text{Sin } NB} = 1$$

This theorem is true for any spherical triangle.

If $\angle B = AN = AM = 90°$ and L the pole of AB, then LMN is a secondary to the arc AB. There are four arcs of great circles; taking any three as forming a spherical triangle and the fourth as the transversal we readily get for the right-angled

1. A.A. Bjornbo, "*Studien über Menelaos' Sphärik*" in Abhandlungen Zur Geschichte der Mathematischen Wissenchaften for 1902, pp. 89 *et seq.*; also Heath, *Greek Mathematics*, vol. II p. 261-73.

triangle ABC, the relations :--

(i) $\sin a = \sin b \sin A$

(ii) $\sin c = \tan a \cot A$

(iii) $\cos b = \cos a \cos c$

(iv) $\tan c = \tan b \cos A$

The above are some of the Napier's rules for a right-angled spherical triangle, deducible from Menelaus's theorem[1]. They are generally sufficient in the case of such triangles. In any spherical triangle, however, this theorem of Menelaus does not in any single step lead to any of the equivalents of the time-altitude or altazimuth equations in spherical astronomy. The ancient Indian methods, though none of them are so highly finished as Menelaus's theorem, yet are not less powerful in tackling the problems that arise in astronomy in connection with the apparent diurnal motion of the heavens. The Greek or Ptolemaic method presents no further points of interest except in its application. We now proceed to illustrate the ancient Indian methods and shall refer to the Ptolemaic method as occasion arises.

Ancient Indian Methods in Spherical Astronomy

In the Indian methods there is no general rule to follow. It is by properties of similar right-angled triangles that a fairly complete set of accurate formulae are obtained. These right-angled plane triangles are classified under the names,—'Krānti-kṣetras' (triangles of declination) and 'Akṣa-kṣetras' (triangles of latitude). We consider the following problems :—

Problem :- To find the time of rising on the equator of a length l, of arc of the ecliptic measured from the first point of Aries.

Let ω be the obliquity of the ecliptic and R. A. the right ascension corresponding to the longitude l, and δ the corresponding declination. The Indian form of the equation is :

1. Three more can be deduced similarly, namely,

(v) $\sin c = \sin b \sin C$

(vi) $\sin a = \tan c \cot C$

(vii) $\tan a = \cos C \tan b$.

*$R \sin R.A. = \frac{R \sin l \times R \sin \omega}{R \cos \delta}$, where R is the radius of the sphere.

Note:— If R be the radius of the circle of reference, the Indian trigonometrical functions for the arc θ, are (1) the 'sine,' (2) the 'cosine' and (3) the versed sine. They are respectively equal to $R \sin \theta$, $R \cos \theta$ and $R \text{ vers } \theta$.

In the adjoining figure, O is the centre of the armillary sphere, ♈Q.♈C are quadrants of the equator and the ecliptic, respectively. P is the celestial pole, PCQ the summer solstitial colure. Join O♈, OQ, OP and OC.

Let ♈S be $=l$, ♈M=R.A., CQ=∠S♈M−ω, SM=δ.

Join OS, OM. PSM is the secondary to the equator.

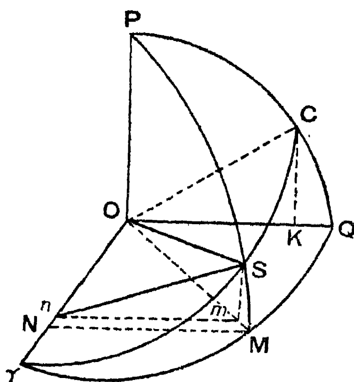


Fig. 6

From C draw CK perpendicular to OQ. From S draw Sm and Sn perpendicular to OM and O♈, respectively. Join MN and from M draw MN perpendicular to O♈.

Then the triangles Smn and CKO are similar. They are called '*Krānti-kṣetras*'[1] or declination triangles,—similar right-angled triangles having one acute angle=ω.

∴ $Sm : Sn = CK : OC$

or $R \sin \delta : R \sin l = R \sin \omega : R$

$$R \sin \delta = \frac{R \sin l \times R \sin \omega}{R} \qquad \text{......(I)}$$

The *Āryabhaṭīya, Gola*, 25. Varāhamihira, in the *Pañcasiddhāntikā* (IV. 92) states it in the form $2R \sqrt{\frac{(R^2 \text{ Sin }^2 l) - R^2 \text{ Sin }^2 \delta}{2R \cos \delta}}$

=R Sin R.A., which is evident from figure. Brahmagupta's equation is identical with that of Āryabhaṭa, (*BrSpSi*. III. 15, *Sūrya-siddhānta* III. 40-41.

Also Bhāskara II, *Grahagaṇita* cap. VIII, stanzas 54-55, is in agreement with Varāhamihira's forms.

Greek Method

In the same figure[1] let PSC be the triangle and ♈MQ be the transversal. Then Menelaus's theorem gives

$$\frac{\sin PM}{\sin MS}\times\frac{\sin S\gamma}{\sin \gamma C}\times\frac{\sin CQ}{\sin QP}=1$$

or $$\frac{1}{\sin\delta}\times\frac{\sin l}{1}+\frac{\sin\omega}{1}=1$$

or $\sin\delta=\sin l\times\sin\omega$.

Indian Method

Again by the Indian method from the same two similar triangles we get

$$mn : nS=OK : OC$$

or, $mn : R\sin l=R\cos\omega : R$

$\because$ $$mn=\frac{R\sin l\times R\cos\omega}{R}$$

Again $MN : mn=OM : Om$

i.e., $R\sin R.A. : mn=R : R\cos\delta$

$\therefore$ $$R\sin R.A.=\frac{R\sin l\times R\cos\omega}{R\cos\delta}$$

Greek Method

Take PQM for the triangle and γSC for the transversal.

Then, $$\frac{\sin PC}{\sin CQ}\times\frac{\sin Q\gamma}{\sin\gamma M}\times\frac{\sin MS}{\sin SP}=1$$

or $$\frac{\cos\omega}{\sin\omega}\times\frac{1}{\sin R.A}\times\frac{\sin\delta}{\cos\delta}=1$$

or $\sin R.A.=\tan\delta\cot\omega$,

The Indian form of the equation is different from that of Ptolemy's. It is also better for the purpose of calculation.

Note :—From the same two similar triangles we have

$On : ON=R\cos\delta ; R$

$\therefore$ $$On : R\cos l=\frac{R\cos R.A.\times R\cos\delta}{R} \quad\text{......(3)}$$

Again, $\tan R.A.=\dfrac{mn}{on}$

$$=\frac{R\sin l\times R\cos\omega}{R\times R\cos l}\quad\text{......(4)}$$

Again, $mn : Sm=OK : KC$

1. Manitius' Edition of *Syntaxis*, I. 51-53.

or $\quad mn=\dfrac{\text{R}\sin\delta\times\text{R}\cos\omega}{\text{R}\sin\omega}$

$\therefore \quad \text{R}\sin\text{R. A.}=\dfrac{\text{MN}}{mn}\times mn=\dfrac{\text{R}}{\text{R}\cos\delta}\times\dfrac{\text{R}\sin\delta\times\text{R}\cos\omega}{\text{R}\sin\omega} \quad (5)$

Problem II :—

Sidereal Time-intervals

Indian Method

The problem discussed above provides the method of finding the sidereal time-intervals in which the signs of the zodiac rise on the equator. To find the corresponding times at any latitude ϕ, it is necessary to calculate and apply what is the ascensional difference due to the elevation of the celestial pole. This ascensional difference is called '*carakāla*' or the variation in the length of half the day. The 'sine' of this '*carakāla*' is called '*carajyā*.' If *ch* denotes this '*carakāla*,'

then,[1] $\text{R. Sin}\, ch=\dfrac{\text{R}\sin\phi\times\text{R}\sin\delta\times\text{R}}{\text{R}\cos\phi\times\text{R}\cos\delta}$

Just as in the solution of the previous problem, the declinational triangles or '*Krānti Kṣetras*' were constructed and used, so in the solution of this and other problems another set of similar triangles were conceived and constructed and were given the name '*Akṣa kṣetras*.[2]

Let NPZH be the meridian (Fig.7), NOH the north-south line passing through the observer O, P the celestial pole, OQ the trace of the equator on the meridian plane, Z the zenith. Join OZ. From Q draw QM perpendicular to OZ. Then the triangle QOM is an '*Akṣa-kṣetra*' or a latitudinal right-angled triangle, as $\angle\text{QOM}=\phi$, the latitude of the station. Another '*Akṣakṣetra*' is thus conceived, in the same figure, let P, P′ be the north and south celestial poles, N, the north point, AB A′B′ the diurnal

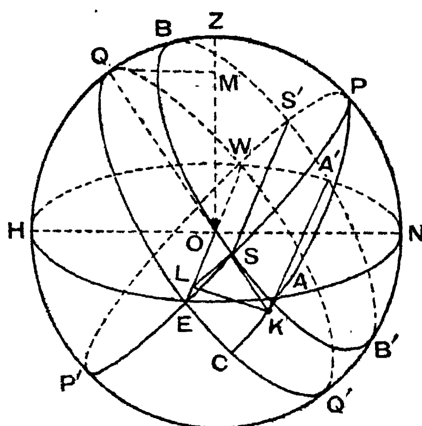


Fig 7

1. *Āryabhaṭīya*, Gola, 26; *Pañca-siddhāntikā*, IV, 34; *Brāhmasphuṭasiddhānta*. II, 57-58; *Sūrya-siddhānta*, II, 91; *Grahagaṇita*. VIII. 48-49.

2. Bhāskara, *Goladhyāya* (Wilkinson and Bapūdeva Śāstri's tr.) PP. 173-76; also, Bhāskara, Grahaganita, Ch. IX. 13-17.

circle of a heavenly body with declination δ, NEHW the horizon, PEP′ W the six O′ clock circle. Here AA′ the line of intersection of the diurnal circle with the horizon is called the "*udayāsta-sūtra*"[1] (or the thread joining the rising and setting points). SS′ the line of interesection of the diurnal circle and the six o′ clock circle, is the horizontal diameter of the diurnal circle. From S draw SK and SL perpendiculars respectively to AA′ and EW. Join KL.

Now since PN=ϕ, the latitude of the station, in the small right-angled triangle KLS, the $\angle$ KLS is also=ϕ.

$$\therefore \quad SK : SL = QM : MO$$

$$\text{or} \quad SK = \frac{SL \times QM}{MO} = \frac{R \sin \delta \times R \sin \phi}{R \cos \phi}$$

Now SK[2] is a "sine" in the small circle AB A′B′ of which the radius is R cos δ; this "sine" reduced to the equator (radius R) is the 'sine' of *cara.*

$$\therefore \quad R \sin ch = R \sin EPA$$

$$= \frac{R \sin \delta \times R \sin \phi \times R}{R \cos \phi \times \cos \delta}$$

Greek Method

Let[3] the arc PA be produced to meet the equator at C. Take PCQ′ for the triangle and EAN for the transversal. Then we get,

$$\frac{\sin PA}{\sin AC} \times \frac{\sin CE}{\sin EQ'} \times \frac{\sin Q'N}{\sin NP} = 1$$

$$\text{or} \quad \frac{\cos \delta}{\sin \delta} \times \frac{\sin CE}{1} \times \frac{\cos \phi}{\sin \phi} = 1$$

$$\therefore \quad \sin CE = \sin ch = \frac{\sin \phi \times \sin \delta}{\cos \phi \times \cos \delta}.$$

Note—The perpendicular distance between AA′ and Ew is called the 'sine' of the amplitude or the '*Agrā*' which is thus calculated :—

$$KL : LS = QO : OM$$

$$\therefore \quad {}^{4}R \sin \text{amplitude} = \text{'}Agr\bar{a}\text{'} = KL$$

$$= \frac{LS \times QO}{OM} = \frac{R \sin \delta \times R}{R \cos \phi}$$

It is now evident that the ancient Indian method is different

1. Bhāskara, *Gola*, VII, 39.
2. This is called by the name '*kujyā*' or '*kṣitijyā*'. i, e., earth-sine. Āryabhaṭa, *Gola*, 26, Brahmagupta, II, 57, *Sūrya-siddhānta*, *II*, *61 etc.*
3. Manitius, ibid, p. 84.
4. Āryabhaṭa, *Gola*. 30, etc.

from the Greek method in this case also. As the triangle KLS is difficult to show in the diagram, it is shown in its projection on the meridian plane in Burgess's translation of the "*Sūrya-siddhānta,*"(page 232)and also in Wilkinson and Bāpūdeva Śāstrī's translation of the '*Siddhānta Śiromaṇi,*' p. 175. This has led Braunmühl to assume that the Indian method of arriving at the equation of ascensional difference and some other equations of spherical astronomy has its origin in the Analemma of Ptolemy. A careful study, however, does not justify the identification of Indian methods with the graphic method of the Analemma, which is deduced from the projections of the position of a heavenly body on the meridian prime vertical and the horizon. It is being presently shown that what was done out of difficulty in drawing the figures properly has been taken by Braunmühl as a Greek connection.

Problem III[1] :—

To find the "Time-altitude" Equation

If from any point S on the diurnal circle a perpendicular be drawn to the *Udyāsta-Sūtra* spoken of before, this perpendicular is called the *cheda* or '*iṣṭahṛti.*' The perpendicular from S on the horizon is called '*Śaṅku*'[2] the sine of the altitude. The line joining the foot of the '*Śaṅku*' and that of the perpendicular on the '*Udayāsta-Sūtra*' goes by the name of '*Śaṅkutala*' and this *Śaṅkutala* lies to the south of the '*Udayāsta-Sūtra*' during the day.

In this figure (Fig 8) if AA′ be the 'Udayāsta-Sūtra' or the intersection of the diurnal circle and the horizon, and S a point on the diurnal circle denoting a position of the Sun, SK, SL perpendiculars on AA′ and the horizon respectively; SL is called the '*Śaṅku,*' SK the '*cheda*' and LK, the '*Śaṅkutala*'. In this triangle KSL, the angle KSL was recognised to be the latitude of the station.

Thus the triangle SKL is not taken in its projection on the meridian plane. The side SK is taken as formed of two parts.

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1. Āryabhaṭa could not arrive at the true equation. Cf. Gola 28. The correct rules occur in *Pañcasiddhāntikā*, IV, 42. 44; *Brāhmasphuṭasiddhānta.* III, 36-38, 26-40 ; *Sūryasiddhānta*, III, 34-35.

2. Bhāskara says : ग्रहस्थानाल्लम्बः शंकुः । तस्यतलमुदयास्तसूत्राद्दक्षिणतो भवति ॥ "*Gola*, VIII-39-41, Āryabhaṭa uses the term शङ्क्वग्रम्" *Gola*, 29.

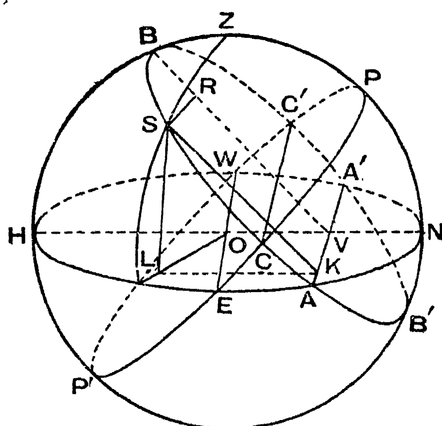


Fig. 8

Let CC′ be the line of intersection of the diurnal circle and the 'six o'clock 'circle EPW. Let SK cut CC′ in M. Then.

$$SK = SM + MK$$

Here SM, the 'sine' in the diurnal circle of the complement of the hour angle is given a distinct name '*Kalā*'[1] and MK as explained before is known by the name '*Kujyā*.' This '*Kalā*' is constructed from the point S in the diurnal circle. Thus the triangles like SKL were not taken in their projections on the meridian plane as Braunmühl would suggest.

From the triangle KSK, we get,

'*Cheda*' : '*Śaṅku*' = R : R cos ϕ where ϕ is the latitude of the observer;

'*Śaṅku*' is here = R cos Z, Z being fhe Sun's zenith distance.

$$\therefore \quad \text{'cheda'} = \frac{R \cos Z \times R}{R \cos \phi}$$

Now '*Cheda*' = radius of the diurnal circle + *Kujyā*—versed sine of the hour-angle in the diurnal circle O′ B + O′ V − BR,

$$= R \cos \delta + \frac{R \sin \delta \times R \sin \phi}{R \cos \phi} - \frac{R \text{ vers } H \times R \cos \delta}{R}$$

As in the previous problem, $Kujy\bar{a} = SK = \dfrac{R \sin \delta \times R \sin \phi}{R \cos \phi}$

$$\text{or} \quad \frac{R \cos Z \times R}{R \cos \phi} = \frac{R \cos \delta}{R} \left\{ R + \frac{R \sin \delta \times R \sin \phi}{R \cos \phi} \times \frac{R}{R \cos \delta} - R \text{ vers } H \right\}$$

The above equation simplified becomes

$\cos Z = \sin\delta \sin \phi + \cos \delta \cos \phi \cos H.$

In this connection we consider the altazimuth equation by the Indian method.

1. Bhāskara's *Grahagaṇita*, VIII, 55.
O′ is the middle point of CC′ or it is the centre of the diurnal circle ABB′.

[1]*Problem IV* :—

The Altazimuth Equation

Indiad Method

Let α denote the azimuth of the Sun from the south. In the same triangle SKL in the same figure, we have,

$$LK : SL = R \sin\phi : R\cos\phi$$

or, $\text{'Śaṅkūtala'} : \text{'Śaṅku'} = R\sin\phi : R\cos\phi$

$$\therefore \quad \text{'Śaṅkutala'} = \frac{R\cos Z \times R\sin\phi}{R\cos\phi}$$

Now '*Śaṅkutala*' is made up of two parts, namely, '*Bāhu*' and '*Agrā*,' of which the former is the distance of L from the observer's East-West line; the 'Agrā' has been already found.

$$\text{Here 'Bāhu'} = \frac{R\sin Z \times R\cos\alpha}{R} \text{ and 'Agrā'} = \frac{R\sin\delta \times R}{R\cos\phi}$$

$$\therefore \quad \text{'Saṅkutala'} = \text{'Bāhu'} + \text{'Agrā'}$$

or $$\frac{R\cos Z \times R\sin\phi}{R\cos\phi} = \frac{R\sin Z \times R\cos\alpha}{R} + \frac{R\sin\delta \times R}{R\cos\phi}$$

or $$R\sin\delta = \frac{R\cos\phi}{R}\left(\frac{R\cos Z \times R\sin\phi}{R\cos\phi} - \frac{R\sin Z \times R\cos\alpha}{\phi}\right)$$

which is easily seen to be equivalent to

$$\sin\delta = \cos Z\sin\phi - \sin Z\cos\phi,\ \cos\alpha$$

Greek Method

Ptolemy[2] has also a method of finding the Sun's altitude at any hour of the day. His method is as follows :—

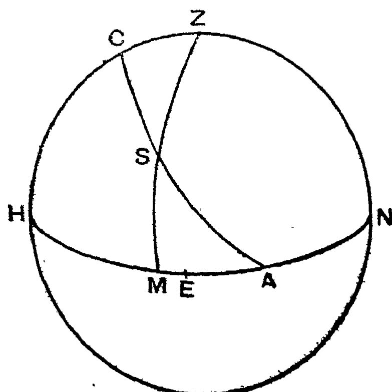


Fig. 9

(i) He would find by means of his tables for the times of risings of the signs of the zodiac, the orient ecliptic point. (ii) He would then find the culminating point of the ecliptic. (iii) He would finally apply Menelaus's theorem in spherics thus :—

Let ASC be any position of the ecliptic,(Fig. 9)NZC the

1. The equivalent of this. in a particular case, is first found in *Brāhma. sphuṭasiddhānta*, Ch. III, 54-56 Cf. *Sūryasiddhānta*, III, 28-31, also Bhāskara *Grahagaṇita*, IX. 50-52.

2. Manitius, ibid, pp. 118, 19.

meridian, NAMH the horizon, Z, the zenith and S the Sun. Here the celestial longitudes of C, S and A are taken to be known; hence ZC and CH are also known.

Now take ZCS for the triangle and HMA to be the transversal ; we then have by Menelaus's theorem.

$$\frac{\sin ZH}{\sin HC}\times\frac{\sin CA}{\sin AS}\times\frac{\sin SM}{\sin MZ}=1$$

$$\text{or } \sin SM=\frac{\cos CZ\times\sin AS}{\sin CA}$$

It is thus clear that Ptolemy had no direct method for connecting the Sun's altitude and the hour-angle. This method is workable for the problem "given time, find the altitude" but is not workable in the converse problem ; besides, the calculation of the longitudes of A and C is very cumbrous.

Again, when EA has been found out, taking ZHM for the triangle and CSA for the transversal, we get,

$\frac{\sin HA}{\sin Am}\times\frac{\sin MS}{\sin SZ}\times\frac{\sin ZC}{\sin CH}=1$, whence and thence HM, the azimuth can be found. The method is here also cumbrous, there being no direct connection between altitude and azimuth ; besides the time-element is not avoided.

The Analemma of Ptolemy and the Indian Method.

When the Sun's declination is zero and his hour-angle, is H, Zeuthen[1] following the method of the 'Analemma' of Ptolemy, as explained by Braunmühl[2] has deduced the following equations :

(1) $\cos Z=\cos H.\cos\phi$

(2) $\tan\alpha=\frac{\tan H}{\sin\phi}$

To these two, Heath following Braunmühl, adds

(3) [3]$\tan ZQ=\frac{\tan H}{\cos\phi}$

1. Heath, *Greek Mathematics*, Vol. II. pp, 290-91.
   Zeauthen, *Bibliotheca Mathematica*, 1_3, 1900, pp. 23-27.
2. Braunmühl , ibid, pp. 12-13,
3. The Indian form of this equatiom is $R\ \text{Sin}\ ZQ=\dfrac{R\ \text{Sin}\ H\times R}{\dfrac{\sqrt{R^2-R^2\cos^2 H\times R^2\ \text{Sin}^2\phi}}{R}}$

   Bhāskara's, *Golādhyāya*, Com. on VIII, 67.

where Z is the zenith and Q is the point of intersection of the prime vertical and its secondary passing through the Sun and the north-south points.

Zeuthen[1] points out that later in the same treatise Ptolemy finds the arc 2β described above the horizon by a star of given declination δ' by a procedure equivalent to the formula.

(4) $\cos \beta = \tan \delta' \tan \phi$.

With regard to the 'Analemma' of Ptolemy. it may be noted, as Heath[2] says, that "the procedure amounts to a method of graphically constructing the arcs required as parts of an auxiliary circle in one plane." Many things may be, in practice, done graphically far more easily than by the theoretical method. Besides, no theoretical calculations occur in the 'Analemma'. Zeuthen[2], following the method of this work, has deduced in the general case, the two equations.

(5) $\cos Z = (\cos \delta, \cos H + \sin \delta. \tan \phi) \cos \phi$.

(6) $$\tan \alpha = \frac{\cos \delta . \sin H}{\frac{\sin \delta}{\cos \delta} + (\cos \delta . \cos H + \sin \delta . \tan \phi) \sin \phi}$$

These equations are suggested to a modern reader from a study of the figures in the 'Analemma.' But neither in this work nor in the '*Syntaxis*' are they to be found. With regard to the first four formulae, it is possible that they were recognised by Ptolemy. With regard to the last two, Zeuthen[3] remarks "mais le texte nen contient rien,' and they were certainly not recognised by Ptolemy.

Besides the tangent function is wholly absent in Greek trigonometry. They are also different in form from those arrived at by the Indian method as explained before. Thus, it is clear that the Indian methods are in no way connected with the method of the 'Analemma.'

Even taking for granted that the Indians followed a method of projection much allied to the method of the Analemma' there is no adequate reason for assuming that their method is derived from any Greek source. Analogy and precedence do not necessarily constitute originality—there is still the chance of a remoter origin from which both the systems drew their inspiration. The method of the 'Analemma,' as has been already stated, presents a

1, 2, Bjornbo. *loc. cit.* p. 86.

3. Zeuthen, *loc, cit.* p. 27.

graphical method for constructing the Sun's altitude and azimuth from the hour angle when the Sun's declination is zero but such a graphical method is generally complex as compared with the elegant Indian method. An astronomer who constructs and uses an armillary sphere to arrive at his equations in spherical astronomy and who has not a well-developed spherical astronomy at his command must have to draw perpendiculars from the positions of the heavenly body, not only on the meridian plane, the horizon or on the prime vertical, as the occasion arises, but also on the line of intersection of the diurnal circle with the horizon. Hence Braunmühl's statement that the Indian methods of spherical astronomy have their origin in the 'Analemma's, in spite of his admitting that Indians were first to utilise its methods, is rather far-fetched and tends to take away the honour from the great Indian astronomers, who devised the beautiful methods. The 'Analemma' as it now exists is a Latin translation from an Arabic version of the original Greek[1]. We may reasonably doubt that the Arabic version was greatly influenced by the ancient Indian system.

We now pass on to the consideration of other allied or similar problems in the two systems of astronomy.

Problem V—

To find the Angle between the Ecliptic and the Meridian

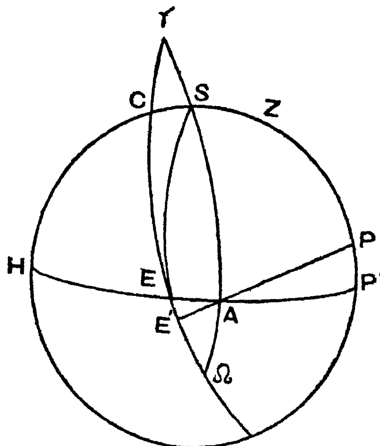


Fig. 10

Indian Method[2]

Let ♈SA be the ecliptic, ♈CE the equator, E the east-point of the horizon (Fig 10). Cut off SH=90° and draw the great circle HEAP′ cutting the meridian P′SCH at the points P′ and H. The aim is to find AP′ but it is enough to find EA since AP′ is the complement of EA′.

Both Āryabhaṭa and Brahmagupta were unable to find EA correctly. Let P be the celestial pole and let PAE′ be

1. On the influence of the ancient Indians on Arab mathematics and astronomy; see Alberuni's India, translated by Dr. E. Sachau, Vol. II, p. 304.

2. Āryabhaṭa, Gola, 45; *BrSpSi*, IV. 17; *Sūrya-siddhānta*, IV. 25; Bhāskara's *Golādhyāya*, VIII. 21-74, first example in his own commentary.

the secondary to the equator cutting it at E'. Both the above astronomers were content with the idea that AE=AE', or that AE=the declination of the point A of the ecliptic which is 90° ahead of S in the above figure. This idea continued till the time of Bhāskara II (1150 A. D.) who found out the correct equation.

He recognised that CS, the declination of S=PP'; P'EH is then the horizon of the station whose north geographical latitude is CS. Also, the 'sine' of EA is the '*Agrā*' or the sine of the amplitude of the point A for the latitude CS.

$$\therefore \text{R} \sin \text{EA} = \frac{\text{R} \sin \text{AE}' \times \text{R}}{\text{R} \cos \text{CS}} = \frac{\text{R} \sin (90^\circ + \gamma\text{S}) \times \text{R} \sin \omega}{\text{R}} \times \frac{\text{R}}{\text{R} \cos \text{CS}}$$

$$\text{or R} \sin \text{EA} = \frac{\text{R} \sin (90^\circ + l) \times \text{R} \sin \omega}{\text{R} \cos \delta}$$

where l stands for γS and δ for CS.

Greek Method :

We give below the Ptolemy's method in a slightly modified form[1]. Let SHA be the triangle and γCE be the transversal; then we have,

$$\frac{\sin \text{SC}}{\sin \text{CH}} \times \frac{\sin \text{HE}}{\sin \text{EA}} \frac{\sin \text{A}\gamma}{\sin \gamma\text{S}} = 1$$

$$\text{or } \frac{\sin \delta}{\cos \delta} \times \frac{\sin 90^\circ}{\sin \text{EA}} \times \frac{\sin (90^\circ + l)}{\sin \iota} = 1$$

$$\therefore \sin \text{EA} = \frac{\sin \delta \times \sin (90^\circ + l)}{\cos \delta \times \sin l},$$

which is readily transformed into Bhāskara's equation. The originality of Bhāskara would be readily admitted.

Problem VI—

To find the Angle between the Ecliptic and the Horrizon

Indian Method :

(A) Āryabhaṭa's method. It consists of the following[2] steps :—

(1) Determination of the orient point of ecliptic.

(2) Finding the sine of its amplitude.

1. Manitius, *ibid*, Book I, pp. 104-06.
2. Āryabhaṭa, *Gola*, 33 : *Sūryasiddhānta*, V. 5-6.

(3) Determination of the culminating point of the ecliptic from the hour-angle of the Sun.

(4) Finding the declination of the culminating point of the ecliptic.

Having obtained the above elements, his rule can be followed thus :

In this Fig. 11 NZH is the meridian, HMEAN the horizon, CN′A the ecliptic. If N′ be the nonagesimal or the highest point of the ecliptic, the altitude of N′ is the inclination of the ecliptic to the horizon.

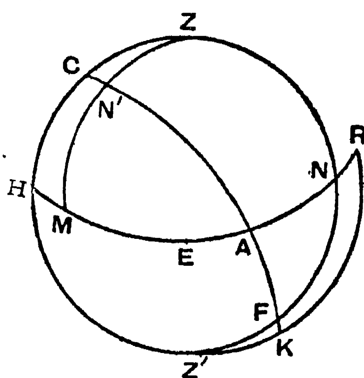


Fig. 11

Let ZN′M be the vertical through N′, meeting the horizon at M.

When the time is given, the longitudes of A and C can be found out, from which CZ the zenith distance of C and EA the amplitude of the orient ecliptic point can be determined.

Here HM=EA.

According to Āryabhaṭa,

$$\text{R sin CN}' = \frac{\text{R sin CZ} \times \text{R sin HM}}{\text{R}}$$

and $\text{R sin ZN}' = \sqrt{(\text{R sin CZ})^2 - (\text{R sin CN}')^2}$

This is only an approximate rule. As expressed here,

$$\text{R sin ZN}' = \frac{\text{R sin CZ} \times \text{R cos HM}}{\text{R}} \text{ approximately.}$$

$$= \frac{{}^1\text{R sin CZ} \times \text{R cos HM} \times \text{R}}{\text{R} \times \text{R cos CN}'} \text{ accurately.}$$

$$= \frac{\text{R sin CZ} \times \text{R cos HM}}{\text{R cos CN}'}.$$

(B) The method of Brahmagupta[2] :

Brahmagupta would also first determine the orient ecliptic

1. This correction was perhaps first noticed by Raṅganātha (1603 A. D.) in his commentary in the *Sūryasiddhānta*.

2. *BrSpSi.* V 3.

point A. Then he subtracts 90° from the longitude of A. Thus having the longitude of N′, he next finds the part of the day elapsed of N′ ; from which by the time-altitude equation discussed above, he finds ZN′. This is of course more accurate than that of Āryabhaṭa. Bhāskara[1] here follows Brahmagupta.

Greek Method :

Let the ecliptic CN′A cut the lower half of the meridian at F. Ptolemy takes AK along the ecliptic=90° and AR along the horizon=90°; then the great circle passing through R and K passes through the nadir Z′. Now take Z′FK for the triangle and ANR for the transversal, then by Menelaus's theorem.[2]

$$\frac{\sin FN}{\sin NZ'}\times\frac{\sin Z'R}{\sin RK}\times\frac{\sin KA}{\sin AF}=1$$

$$\therefore \sin RK=\frac{\sin FN}{\sin AF}=\frac{\cos FZ'}{\sin AC}=\frac{\cos CZ}{\sin AC}=\frac{\sin CH}{\sin AC}$$

$$\text{or } \sin MN'=\frac{\sin CH}{\sin AC}.$$

Here Ptolemy's equation is simpler than that of Āryabhaṭa; hence they must be independent of each other.

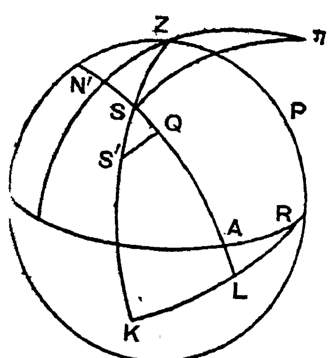


Fig. 12

Problem VII:—

To find the Angle made by the Vertical through any Point of the Ecliptic with the Latter

This problem is considered by Ptolemy but it is not considered separately in Indian Astronomy, but from the rule for parallax in longitude, the rule for its calculation can be deduced.

Indian Method :

In Fig. 12 S represents the true position of the Sun and S′ the Sun's position as depressed by parallax. N′SA is the ecliptic. If from S′, S′Q be drawn perpendicular to the ecliptic, then, if P is the horizontal parallax,

1. *Grahagaṇita*; XII, 3-4.
2. Manitius, *ibid.* pp. 110-111.

$$SQ = SS' \times \frac{R\cos S'SQ}{R} = \frac{P \times R\sin ZS}{R} \times \frac{R\cos S'SQ}{R}$$

$$^{1}= \frac{P}{R}\sqrt{(R\sin ZS)^2 - (R\sin ZN')^2}$$

$$^{2}= \frac{P}{R^2} \times R\sin N'S \times R\cos ZN',$$ where N′ is the nonagesimal

Thus R cos S′SQ is seen to be

$$= \frac{R\sin N'S \times R\cos ZN'}{R\sin ZS}$$

The Indian method is fully described by Bhāskara in his '*Golādhyāya*. VIII, 12-25. The truth of the Indian rule for R cos S′SQ is easily seen from the spherical triangle AZS, where A is the pole of the ecliptic.

Greek Method :

[3]Ptolemy takes SK and SL 90° each, along the vertical circle ZSEK and the ecliptic N′SA. The great circle through K and L cuts the horizon at R which is the pole of the vertical circle. He takes SKL for the triangle and EAR for the transversal, then

$$\frac{\sin SE}{\sin EK} \times \frac{\sin KR}{\sin LR} \times \frac{\sin LA}{\sin AS} = 1$$

or $$\sin LR = \frac{\cos ZS \times \cos AS}{\sin ZS \times \sin AS}$$

or $$\cos S'SQ = \cot ZS \times \cot AS = \tan SE \times \cot AS.$$

The Indian and the Greek rules are altogether different both in form and method. There can, therefore, be no question of any connection between them.

Problem VIII :—

To convert the Celestial Longitude of a Heavenly Body into its Polar Longitude

If σ be the position of a (Fig.13), γK and σK are the celestial longitude and the celestial latitude, respectively ; γM and σM are the polar longitude and polar latitude ; γN and σV are the right ascension and declination of the star.

Indian Method :

All Indian astronomers attempt at finding MK which sub-

1. Āryabhaṭa, *Gola*, 34; *Pañcasiddhāntikā*, IX, 22 *BrSpSi*, XI, 23.
2. *BrSpSi*. V, 4-5 ; *Sūryasiddhānta*, V, 7-8 Bhāskara, *Grahagaṇita*, XII, 4.
3. Manitius, ibid, p. 119.

point A. Then he subtracts 90° from the longitude of A. Thus having the longitude of N′, he next finds the part of the day elapsed of N′ ; from which by the time-altitude equation discussed above, he finds ZN′. This is of course more accurate than that of Āryabhaṭa. Bhāskara[1] here follows Brahmagupta.

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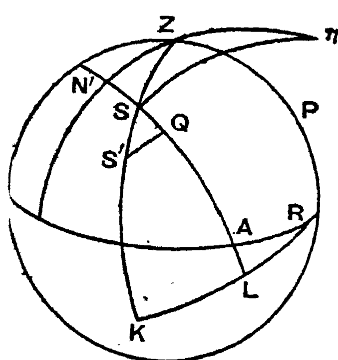


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1. *Grahagaṇita*; XII, 3-4.

2. Manitius, *ibid.* pp. 110-111.

$$SQ=SS'\times\frac{R\cos\ S'SQ}{R}=\frac{P\times R\sin\ ZS}{R}\times\frac{R\ \cos\ S'SQ}{R}$$

$$^{1}=\frac{P}{R}\sqrt{(R\sin ZS)^2-(R\ \sin ZN')^2}$$

$$^{2}=\frac{P}{R^2}\times R\sin N'S\times R\cos\ ZN',$$ where N′ is the nonagesimal.

Thus R cos S′SQ is seen to be

$$=\frac{R\sin\ N'S\times R\cos\ ZN'}{R\sin ZS}$$

The Indian method is fully described by Bhāskara in his '*Golādhyāya*. VIII, 12-25. The truth of the Indian rule for R cos S′SQ is easily seen from the spherical triangle πZS, where π is the pole of the ecliptic,

Greek Method :

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$$\frac{\sin\ SE}{\sin\ EK}\times\frac{\sin\ KR}{\sin\ LR}\times\frac{\sin\ LA}{\sin\ AS}=1$$

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1. Āryabhaṭa, *Gola*, 34; *Pañcasiddhāntikā*, IX, 22 *BrSpSi.* XI. 23.
2. *BrSpSi.* V, 4-5 ; *Sūryasiddhānta*, V, 7-8 Bhāskara, *Grahagaṇita*, XII, 4.
3. Manitius, ibid, p. 119.

tracted from, or added to, γK the celestial longitude, gives γM the polar longitude.

According to Āryabhaṭa[1],

$$MK=\frac{\sigma K\times R \text{ vers } \gamma K\times R \sin\omega}{R^2}.$$

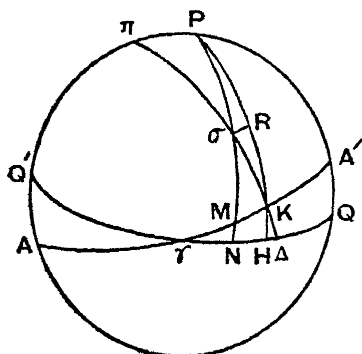


Fig- 13

Brahmagupta[2] makes a distinct improvement on Āryabhaṭa and gives his rule for finding the projection MK on the celestial equator.

If P be the celestial pole, PKH the secondary to the equator, Brahmagupta says that,

$$NH=\frac{\sigma K\times R \sin(\gamma K+90^\circ)\times R\sin\omega}{R}$$

If from σ, σR is drawn perpendicular to PKH, it is evident that,

$$R\sin\sigma R=\frac{R\sin\sigma K\times R\sin\sigma KR}{R}.$$

According to Āryabhaṭa and Brahmagupta, as explained before,

$$R\sin\sigma KR=\frac{R\sin(\gamma K+90^\circ)\times R\sin\omega}{R}$$

Hence Brahmagupta intends that,

$$NH=\sigma R=\frac{\sigma K\times R\sin\sigma KR}{R}$$

which is rather a big assumption. He then directs the finding of the part of the ecliptic of which σR or NH is the projection on the equator thus approximately to MK.

Āryabhaṭa, Brahmagupta[3] and the modern *Sūryasiddhānta* take the declination $\sigma N=\sigma K+KH$ where σK is small. They do not consider the case where σK is large.

Bhāskara alone gives us fairly correct rules for this transformation of co-ordinates.

1. Āryabhata, *Gola*, 36.
2. *BrSpSi* X. *17*.
3. *BrSpSi*, X. 15, *Sūryasiddhānta*, II, 58.

In order to find σN, he would multiply

σK by $\frac{R \cos \sigma KP}{R}$; according to him,

$$\sigma N = \frac{\sigma K \times R \cos \sigma KP}{R} + KH^1$$

This is a decided improvement on Brahmagupta's corresponding rule. The declination σN obtained would be very nearly accurate.

Having obtained σN, Bhāskara[2] then directs the finding of NH, thus,

$$NH = \frac{\sigma K \times R \sin \sigma KP}{R \cos \sigma N}$$

He then directs the finding of MK on the ecliptic of which NH is the projection by means of the times of rising of the signs of the zodiac on the equator.

Thus, the Indian methods show a beginning and development only. The Greek method as given by Ptolemy is mathematically accurate.

Greek Method[3]

To transform the celestial longitude and celestial latitude to right ascension and declination.

Let the great circle $\pi\sigma$K meet the equator at Δ. Ptolemy would then from the given value of γK, find $\gamma\Delta$ and ΔK by using his tables for the rising of signs of the zodiac on the equator. He then takes $\pi P\sigma$ for the triangle and $\gamma N\Delta Q$ for the transversal. The Menelaus' Equation, then, is

$$\frac{\sin \pi Q}{\sin QP} \times \frac{\sin PN}{\sin N\sigma} \times \frac{\sin \sigma\Delta}{\sin \Delta\pi} = 1^2$$

Here $\pi Q = 90° + \omega$, $QP = 90°$, $PN = 90°$; $\sigma\Delta = \sigma K + K\Delta$. $\pi\Delta = 90° + K\Delta$, whence $N\sigma$ is obtained.

He next takes PNQ for the triangle and $\pi\sigma\Delta$ for the transversal,

$$\therefore \frac{\sin P\pi}{\sin \pi Q} \times \frac{\sin Q\Delta}{\sin \Delta N} \times \frac{\sin N\sigma}{\sin \sigma P} = 1$$

Here $P\pi = \omega$, $\pi Q = 90° + \omega$, $Q\Delta = 90° - \gamma\Delta$.

Hence the above equation gives him ΔN. Now,

$\gamma N = \gamma\Delta - \Delta N$,

1. Bhāskara, *Grahagaṇita* XIII, 3.
2. Ibid. XIII, 4.
3. Manitius, Ibid, Vol, II. *Achtes Buch*, pp. 84-85.

It is almost needless to say that neither in the method nor in the rules is there any agreement between the Indian and Greek spherical astronomy in the solution of this problem.

Kaye's view[1]

As to Kaye, it appears that he has not been able to find a method in the translation of the *Sūyrasiddhānta* by Burgess. The figures of his paper referred to before do not show the "*Akṣakṣetras*" even in their projections on the meridian place. He refers to Braunmühl's *History of Trigonometry* but does not appear to have been able to follow him in his "*Methode der indischen Trigonometrie.*" Kaye, however, is not slow in belittling Indian trigonometry when he says :—The Indian astronomers employed the sine function principally and the versed sine occasionally ; they never employed the tangent function; and generally, but not always, preferred to employ the sine of the complementary angle rather than the cosine functions.''

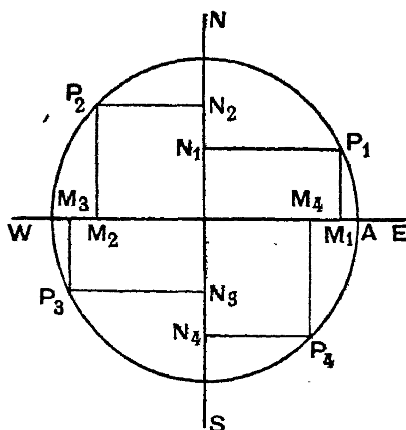


Fig. 14

It is evident that Kaye never understood the meaning of the Indian functions of 'sine' and 'cosine.' These functions are fully explained by Bhāskara[2] when he says :—

"Of that point the distance from the east-west line is the sine and the distance of the point from the north-south line is the "cosine".

In (Fig. 14), of the arc AP_1, P_1M_1 is the "sine" and P_1N_1 is the "cosine" of AP_2, P_2M_2 is the "sine" and P_2N_2 is the "cosine"; of AP_3, P_3M_3 is the "sine" and P_3N_3 is the "cosine"; etc. It is evident that a better definition of these functions was never given.

We have thus seen that some of the solutions of Āryabhaṭa

1. J. A. S. B., N. S., XV, p. 154.
2. तस्य बिन्दोः प्राच्य-परायाश्च यदन्तरं सादोर्ज्यां ।
बिन्दोर्याम्योत्तरायाश्च यदन्तरं सा कोटिज्या ॥
—(Bhāskara, *Grahagaṇita*, commentary. II. 88-21

are imperfect, of Brahmagupta the solutions are more accurate, while those of Bhāskara are generally mathematically correct. The date of the scientific ancient Indian Astronomy is indeed 499 A. D., while that of the Syntaxis is about 150 A. D. It is by these shortcomings and differences in the methods, new ideas (e.g., the idea of the differential calculus)* and the like, that we can safely say that Indian Astronomy in its scientific form, although of a later date than the "Syntaxis" of Ptolemy, is original and not borrowed from foreign source. There is evidence that some crude form of Greek astronomy was transmitted to India and went by the name of the "*Romaka*" or the "*Pauliśa*" Siddhānta, prior to the time of Āryabhaṭa but our great Indian astronomers, Āryabhaṭa with his pupils, Varāha-mihira and Brahmagupta, had to construct a new science altogether.

(This Chapter is almost a reproduction of the paper by P. C. Sengupta, as acknowledged earlier).

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Reference

P.C. Sengupta : The *Khaṇḍakhādyaka*, 1934

CHAPTER VII

Epicyclic Theory of Ancient Indians

We shall give here some details of the Indian concepts regarding the motion of planets or wandering bodies among the stars. The *Vedāṅga Jyotiṣa* (1400 B. C. or earlier) does not speak of this, A comparison of the astronomical constants of the Greek and the ancient Indian systems, points unmistakably to the conclusion that the Indian constants as determined by Āryabhaṭa I and his successors, are almost in all cases different from those of Greeks. Indian astronomers were highly original in their concepts and treatment. The originality of Āryabhaṭa I and other astronomers would be seen from what we are discribing below.

Apparent Motions of the Sun and Moon

We have the following passages from Āryabhaṭa :

All planets move in eccentrics to their orbits at the mean rates of angular motion, in the direction of the signs of the zodiac from their apogees (or aphelia) and in the opposite directions from their *Śighroccas.*

The eccentric circles of planets are equal to their concentrics and the centre of the eccentric is removed from the centre of the Earth.

The distance between the centre of the Earth and the centre of the eccentric is equal to the radius of the planet's epicycle; on the circumference (whether of the epicycle or of the eccentric) the planet undoubtedly moves with the mean motion.

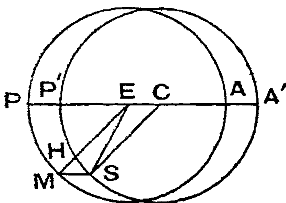


Fig. 15

Here the central idea was that undoubtedly planets moved unifomly in circles round the Earth; if the motion appeared to be variable, it was due to the fact that the centres of such circle (i. e. the concentric circles) did not coincide with the centre of the Earth.

Let E represent the centre of the Earth(Fig.15), APM the Sun's circular orbit or concentric; let A and P be the apogee and the perigee respectively. From EA, cut off EC equal to the radius of the Sun's epicycle. With centre C and radius equal to EA describe the eccentric A'P'S cutting AP and AP produced at P' and A'. Here A' and P' are the real apogee and perigee of the Sun's orbit. Let PM and P'S be any two equal arcs measured from P and P.'

The idea is that the mean planet M and the apparent Sun S move simultaneously from P and P' in the counterclockwise direction along the concentric and the eccentric circles. They move with the same angular motion and arrive simultaneously at M and S.

Here EM and CS are parallel and equal, hence MS is also equal and parallel to EC. Let SH be drawn perpendicular to EM.

The angle PEM is the mean anomaly and the angle P'ES the true anomaly; the angle SEM is the equation of the centre, is readily seen to be plus (+) from P' to A' and minus (−) from A' to P'.. Thus as regards the character of the equation, the eccentric circle is quite right. We now turn to exmine how far it is true as to the amount.

Let the angle SEM denoted by E and the angle $\angle$PEM $=\angle P'CS=\theta$; $EP=CP'=a$; $EC=MS=p$, then

$$\tan E=\frac{SH}{HE}=\frac{p\sin\theta}{a-p\cos\theta}$$

$$\therefore \qquad E=\frac{p}{a}\sin\theta-\frac{p^2}{2a^2}\sin 2\theta+\frac{p^3}{3a^3}\sin 3\theta\ldots\ldots\ldots$$

Now the true value of E in elliptic motion is given by

$$E=\left(2e-\frac{e^3}{4}\right)\sin\theta+\frac{5}{4}e^2\sin 2\theta+\frac{13e^3}{12}\sin 3\theta^*;\ldots$$

It we now put $\frac{p}{a}=2e-\frac{e^3}{4}$, as a first appoximation $\frac{p}{a}=2e$.

Hence $\frac{p^2}{2a^2}=2e^2$, which is greater than $\frac{5}{4}e^2$ by $\frac{3}{4}e^2$. In the case of the Sun if the value of p be correctly taken the error in the coefficient of the second term becomes+3'; similarly in the case of the Moon, the corresponding error becomes+8'.

*Godfray's *Astronomy*, p. 149.

Again if $\frac{p}{a}=2e$, what is the centre of the eccentric circle is the empty focus of the ellipse or that the ancient astronomers practically took the planets to be moving with uniform angular motion round the empty focus. This was not a bad approximation.

Also ES$=r=$EH approximately,

$$\therefore \quad r=a\left(1-\frac{p}{a}\cos\theta\right)$$

but in the elliptic motion

$$r=a\,(1-e\cos\theta).*$$

Hence the error is not very considerable here also.

This is the way in which the ancient astronomers, both Greek and Hindu, sought to explain the inequalities in the motion of the Sun and the Moon. In the case of the Moon, these astronomers took the coefficient $2e-\frac{e^3}{4}=300'$ nearly; the modern value is 377′ nearly. The reason for this has been pointed out to be that the Moon was observed correctly only at times of eclipses. At the eclipses of sygygies, the evection term of the Moon's equation diminishes (numerically) the principal ecliptic term by about 76′.

We have thus far explained the idea of planetary motion of the ancients under the eccentric circle costruction. The same, however, is explained under the epicyclic construction.

Let AMP be the circular orbit of the Sun, having E the centre of the earth for the centre. (Fig. 16) Let the diameter AEP be the apse line. A the apogee and P the perigee. Let M be the mean position of the Sun in the orbit. With M as the centre, describe the epicycle UNS. Let EM cut the epicycle at N and U. Now the construction for finding S the apparent Sun is thus given:—

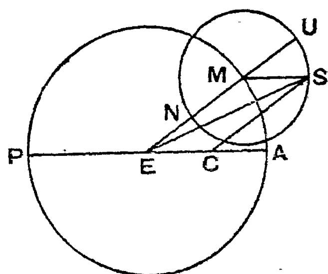


Fig. 16

Make ∠UMS=∠MEA, the arc US is measured clockwise whereas the arc A to M is measured counterclockwise.

From this construction MS is parallel to EA. If EC be measured equal to MS, the radius of the epicycle, along EA to-

* Godfray's *Astronomy*, p. 149.

wards the apogee, then CS is a constant length and C is a fixed point. Hence the locus of S is an equal circle with the centre at C. Thus both the eccentric, and the epicycle and the concentric combined, led to the same position.

It was thus usual to explain the planetary motion under both the assumed constructions; and both gave the position for a planet. The eccentric circle construction appears to be the earlier in the history of astronomy and the latter was later. If the former construction can be traced to Apollonius of Perga who did so much to develop the "conic sections" as science, the reason why he preferred the eccentric circle to the ellipse, appears to be that either that this planetary construction was always deep-rooted in the minds of men or that he was carried by the idea that "the circle was the most perfect curve." We are inclined to the view that the eccentric circle idea was transmitted from Babylonia to Greece. We now pass on to consider the Indian construction for the possition of superior and inferior planets.

Superior Planets

With regard to the five planets, Mercury, Venus, Mars, Jupiter and Saturn, the Indian astronomers give only one construction for finding the apparent geocentric position. Each of these "star planets" is conceived as having twofold planetary inequalities : (i) the inequality of apsis, (ii) the inequality of the *śighra*. With regard to the superior planets, the *śighra* apogee or the *śighrocca* coincided with the mean position of the Sun. As Varāhamihira observed, of the other planets beginning with Mars, the Sun is the so-called *śighra*. (*PSi*. XVII. 1)

Let AMSP be the concentric of which the centre E is the same as that of the earth(Fig.17); $A'M_1P'$ the eccentric circle of apsis of a superior planet, of which the centre is C;A,M,S,P be respectively the apogee, the Mars planet, the direction of the *śighra* and the perigee of the concentric; A', M_1, P' be the apogee, the planet as corrected by the equation of apsis, P′ the perigee in the eccentric. The arc

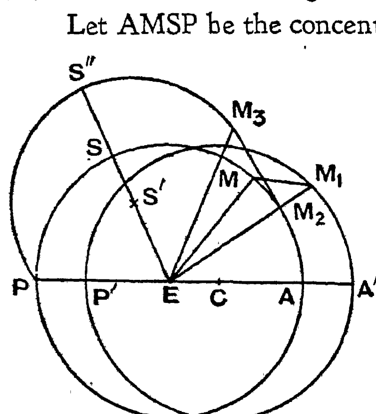


Fig. 17

AM=arc $A'M_1$; MM_1 is parallel and equal to EC. As used before, both the concentric and the eccentric are of the same radius.

Here the mean planet M in the concentric is taken to be deflected to M_1 due to the true motion in the eccentric circle. Join EM_1 cutting the concentric at M_2. Now let ES be joined and let S′ be taken along ES, such that

$$\frac{ES'}{ES}=\frac{\text{Śighra periphery of the planet in degrees}}{360}$$

$$=\frac{\text{Sun's mean distance from the Earth}}{\text{Planets mean distance from the Sun or the Earth;}}$$

ES′ thus determined is called the radius of the *śighra* epicycle of the superior planet.

With S′ as the centre and the radius equal to ES or EA describe another circle which is called the *śighra* eccentric cutting ES produced at S″. Now measure the arc $S''M_3$ in the concentric=SM_2 in the concentric. The apparent superior planet is seen in the direction EM_3 from the Earth. This is the construction used in Hindu astronomy calculating the geocentric longitude of any star planet.

It is evident in the case of a superior planet that the eccentric having S′ for the centre and whose radius=EA=R the standard radius for any circular orbit, is the mean orbit of the planet and S′ the mean position of the Sun. In other words, in the case of a superior planet, the *śighra* eccentric represents the mean orbit round the Sun. If the parallelogram CES′C′ be constructed, then an equal circle described with C′ as the centre is the apparent eccentric orbit of the superior planet.

In the actual method of calculating the geocentric longitude of a "star planet" there are four operations given, the first two of which have the effect of changing the arc MA or rather the point A. The last two operations relate to the two displacements MM_1 and M_2M_3. We have here followed solely the construction of the eccentric circles; the same geocentric position of a superior planet could be equally well obtained by the epicyclic construction. In describing the constructions for finding the position of an inferior planet we shall follow the epicyclic construction only

Inferior Planets

Let E be the centre of the Earth (Fig. 18), AMS the orbit of

a mean inferior planet or the mean Sun. EA the direction of the apogee of apsis and ES that of the *śighra*. The inequality of the apsis takes the mean geocentric planet from M to M_1, such that MM_1 is parallel to EA. Let EM_1 be joined cutting the concentric at M_2 ; M_2 is taken as the centre of the *śighra* epicyle or the real circular orbit in which the apparent planet moves.

Fig. 18

With M_2 as the centre and the radius of the inferior planents' *śighra* epicycle as radius, describe the circle NVU which is here the *śighra* epicycle or the real circular orbit. In it draw the radius M_2V parallel to ES; then VP is the geocentric position of the inferior planet.

Here the first displacement MM_1 is due to the inequality of apsis and is for finding the position of M_2 the centre of the real circular orbit. The idea was that the apparent planet moved in a circular orbit of which the centre was very near the mean position of the Sun, the first operation in this construction was calculated to determine the centre of this so-called circular orbit of an inferior planet.

The *śighra* of an inferior planet moves round the Earth at the same mean rate in which the inferior planet moves round the Sun; hence the line ES in this figure is always parallel to the line joining the Sun to the mean heliocentric inferior planet, and in our construction, it is parallel to M_2V.

This in brief is an outline of the Indian idea of planetary motion as taught by Āryabhaṭa I, Brahmagupta and Bhāskara II.

—: o :—

Reference

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CHAPTER VIII

Brahmagupta and Arithmetic

Scope of Gaṇita

The word *Gaṇita* means the science of calculation. The term occurs in the *Vedāṅga Jyautiṣa* (c. 1200 B. C.) :

> Just as the crest is to the peacocks, and just as the head-gem is to the snakes, so the Gaṇita among the Vedāṅga Śāstras stands at the head.[1] (VJ. 4)

In the ancient Buddhistic literature, we find mention of three classes of *gaṇita* : (i) *mudrā* (finger arithmetic). (ii) *gaṇanā* (mental arithmetic), and (iii) *saṁkhyāna* (higher arithmetic in general). In the *Brāhmasphuṭasiddhānta*, Brahmagupta uses the word *gaṇita* in the sense of entire calculations. His *gaṇitādhyāya* (Chapter XII) includes ;

> (i) *Miśraka* (mixtures). (ii) *Śreḍhī* (series). (iii) *Kṣetra* plane figures), (iv) *Vṛtta-kṣetra* (circles), (v) *Khāta* (excavations), (vi) *Citi* (piles of bricks), (vii) *Krākacika* (sawn pieces of timber), (viii) *Rāśi* (heaps or mounds of grain, and (ix) *Chāyā* (shadow).

Brahmagupta also uses the term *Dhūlikarma* (literally meaning "dustwork") for higher mathematics :

> The one learned man who knows the *dhūlikarma* or the science of mathematics as propounded by Brahmagupta would far excell them in learning who are taught the calculations according to Āryabhaṭa. Viṣṇucandra and others.[2]

> In these ten chapters of the *Brahmasiddhānta* has been given the *dhūlikarma* or the science of entire calculations

1. यथा शिखा मयूराणां नागानां मणयो यथा ।
तद् वद् वेदांग-शास्त्राणां गणितं मूर्धनि स्थितम् ॥ *VJ. 4.*

2. नावार्यो ज्ञातेरपि तन्त्रैरार्यभटविष्णुचन्द्राद्यैः ।
यो ब्रह्म धूलिकर्मविदाचार्यत्वं भवति तस्य ॥ —*BrSpSi. X. 62.*

> which is faultless.[1]
>
> This science of *dhūlikarma* has not been imparted by great teachers for blasphemy. One who would be using it for this purpose would lose all good name.[2]

Brahmagupta uses the term *gaṇita* only for those calculations which are of arithmetical in nature. The science of algebra, the foundations of which was laid by Āryabhaṭa I, was named as *kuṭṭaka* or *kuṭṭākāra* by Āryabhaṭa, and in the *Brāhmasphuṭa-siddhānta* also it is separately dealt with under *Kuṭṭādhyāya* or *kuṭṭakādhāya* (Chapter XVIII). Later on the term *bījagaṇita* was specifically given to the science of algebra.

The *Kuṭṭādhyāya* of the *Brāhmasphuṭasiddhānta* deals with the (i) concept of *kuṭṭaka* (pulveriser), addition of positive and negative as well as zero quantities, equations in one unknown (*eka-varṇa samīkaraṇa*), equations in several unknowns (*aneka-varṇa samīkaraṇa*), equations involving products of unknowns (*bhāvita*) and quadratic equations (*varga-prakṛtiḥ*) (Chapter XVIII of the *Brāhmasphuṭasiddhānta*).

Āryabhaṭa, Bhāskara and Brahmagupta use Place Value Notations.

In Europe the first definite traces of the place-value numerals are found in the tenth and eleventh centuries, but the numerals came into general use in mathematical text books only in the seventeenth century. In India, however, Āryabhaṭa I (499), Bhāskara I (522), Lalla (c. 598) and Brahmagupta (628) all use the place value numerals. There is no trace of any other system in their works. Perhaps in this country we had the place value system as early as 200 B.C. if not earlier. The use of a symbol for zero is found in Piṅgala's *Chandaḥ Sūtra* (perhaps of 200 B.C.). In literature, we have an indication of the place value from about 100 B.C. and later in the Purāṇas from the second to the fourth century A.D. The *Bakhaśālī Manuscript* (perhaps of 200 A.D.) uses the place-value notations. The earliest use of the place value principle with the letter numerals

1. ग्रहयोगोत्र ग्रहयुतिरार्योत्रिशतियुताष्टसप्तत्या ।
अध्यायैर्दशभिर्धूलिकर्म वोच्चैर्विना ब्रह्मै ॥ —*BrSpSi*. X. 66.

2. गुरुणा न धूलिकर्म प्रतिकंचुककारिणे प्रदातव्यम् ।
दत्त सुकृतप्रणाशं कुरुते प्रतिकंचुकं यस्य ॥ —*BrSpSi*. X. 67

is found in the works of Bhāskara I about the beginning of the sixth century A.D. Thus for 3179, the expressive words are *Navādrirūpāgni*[1] (*nava* 9, *adri* 7. *rupa* 1 and *agni* 3). Similarly in the *Brāhmasphuṭasiddhānta*, for a large number like 2296828522, the expressive terms are DVIYAMAŚARĀṢṬAPAKṢAVASŪRASANAVADVIYAMĀḤ(*Dviyama* two twos 22, *Śara* 5,aṣṭa 8, *pakṣa* 2, *vasū* 8, *rasa* 6. *nava* 9, *dviyamāḥ* 22).[2] Such usages are to be found in all works, which clearly state the place value concept was popular as a routine. From India, this system reached Arabia. During the reign of the Khalif Al-Mansur (753-774 A.D.) there came embassies from Sindh to Baghdad, and among them were scholars, who brought along with them several works on mathematics including the *Brāhmasphuṭasiddhānta* and the *Khaṇḍakhādyaka* of Brahmagupta: With the help of these scholars, Al-fazari, perhaps also Yakub ibn Tarik, translated them into Arabic. Both works were largely used and exercised great influence on Arab mathematics. It was on that occasion that the Arabs first became acquainted with a scientific system of astronomy. It is acceptable to all writers on the subject that it was at that time that the Hindu numerals were first definitely introduced amongst the Arabs. Arabs at first adopted the *ghobar* form of numerals which they had already obtained (but without zero) from the Alexandrians or from the Syrians. This they continued for about two centuries, but since they were not suited to their right-to-left script, they gave them up and adopted the more convenient ones. For a detailed discussion on how numerals went to the west from India and spread in Europe one is referred to this discussion in the *History of Hindu Mathematics.* Part I by Datta and Singh (1935, Single volume Edition, 1962, pp. 83-104). It is remarkable that Brahmagupta's works like the *Brāhmasphuṭasidhānta* and the *Khaṇḍakhādyaka* became instrumental in the spread of the place-value notation in the neighbouring countries of the Middle East, and from their this system spread into Europe.

Operations and Determinations in Pāṭīgaṇita

The word *Pāṭīgaṇita* is a compound formed from the words *pāṭī*, meaning 'board', and *gaṇita*, meaning 'science of calculation',

1. *MBh. 1. 4;*
2. *BrSpSi 1-16.*

hence it means the science of calculation which requires the uses of writing material (the board). The word *pāṭi* is not Sanskrit (it originated in the non-Sanskrit literature in India); the oldest term in Sanskrit for the board is *Phalaka* or *paṭṭa*. However this term got currency in the Sanskrit literature also about the beginning of the seventh century. Brahmagupta does not use the term *pāṭīgaṇita*: he favours the use of the term *dhūlikarma* or writing figures on dust spread on a board or on the ground. The word *pāṭīgaṇita* was translated into Arabic as *ilm-hisab-al-takht* (calculation on board) and the word *dhūlikarm a* as *hisab-al-ghobār* (cal culation on dust).

Brahmagupta, in the very first verse in the Chapter XII (*Gaṇitādhyāya*) refers to twenty operations (*parikarma*) and eight determinations :

> He who distinctly and severally knows the twenty logistics, addition etc.. and the eight determinations (*vyavahāra*) inculding (measurement by) shadow is a *gaṇaka* (mathe-m atician).[1]

The commentators have given the list of these logistics (*parikarma*) and determinations (*vyavahāra*) as follows;

(A) *Parikarma* or logistics

1. Saṁkalitam (addition)
2. Vyavakalitam (subtraction)
3. Gaṇanam (multiplication)
4. Bhāgahāraḥ (division)
5. Vargaḥ (square)
6. Vargamūlam (square-root)
7. Ghanaḥ (cube)
8. Ghanamūlam (cube root)
9. 13. Five standard forms of fractions (Pañca-jāti)
14. Trairāśikam (the rule of three)
15. Vysta-trairāśikam (the inverse rule of three)
16. Pañca-rāśikam (the rule of five)
17. Sapta-rāśikam (the rule of seven)
18. Nava-rāśikam (the rule of n ine)

---

1. परिकर्म विंशतिं यः संकलितयाद्यां पृथक् विजानाति ।
अष्टौ च व्यवहारान् छायान्तान् भवति गणकः सः ॥ —*BrSpSi*. XII. 1

19. Ekādaśa-rāśikam (the rule of eleven)
20. Bhāṇḍa-pratibhāṇḍam (barter and exchange)

(B) *Vyavahāra* or determinations

1. Miśrakaḥ (mixture)
2. Śreḍhī (progession or series)
3. Kṣetram (plane figures)
4. Khātam (excavation)
5. Citiḥ (stock)
6. Krākacikaḥ (saw)
7. Rāśiḥ (mound)
8. Chāyā (shadow)

Of the operations enlisted here, the first eight have been considered fundamental by later writers as Mahāvīra. The operations of duplation and mediation (doubling and halving) were considered fundamental by Arabs, Greeks and Egyptians; since they were not familiar with the place-value system.

Mathematics in this country developed as an aid to astronomy, and therefore, for the first time we find Āryabhṭa(499AD.) in his *Āryabhaṭīya* describing as a special section (*Gaṇitapāda*). Brahmagupta (628 A.D.) also followed Āryabhaṭa in this respect and gave the science of calculation (*gaṇita*) a special place in his treatise on astronomy. The *Siddhānta* treatises, earlier than those of Āryabhaṭa and Brahmagupta do not contain a chapter exclu-ʌᴉsʎlǝ devoted to *gaṇita* (the *Sūrya-Siddhānta* and the Siddhāntas of *Vasiṣṭha,Pitāmaha* and *Romaka* are thus without *gaṇita* chapetrs). Later on Bhāskara I and Lalla also did not include *gaṇita* as a section or chapter in their treatises.It is said, however, that Lalla wrote a separate treatise on *Pāṭīgaṇita.*

It may further be remarked here that Āryabhaṭa I gives the rules for finding the square and cube-roots only whilst Brahmagupta gives the cube-root rule only (*BrSpSi.* XII. 7).

Multiplication

Undoubtedly the common Indian name 'multiplication' is '*guṇana*', this term occurs in the Vedic literature also. The other terms for this logistics are *hanana, vadha, kṣaya* etc., which all mean 'killing' or 'destroying.' The synonyms of '*hanana*' (killing) for multiplication have been used by Āryabhaṭa I (499). Brahmagupta (628), Śrīdhara (c.750) and later writers, and these terms

also occur in the Bakhaśālī Manuscript.

Āryabhaṭa I does not mention the everyday methods of multiplication in his *Āryabhaṭīya* probably because they were too elementary to be included in a Siddhānta work. Brahmagupta, however, in a supplement to the section on mathematics in his *Siddhānta*, gives the names of some methods with very brief descriptions of the processes:—

> The multiplicand repeated, as in *gomūtrikā* as often as there are digits in the multiplier, is severally multiplied by them and (the results) added according to places; this gives the product. Or the multiplicand is repeated as many times as there are component parts in the multiplier.[1]

(the word *bheda* occurring in the verse has been translated as "integrant portions" by Colebrooke p. 319. Again by the term *bheda* are meant portions which added together make the whole, or aliquot parts which multiplied together make the entire quantity.

> The multiplicand is multiplied by the sum or the difference of the multiplier and an assumed quantity and, from the result the product of the assumed quantity and the multiplicand is subtracted or added.[2]

(Colebrooke thinks that this is a method to obtain the true product when the multiplier has been taken to be too great or too small by mistake.[3] Datta and Singh think, however, that this is not correct.[4]

Thus Brahmagupta mentions four methods of multiplication: (i) *gomūtrikā*, (ii) *khaṇḍa*. (iii) *bheda*, and (iv) *iṣṭa*. The common and the well known method of *kapāṭa-sandhi* has been omitted by him.

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1. गुणकारखण्डतुल्यो गुण्यौ गोमूत्रिकाकृतो गुणितः ।
सहितः प्रत्युत्पन्नो गुणकारकभेदतुल्यो वा ॥ —*BrSpSi XII. 55*

2. गुण्यो राशिगु णकारराशिनेष्टाधिकोनकेन गुणः ।
गुण्येष्टवधो न युतो गुणकेऽभ्यधिकोनके कार्यः ॥ —*BrSpSi. XII. 56*

3. Colebrooke, T. H., *Hindu Algebra*, p. 320.

4. Datta, B. and Singh, A. N., *History of Hindu Mathematics* Pt. I (Arithmetic), p. 135 (1962).

(i) *Gomūtrika*-method or zig-zag method. The word *gomūtrikā* means "similar to the course of cow's urine", hence "zigzag". This method in all essentials is the same as the *sthāna-khaṇḍa* method. The following illustration is based on the commentary of Pṛthūdaka Svāmī :

Example : To multiply 1223 by 235.

The numbers are written thus :

```
2   1223
3    1223
5     1223
```

The first line of figures is then multiplied by 2, the process beginning at units place, thus : $2 \times 3 = 6$; 3 is rubbed out and 6 substituted in its place, and so on. After all the horizontal lines have been multiplied by the corresponding numbers on the left in the vertical line, the numbers on the *pāṭī* stand thus :

```
2446
 3669
  6115
------
287405
```

after being added together as in the present method.

The *sthāna-khaṇḍa* and the *gomūtrikā* methods resemble modern plan of multiplication most closely.

(ii) *Khaṇḍa* Method or Parts Multiplicatian Method : Since the days of Brahmagupta, this method of multiplication also became very popular. We have two methods under this head :

(i) The multiplier is broken up into two or more parts whose sum is equal to it. The multiplicand is then multiplied severally by these and the results added.

To take an example :

$$13 \times 158 = (6+7) \times 158 = (6 \times 158) + (7 \times 158)$$
$$= 948 + 1106$$
$$= 2054$$

(ii) The multiplier is broken up into two more aliquot parts. The multiplicand is then multiplied by one of these, the resulting product by the second and so on till all the parts are exhausted. The ultimate product is the result.

Thus for example :

$$
\begin{aligned}
96\times 237 &= (4\times 4\times 6)\times 237\\
&= (4\times 237)\times 4\times 6 = 948\times 4\times 6\\
&= (4\times 948)\times 6 = 3792\times 6\\
&= 22752
\end{aligned}
$$

These methods of multiplication are found among the Arabs and the Italians, having obtained from people of India. They were known as the "Scapezzo" and "Repiego" methods respectively amongst Italians.

(iii) *Iṣṭa-guṇana* Method or the Algebraic Method.

We have already quoted the relevant verse from the *Brāhmasphuṭa-siddhānta* in this connection; (XII. 56) :

> The multiplicand is multiplied by the sum or the difference of the multiplied and an assumed quantity and from the result the product of the assvmed quantity and the multiplicand is subtracted or added.[1]

This method is of two kinds according as we (i) add or (b) subtract an assumed number. The assumed number is so chosen as to give two numbers with which multiplication will be easier than with the original multiplier. The two ways are illustrated below :

(i) $93\times 13=(93+7)\times 13-7\times 13=1300-91=1209.$

(ii) $93\times 13=(90+3)13=90\times 13+3\times 13=1170+39$
$=1209$

This method was in use among the Arabs and in Europe, obviously having gone out from this country.

This process has been regarded as an inverse of multiplication. The terms used for this operation are *bhāgahāra*, *bhājana*, *haraṇa*, *chedana*, etc., all these terms more or less carrying the sense "to break into parts", "to divide" etc., excepting "*haraṇa*" which denotes "to take away". This term shows the relation of division to the operation of subtraction. The dividend is termed as *bhājya*. *hārya* etc., the divisor is known as

1. गुण्यो राशिर्गुणकारराशिनेष्टाधिकोनकेन गुणः ।
गुण्येष्टवधो न युतो गुणकेऽभ्यधिकोनके कार्यः ॥ —*BrSpSi. XII. 56*

bhājaka, *bhāgahāra* or simply *hara*; quotient is known as *labdhi* or *labdha* (or "what is obtained").

India never regarded this operation as a difficult one; in Europe, this operation was regarded as a tedious one till the 15th century or so. Division was such a common operation that Āryabhaṭa did not regard it as worth being included in his treatise. But since he has given the methods of extracting square-roots and cube-roots, which obviously depend on division, we conclude that the method of division was known to him. Most *Siddhānta* writers have followed Āryabhaṭa I in omitting this operation from their texts, this being regarded too elemantary to be included. Brahmagupta does not give details of this operation. The later treatises on Arithmetic as Śrīdhara's *Triśatikā* and the *Pāṭīgaṇita* (I.20) and Āryabhaṭa II (c.950 A.D.) have given the details of this operation.

Square

The Sanakrit term for square is *varga* or *kṛti* (*varga* literally means "rows" or "troops" of similar things). In mathematics, it usually means the square power and also the square figure or its area. Thus we find in the *Āryabhaṭīya* :

> A square figure of four equal sides (and the number representing its area) are called *varga*. The product of the two equal quantities is also *varga*[1].

The term *kṛti* means "doing", "making" or "action". It carries with it the idea of specific performance probably the graphical representation.

For the first time we have a definite rule for squaring in the writings of Brahmagupta. But it does not mean that prior to him it was not known. It must have been known to Āryabhaṭa I since he has given the square-root method.

Brahmagupta gives his method of squaring briefly as follows :

> Combining the product, twice the digit in the less (lowest) place into the several others (digits) with its (i.e. of the digit in the lowest place) square (repeatedly) gives the square.[2]

---

1. वर्गस्समचतुरश्रः फलञ्च सदृशद्वयस्य संवर्गः । —*Ārya. II.* 3.

2. राशेरन्त्यं द्विगुणं बहुतरगुणमूनकृतियुतं वर्गः । —*BrSpSi. XII.* 63.

The method has been more clearly enunciated by Mahāvīra (850 A.D.) in the *Gaṇitasārasaṁgraha :*

> Having squared the last (digit), multiply the rest by the digits by twice the last, (which) is moved forward (by one place). Then moving the remaining digits continue the same operation (process), This gives the square.[1]

Brahmagupta's method of squaring is shown by the following example :

To square 125.

The number is written down

125

The square of the digit in the last place, i. e., $5^2=25$ is set over it thus :

25
125

Then, $2 \times 5=10$ is placed below the other digits, and 5 is rubbed out, thus :

25
12
10

Multiplying by 10 the rest of the digits, i.e., 12 and setting the product over them (the digits), we have.

1225
12
10

Then rubbing out 10 which is not required and moving the rest of the digits, i. e. 12 we, have

1225
12

Thus one round of operations is completed.

Again as before, setting the square of 2 above it and $2 \times 2=4$ below 1. we have

1625
1
4

1. GSS. P. 12.

Multiplying the remaining digit 1 by 4, and setting the product above it, we have

5625
1

Then moving the remaining digit 1, we obtain

5625
1

Thus the second round of operations is completed.

Next setting the square of 1 above it the process is completed for there are no remaining figures, and the result stands thus :

15625

Algebraic Method of Squaring

Brahmagupta in his *Brāhmasphuṭasiddhānta* gives a minor method of squaring thus :

> The product of the sum and the difference of the number (to be squared) and an assumed number plus the square of the assumed number give square[1].

This may be represented by the following identity :

$$n^2=(n-a)(n+a)+a^2$$

This identity has been used for squaring by most of the Indian mathematicians. Thus

$$15^2=(15-5)(15+5)+5^2=225$$

We are not giving here other identities which have been used by latter mathematicians of India in getting the squares of numbers; for example, when Mahāvīra says :

> The sum of the squares of the two or more portions of the number together with their products each with the others multiplied by two gives the square[2] :

he obviously refers to the identity

$$(a+b+c\ldots\ldots\ldots\ldots)^2=a^2+b^2+c^2+\ldots\ldots+2ab+\ldots\ldots$$

Cube

The Sanskrit term for cube is *ghana*. It when used in the geometrical sense also means the solid cube. In the arithmetical sense, it means the continued product of the same number taken three times. Thus we have the definition in the *Ārya-*

1. राशेरिष्ट्युतोनाद्वधः कृतिर्वेष्टकृतियुक्तः । – *BrSpSi. XII. 63*
2. *GSS.* p. 13.

bhaṭīya :

> The continued product of three equals and also the solid having twelve (equal) edges are called *ghana*.[1]

A method of cubing applicable to numbers written in the decimal place-value notation, has been in use in this country from before the 5th century A.D. Āryabhaṭa I (499 A.D.) had the familiarity with this method; he, however, does not give the method of cubing in his treatise, though he describes the inverse process of extracting the cube-root.

Brahmagupta gives the method of cubing in the following verse :

> Set down the cube of the last (*antya*); then place at the next place from it, thrice the square of the last multiplied by the succeeding; then place at the next place thrice the square of the succeeding multiplied by the last, and (at the next place) the cube of the succeeding. This gives the cube.[2]

The rule may be illustrated by an example.

Example : To cube 1357.

The given number has four places, i.e., four portions. First we take the last digit 1 and the succeeding digit 3, i.e. 13 and apply the method of cubing thus :

(i) Cube of the last (1^3) = 1

(ii) Thrice the square of the last (3.1^2) multiplied by the succeeding (3) gives ($3.3.1^2$) = 9 (placing at the next place)

(iii) Thrice the square of the succeeding, multiplied by the last gives ($3.3^2.1$) = 27 (placing at the next place)

(iv) Cube of the succeeding (3^3) = 27 (placing at the next place)

Thus 13^3 is the sum 2197

1. सदृशत्रयसंवर्गो घनस्तथा द्वादशाश्रस्स्यात् ॥ —*Ārya*, *II*. 3.
2. स्थाप्योऽन्त्यघनोऽन्त्यकृतिस्त्रिगुणोत्तरसंगुणा च तत्प्रथमान् ।
उत्तरकृतिरन्त्यगुणा त्रिगुणा चोत्तर घनश्च घनः । —*BrSpSi*. *XII*, 6.

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(iii) Thrice the square of the succeeding, multiplied by the last gives ($3.3^2.1$)	=	27 (placing at the next place)
(iv) Cube of the succeeding (3^3)	=	27 (placing at the next place)
Thus 13^3 is the sum		2197

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2. स्थाप्योऽन्त्यघनोऽन्त्यकृतिस्त्रिगुणोत्तरसंगुणा च तत्प्रथमान् ।
उत्तरकृतिरन्त्यगुणा त्रिगुणा चोत्तर घनश्च घनः । —*BrSpSi. XII, 6.*

After this we take the next figure, 5, i.e., the number 135, and in this consider 13 as the last and 5 as the succeeding. Then the method proceeds thus :

(i) The cube of the last (13^3) as already obtained = 2197

(ii) Thrice the square of the last multiplied by the succeeding, i.e. $3.13^2.5$ = 2535 (placing at the next place)

(iii) Thrice the square of the succeeding multiplied by the last, i.e, $3.5^2.13$ = 975 (placing at the next place)

(iv) Cube of the succeeding, i.e. 5^3 = 125 (placing at the next place)

Thus 135^3 is the sum 2460375

Now the remaining figure 7 is taken, so that the number is 1357, of which 135 is the last and 7 the succeeding. The method proceeds thus :

(i) Cube of the last, i.e. (135^3) as already obtained = 2460375

(ii) Thrice the square of the last into the succeeding, i.e, $3.(135)^2.7$ = 382725 (placing at the next place)

(iii) Thrice the square of the succeeding into the last, i.e. $3.7^2.135$ = 19845 (placing at the next place)

(iv) Cube of the succeeding i.e. 7^3 = 343 (placing at the next place)

Thus $(1357)^3$ is the sum 2498846293

Evidently these methods of cubing are based on the identity:

$$(a+b)^3=a^3+3a^2b+3ab^2+b^3$$

and keeping in mind the place values of numerals in a given

number (this accounts for keeping the results of each of the four operations at the next place).

Square-Root

Indian synonyms for square-root are *vargamūla* or *pada* of a *kṛti*. The word *mūla* means the "root" of a tree, which may also mean the "foot" or the lowest part or bottom of a thing and hence "pada" or foot also became a synonym of root. Brahma-Gupta defines square-root as follows :

> The *pada* (root) of a *kṛti* (square) is that of which it is the square.[1]

While the word *mūla* for *root* is the oldest in Indian literature (it occurs in *Anuyogadvāra-sūtra*, c. 100 B.C.), the word *pada* for root probably for the first time occurs in the writings of Brahmagupta. The term *mūla* was borrowed by the Arabs who translated it by *jadhr*, meaning "basis of square". The Latin term *radix* also is a translation of the term *mūla*. In the Śulba literature and in the Prākṛta texts, we find a term *karaṇī* for square-root. In geometry, this term *karaṇī* means a "side", In later days, the term *karaṇī* was reserved for surds, i.e. a square-root which cannot be exactly evaluated, but which may be represented by a line.

We would like to quote here a rule for determining square-root of numbers from the *Āryabhaṭīya* :

> Always divide the even place by twice the square-root (upon the preceding odd place); after having subtracted from the odd place the square (of the quotient), the quotient put down at the next place (in the line of the root) gives the root[2].

As an illustration, we shall proceed to find the square-root of 18225.

The odd and even places are marked out by vertical (I) and horizontal (—) lines : The other steps are as follows :

1. पदं कृतिर्यत् तत् *BrSpSi.* XVIII. 35

2. भागं हरेदवर्गान्नित्यं द्विगुणेन वर्गमूलेन ।
   वर्गाद्वर्गे शुद्धे लब्धं स्थानान्तरे मूलम् ॥ —*Ārya*, II. 4.

	1 – 1 – 1	
	18225	
Subtract square	1	root = 1
Divide by twice the root	2) 8 (3	placing quotient at the
	6	next place, the root=13
	22	
Subtract square of quotient	9	
Divide by twice	26)132(5	placing quotient at the
the root	130	next place, the root=135
Subtract square	25	
of the quotient	25	

The process ends. The square-root of 18225 is thus 135.

It has been stated by Kaye, that Āryabhaṭa's method of finding out the square-root is algebraic in character, and that it resembles the method given by Theon of Alexandria. Āryabhaṭa's method is purely atithmetic and not algebraic is the view of Datta and Singh who do not agree with Kaye on this point.

Cube Root

The Sanskrit term for cube-root is *ghanamūla* or *ghanapada*. The first mention of the operation of cube-root is found in the *Āryabhaṭīya* of Āryabhaṭa I (499 A.D.), though the operation is given in only a concise form:

> Divide the second *aghana* place by thrice the square of the cube-root; subtract from the first *aghana* place the square of the quotient multiplied by thrice the preceding (cube-root); and (subtract) the cube (of the quotient) from the *ghana* place; (the quotient put down) at the next place (in the line of the root) gives (the root).[1]

As has been explained by all the commentators on the *Āryabhaṭīya*, the units place is *ghana*; the tens place is first *aghana*, the hundreds place is the second aghana, the thousands place is ghana, the ten thousands place is first *aghana*, the hun-

1. अघनाद् भजेद् द्वितीयात् त्रिगुणेन घनस्य मूलवर्गेण ।
वर्गस्त्रिपूर्वं गुणितश्शोध्यः प्रथमाद् घनश्च घनात् ॥ —*Ārya*. II. 5

dred-thousands place is second *aghana*, and so on. Thus to find out the cube-root, one has to mark out the *ghana*, first *aghana* and second *aghana* places, then the process of finding out the cube-root begins with the subtraction of the greatest cube number from the figures up to the last *ghana* place. Though this has not been explicitly mentioned in the rule, the commentators say that it is implied in the expression *ghanasya mūla-vargeṇa* etc. ("by the square of the cube-root etc.")

We are reproducing here an illustration given by Datta and Singh.

Example. Find the cube-root of 1953125.

The places are divided into groups of three by marking them as below [*ghana* (|) first *aghana* (—) and second *aghana* (—)]:

	| — — | — — |	
	1 9 5 3 1 2 5	
Subtract cube	1	(c) Root=1
Divide by thrice square of root, i.e. 3.1^2	3)9(2 ...	(a) Placing quotient after the root 1 gives the root 12
Subtract square of quotient multiplied by thrice the previous root, i.e. $2^2.3.1$	6 35 12 ...	(b)
Subtract cube of quotient, i.e. 2^3	233 8 ...	(c)
Divide by thrice square of the root, i.e. 3.12^2	432)2251(5 ...	(a) Placing quotient after the root 12 gives the root 125
Subtract square of quotient multiplied by thrice the previous root, i.e. $5^2.3.12$	2160 912 900	
Subtract cube of quotient, i.e. 5^3	125 ... 125 ...	(b) (c)

Thus the cube-root=125.

From the details given, it would be clear that the present

method of extracting the cube-root is almost a contraction of the method first given by Āryabhaṭa I (499 A.D.)

The method of Āryabhaṭa has been invariably followed by Indian mathematicians. Brahmagupta in his *Brāhmasphuṭa-siddhānta* repeats the method in the following words :

> The divisor for the second *aghana* place is thrice the square of the cube-root; the square of the quotient multiplied by three and the preceeding (root) must be subtracted from the next (*aghana* place to the right). and the cube (of the quotient) from the *ghana* place (the procedure repeated gives) the root.[1]

Śrīdhara and Āryabhaṭa II have further improved on the method of extracting cube-root proposed by Āryabhaṭa I and followed by Brahmagupta. Rule for finding the cube-root as given by Śrīdhara in his *Pāṭīgaṇita* is as follows :

> (Divide the digits beginning with the units' place into periods of) one *ghana*-pada (one "cube" place) and two *aghana-padaṣ* (two "non-cube" places). Then subtracting the (greatest possible) cube from the (last) *ghana-pada* and placing the (cube) root underneath the third place (to the right of the last *ghana-pada*), divide out the remainder up to one place less (than that occupied by the cube root) by thrice the square of the cube-root, which, is not destroyed. Setting down the quotient (obtained from division) in the line (of the cube-root), (and designating the quotient as the 'first' (*ādima*) and the cube-root as the 'last' (*antya*), subtract the square of that quotient, as multiplied by thrice the 'last' (*antya*) from one place less than that occupied by the quotient (*uparima-rāśi*) as before, and the cube of the 'first' (*ādima*) from its own place.
>
> (The number now standing in the line of cube-root is the cube-root of the given number up to its last-but one *ghana-pada* (cube place) from the left).
>
> Again apply the rule, "(placing cube-root) under the third place" etc. (provided there be more than two *ghana-padas* (cube places) in the given number; and

1. छेदो घनाद् द्वितीयाद् घनमूलकृतिस्त्रिसंगुणाप्तकृतिः ।
शोध्या त्रिपूर्वगुणिता प्रथमाद् घनतो घनो मूलम् ॥ —*BrSpSi.* XII. 7

continue the process till all *ghana-padas* (cube-places) are exhausted). This will give the (cube) root (of the given number).[1]

K.S. Shukla in his translation and commentary of this book has given the illustration of extracting cube - root as follows :

Example :- To find the cube root of 277167808.

Let us indicate *ghana-padas* or 'cube' places by "*c*" and *aghana-padas* or non-cube places as "*n*" :

n n c n n c n n c
2 7 7 1 6 7 8 0 8

Subract the greatest possible cube (i.e. 6^3 or 216) from the last 'cube' place (i.e. from 277) and place the cube-root (i.e. 6) underneath the third place to the right of the last 'cube' place; thus we have

n n c n n c n n c
6 1 1 6 7 8 0 8 (remainder)
6 (line of cube-root)

Dividing out by thrice the square of the cube-root (i.e. by 3.6^2 or 108) the remainder up to one place less than that occupied by the cube-root (i.e. 611) and setting down the quotient in the line of the cube-root (to the right of the cube-root), we have

n n c n n c n n c
7 1 6 7 8 0 8 (remainder)
6 5 (line of cube-root)

Let now quotient 5 be called the 'first' (*ādima*) and the cube-root 6 the 'last' (*antya*). Then subtracting the square of the 'first' (*ādima*) as multiplied by thrice the 'last' (*antya*) (i.e. $3 \times 6 \times 5^2$ or 450) from one place less than that occupied by the quotient (i.e. from 716), we get

1. घनपदमघनपदे द्वे घन (पद) तोऽपास्य घनमदो मूलम् ।
संयोज्य तृतीयपदस्याधस्तदनष्टवर्गेण ॥ २९ ॥
एकस्थानोनतया शेषं त्रिगुणेन (सं) भजेत्तस्मात् ।
लब्धं निवेश्य पङ्क्त्यां तद्वर्गं त्रिगुणमन्त्यहतम् ॥ ३० ॥
जह्यादुपरिमराशेः प्राग्वद् घनमादिमस्य (च) स्वपदात् ।
भूयस्तृतीय पदस्याध इत्यादिक विधिमूलम् ॥ ३१॥

—Śrīdhara, *Pāṭīgaṇita*, 29-31

n n c n n c n n c
2 6 6 7 8 0 8 (remainder)
6 5 (line of cube-root)

And subtracting the cube of the 'first' (*ādima*) (i.e. 5^3 or 125) from its own place (i.e. from 2667), we get

n n c n n c n n c
2 5 4 2 8 0 8 (remainder)
6 5 (line of cube-root)

One round of the operation is now over; and the number 65 standing in the line of the cube-root is the cube-root of the given number (277167808) up to its last-but-one 'cube' place (*ghana pada*) from the left (i.e. of 277167),

As there is one more 'cube' place (*ghana-pada*) on the right, the process is repeated, Thus placing the cube-root (i.e. 65) under the third place beginning with the last-but-one 'cube' place (*ghana-pada*), we have

n n c n n c n n c
2 5 4 2 8 0 8 (remainder)
6 5 (line of cube-root)

Dividing out 25428 by 3.65^2 (=12675) as before, and placing the quotient in the line of the cube-root, we have

n n c n n c n n c
7 8 0 8 (remainder)
6 5 2 (line of cube-root)

Subtracting $3 \times 65 \times 2^2$ (=780) we get.

n n c n n c n n c
8 (remainder)
6 5 2 (line of cube-root)

Finally subtracting $2^3=8$ from 8, we get

n n c n n c n n c
0 (remainder)
6 5 2 (line of cube-root)

The second round of operation is now over. There being no more of *ghana-pada* ('cube' place) on the right, the process ends, The quantity in the line of cube root, viz., 652, is the cube-root of the given

number. The remainder being zero, the cube-root is exact.

Fractions

The concept of fractions in India can be traced to very early times. In the *Ṛgveda*,[1] we find such terms as one-half (*ardha*) and three-fourths (*tri-pāda*). In a passage of the *Maitrāyaṇī Saṁhitā*[2] are mentioned the fractions one-sixteenth (*kalā*), one-twelfth (*kuṣṭha*), one-eighth (*śapha*) and one-fourth (*pāda*). In the *Śūlba Sūtras*[3] we have not only a mention of fractions, but they have been used in the statement and solution of problems of geometric nature. Here in the *Śulba*, unit fractions are denoted by the use of cardinal number with the term *bhāga* or *aṁśa*; thus *pañca-daśa-bhāga* (literally "fifteen parts") is equivalent to one-fifteenth, *sapta-bhāga* (literally, "seven parts") is equivalent to one-seventh, and so on... The use of ordinal numbers with the term *bhāga* or *aṁśa* is also quite common: thus *pañcama bhāga* stands for one-fifth. The composite fractions like *tri-āṣṭama* stands for three-eighths and *dvi-saptama* for two-sevenths. In the *Bakhaśālī Manuscript*, the term *tryaṣṭa* occurs for 3/8 and $3\frac{3}{8}$ is called *trayastrayasta* (three-three-eighths).

The Sanskrit term for fraction is *bhinna* (literally meaning 'broken'). Obviously the European terms as *fractio, fraction, roupt, rotto* or *rocto* are translations of the same term; they are derived from the Latin *fractus (frangere)* or *ruptus* meaning 'broken'. The Indian term *bhinna* has a few more connotations; it stands for such numbers of the form:

$$\left(\frac{a}{b}\pm\frac{c}{d}\right),\ \left(\frac{a}{b}\text{ of }\frac{c}{d}\right),\ \left(\frac{a}{b}\pm\frac{c}{d}\text{ of }\frac{a}{b}\right)\text{or}\left(a\pm\frac{b}{c}\right).$$

These forms were termed *jāti*' i.e., 'classes', and the Indian treatises contain special rules for their reduction to proper fractions. Śrīdhara and Mahāvīra each enumerate six *jātis*. while our author, Brahmagupta, gives only five (Bhāskara II gives only four). The need for division of fractions in 'classes' arose out of the lack of proper symbolism to indicate mathematical operations. (Datta and Singh *Arithmetic*, p. 188). The only operational symbol in use was a dot, standing for the negative sign.

1. *Ṛv*. X. 90.4
2. *Mait* S. III. 7.7.
3. B. Datta, *Śulba*, pp. 212ff.

Reduction to lowest terms.—A non-mathematical work, *Tattvārthādhigama-Sūtra-Bhāṣya* by Umāsvāti (c.150A.D.) casually mentions as follows in the context of a philosophic discourse:

> Or, as when the expert mathematician, for the purpose of simplifying operations, removes common factors from the numerator and denominator of a fraction, there is no change in the value of the fraction, so,...[1]

Reduction to common denominator. Whenever we have to add or subtract fractions, we follow this reduction operation to a common denominator. Brahmagupta gives the reduction along with the similar processes :

> By the multiplication of the numerator and denominator of each of the (fractional) quantities by other denominators, the quantities are reduced to a common denominator. In addition, the numerators are united, In subtraction their difference is taken.[2]

Fractions in combination :—Since there was no proper symbolism available to these early Indian mathematicians, they divided combination of fractions into four classes :

Bhāga, prabhāga, bhāgāpavāha and *bhāga-bhāga.*

(i) *Bhāga* has been mentioned by Brahmagupta (*BrSpSi.* XII, 8) thus : $\left(\frac{a}{b} \pm \frac{c}{d} \pm \frac{e}{f} \pm \ldots\ldots\ldots\right)$ usually written as

$$\begin{array}{|c|c|c|} a & c & e \\ b & d & f \end{array} \text{ or } \begin{array}{|c|c|c|} a & .c & .e \\ b & d & f \end{array}$$

where the dots denote subtraction.

(ii) *Prabhāga* : The form $\left(\frac{a}{b} \text{ of } \frac{c}{d} \text{ of } \frac{e}{f} \ldots\ldots\ldots\right)$

This is written as

$$\begin{array}{|c|c|c|} a & c & e \\ b & d & f \end{array}$$

(iii) *Bhāgānubandha* :The form $\left(a + \frac{b}{c}\right)$ is written as

$$\begin{array}{|c|} a \\ b \\ c \end{array}$$

1. II, 52.
2. विपरीतच्छेदगुणा : राश्योश्छेदांशकाः समच्छेदाः ।
संकलितेंऽशा योज्या व्यवकलितेंऽशान्तरं कार्यम् ॥ —*BrSpSi*. XII. 2.

and the form

$$\frac{p}{q}+\frac{r}{s} \text{ of } \frac{p}{q}+\frac{t}{u} \text{ of}\left(\frac{p}{q}+\frac{r}{s} \text{ of} \frac{p}{q}\right)+\ldots\ldots\ldots\ldots$$

is written as

$$\begin{array}{|c|} \hline p \\ q \\ \hline r \\ s \\ \hline t \\ u \\ \hline \end{array}$$

(iv) *Bhāgāpavāha*, i.e., the form $\left(a-\frac{b}{c}\right)$ is written as

$$\begin{array}{|c|} \hline a \\ .b \\ c \\ \hline \end{array}$$

and the form $\frac{p}{q}-\frac{r}{s} \text{ of} \frac{p}{q}-\frac{t}{u} \text{ of}\left(\frac{p}{q}-\frac{r}{s} \text{ of } \frac{p}{q}\right)-\ldots\ldots\ldots$

is written as

$$\begin{array}{|c|} \hline p \\ q \\ \hline .r \\ s \\ \hline .t \\ u \\ \hline \end{array}$$

(v) Bhāga-bhāga : The form

$$\left(a\div\frac{b}{c}\right) \text{ or}\left(\frac{p}{q}\div \frac{r}{s}\right)$$

There does not appear to have been any notation for division, such compounds being written as

$$\begin{array}{|c|} \hline a \\ b \\ c \\ \hline \end{array} \text{ or } \begin{array}{|c|} \hline p \\ q \\ \hline r \\ s \\ \hline \end{array}$$

just as for *bhāgānubandha*. That division is to be performed was known from the problem, e.g., $1\div\frac{1}{6}$ was written as ṣaḍ-bhāga-bhāga, i.e., "one-sixth *bhāga-bhāga*" or "one divided by one-sixth". It is only in the Bakhśālī Manuscript that the term *bhā* is sometimes placed before or after the quantity affected.

(vi) *Bhāga-mātṛ*, i.e., combinations of forms enumerated above. Mahāvīra, the author of the *Gaṇitasārasaṁgraha* (850

A.D.) gives twenty-six variations of this class. We shall illustrate it by the following example from Śrīdhara :

> What is the result when half, one-fourth of one-fourth, one divided by one-third, half-plus half of itself, and one-third diminished by half of itself, are added together ? (*Triśatikā*, p. 12).

A modern writer would have written it as :

$$\frac{1}{2}+(\frac{1}{4}\text{ of }\frac{1}{4})+(1\div\frac{1}{3})+(\frac{1}{2}+\frac{1}{2}\text{ of }\frac{1}{2})(\frac{1}{3}-\frac{1}{2}\text{ of }\frac{1}{3})$$

In the old Indian notation, it is written as

1	1	1	1	1	1
2	4	4	1	2	3
			3	1	.1
				2	2

The defect of the notation is obvious: | 1 | 1 | over | 4 | 4 | can be read also as $\frac{1}{4}+\frac{1}{4}$ and | 1 | 1 | 3 | (1 over 1 over 3) can also be read as $1\frac{1}{3}$.

And therefore the original meaning is inferred from the context or from the enunciation of the problem.

The rules for reduction of the first two classes (*bhāga* and *prabhāga)* are those of addition or subtraction and multiplication. The rule for the reduction of the third (*bhāgānubandha)* and fourth (*bhāgāpavāha)* classes are given by Brahmagupta in the *Brāhmasphuṭa-siddhānta* thus :

> The (upper) denominator is multiplied by the denominator and the upper numerator by the same (denominator) increased or diminished by its own numerator.[1]

"Numerator" is known as "*aṁśa*" and the "denominator" as "*cheda*."

We give here from Śrīdhara's *Pāṭigaṇita* (about 900 A.D., according to K.S. Shukla, 750 A.D. according to Datta and Singh) a rule for reducing a fraction of the *bhāgānubandha* class (i.e., a whole number increased by a fraction or a fraction increased by a fraction itself) :

1. ऊर्ध्वांशाश्छेदगुणास्तृतीयजातौ द्वयोः पृथक्परयोः ।
छेदैश्छेदा गुणिताः स्वांशयुतोनैरुपरिमांशाः ।। —*BrSpSi. XII. 9.*

> In the *bhāgānubandha* class, the whole number (*rūpa-gaṇa*) is multiplied by the denominator (of the fraction) should be increased by the numerator (of the fraction) or the upper denominator having been multiplied by the lower denominator, the initial numerator (i.e. the upper numerator) should be multiplied by the sum of the lower numerator and denominator.[1]

(*Pāṭīgaṇita*, 39 *cf*. *BrSpSi*. *XII*. 9 (*ii*); *GSS*. (iii) 113

This means that

(i) $a+\frac{b}{c}=\frac{ac+b}{c}$

(ii) $\frac{a}{b}+\frac{c}{d}$ of $\frac{a}{b}$ (which was written by Indians in the style

$$\begin{array}{|c|} \hline \frac{a}{b} \\ \frac{c}{d} \\ \hline \end{array}$$

is equal to $\frac{a(d+c)}{bd}$

Addition and Subtraction of Fractions

In the *Brāhmasphuṭa-siddhānta*, Brahmagupta gives the rule for the addition and subtraction of fractions :

> If the denominators (*cheda*) of fractions are different then reduce these fractions to a common denominator. Now for the additions, unite the numerators and take their difference in case of subtraction.[2]

Brahmagupta and Mahāvīra give the method under *Bhāga-jāti*.

Multiplication

Brahmagupta says :

The product of the numerators divided by the pro-

1. भागानुबन्धजातौ रूपगणश्छेद सङ्गुणः सांशः ।
अवरहरघ्नोर्ध्वं हरेऽधोंशाऽयुतहरघ्न आद्यंशः ॥ —*Pāṭīgaṇita 39.*
2. विपरीतच्छेदगुणाः राश्योश्छेदांशकाः समच्छेदाः ।
संकलितेंऽशा योज्या व्यवकलितेंऽशान्तरं कार्यम् ॥ —*BrSpSi*. XII. 2

duct of the denominators is the (result of) multiplication of two or more fractions.[1]

While all other writers give the rule in the same way as Brahmagupta, Mahāvīra in the *Gaṇitasārasaṁgraha* refers to cross reduction in order to shorten the work :

> In the multiplication of fractions, the numerators are to be multiplied by the numerators and the denominators by denominators, after carrying out the process of cross reduction, if that be possible.[2]

Division of Fractions

The *Āryabhaṭīya* does not explicitly give the rule of division, but under the Rule of Three, we have an indication of this operation. The Rule of Three states the result as $\frac{f \times i}{p}$, where f stands for *phala* i.e. "fruit", i for *icchā*, i.e., demand or requisition, and p for *pramāṇa* i.e. argument. When these quantities are fractional, we get an expression of the form

$$\frac{\frac{a}{b} \times \frac{c}{d}}{\frac{m}{n}}$$

for the evaluation of which Āryabhaṭa I states :

> The multipliers and the divisor are multiplied by the denominators of each other.

These quantities are written in the following way

$$\begin{array}{|cc|} \frac{a}{b} & \frac{m}{n} \\ \hline \frac{c}{d} & \\ \hline \end{array}$$

Transferring the denominators we have

$$\begin{array}{|cc|} a & m \\ n & b \\ c & d \\ \hline \end{array}$$

Performing multiplication, the result is $\frac{anc}{mbd}$. The above interpretation of the obscure line in the *Āryabhaṭīya* is based

1. रूपाणिच्छेद गुणान्यंशयुतानि द्वयोर्बहूनां वा ।
प्रत्युत्पन्नो भवति च्छेदवधेनोद्धृतोऽशवधः ॥ —*BrSpSi*. XII. 3

2. GSS. p. 25. (2)

on the commentaries of Sūryadeva and Bhāskara I (the commentary of Parameśvara on this line is vague and misleading). Sūryadeva in this connection says :

> Here by the word *guṇakāra* is meant the multiplier and multiplicand, i.e., the *phala* and *icchā* quantities that are multiplied together. By *Bhāgahāra* is meant the *pramāṇa* quantity. The denominators of the *phala* and *icchā* are taken to the *pramāṇa*. The denominator of the *pramāṇa* is taken with the *phala* and *icchā*. Then multiplying these, i.e., (the numerators of) the *phala* and *icchā* and this denominator, and dividing by (the product of) the numbers standing with the *pramāṇa* the result is the quotient of the fractions.

Brahmagupta gives the method of division as follows :

> The denominator and numerator of the divisor having been interchanged, the denominator of the dividend is multiplied by the (new) numerator. Thus division of *proper fractions* is performed.[1]

Square and Square-Root of Fractions

Brahmagupta says as follows in this connection:—

> The square of the numerator of a proper fraction divided by the square of the denominator gives the square[2].

This rule of Brahmagupta has been followed by other authors also. The rule regarding the square-root as given by Brahmagupta is as follows :

> The square-root of the numerator of a proper fraction divided by the square-root of the denominator gives the square-root.[3]

The Rule of Three :

The Indian term in Sanskrit for the Rule of Three is *Trairāśika* (literally, "three terms"). The term occurs in the *Bakhśālī Manuscript* also, and also in the *Aryabhaṭīya*, indicating the

1. परिवर्त्य भागहारंच्छेदांशौ छेद संगुणच्छेदः ।
अंशोऽशगुणो भाज्यस्य भागहारः सवर्णितयोः ॥ —*BrSpSi*. XII. 4

2. संवर्णितांशवर्गश्छेदकृतिविभाजितो भवति वर्गः । —*BrSpSi*. XII. 5 (1)

3. संवर्णितांशमूलं छेदपदेनोद्धृतं मूलम् । —*BrSpSi*. XII. 5 (2)

antiquity of the term. Bhāskara in his commentary of the *Āryabhaṭīya* gives a justification of the use of this term for the Rule of Three thus :

> Here three quantities are needed (in the statement and calculation) so the method is called *trairāśika* (meaning thereby the "rule of three terms").

The problem of the Rule of Three has the form :

> If *p* (*pramāṇa*) yields *f* (*phala*), what will *i* (*icchā*) yield ?

Āryabhaṭa II (the author of the *Mahāsiddhānta*, 950 A.D.) uses the terms *māna*, *vinimaya* and *icchā*, instead of *pramāṇa*, *phala* and *icchā* respectively. It has also been pointed out by several authors that the first and third terms are similar, i.e., of the same denomination.

We shall give here the Rule of Three as given by Āryabhaṭa I and Brahmagupta :

> In the Rule of Three, the *phala* ("fruit"), being multiplied by the *icchā* ("requisition') is divided by the *pramāṇa* ("argument"). The quotient is the fruit corresponding to the *icchā* The denominators of one being multiplied with the other give the multiplier (i.e. numerator) and the divisor (i.e. denominator).[1]
> In the Rule of Three *pramāṇa* ("argument"), *phala* ("fruit") and *icchā* ("requisition") are the (given) terms; the first and the last terms must be similar. The *icchā* multiplied by the *phala* and divided by the *pramāṇa* gives the fruit (of the demand).[2]

Śrīdhara also gives the Rule of Three almost in the same words. Bhāskara II, Nārāyaṇa and others follow Brahmagupta and Śrīdhara in the *Trairāśika* operation. Śrīdhara in his *Pāṭīgaṇita* says :

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1. त्रैराशिकफलराशिं तमथेच्छाराशिनाहतं कृत्वा ।
लब्धं प्रमाणभजितं तस्मादिच्छाफलमिदं स्यात् ॥
छेदाः परस्परं हता भवन्ति गुणकार भागहाराणां ।
छेदगुणं सच्छेदं परस्परं तत्सवर्णत्वम् ॥ —*Arya*; II 26-27.

2. त्रैराशिके प्रमाणं फलमिच्छाद्यन्तयोः सदृशराशी ।
इच्छाफलेन गुणिता प्रमाणभक्ता फलं भवति ॥ —*BrSpSi* XII. 10

> In (solving problems on) the Rule of Three, the argument (*pramāṇa*) and the requisition (*icchā*), which are of the same denomination, should be set down in the first and last places; the fruit (*phala*), which is of a different denomination, should be set down in the middle, (this having been done) that (middle quantity multiplied by the last quantity should be divided by the first quantity.[1]

We shall illustrate the Rule of Three by an example from the *Pāṭīgaṇita* (Example 25):

> Example, If 1 *pala* and 1 *karṣa* of sandalwood are obtained for ten and a half *paṇas*, then for how much will nine *palas* and one *karṣa* (of sandalwood) be obtained ?[2]

Here in this Example.

argument=1 *pala* and 1 *karṣa*=$1\frac{1}{4}$ or 5/4 *palas*; fruit=$10\frac{1}{2}$ or 21/2 *paṇas*;

and requisition=9 palas and 1 karṣa=$9\frac{1}{4}$ or 37/4 palas. According to the Rule we shall write them as :

1	10	9
1	1	1
4	2	4

Converting these into proper fractions we have

5	21	37
4	2	4

Then applying the rule, (i.e. multiplying the second and the last and dividing by the first), we have

21	5
2	4
37	
4	

$$=\frac{\frac{21}{2}\times\frac{37}{4}}{\frac{5}{4}}$$

Or transferring denominators

21	5
4	2
37	4

$$=\frac{21.4.37}{5.2.4}\ \textit{pala}$$

1. आद्यन्तयोस्त्रिराशावभिन्नजाती प्रमाणमिच्छा च ।
फलमन्यजातिमध्ये तदन्त्यगुणमादिना विभजेत् ॥ —*Pāṭīgaṇita* 43.

2. चन्दनपलं सकर्षं सार्धैर्यदि लभ्यते पणैर्दशभिः ।
तत्किं लभ्यन्ते पलानि नव कर्षयुक्तानि ॥ —*Pāṭīgaṇita*. Ex. 25.

=4 purāṇa, 13 paṇas, 2 kākiṇīs and 16 varāṭakas. (One purāṇa is equivalent to 16 paṇas; one paṇa is equivalent to 4 kākiṇīs, and one kākiṇī is equivalent to 20 varāṭakas or cowries.

Inverse Rule of Three

This is known as *vyasta-trairāśika* (literally meaning "inverse rule of three terms)". After having described the rule of three, Brahmagupta proceeds to give an account of this inverse rule of three :

> Divide the *phala* with *icchā* and multiply by *pramāṇa*; this gives the *vyasta-trairāśika* inverse rule of three[1].

Here *pramāṇa* is the argument also known as the first term and, and *phala* is the fruit also known as the middle term and *iccha* is known as requisition or the last term. As Bhāskara II clearly states, this rule is applied where with the increase of the *icchā*, the *phala* decreases or with its decrease the *phala* increases (*Līlāvatī*).

Rule of Compound Proportion

Brahmagupta and other writers call the rule of compound proportions as *pañca-rāśika*, *sapta-rāśika* etc., meaning the rule of five terms, rule of seven terms etc. depending on the number of terms involved the problems. These are sometimes grouped under the general application of the "Rule of Odd Terms". Āryabhaṭa I (499 A.D.) though actually gives the rule of three appears to have been quite familiar with the rule of compound proportion also. In fact the difference between the rule of three and compound proportion is more or less artificial. This view was expressed by Bhāskara I (525 A.D.) in his commentary on the *Āryabhaṭīya* :

> Here Ācarya Āryabhaṭa has described the Rule of Three only. How the well-known Rules of Five etc. are to be obtained ? I say thus : The Ācarya has described only the fundamentals of *anupāta* (proportion). All others such as the Rule of Five etc. follow from that fundamental rule of proportion. How ? The Rule of Five etc. consist of combinations of the Rule of Three. ......In the Rule of Five, there are two Rules of

1. व्यस्त त्रैराशिक फलमिच्छा भक्तः प्रमाण फलघातः ।
त्रैराशिकादिषु फलं विषमेष्वेकादशान्तेषु ॥ —*BrSpSi* XII. 11

> Three, in the Rule of Seven three Rules of Three, and so on. This I shall point out in the examples.

Brahmagupta gives the following rule relating to the solution of problems in compound proportion :

> In the case of odd terms beginning with three terms up to eleven, the result is obtained by transposing the fruits of both sides, from one side to the other, and then dividing the product of the larger set of terms by the product of the smaller set. In all the fractions, the transposition of denominators, in like manner, takes place on both sides.[1]

This may be illustrated by taking an example from the commentary of Pṛthūdaka Svāmī on the *Brāhmasphuṭasiddhānta* :

Example —If there is an increase of 10 in 3 months on 100 (*niṣkas*), what would be the increase on 60 (*niṣkas*) in 5 months.

Here the *Pramāṇa pakṣa* (the first set of terms) is
100 niṣkas, 3 months, 10 niṣkas (phala)

The second set or the *icchā pakṣa* is
60 *niṣkas*, 5 months, x *niṣkas*

The terms are written in compartments as below :

100	60
3	5
10	0

In the above 10 (written lowest) is the *fruit* of the first side (*pramāṇa pakṣa*), and there is no *fruit* on the second side or the *iccā pakṣa.* Interchanging the *fruits* we get

100	60
3	5
0	10

The larger set of terms is on the second side (*icchā pakṣa*). The product of the numbers is 3,000. The product of the

1. व्यस्त त्रैराशिक फलमिच्छा भक्तः प्रमाणफलघातः ।
त्रैराशिकादिषु फलं विषमेष्वेकादशान्तेषु ॥
फलसंक्रमणमुभयतो बहुराशि वधोऽल्पवधहृतो ज्ञेयम् ।
सकलेष्वेवं भिन्नेषूभयतश्छेदसंक्रमणम् ॥ —*BrSpSi:* XII. 11-12.

number on the side of the smaller set of terms is 300. Therefore the required result is $\frac{3000}{300}=10$.

Rule of Three as a Particular Case

According to Brahmagupta, the above method of "compound proportion" may be applied to the Rule of Three. Taking the example solved under the Rule of Three:

> If one *pala* and one *karṣa* of sandal wood are obtained for ten and a half *paṇas*, for how much will be obtained nine *palas* and one *karṣa*?
>
> (4 karṣas=1 pala)

We shall represent them according to the Rule of Compound Proportion as

Pramāṇa pakṣa : 1 *pala*, 1 *karṣa*, $10\frac{1}{2}$ *paṇa*
or $\frac{5}{4}$ *pala* , $\frac{21}{2}$ *paṇa*
Icchā pakṣa : 9 *pala*, 1 *karṣa*, x *paṇa*
or 37/4 *pala* , x *paṇa*

This we shall represent as

5	37
4	4
21	0
2	

Transposing the fruits, we have

5	37
4	4
0	21
	2

Transposing denominators

5	37
4	4
0	21
2	

The product of numbers on the side of the larger set is divided by the product of the numbers on the side of the smaller set, 0 in this case is not a number. It is the symbol for the unknown or absence, Hence the result is :

$$\frac{37.4.21}{5.4.2} \textit{ paṇas}$$

> The above method of working Rule of Three is found among Arabs, although it does not seem to have been used in India after Brahmagupta.

Problem Containing Quadratic Equation

Perhaps Āryabhaṭa I is the first man in the history of mathematics to give a solution of a quadratic equation (499 A.D.). In his *Āryabhaṭīya*, he gives a rule for the solution of the following problem (I am reproducing it as described by Datta and Singh):

> The principal sum p (=100) is lent for one month (interest unknown=x). This unknown interest is then lent out for t(=six) months. After this period, the original interest (x) plus the interest on this interest amounts to A(=16). The rate-interest (x) on the principal (p) is required.

This problem requires the solution of the quadratic equation :—

$$tx^2+px-AP=0$$

which gives $x=\dfrac{-p/2\pm\sqrt{(p/2)^2+Apt}}{t}$

The negative value of the radical does not give a solution of the problem; so that the result is

$$x=\frac{\sqrt{Apt+(p/2)^2}-p/2}{t}$$

This solution is stated by Āryabhaṭa I in the following words:

> Multiply the sum of the interest on the principal and the interest (A) by the time (t) and by the principal (p). Add to this result the square of half the principal $(p/2)^2$. Take square-root this. Subtract half the principal ($p/2$) and divide the remainder by the time (t). The result will be the (unknown) interest (x) on the principal.[1]

Here the Sanskrit terms are *mūla* for principal and *phala* for interest.

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1. मूलफलं सफलं कालमूलगुणमर्धमूलकृतियुक्तं ।
मूलं मूलार्धोनं कालहृतं स्यात्स्वमूलफलम् ॥ *Ārya. II. 25,*

Brahmagupta (628 A.D.) gives a more general rule: He enunciates his problem thus:

> The principal (p) is lent out for t_1 months and the unknown interest on this ($=x$) is lent out for t_2 months at the same rate and becomes A. To find x.

This evidently gives the quadratic:

$$x^2+\frac{pt_1}{t_2}\ x-\frac{Apt_1}{t_2}=0$$

whose solution is

$$x=\pm\sqrt{\frac{Apt_1}{t_2}+\left(\frac{pt_1}{2t_2}\right)^2}-\frac{pt_1}{2t_2}$$

The negative value of the radical does not give a solution of the problem, so it is discarded.

Brahmagupta states the formula thus:

> Multiply the principal (p) by its time (t_1) and divide by the other time (t_2) (placing the result) at two places. Multiply the first of these by the mixture (A). Add to this the square of half the other. Take the square-root of this (sum). From the result subtract half the other. This will be the interest (x) on the principal.[1]

A Problem on Interest

Brahmagupta gives a solution of a problem on interest:

> In what time will a given sum s, the interest on which for t months is r, become k times itself?

The rule for the solution of this problem as given by Brahmagupta is:

> The given sum multiplied by its time and divided by the interest (*phala*), being multiplied by the factor (*guṇa*) less one, is the time (*required*).[2]

Miscellaneous Problems

Brahmagupta in his *Gaṇitādhyāya* of the *Brāhmasphuṭa-siddhānta* gives numerous solutions in relation to miscellaneous problems. Here I shall be quoting a few of the problems which

1. कालप्रमाणघातः परकालहृतो द्विधाऽऽयमिश्रवधात् ।
अन्यार्धकृतियुतात् पदमन्यार्धोनं प्रमाणफलम् ॥ —*BrSpSi*. XII. 15.

2. कालगुणितं प्रमाणं फलभक्तं व्येकगुणहतं कालः ।
स्वफलयुतरूपभक्तं मूलफलैक्यं भवति मूलम् ॥ —*BrSpSi*. XII. 14.

have been quoted by his commentator Pṛthūdaka Svāmī in connection with one of his karaṇa-sūtra.[1]

1. A horse was purchased by (nine) dealers in partnership, whose contributions were one, etc. up to nine; and was sold by them for five less than five hundred. Tell me what was each man's share of the sale proceed[2]
2. Four colleges (mathas), containing an equal number of pupils, were invited to partake of a sacrificial feast. A fifth, a half, a third and a quarter (of the total number of pupils in the college) came from the respective colleges to the feast; and added to one, two, three and four, they were found to amount to eighty-seven; or, with those deducted, they were sixty seven. Find the actual number of the pupils that came from each college.[3]

3. Three (unequal) jars of liquid butter, of water and of honey, contained thirty-two, sixty and twenty-four *Pala* respectively; the whole was mixed together and the jars filled again. Tell me the quantity of butter, of water and of honey in each jar[4].

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1. प्रक्षेपयोगहृतया लब्ध्वा प्रक्षेपका गुणा लाभाः ।
ऊनाधिकोद्धरास्तद्युतोनया स्वफलमूनयुत ॥ *BrSpSi.* XII. *16.*

2. एकाद्यैर्नव पर्यन्तैर्वणिग्भिर्मूलराशिभिः ।
क्रीतो हयोऽसौ विक्रीतः पञ्चोनैः पञ्चोनैः पंचभिः शतैः ।
किमेकैकस्य तत्रासीद् ब्रूहि त्वं मिश्रकान् मम ॥

3. मठस्थानानि चत्वारि छात्राणां समसंख्यया ।
भोक्तुं संमन्त्रितान्यासन् दीक्षायां किल यज्वना ॥
पंचार्धत्रिचतुर्थांशास्तेभ्यो भोक्तुं समागताः ।
एकद्वित्रिचतुर्युक्ता ह्यशीतिः ससप्तका ॥
एवोत्तरैरथवा हीना सप्तषष्टिश्चतेऽशकाः ।
मठेभ्यश्छात्रसंख्यां मे ब्रूहि ये चागता यतः

4. घृतोदक मधूनां ये त्रयः कलसकाः पलैः ।
रदषष्टिजिनैः पूर्णा एकीभूतास्ततः पुनः ॥
मिश्रेण पूरिता यावत् तावत् संख्यां न वेद्म्यहम् ।
घृतोदकमधूनां तामेकैकत्र गतां वद ॥

—: o :—

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CHAPTER IX

Brahmagupta as an Algebraist

Ancient Indian name for algebra is *Bījagaṇita* where *bīja* means *element* or *analysis* and *gaṇita* stands for the *science of calculation*. As early as 860 A.D., Pṛthūdaka Svāmi used this epithet for algebra in his commentary. Brahmagupta calls algebra as *Kuṭṭakagaṇita* or merely *kuṭṭaka*, a term which was later on used for "*pulveriser*" which deals with that special section of algebra which is connected with indeterminate equations of the first degree. Algebra is often also known as *avyakta-gaṇita* or the calculations with *unknowns*, in contrast to arithmetic which was known as *vyakta-gaṇita* or the calculations with *knowns*.

Algebra goes to Europe from India

In the history of mathematical sciences, as Colebrooke rightly remarks, it has long been a question to whom the invention of algebraic analysis is due. There is no doubt that Europe got algebra from Arabs mediately or immediately. But the Arabs themselves scarcely pretend to the discovery of algebra. Colebrooke says that they were not in general inventors but scholars during the short period of their successful culture of the sciences; and the germ at least of the algebraic analysis is to be found among the Greeks in an age not precisely determined, but more than probably anterior to the earliest dawn of civilisation among the Arabs; and this science in a more advanced state subsisted among the Hindus prior to the earliest disclosure of it by the Arabians to modern Europe. (Colebrooke: *Dissertation on the Algebra of the Hindus*)[1].

Colebrooke based his observations on the texts he could procure for his studies. These were: Bhāskara II's *Bījagaṇita* or *Vījagaṇita* (1150A.D.) and *Līlāvatī* (1150A.D.), the *Gaṇitādhyāya* and *Kuṭṭakādhyāya* of Brahmagupta in his famous treatise the *Brahma Siddhānta* or rather the *Brāhmasphuṭasiddhānta* (628

1. Colebrooke, H. T., *Miscellaneous Essays*, Vol. II, 1872, p. 418.

A.D.). There can be no doubt regarding the age of these two authors. Bhāskara II completed his great work on the *Siddhānta-śiromaṇi* in 1072 Śaka, and *Karaṇa-kutūhala* a practical astronomical treatise in 1105 Śaka; these dates are based on the passages given by Bhāskara himself in his works. The *Bīja-gaṇita* and the *Līlāvatī* form parts of the great treatise, the *Siddhānta-śiromaṇi*. The genuineness of the text is established, as Colebrooke says, with no less certainty by numerous commentators in Sanskrit, besides a Persian version of it. Those commentaries comprise a perpetual gloss, in which every passage of the original is noticed and interpreted : and every word of it is repeated and explained. From comparison and collation of various texts, it appears then that the work of Bhāskara, exhibiting the same uniform text which the modern transcripts of it do, was in the hands of both Muhammedans and Hindus, between two or three centuries ago : and numerous copies of it having been diffused throughout India, at an earlier period, as of a performance held in high estimation, It was the subject of study and habitual reference in countries and places so remote from each other as the north and west of India and the Southern Peninsula.

This though not marking any extraordinary antiquity, nor approaching to that of the author himself, was a material point to be determined : as there will be in the sequel, so says Colebrooke, occasion to show, that modes of analysis, and in particular, general methods for the solution of indeterminate problems both of the first and second degrees, are taught in the *Bīja-gaṇita*, and those for the first degrees repeated in the *Līlāvatī*, which were unknown to the mathematicians of the West, until invented anew in the last two centuries by algebraists of France and England.[1] Bhāskara who himself flourished more than six hundred and fifty years ago, was in this respect a compiler and took those methods from Indian authors as much more ancient than himself.

Regarding the age of the precursors of Bhāskara II, Colebrooke says: The age of his precursors cannot be determined with equal precision. He then proceeds to examine the evidence as follows :

1. Colebrooke, H. T., *Miscellaneous Essays*, p. 421.

Towards the close of his treatise on Algebra, Bhāskara II informs us, that it is compiled and abridged from the more diffuse works on the same subject, bearing the names *Brāhme* (meaning no doubt Brahmagupta), Śrīdhara and Padmanābha; and in the body of his treatise, he has cited a passage of Śrīdhara's algebra and another of Padmanābha. He repeatedly adverts to preceding writers and refers to them in general terms, where his commentators understand him to allude to Āryabhaṭa, to Brahmagupta to the latter's scholiast Caturveda *Pṛthūḍaka Svāmī* and to the other writers above mentioned.

Most, if not all, of the treatises, to which he thus alludes, must have been extant, and in the hands of his commentators, when they wrote; as appears from their quotations of them; more especially those of Brahmagupta and Āryabhaṭa, who are cited, and particularly the first mentioned, in several instances. A long and diligent research in various parts of India, has, however, failed of recovering any part of the *Padmanābha Bīja* (or the algebra of Padmanābha) and of the algebraic and other works of Āryabhaṭa.

But the translator has been more fortunate in regard to the works of Śrīdhara and Brahmagupta, having in his collection Śrīdhara's compendium of arithmetic, and a copy incomplete however, of the text and scholia of Brahmagupta's *Brahmasiddhānta* comprising among other no less interesting matter, a chapter treating of arithmetic and mensuration; and another, the subject of which is algebra : both of them fortunately complete. The commentary is a perpetual one; successively quoting in length each verse of the text; procceeding to the interpretation of it, word by word; and subjoining elucidations and remarks; and its colophon, at the close of each chapter, gives the title of the work and the name of the author. Now the name which is there given, Caturveda Pṛthūdaka Svāmī, is that of a celebrated scholiast of Brahmagupta, frequently cited as such by the commentaries of

Bhāskara and by other astronomical writers; and the title of the work, *Brāhmasiddhānta* or sometimes *Brāhmasphuṭasiddhānta*, corresponds, in the shorter form, to the known title of Brahmagupta's treatise in the usual references to it by Bhāskara's commentators, and answers, in the longer form, to the designation of it, as indicated in an introductory couplet which is quoted from Brahmagupta by Lakṣmīdāsa, a scholiast of Bhāskara II. Remarking this coincidence, the translator proceeded to collate, with the text and commentary, numerous quotations from both, which he found in Bhāskara's writings or in those of his expositors. The result confirmed the indication and established the identity of both text and scholia as Brahmagupta's treatise, and the gloss of Pṛthūdaka. The authenticity of the *Brāhmasiddhānta* is further confirmed by numerous quotations in the commentary of Bhaṭṭotpala on the *Saṁhitā* of Varāhamihira : as the quotations from the *Brāhmasiddhānta*, in that commentary, (which is the work of an author who flourished eight hundred and fifty years ago) are verified in the copy under consideration. A few instances of both will suffice, and cannot fail to produce conviction.

It is confidently concluded, that the chapters on arithmetic and algebra, fortunately entire in a copy in many parts imperfect, of Brahmagupta's celebrated work as here described, are genuine and authentic. It remains to investigate the age of the author.

Mr. Davis, who first opined to the public a correct view of the astronomical computations of the Hindus, is of opinion, that Brahmagupta lived in the seventh century of the Christian era. Dr. William Hunter, who resided for some time with a British Embassy at Ujjayinī, and made diligent researches into the remains of Indian science at that ancient seat of Hindu astronomical knowledge, was there furnished, by the learned astronomers whom he consulted, with the ages of the principal ancient authorities. They assigned to Brahmagupta the date of 550 Saka; which answers to A.D.

628. The grounds on which they proceeded are unfortunately not specified: but as they gave Bhāskara's age correctly, as well as several other dates right, which admit of being verified; it is presumed that they had grounds, though unexplained, for the information which they communicated.

Mr. Bentley, who is little disposed to favour the antiquity of an Indian astronomer, has given his reasons for considering the astronomical system which Brahmagupta teaches, to be between twelve and thirteen hundred years old (1263 years in A.D. 1799). Now as the system taught by this author is professedly one corrected and adapted by him to conform with the observed positions of the celestial objects when he wrote, the age, when their positions would be conformable with the results of computations made as by him directed, is precisely the age of the author himself: and so far as Mr. Bentley's calculations may be considered to approximate the truth, the date of Brahmagupta's performance is determined with like approach to exactness, within a certain latitude however of uncertainty for allowance to be made on account of the inaccuracy of Hindu observations.

The translator has assigned on former occasions the grounds upon which he sees reason to place the author's age, soon after the period when the vernal equinox coincided with the beginning of the lunar mansion and zodiacal asterism *Aśvini*, where the Hindu ecliptic now commences. He is supported in it by the sentiments of Bhāskara and other Indian astronomers, who infer from Brahmagupta's doctrine concerning the solistitial points, of which he does not admit a periodical motion, that he lived when the equinoxes did not, sensibly to him, deviate from the beginning of *Aśvini* and middle of *citrā* on the Hindu sphere. On these grounds it is maintained, that Brahmagupta is rightly placed in the sixth or beginning of the seventh century of the Christian era, as the subjoined calculations will more particularly show. The age when Brahmagupta

flourished, seems then, from the concurrence of all these arguments, to be satisfactorily settled as antecedent to the earliest dawn of the culture of sciences among the Arabs; and *consequently establishes* the fact, that *the Hindus were in possession of algebra before* it was known to the Arabians.

Brahmagupta's treatise, however, is not the earliest work known to have been written on the same subject by an Indian author. The most eminent scholiast of Bhāskara II (Gaṇeśa) quotes a passage of Āryabhaṭa specifying algebra under the designation of *Bīja*, and making separate mention of *Kuṭṭaka*, which more particularly intends a problem subservient to the general method of resolution of indeterminate problems of the first degree : he is understood by another of Bhāskara's commentators to be at the head of the elder writers, to whom the text then under consideration adverts, as having designated by the name of *Madhyamāharaṇa* the resolution of affected quadratic equations by means of the completion of the square. It is to be presumed, therefore, that the treatise of Āryabhaṭa then extant, did extend to quadratic equations in the determinate analysis, and to indeterminate problems of the first degree; if not to those of the second likewise, as most probably it did.

This ancient astronomer and algebraist, so says Colebrooke, was anterior to both Varāhamihira and Brahmagupta, being repeatedly named by the latter; and the determination of the age when he flourished is particularly interesting as his astronomical system, though on some points agreeing, essentially disagreed on others, with that which the Hindu astronomers still maintain.

He, as Colebrooke says, is considered by the commentators of the *Sūryasiddhānta* and *Śiromaṇi*, as the earliest of uninspired and mere human writers on the science of astronomy, as having introduced requisite corrections into the system of Parāśara, from whom he took the numbers for the planetary mean motions; as

having been followed in the tract of emendation, after a sufficient interval to make further correction requisite, by Durgāsinha and Mihira; who were again succeeded after a further interval by Brahmagupta, son of Jiṣṇu.

In short, says Colebrooke, Āryabhaṭa was founder of one of the sets of Indian astronomers, as Puliśa, an author likewise anterior to both Varāhamihira and Brahmagupta, was of another : which were distinguished by names derived from the discriminative tenets respecting the commencement of planetary motions at sunrise according to the first, but at midnight according to the latter, on the meridian of Laṅkā, at the beginning of the great astronomical cycle. A third sect began the astronomical day, as well as the great period, at noon.

Āryabhaṭa's name accompanied the intimation which the Arab astronomers (under the Abbasside Khalifs, as it would appear,) received, that three distinct astronomical systems were current among the Hindus of those days : and it is but slightly corrupted, certainly not at all disguised, in the Arabic representation of it *Arjabahar*, or rather *Arjabhar*, (corrupted form of Āryabhaṭa). The two other systems were, first, Brahmagupta's *Siddhānta* which was the one they became best acquainted with, and to which they apply the denomination of the *sind-hind*; and second, that of *Arca*, the Sun, which they write *Arcand* a corruption still prevalent in the vulgar Hindi.

Āryabhaṭa appears to have had more correct notions of the true explanation of celestial phenomena than Brahmagupta himself, so says Colebrooke; who in a few instances, correcting errors of his predecessor, but oftener deviating from that predecessor's juster views, has been followed by the herd of modern Hindu astronomers, in a system not improved, but deteriorated, since the time of the more ancient author.

Considering the proficiency of Āryabhaṭa in astronomical science, and adverting to the fact of his having

written algebra, as well as to the circumstance of his being named by numerous writers as the founder of a sect, or author of a system in astronomy, and being quoted at the head of algebraists, when the commentators of extant treatises have occasion to mention early and original writers on this branch of science, it is not necessary to seek further for a mathematician qualified to have been the great improver of the analytic art, and likely to have been the person by whom it was carried to the pitch to which it is found to have attained among the Hindus, and at which it is observed to be nearly stationary through the long lapse of ages which have since passed : the later additions being few and unessential in the writings of Brahmagupta, of Bhāskara and of Jñānarāja, though they lived at intervals of centuries from each other.

Āryabhaṭa, Colebrooke rightly says, then being the earliest author known to have treated of Algebra among the Hindus, and being likely to be, if not the inventor, the improver of that analysis, by whom too it was pushed nearly to the whole degree of excellence which it is found to have attained among them; it becomes in an especial manner interesting to investigate any discoverable trace in the absence of better and more direct evidence, which may tend to fix the date of his labours; or to indicate the time which elapsed between him and Brahmagupta, whose age is more accurately determined.

Taking Āryabhaṭa, for reasons given, to have preceded Brahmagupta and Varāhamihira by several centuries; and Brahmagupta to have flourished more than twelve hundred years ago, and Varāhamihira, concerning whose works and age, Colebrooke has given a few notes, and has placed him at the beginning of the sixth century after Christ, it appears probable that this earliest of known Hindu algebraists wrote as far back as the fifth century of the Christian era; and perhaps in an earlier age. Hence it is concluded that he is nearly as ancient as the Greecian algebraist Diophantus, sup-

posed on the authority of Abulfaraj, to have flourished in the time of the Emperor Julian or about A. D. 360.

Colebrooke further says : Admitting the Hindu and Alexandrian authors to be nearly equally ancient, it must be conceded in favour of the Indian algebraist, that he was more advanced in the science; since he appears to have been in possession of the resolution of equations involving several unknowns, which it is not clear, nor fairly presumable, that Diophantus, knew; and a general method of indeterminate problems of at least the first degree, to a knowledge of which the Greecian algebraist had certainly not attained ; though he displays infinite sagacity and ingenuity in particular solutions ; and though a certain routine is indiscernible in them.

Colebrooke appears to be of the view that Greeks were the first to discover the solution of equations involving one unknown; and this knowledge was passed to ancient Indians by their Greek instructors in improved astronomy. But "by the ingenuity of the Hindu-scholars, the hint was rendered fruitful and the algebraic method was soon ripened from that slender beginning to the advanced state of a well arranged science, as it was taught by Āryabhaṭa, and as it is found in treatises compiled by Brahmagupta and Bhāskara."

We do not agree with this analysis in entirety. Indian algebra is entirely of Indian roots. It had its beginning in the times of Saṃhitās and Brāhmaṇas. Some of the equations and problems were solved by geometric methods. It must have had its origin in the Śulba period if not before. Āryabhaṭa undoubtedly was the discoverer of many algebraic solutions of equations of the first and higher order with one and more unknowns. It is rather too much to trace the influence of Diophantus on Indian algebra which developed in this country independently. Brahmagupta is one of the most brilliant algebraists we ever had in the entire history of mathematics.

Technical Terms

Coefficient—

In the ancient Indian algebra, there is no systematic term for the coefficient. Usually, the power of the unknown is mentioned when the reference is to the coefficient of that power. At one place, for example, we find Pṛthūdaka Svāmī (the commentator of Brahmagupta's *Brāhmasphūṭasiddhānta*) writing "the number (*aṅka*) which is the coefficient of the square of the unknown is called the '*square*' and the number which forms the coefficient of the (simple) unknown is called the 'unknown quantity' (*avyakta-māna*)."[1] However, at many places, we find the use of a technical term also. Brahmagupta once calls the coefficient *saṁkhyā*[2] (number) and on several other occasions *guṇaka*[3] or *guṇakāra*[4] (multiplier). Pṛṭthūdaka Svāmī (860 A.D.) calls it *aṅka* (number) or *prakṛti* (multiplier). These terms may also be seen in the works of Śrīpati[6] (1039) and Bhāskara II[7] (1150 A.D.), The former also used the word *rūpa* for the same purpose.[8]

Unknown Quantity

The unknown quantity has been termed as *yāvat-tāvat* (meaning so-much-as or as-many-as) in literature as early as 300 B. C. (vide the *Sthānāṅga-sūtra*[9]). In the *Bakhaśālī Manuscript*, it has been termed as *yadṛcchā*. *vāñchā* or *kāmikā* (or any desired quantity)[10]. Āryabhaṭa I in one of his verses calls the unknown as *gulikā*[11] (literally meaning a shot) From the early seventh century A.D., the word *avyakta* was used for unknown quantities. Brahmagupta uses this term in his *Brāhmasphuṭasiddhānta*[12]

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1. *BrSpSi. XVIII. 44* (Com.)
2. वर्णप्रमाण भावितघातो भवतीष्ट वर्णं संख्यैवम् । —*BrSpSi. XVIII 63*
3. मूलं द्विधेष्ट वर्गाद् गुणक गुणादिष्ट युत विहीनाच्च । —*BrSpSi. XVIII 64*
   वर्गच्छिन्ने गुणके प्रथमं तन्मूल भाजितं भवति । —*BrSpSi. XVIII 70*
4. प्रथमोन्यमूलमन्यो गुणकार पदोद्धृतः प्रथमः । —*BrSpSi. XVIII 69*
5. *BrSpSi XVIII. 44* (Com.)
6. *Siśe XIV. 33-5.*
7. *Bījagaṇita*
8. Si*śe XIV. 33-5.*
9. *Sūtra 747.*
10. *BMs.* Folio 22, verso; 23, recto and verso,
11. गुलिकान्तरेण विभजेद् द्वयोः ।
12. अव्यक्तवर्गं घनवर्गं वर्गपंचगत षड्गतादीनाम् ।

Power

Since long, the word *varga* has been used for the second power; the word also stands for *square* (*Uttarādhyayana Sūtra*[1], B. C. c. 300). The third power is similarly known as *ghana*, the fourth power as *varga-varga* (square-square), the sixth power as *ghana-varga* (cube-square) and the twelfth power as *ghana-varga-varga* (cube-square-square). In later days, the fifth power was called *vargaghana ghāta* (here the word *ghāta* means product; the term means product of cube and square). The former system was multiplicative, rather than additive; wheras the latter was on the additive system. The seventh power on the additive system was known as *varga-varga-ghana-ghāta* (product of square-square and cube). Brahmagupta, however, uses a more scientific system for expressing the powers more than four. He calls the fifth power as *Pañca gata* (literally meaning, raised to the fifth), the sixth power as *ṣaḍ-gat* (raised to the sixth) and so on, thus adding the suffix *gata* to the name of the number indicating that power.[2] Bhāskara II has followed the system of Brahmagupta almost consistently for powers one and upwards.

Equation

Perhaps Brahmagupta has for the first time used the term *samakaraṇa* or *samīkaraṇa* (literally meaning making equal) or simply *sama* (equal or equation)[3]. Pṛthūdaka Svāmī (860) employs the term *sāmya* (equality or equation) for equation[4]. The equation is said to possess two *Pakṣas*[5] (sides) *Itara-Pakṣa* and *apara-pakṣa*.

Absolute Term

Brahmagupta uses the term *rūpa* (literally meaning appearance) for an absolute term. It represents the visible or known

1. Chapter XXX, 10. 11.
2. अव्यक्तवर्ग घनवर्ग-वर्ग-पंचगत-षड्गतादीनाम् ।
सदृश द्विवधो वर्गस्त्यादि वधस्तद्गतोऽन्य जातिवधः ॥
3. वर्ण प्रमाण भावित-घातो भवतीष्टवर्ण संख्यैवम् ।
सिध्यति विनाऽपि भावित-समकरणात् किं कृतं तद्तः ॥
अव्यक्तान्तर भक्तं व्यस्तं रूपान्तरं समेऽव्यक्तः ।
4. *Siśe.* XIV. 19.
5. *Bījagaṇita.*

portion of the equation whilst its other part is practically invisible or unknown[1].

Unknowns and Symbolism

Āryabhaṭa I (499 A. D.) probably used coloured *gulikās* or shots for represtnting different unknowns. Brahmagupta mentions *varṇa* as the symobls for unknown. He has, however, not indicated how these *varṇas* or colours were used as symbols for unknowns. Perhaps we might conculude from this that the method of using colours as symbols for unknown quantities was very common and familiar to the algehraists. Datta and Singh say that the Sanskrit word *varṇa* denotes colour as well as a letter of alphabet, and therefore, letters of alphabet came into use for unknown quantities : *kālaka* (black), *nīlaka* (blue), *pītaka* (yellow), *lohita* (red), *harītaka* (green), *śvetaka* (white), *citraka* (variegated), *kapilaka* (tawny), *piṅgalaka* (reddish-brown), *dhūmraka* (smoke-coloured), *pāṭalaka* (pink). *śavalaka* (spotted), *śyāmalaka* (blackish) *mecaka* (dark blue) etc[2].

It should be further noted that the first unknown quantity *yāvat-tāvat* is not a *varṇa* or colour. It thus clearly indicates that the use of colours as symbols came at a later stage, whilst the word *yāvat-tāvat* was in currency from much earlier times. Some authorities think that the term *yāvat-tāvat* is a corrupted form of *yāvakastāvat* (where *yāvaka* means red). Pṛthūdaka Svāmī has sometimes used the term *yavaka* for an unknown quantity[3].

Laws of Signs

Brahmagupta has in his Chaper XVIII devoted a special section entitled "*Dhanarṇa Śunyānām Samkalanam*" or calculations dealing with quantities bearing positive and negative signs and zero,

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1. अव्यक्तान्तरं भक्तं व्यस्तं रूपान्तरं समेऽव्यक्तः । —*BrSpSi* XVIII. 43
वर्गं चतुर्गुणितानां रूपाणां मध्यवर्गं सहितानाम् ॥ —*BrSpSi* XVIII. 44

2. यावत्-तावत् कालको नीलकोऽन्यो वर्णः पीतो लोहितश्चैतदाद्याः ।
अव्यक्तानां कल्पिता मानसंज्ञास्तत्संख्यानं कर्तुमाचार्यवर्यैः ॥
यावत्-तावत् कालक नीलक पीताश्च लोहितो हरितः ।
श्वेतक चित्रक कपिलक पाटलकाः पण्डु धूम्र शवलाश्च ॥
श्यामलक-मेचक-धवलक-पिशङ्ग-शारङ्ग-बभ्रु गौराद्याः । —Nārāyaṇa, *Bījagaṇita*

3. *BrSpSi XII. 15.* (Com.) ; XII 18.

Regarding *addition*, Brahmagupta says :

> The sum of two positive numbers is positive, of two negative numbers is negative; of a positive and negative number is the difference[1].

Regarding *subtraction*, Brahmagupta further says :

> From the greater should be subtracted the smaller; (the final result is) positive, if positive from positive, and negative, if negative, from negative. If, however, the greater is subtracted from the less, that difference is reversed (in sign), negative becomes positive and positive becomes negative. When positive is to be subtracted from negative or negative from positive, then they must be added together[2].

Mahāvīra (850 A. D.), Bhāskara II (1150 A.D.) and Nārāyaṇa (1350 A. D.) have also given similar rules regarding addition (*Saṁkalanam*) and the subtraction (*vyavakalanam*).

Again, the rule given by Brahmagupta regarding *Multiplication* is as follows :

> The product of a positive and a negative (number) is negative; of two negatives is positive; positive multiplied by positive is positive[3].

His rule regarding *division* is as follows ;

> Positive divided by positive or negative divided by negative becomes positive. But positive divided by negative and negative divided by positive remains negative[4].

Similar rules for multiplication and division were provided by later authorities as Mahāvīra and Bhāskara II.

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1. *BrSpSi XII. 15. (Com.); XII 18. (Com.)*
2. धनयोर्धनमृणमृणयोर्धनर्णयोरन्तरं समैक्यं खम् ।
   ऋणमैक्यं च धनमृणधन शून्ययोः शून्ययोः शून्यम् ॥ —*BrSpSi*. XVIII-30
3. ऊनमधिकाद्विशोध्यं धनं धनादृणमृणादधिकमूनात् ।
   व्यस्तं तदन्तरं स्यादृणं धनं धनमृणं भवति ॥
   शून्यविहीनमृणमृणं धनं धनं भवति शून्यमाकाशम् ।
   शोध्यं यदा धनमृणादृणं धनाद्वा तदा क्षेप्यम् ॥ —*BrSpSi* XVIII. 31-32
4. ऋणमृणधनयोर्घातो धनमृणयोर्धनवधो धनं भवति ।
   शून्यर्णयोः ख धनयोः ख शून्ययोर्वा वधः शून्यम् ॥ —*BrSpSi* XVIII. 33
5. धनभक्तं धनमृणहृतमृणं धनं भवति खं खभक्तं खम् ।
   भक्तमृणेन धनमृणं धनेन हृतमृणमृणं भवति ॥ —*BrSpSi*. XVIII. 34

Brahmagupta lays down the rules regarding *evolution* and *involution* as follows :

> The square of a positive or a negative number is positive .....The (sign of the) root is the same, as was that from which the square was derived[1].

As regards the latter portion of this rule, Pṛthūdaka Svāmī has the following comment to make : "The square-root should be taken either negative or positive, as will be most suitable for subsequent operations to be carried on."

It will be interesting to observe the following observation of Mahāvīra (850 A. D.) regarding square-root of a negative quantity "Since a negative number by its own nature is not a square, it has no square-root."[2] So says Śrīpati : "A negative number by itself is non-square, so its square-root is unreal; so the rule (for the square-root) should be applied in the case of a positive number."[3]

Algebraic Operations

Brahmagupta and other algebraists recognise six operations as fundamental in algebra : addition, subtraction, multiplication, division, squaring and the extraction of the square-root.

Regarding *addition* and *subtraction* Brahmagupta says :

> Of the unknowns, their squares, cubes, fourth powers, fifth powers, sixth powers, etc., addition and subtraction are (performed) of the like; of the unlike (they mean simply their) statement severally.[4]

In place of "of the like", Bhāskara II uses the term "of those of the same species (*jāti*) amongst unknowns" :

> Addition and subtraction are performed of those of the same species (*jāti*) amongst unknowns; of different species they mean their separate statement.[5]

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1. खोद्धृत मृणं धनं वा तच्छेदं खमृणधनविभक्तं वा ।
ऋणधनयोर्वर्गः स्वं खं खस्य पदं कृतिर्यत् तत् ॥ —*BrSpSi*, XVIII. 35
2. GSS. I. 52.
3. *Śiśe.* XIV. 5.
4. अव्यक्तवर्गं घनवर्गं वर्गं पंचगत षड्गतादीनाम् ।
तुल्यानां संकलित व्यवकलिते पृथगतुल्यानाम् ॥ —*BrSpSi.XVIII. 41.*
5. योगोऽन्तरं तेषु समान जात्योर्विभिन्न जात्योश्च पृथक् स्थितिश्च ।
– *Bhāskara* II, *Bījagaṇita.*

This means that the numerical coefficients of x cannot be added to or subtracted from the numerical coefficients of y or x^2 or x^3 or xy and so on because these terms belong to different *jāti* or they do not belong to the category of the "*like*".

Again, regarding *multiplication*, Brahmagupta says :

> The product of the two like unknowns is a square; the product of three or more like unknowns is a power of that designation. The multiplication of unknowns of unlike species is the same as the mutual product of symbols; it is called *bhāvita* (product or factum).[1]

Having given the rules of the operations for addition, subtraction and multiplication, Brahmagupta does not think it necessary to deal with other operations. His section on the calculations with zero, negative and positive quantities ends here.

How is an Equation Formed?

Pṛthūdaka Svāmī while commenting on a verse in *Brāhma-sphuṭasiddhānta* speaks as follows :

> In this case, in the problem proposed by the questioner, *yāvat-tāvat* is put for the value of the unknown quantity. Then performing multiplication, division etc. as required in the problem the two sides shall be carefully made equal. The equation being formed in this way, then the rule (for its solution) follows.[2]

Plan for Writing Equations

When in regards to a given problem, an equation has been formed, it has to be written down for further operations. This writing down of an equation is technically known as *nyāsa* Perhaps the oldest record of *nyāsa* is to be found in the *Bakhaśālī Manuscript*. According to the procedure prescribed in this work, the two sides of an equation are put down one after the other in the same line without any sign of equality being interposed. Thus the equations :

$$\sqrt{x+5}=s, \quad \sqrt{x-7}=t$$

appear as

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1. सदृशद्विवधो वर्गस्त्र्यादिवधस्तद् गतोऽन्यजातिवधः ।
अन्योऽन्यवर्णघातो भावितकः पूर्ववच्छेषम् ॥ —*BrSpSi*.XVIII. 42.

2. *BrSpSi*. XVIII. 43 (com)

$$\left|\begin{array}{ccccc|cccccc} 0 & 5 & yu & m\bar{u} & 0 & sa & 0 & 7 & + & m\bar{u} & 0 \\ 1 & 1 & & & 1 & & 1 & 1 & & & 1 \end{array}\right|$$

Here *yu* (यु) stands for *yuta* (युत), meaning added, subtraction is+sign, derived from Kṣaya or (क्षय) meaning diminished, *gu* (गु) for guṇa or *guṇita*, meaning multiplied; *bhā* (भा) for division from *bhājita* and *mū* (मू) for square-root, from *mūla* meaning root; *zero* (o) was used to mark a vacant place.

Again, the following equation

$$x+2x+3\times3x+12\times4x=300$$

is represented as ;

$$\left|\begin{array}{c|cc|cc|cc|} 0 & 2 & 1 & 3 & 3 & 12 & 4 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{array}\right. \qquad d\d{r}\acute{s}ya\ 300$$

There is no sign for unknown in the *Bakhaśālī Manuscript.*

Later on this plan of writing equations as adopted in *Bakhaśālī Manuscript* was abandoned in India; a new one was adopted in which the two sides are written one below the other without any sign of equality. It must be stated that in this new plan the term of similar denominations are usually written one below the other and even the terms of absent denominations on either side are clearly indicated by putting zeros as their coefficients. We find a reference to this new plan in the algebra of Brahmagupta.

> From which the square of the unknown and the unknown are cleared, the known quantities are cleared (from the side) *below* that[1].

Here in this verse, the words "*adhastāt*" clearly indicate that one side of the equation is written below the other., As an illustration, Pṛthūdaka Svāmī represented the equation[2] :—

$$10x-8=x^2+1$$

as :

yā va 0 *yā* 10 *rū* $\dot{8}$ $(x^2.0+x.10-8)$
yā va 1 *yā* 0 *rū* 1 $(x^2.1+x.0+1)$

which means, x^2 was written as *yāvat-varga* (*yā va*) and x was written as *yāvat* or *yā*. The minus sign was represented by a dot at the top of the number.(-8 was written as $\dot{8}$). We shall take another illustration from Pṛthūdaka Svāmī.

He would write the equation

$$197x-1644\ y-z=6302$$

as

1. *BrSpSi.* XVII. 43; compare also Bhāskara II, *Bījagaṇita.*
2. *Br SpSi.* XVIII. 49 (*com.*)

yā	197	*kā*	$\dot{1644}$	*nī*	$\dot{1}$	*rū*	0
yā	0	*kā*	0	*nī*	0	*rū*	6302

Here the first unknown x is represented by *yā(vat)*, the second unknown y by *kā(laka)* and the third unknown z by *nī-(laka)* and the term without unknown, a mere number is wrirten by *rū(paka)*. The two sides, one written below the other if written in the present form, would appear as :

$$197x—1644y—z+0=0x+0y+0z+6302.$$

The *Bījagaṇita* of Bhāskara II also follows the same procedure. One instance from it would be quoted here to illustrate the method of expressing equations.

$$8x^3+4x^2+10y^2x=4x^3+12y^2x$$

or $8x^3+4x^2+10y^2x=4x^3+0x^2+12y^2x$

is written as follows on Bhāskara's or Brahmagupta's plan :

x^3 is *ghana* of *yāvat* (abbreviated as *yā gha*)
x^2 is *varga* of *yāvat* (abbreviated as *yā va*)
y^2 is *varga* of *kālaka* (abbreviated as *kā va*)
the coefficients 10 and 12 are *bhāvita* (abbreviated as *bhā*).

The equation is :

yā gha 8 *yā va* 4 *kā va yā. bhā* 10
yā gha 4 *yā va* 0 *kā va yā. bhā* 12

Datta and Singh state that the use of the old plan of writing equations is sometimes met with in later works also. For instance, in the MS. of Pṛthūdaka Svāmī's commentary[1] on the *Brāhmasphuṭasiddhānta*, an incomplete copy of which is preserved in the library of the Asiatic Society of Bengal (No. I B6), we find a statement of equations thus : "first side *yāvargaḥ* 1 *yāvakaḥ* 200 *rū* 0; second side *yāvargaḥ* 0 *yāvakaḥ* 0 *rū* 1500.

Śodhana or Clearancc of an Equation

After *nyāsa* or statement of an equation, the operation to be performed is known as *śodhana* (clearance) or *saṁśodhana* (equi-clearance or complete clearance). The nature of this clearance varies according to the kind of equation In the case of an equation in one unknown only, whether linear,

1. *BrSpSi*. XII. 15 (*com.*)

quadratic or of higher powers, one side of it is cleared of the unknowns of all denominations and the other side of it of the absolute terms, so that the equation is ultimately reduced to one of the form

$$ax^2+bx=c,$$

where a, b, c may be positive or negative; some of them may even be zero. Thus Brahmagupta observes :

> From which the square of the unknown and the unknown are cleared, the known quantities (*rūpāṇi*) are cleared (from the side) *below* that.[1]

On this Pṛthūdaka Svāmi comments as follows :

> This rule has been introduced for that case in which the two sides of the equation having been formed in accordance with the statement of the problem, there are present the square and other powers of the unknown together with the (simple) unknown. The absolute terms should be cleared off from the side opposite to that from which are cleared the square (and other powers) of the unknown and the (simple) unknown. When perfect clearance (*saṁśodhana*) has been made...[2]

Śrīdhara and Bhāskara II have also given the rules of clearance almost on the same lines. Thus the equation

yā va 0 *yā* 10 *rū* $\dot{8}$
yā va 1 *yā* 0 *rū* 1

after perfect clearance having been made will be (according to Pṛthūdaka Svāmī)

yā va 1 *yā* 10 *rū* $\dot{9}$

i.e. the equation $10x-8=x^2+1$
after clearance would become

$$x^2-10x=-9.$$

Classification of Equations

Usually equations are classified as :
simple equation : *yāvat-tāvat*
quadratic : *varga*

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1. कांव्यक्ताः शोध्या यस्माद् रूपाणि तदधस्तात् ॥ —*BrSpSi*. XVIII. 43.
2. *BrSpSi*. XVIII. 43 (*com.*)

cubic : *ghana*
biquadratic : *varga-varga*

Brahmagupta classified them as

(i) equations in one unknown quantity : *eka-varṇa samīkaraṇa.*

(ii) equations in several unknowns : *aneka-varṇa samīkaraṇa.*

(iii) equations involving products of unknowns : *bhāvita.*

Eka-varṇa samīkaraṇas (equations with one unknown) are further divided into (i) linear equations, and (ii) quadratic equations (*avyakta-varga samīkaraṇa*).

Pṛthūdaka Svāmī has classified equations in a different manner as follows :

(i) linear equations with one unknown : *eka-varṇa samīkaraṇa.*

(ii) linear equations with more unknowns : *aneka-varṇa samīkaraṇa.*

(iii) equations with one, two or more unknowns in their second or higher powers : *madhyamāharaṇa.*

(iv) equations involving products of unknowns : *bhāvita.*

As the method of solution of an equation of the third class (i.e. equations with one or several unknowns in their second or higher powers) is based upon the principle of the elimination of the middle term, that class is called by the term *madhyama* (middle) *āharaṇa* (elimination). The classification of Brahmagupta and Pṛthūdaka Svāmī more or less received recognition by later writers on algebra as Bhāskara II and others.

Linear Equations with One Unknown and Their Solutions

The first solution of a linear equation with one unknown is obtainable in the *Śulba Sūtras* but not through an algebraic process,—the Śulba process is geometrical. It is said that there is a reference in the *Sthānāṅga Sūtra* (c. 300 B.C.) to a linear equation by its name *yāvat-tāvat*. There has been a good deal of

controversy regarding the date of the *Bakhaśalī Manuscript* where we have definitely a method of solving linear equations by the *Rule of False Position.* It would be interesting to give an account of this rule here by taking an illustration from the *Bakhaśālī Manuscript.*

> *Problem* :
>
> The amount given to the first is not known. The second is given twice as much as the first; the third thrice as much as the second; and the fourth four times as much as the third. The total amount distributed is 132. What is the amount of the first ?
>
> (*BMS.* Folio 23, recto)

In modern algebraic language, the solution of the problem would be given by the equation

$$x+2x+6x+24x=132$$

where x is the amount given to the first.

The solution of this equation is given as follows in the *Bakhaśālī Manuscript* :

> 'Putting any desired quantity in the vacant place'; any desired quantity is ‖ 1 ‖ , 'then construct the series'
>
> $\left| \begin{matrix} 1 \\ 1 \end{matrix} \right| \begin{matrix} 2 \\ 1 \end{matrix} \left| \begin{matrix} 2 \\ 1 \end{matrix} \right| \begin{matrix} 3 \\ 1 \end{matrix} \left| \begin{matrix} 6 \\ 1 \end{matrix} \right| \begin{matrix} 4 \\ 1 \end{matrix} \right|$
>
> 'multiplied' ‖ 1 | 2 | 6 | 24 | ; 'added' 33. 'Divide the visible quantity' $\left| \begin{matrix} 132 \\ 33 \end{matrix} \right|$; which) on reduction becomes $\left| \begin{matrix} 4 \\ 1 \end{matrix} \right|$. (This is) the amount given (to the first)
>
> (*BMS.* Folio 23, recto)

The Rule of False Position may be regarded as an early stage of the development of the science of algebra, since no symbol could have been evolved for an unknown quantity. As soon as the system of notations was introduced, the application of this Rule was no longer considered as necessary. Thus we find that Āryabhaṭa I does not mention of this Rule.

Āryabhaṭa I states as follows regarding the solution of linear equations :

> The difference of the known 'amounts' (*rūpaka*) relating to two persons should be divided by the difference

> of the coefficients on the unknown (*gulikā*). The quotient will be the value of the unknown (*gulikā*), if their possessions be equal.[1]

The original verse contains the term "*gulikāntara*" which has been here translated as the difference of the coefficients of the unknowns. We have already stated earlier that Āryabhaṭa uses the term *gulikā* or shot for an unknown quantity.(*gulikāntara* literally means only the difference of unknowns). This practice is also followed by other Indian algebraists. Pṛthūdaka Svāmī rightly observed that according to the usual practice in this country, "the coefficient of the square of the unknown is called the square (of the unknown) and the coefficient of the (simple) unknown is called the unknown.[2]

The rule given by Āryabhaṭa, then, contemplates a problem of this kind :

> Two persons, who are equally rich, possess respectively a, b times a certain unknown amount together with c, d units of money in cash. What is that amount ?

Now if x be the amount unknown, then according to the problem

$$ax+c=bx+d$$

Thence

$$x=\frac{d-c}{a-b}$$

Āryabhaṭa has merely expressed this solution in his language.

Regarding the solution of linear equations, Brahmagupta says :

> In a (linear) equation in one unknown, the difference of the known terms taken in the reverse order, divided by the difference of the coefficients of the unknown (is the value of the unknown).[3]

1. गुलिकान्तरेण विभजेद् द्वयोः पुरुषयोस्तु रूपकविशेषम् ।
लब्धं गुणिकामूल्यं यद्यर्थं कृतं भवति तुल्यम् ॥ —*Ārya*. II. 30

2. *BrSpSi*, XVIII. 44 (*com.*)

3. अव्यक्तान्तरभक्तं व्यस्तं रूपान्तरं समेऽव्यक्तः ।
वर्गाव्यक्ताः शोध्या यस्माद् रूपाणि तदधस्तात् ॥ —*BrSpSi*. XVIII. 43

Similar solutions have been offered by the other Indian algebraists who followed Brahmagupta like Śrīpati, Bhāskara II and Nārāyaṇa. Here again, we take a problem proposed by Brahmagupta in this connection :

Problem :

> Tell the number of elapsed days for the time when four times the twelfth part of the residual degrees increased by one, plus eight will be equal to the residual degrees plus one.[1]

Pṛthūdaka Svāmī has solved this problem as follows :

Here the residual degrees are (put as) *yāvat-tāvat*, *yā*; increased by one, *yā* 1 *rū* 1; twelfth part of it, $\frac{yā\ 1\ rū\ 1}{12}$; four times this, $\frac{yā\ 1\ \ rū\ 1}{3}$; plus the absolute quantity eight, $\frac{yā\ 1\ \ rū\ 25}{3}$. This is equal to the residual degrees plus unity. The statement of both sides tripled is

yā 1   *rū* 25
yā 3   *rū* 3

This difference between the coefficients of the unknown is 2. By this the difference of the absolute terms, namely 22, being divided, is produced the residual of the degrees of the Sun, 11. These residual degrees should be known to be irreducible. The elapsed days can be deduced then, (proceeding) as before.

If put in the modern notations, it means the solution of the equation :

$$\frac{4}{12}(x+1)+8=x+1,$$

from which we have

$$x+25=3x+3$$

or $$2x=22$$

or $$x=11.$$

Rule of Concurrence or Saṁkramaṇa

Brahmagupta has included this rule in algebra, whereas other Indian mathematicians included it in arithmetic. *Saṁ-*

1. सैकादंशकशेषाद् द्वादशभागश्चतुर्गुणोऽष्टयुतः ।
सैकांशशेषतुल्यो यदा तदाऽहर्गणं कथय ॥ —*BrSpSi. XVIII.* 46

kramaṇa is the solution of the simultaneous equations of the type :

$$x+y=a$$
$$x-y=b$$

Brahmagupta's rule for solution is:

> The sum is increased and diminished by the difference and divided by two; (the result will be the two unknown quantities) : (this is) concurrence (*Saṁkramaṇa*).[1]

Brahmagupta restates this rule in the form of a problem and its solution :

> The sum and difference of the residues of two (heavenly bodies) are known in degrees and minutes. What are the residues ? The difference is both added to and subtracted from the sum, and halved; (the results are) the residues.[2]

Linear Equations with Several Unknowns

The first mention of a solution of the problem with more than one unknown is found in the *Bakhaśālī Manuscript*, and a system of linear equations of this type is solved in the Bakhaśālī treatise substantially by the False Position Rule.

A generalised system of linear equations will be

$$b_1\Sigma x-c_1x_1=a_1,\ b_2\Sigma x-c_2x_2=a_2,\ldots\ldots,$$
$$b_n\Sigma x-c_nx=a_n$$

Therefore

$$\Sigma x=\frac{\Sigma(a/c)}{\Sigma(b/c)-1}$$

Hence

$$x_r=\frac{b_r}{c_r}\times\frac{\Sigma(a/c)}{\Sigma(b/c)-1}-\frac{a_r}{c_r}$$
$$r=1, 2, 3,\ldots\ldots, n$$

One particular case, where $b_1=b_2=b_3=\ldots\ldots=b_n=1$ and $c_1=c_2=c_3=\ldots\ldots=c_n=c$ has been treated by Brahmagupta at one place. He gives the rule as follows :

1. योगोऽन्तरयुतहीनो द्विहृतः संक्रमणमन्तरविभक्तं वा ।
वर्गान्तरमन्तरयुतहीनं द्विहृतं विषमकर्म ।। —*BrSpSi. XVIII. 36*
2. भागकला विकलैक्यं दृष्ट्वा विकलान्तरं च के शेषे ।
ऐक्यं द्विधाऽन्तराधिक हीनं च द्विभाजितं शेषे ।। —*BrSpSi. XVIII. 96*

> The total value (of the unknown quantities) plus or minus the individual values (of the unknowns) multiplied by an optional number deing severally (given), the sum (of the given quantities) divided by the number of unknowns increased or decreased by the multiplier will be the total value; thence the rest (can be determined).[1]

$$\Sigma x \pm cx_1 = a_1,\ \Sigma x \pm cx_2 = a_2,\ \Sigma x \pm cx_3 = a_3, \ldots\ldots,$$
$$\Sigma x \pm cx = a_n$$

Therefore

$$\Sigma x = \frac{a_1 + a_2 + a_3 + \ldots\ldots + a_n}{n \pm c}$$

Hence

$$x_1 = \frac{1}{c}\left(\pm a_1 \mp \frac{a_1 + a_2 + a_3 + \ldots\ldots + a_n}{n \pm c} \right);$$

and so on for x_2, x_3 etc.

Now we shall give the rule enunciated by Brahmagupta for solving linear equations involving several unknowns :

> Removing the other unknowns from (the side of) the first unknown and dividing by the coefficient of the first unknown, the value of the first unknown (is obtained). In the case of more (values of the first unknown), two and two (of them) should be considered after reducing them to comon denominators. And (so on) repeatedly. If more unknowns remain (in the final equation), the method of the pulveriser (should be employed). (Then proceeding) reversely (the values of other unknowns can be found).[2]

Pṛthūdaka Svāmī has commented on this rule as follows :

> In an example in which there are two or more unknown quantities, colours such as *yāvat-tāvat*, etc., should be assumed for their values. Upon them should

1. गच्छधनमिष्ट गुणितैर्धनैर्युतोनं पृथक् पृथक् सहितम् ।
गुणकयुतोन पदहृतं सर्वधनमतोऽवशेषाणि ॥ —*BrSpSi.* XIII. 47

2. आद्याद्वर्णादन्यान् वर्णान् प्रोह्याद्यमानमाद्यहृतम् ।
सदृशच्छेदावसकृद् द्वौ व्यस्तौ कुट्टको बहुषु ॥ —*BrSpSi.* XVIII. 51

> be performed all operations conformably to the statement of the example and thus should be carefully framed two or more sides and also equations. Equi-clearance should be made first between two and two of them and so on to the last: from one side one unknown should be cleared, other unknowns reduced to a common denominator and also the absolute numbers should be cleared from the side opposite. The residue of other unknowns being divided by the residual coefficient of the first unknown will give the value of the first unknown. If there be obtained several such values, then with two and two of them, equations should be formed after reduction to common denominators. Proceeding in this way to the end find out the value of one unknown. If that value be (in terms of) another unknown then the coefficients of those two will be reciprocally the values of the two unknowns. If, however, there be present more unknowns in that value, the method of the pulveriser should be employed. Arbitrary values may then be assumed for some of the unknowns.

Datta and Singh have said that the above rule of Brahmagupta, and also the one indicated in the commentary of Pṛthūdaka Svāmī, embraces the solution of indeterminate as well as the determinate equations. In fact, all the examples given by Brahmagupta in illustration of the rule are of indeterminate character. So far as the determinate simultaneous equations are concerned, Brahmagupta's method for solving them will be easily recognised to be the same as our present one.

Quadratic Equations

The geometrical solution of a quadratic equation in this country would take us to the Vedic Śulba period. The *Bakhaśālī Manuscript* also contains certain problems which need the solving of quadratic equations. I shall quote one out of the numerous available:

> A certain person travels s *yojana* on the first day and b *yojana* more on each successive day. Another who travels at the uniform rate of S *yojana* per day, has a start of t days. When will the first man overtake the second ?

This problem would today be expressed in terms of the following equation :

$$S(t+x)=x\ \{s+\left(\frac{x-1}{2}\right)b\},$$

where x is the number of days after which the first overtakes the second. We may write this equation as

$$bx^2-\{2(S-s)+b\}x=2tS$$

whence the value x would be after solving the quadratic :

$$x=\frac{\sqrt{\{2(S-s)+b\}^2+8bts}+\{2(S-s)+b\}}{2b}$$

The *Bakhaśālī Manuscript* gives this solution as follows :

> The daily travel (S) diminished by the march of the first day (s) is doubled; this is increased by the common increment (b). That (*sum*) multiplied by itself is designated (as the *kṣepa* quantity). The product of the daily travel and the start (t) being multiplied by eight times the common increment, the *kṣepa* quantity is added. The square-root of this (is increased by the *kṣepā* quantity; the sum divided by twice the common increment will give the required number of days), (*BMS*. Folio 5, recto)

Āryabhaṭa I (499 A.D.) is regarded as the founder of algebra, since he gives the solutions of a few quandratic problems. For example, to find the number of terms of an arithmetical progression (A.P.), he gives the following rule :

> The sum of the series multiplied by eight times the common difference is added by the square of the difference between twice the first term and the common difference: the square-root (of the result) is diminished by twice the first term and (then) divided by the common difference : half of this quotient plus unity is the number of terms.[1]

In the modern notations of algebra, the solution would be expressed as follows :

---

1. गच्छोऽष्टोत्तर गुणिताद् द्विगुणाद्युत्तर विशेषवर्गयुतात् ।
मूलं द्विगुणाद्यूनं स्वोत्तर भजितं सरूपार्धं ॥ —*Ārya*. II, 20

$$n=\frac{1}{2}\left\{\frac{\sqrt{8bs+(2a-b)^2}-2a}{b}+1\right\}$$

There is another certain interest problem[1], the solution of which has been provided in the *Āryabhaṭīya* as

$$x=\frac{\sqrt{Apt+(p/2)^2}-p/2}{t}$$

which is the solution of the quadratic equation :

$$tx^2+px-Ap=0$$

Āyabhaṭa I has thus given the solutions of a few quadratic equations, but he nowhere gives the procedure of solving these equations.

We give here the Rules of Brahmagupta for the solution of quadratic equations. He undoubtedly is not the discoverer of these rules; but perhaps for the first time in the history of algebra we find the process of solving a quadratic equation so clearly indicated.

First Rule :

> The quadratic : the absolute quantities multiplied by four times the coefficient of the square of the unknown are increased by the square of the coefficient of the middle (i.e. unknown); the square-root of the result being diminished by the coefficient of the middle and divided by twice the coefficient of the square of the unknown, is (the value of) the middle."[2]

This expressed in the modern notations would mean

$$x=\frac{\sqrt{4ac+b^2}-b}{2a}$$

It would be noted that in this rule, Brahmagupta has employed the term *madhya* (middle) to imply the simple unknown as well as its coefficient. The origin of the term is doubtless connected with the mode of writing the quadratic equation in the form

$$ax^2+bx+0=0x^2+0x+c$$

so that there are three terms on each side of the equation.

---

1. मूलफलं सफलं कालमूल गुणमर्धमूल कृति युक्तम् ।
   मूलं मूलार्धोनं कालहृतं स्यात्स्वमूलफलम् ॥ —*Ārya. II. 25.*
2. वर्गं चतुर्गुणितानां रूपाणां मध्यवर्गसहितानाम् ।
   मूलं मध्येनोनं वर्गं द्विगुणोद्धृतं मध्यः ॥ —*BrSpSi*. XVIII. 44.

Second Rule :

> The absolute term multiplied by the coefficient of the square of the unknown is increased by the square of half the coefficient of the unknown; the square-root of the result diminished by half the coefficient of the unknown and divided by the coefficient of the square of the unknown is the unknown.[2]

This when expressed in the modern algebraic notations would be

$$x=\frac{\sqrt{ac+(b/2)^2}-(b/2)}{a}$$

Here if the quadratic equation is

$$ax^2+bx+c=0$$

the 'absolute term' is c (the one without the unknown x), 'the coefficient of the square of unknown' means the coefficient of x^2, i.e. a, and the 'coefficient of the unknown' means the coefficient of x, i.e. b.

The above two methods of Brahmagupta are exactly the same as were suggested by Āryabhaṭa I.

The root of the quadratic equation for the number of terms of an arithmetic progression (A.P.) is given by Brahmagupta according to the first rule [2] :

$$n=\frac{\sqrt{8bs+(2a-b)^2}-(2a-b)}{2b}$$

Third Rule :

> Brahmagupta also suggests a Third Rule which is very much the same as is used commonly now. Though it has not been expressedly suggested as a new rule, we find its application in a few instances. For example this rule has been suggested in connection with the following problem on interest :
>
>> A certain sum (p) is lent out for a period (t_1); the interest accrued (x) is lent out again at this

1. वर्गाहत रूपाणामव्यक्तार्धकृति संयुतानां यत् ।
पदमव्यक्तार्धोनं तद्वर्गं विभक्तमव्यक्तः ॥ —*BrSpSi.* XVIII. 45

2. उत्तरहीनद्विगुणादि शेषवर्गं धनोत्तराष्टवधे ।
प्रक्षिप्य पदं शेषोनं द्विगुणोत्तरहृतं गच्छः ॥ —*BrSpSi.* XII. 18

rate of interest for another period (t_2) and the total amount is A. Find x.

The equation for determining x is

$$\frac{t_2}{pt_1}x^2+x=A.$$

The solution of this equation would be :

$$x=\sqrt{\left(\frac{pt_1}{2t_2}\right)^2+\frac{A\ \ 1}{t_2}}-\frac{pt_1}{2t_2}$$

Brahmagupta has stated the result in exactly the same form. Pṛthūdaka Svāmī has illustrated it in solving the following problem of interest :

Problem :

A sum of five hundred *paṇas* (p) is lent out for a period of 4 months (t_1); the interest accrued (x) is lent out again at this rate of interest for another period of 10 months (t_2) and the total amount is 78 (A). Give the *pramāṇa-phala*, i.e., the interest accrued x.

Here *pramāṇa-kāla* (t_1)=4 months
pramāṇa-dhana (p)=500 paṇas
para-kāla (t_2), the subsequent period=10 months
miśra dhana or the total interest accrued (A) =78 *paṇas.*

Brahmagupta states his solution of such quadratics like this :

Take the product of the *pramāṇa-dhana* (p) or the sum originally lent out and *pramāṇa-kāla*, i.e. the period for which originally lent out (t_1); and divide by the *para-kāla* or the subsequent time (t_2); place this result at two places. Multiply the one placed at the first place with the *miśra-dhana* (A), that is with the total interest accrued; in this product add the square of half the one placed in the second place; now take the square-root of it, and from it subtract half of the one placed at the second place.[1]

1. कालप्रमाणघातः परकालहृतो द्विधाऽऽद्यमिश्रवधात् ।
अन्त्यार्धकृति युतात् पदमन्त्यार्धोनं प्रमाण फलम् ॥ —*BrSpSi. XII. 15:*

Thus in the above example the product of *pramāṇa-dhana* and *pramāṇa kāla* divided by *parakāla* is (pt_1/t_2) is $\frac{500 \times 4}{10} = 200$. This is first multiplied by the total interest accrued (A); it becomes 200×78=15600. To this is now added square of half of 200 (which is 10000) ; it becomes 15600 plus 10000=25600. Its square-root is taken which is 160. From this is subtacted half of the quantity (i.e. half of 200 which is 100). Thus 160–100=60, which is the answer. It was the interest which first accrued (x).

Another Quadratic Problem :

Brahmagupta refers to an astronomical problem which involves the quadratic equation

$$(72+a^2)x^2 \mp 24\, apx=144\left(\frac{R^2}{2}-p^2\right),$$

where a=*agra* (the sine of the amplitude of the Sun), b=*palabhā* (the equinoctial shadow of a gnomon 12 aṅguli long), R=radius, and x=*koṇaśaṅku* (sine of the altitude of the Sun when his altitude is 45°). Dividing out by $(72+a^2)$ we have

$$x^2 \mp 2mx=n,$$

where

$$m=\frac{12\, ap}{72+a^2},\ n=\frac{144(R^2/2-p^2)}{72+a^2}$$

Therefore we have

$$x=\sqrt{m^2+n} \pm m,$$

as stated by Brahmagupta. We find the same result in the *Sūrya-siddhānta* and in the text of Śrīpati. Āryabhaṭa II (1150) also followed the method of Āryabhaṭa I and Brahmagupta in solving a quadratic equation in connection with finding out the number of terms in an arithmetical progression (A.P.) whose first term is (a), common difference is b and the sum is s. The number of terms n is given by[1]

$$n=\frac{\sqrt{2bs+(a-b/2)^2}-a+b/2}{b}$$

Two Roots of a Quadratic Equation and Brahmagupta

A quadratic equation has two roots. This must have been known to Indian algebraists even at a very early stage. Bhāskara II in his *Bījagaṇita* has quoted a rule ascribed to an ancient writer Padmanābha whose works are not available now :

1. *Mahāsiddhānta*- Bhāskara II, XV. 50

> If (after extracting roots) the square-root of the absolute side (of the quadratic) be less than the negative absolute term on the other side, then taking it negative as well as positive two values (of the unknown) are found[1].

The term used here is *dvividhotpadyate mitiḥ* which means that two values are obtained.

The existence of two roots of a quadratic equation appears to have been known also to Brahmagupta (628 A.D.). In illustration of his rules for the solution of a quadratic he has stated two problems involving practically the same equation :

> *Problem I* : The square-root of the residue of the revolution of the Sun less 2 is diminished by 1, multiplied by 10 and added by 2; when will this be equal to the residue of the revolution of the Sun less 1, on Wednesday ?[2]

> *Problem II* : When will the square of one-fourth the residue of the exceeding months less three be equal to the residue of the exceeding months ?

We shall follow Pṛthūdaka Svāmi in solving the Problem I. In this problem the residue of the revolutions of the Sun may be supposed to be x^2+2; then by the question, we have

$$10(x-1)+2=x^2+1,$$
$$\text{or } x^2-10x=-9$$

Again in Problem II, if we put $4x$ for the residue of the exceeding month, then we have

$$(x-3)^2=4x$$
$$\text{or } x^2-10x=-9.$$

Now by the second rule of Brahmagupta, retaining both the signs of the radical, we get :

$$x=5\pm\sqrt{25-9}=9 \text{ or } 1,$$

---

1. व्यक्त पक्षस्य चेन्मूलमन्यपक्षर्णरूपतः ।
अल्पं धनर्णगं कृत्वा द्विविधोत्पद्यते मितिः ॥ —Bhāskaka, *Bījagaṇita*

2. मण्डलशेषाद् द्वयूनान्मूलं व्येकं दशाहतं द्वियुतम् ।
मण्डलशेषं व्येकं भानोर्ज्ञदिने कदा भवति ॥ —*BrSpSi.* XVIII. 49

3. अधिमासशेषपादात् त्र्यूनाद्वर्गोऽधिमासशेषसमः ।
अवमावशेषतो वावमशेषसमः कदा भवति ॥ —*BrSpSi.* XVIII. 50.

As shown by Pṛthūdaka Svāmī, the first value is taken by Brahmagupta for the Problem I and second value for the problem II. Thus it is quite clear that Brahmagupta uses sometimes the positive and at other times the negative sign with the radical. Hence we shall say that Brahmagupta knew that a quadratic equation would have two roots, and according to the requisiteness of the problem, one value out of the two would be utilised.

Simultaneous Quadratic Equations

Indian authors usually treated problems involving various forms of simultaneous quadratic equations.

$$\text{(i)} \left.\begin{array}{l} x-y=d \\ xy \;\;=b \end{array}\right\} \qquad \text{(ii)} \left.\begin{array}{l} x+y=a \\ xy \;\;=b \end{array}\right\}$$

$$\text{(iii)} \left.\begin{array}{r} x^2+y^2=c \\ xy=b \end{array}\right\} \quad \text{(iv)} \left.\begin{array}{r} x^2+y^2=c \\ x+y=a \end{array}\right\}$$

For the solution of the combination (i), Āryabhaṭa I gives the following rule in his *Āryabhaṭīya* .

> The square-root of four times the product (of two quantities) added with the square of their difference, being added and diminished by their difference and halved gives the two multiplicands.[1]

This means that

$$x=\tfrac{1}{2}\sqrt{d^2+4b}+d),\; y=\tfrac{1}{2}(\sqrt{d^2+4b}-d)$$

For the solution of the same combination, Brahmagupta states as follows :

> The square-root of the sum of the square of the difference of the residues and two squared times the product of the residues, being added and subtracted by the difference of the residues, and halved (gives) the desired residues severally.[2]

(Here by difference of the residues is mesnt $x-y$; and by product of the residues is meant xy.)

Brahmagupta does not seem to give the solution for simultaneous equations of the combination (ii). Mahāvīra (850 A.D.)

1. द्विकृति गुणात्संवर्गाद् द्व्यन्तरवर्गेण संयुतान्मूलम् ।
अन्तरयुक्तं हीनं तद्गुणकारद्वयं दलितम् ॥ —*Ārya. II. 24*

2. शेषवधाद् द्वि कृति गुणात् शेषान्तर वर्ग संयुतान्मूलम् ।
शेषान्तरेन युक्तं दलितं शेषे पृथगभीष्टे ॥ —*Br SpSi. XVIII. 99*

has given the solution :

> Subtract four times the area (of a rectangle) from the square of the semi-perimeter then by *sankramaṇa* between the square-root of that (remainder) and the semi-perimeter, the base and the upright are obtained.[1] (*GSS*. VII. 129½)

This expressed in the modern notations would be :

$x=\frac{1}{2}(a+\sqrt{a^2-4b}),\ y=\frac{1}{2}(a-\sqrt{a^2-4b})$

For the combination (iii), Mahāvīra in his *Gaṇita-Sāra-Saṃgraha* gives the following rule :

> Add to and subtract twice the area (of a rectangle) from the square of the diagonal and extract the square-roots. By *sankramaṇa* between the greater and lesser of these (roots), the side and upright (are found).[2]

This put in modern notations would be :

$$x=\frac{1}{2}\ \sqrt{c+2b}+\sqrt{c-2b}).$$
$$y=\frac{1}{2}\ (\sqrt{c+2b}-\sqrt{c-2b}).$$

For the combination (iv), Āryabhaṭa I gives the following rule :

> From the square of the sum (of two quantities) subtract the sum of their squares. Half of the remainder is their product.[3]

The remaining operations will be similar to those for the equations (ii); so that

$$x=\frac{1}{2}\ (a+\sqrt{2c-a^2}),\ y=\frac{1}{2}\ (a-\sqrt{2c-a^2}).$$

Brahmagupta in this connection says :

> Subtract the square of the sum from twice the sum of squares; the square-root of the remainder being added to and subtracted from the sum and halved, (gives) the desired residues.[4]

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1. *GSS*. VII. 129½
2. *GSS*. VII. 127½
3. संपर्कस्य हि वर्गाद्विशोधयेदेव वर्गसंपर्कम् ।
   यत्तस्य भवत्यर्धं विद्याद् गुणकारसंवर्गम् ॥ —*Āaya*. II. 23
4. कृति संयोगाद् द्विगुणाद्युति वर्गं प्रोह्य शेष मूलं यत् ।
   तेन युतोनो योगो दलितः शेषे पृथगभीष्टे ॥ —*BrSpSi. XVIII*. 98

These equations have also been treated by Mahāvīra, Bhāskara II and Nārāyaṇa. Nārāyaṇa has attempted two other forms of quadratic equations :

$$\text{(v)}\quad \left.\begin{array}{l} x^2+y^2=c \\ x-y=d \end{array}\right\} \qquad \text{(vi)}\quad \left.\begin{array}{r} x^2-y^2=m \\ xy=b \end{array}\right\}$$

For their solutions, see Datta and Singh, *Algebra*, P. 84.

Rule of Dissimilar Operations :

Datta and Singh say that the process of solving the following two particular cases of simultaneous quadratic equations was distinguished by most Indian mathematicians by the special designation *viṣama-karma* or dissimilar operation :

$$\text{(i)}\quad \left.\begin{array}{l} x^2-y^2=m \\ x-y=n \end{array}\right\} \qquad \text{(ii)}\quad \left.\begin{array}{l} x^2-y^2=m \\ x+y=p \end{array}\right\}$$

These equations have been regarded by these mathematicians as if of fundamental importance. They have given the following solutions (expressed in modern algebraic symbols) :

For the combination (i) :

$$x=\tfrac{1}{2}\left(\frac{m}{n}+n\right),\ y=\tfrac{1}{2}\left(\frac{m}{n}-n\right),$$

For the combinaticn (ii) :

$$x=\tfrac{1}{2}\left(p+\frac{m}{p}\right),\ y=\tfrac{1}{2}\left(p-\frac{m}{p}\right).$$

We shall express these solutions as follows in the words of Brahmagupta :

> Thc difference of the squares (of the unknowns) is divided by the difference of the unknowns and the quotient is increased and diminished by the difference and divided by two ; (the results will be the two unknown quantities) ; (this is) dissimilar operation.

The same rule is restated by him on a different occasion in the course of solving a problem.

> If then the difference of their squares, also the difference of them (are given) ; the difference of the squares

1. योगोऽन्तरयुन्हीनो द्विहतः संक्रमणमन्तर विभक्तं वा ।
वर्गान्तरमन्तर-युतहीनं द्विहृतं विषमकर्म । *BrSpSi*. XVIII. 36

is divided by the difference of them, and this (latter) is added to and subtracted from the quotient and then divided by two ; (the results are) the residues whence the number of elapsed days (can be found).[1]

This *viṣama-karma* or dissimilar operation has been described by other Indian algebraists also, as Āryabhaṭa II (*Mahāsiddhānta*, XVII, 22); Śrīpati (*Siddhānta-śekhara*, XIV. 13) ; Bhāskara II (*Līlāvatī*) and Nārāyaṇa (*Gaṇita-kaumudī*, I, 32).

Indeterminate Equations of the First Degree

Āryabhaṭa I should be given the credit of giving for the first time a treatment of the indeterminate equation of the first degree. In his *Āryabhaṭīya*, we find a method for obtaining the general solution in positive integers of the simple indeterminate equation :

$$by-ax=c$$

for integral values of a,b,c, and further indicated how to extend it to get positive integral solutions of simultaneous indeterminate equations of the first degree. His disciple Bhāskara I (522) showed that the same method might be applied to solve :

$$by-ax=-c$$

and further that the solution of this equation would follow that of $by-ax=-1$. These methods of Āryabhaṭa I and Bhāskara I have also been adopted by Brahmagupta, and in certain cases, the improvement were suggested by Āryabhaṭa II in the middle of the tenth century A.D.

The problems which were treated by ancient Indian algebraists and which led them to the investigation of the simple indeterminate equation of the first degree may be classified under three heads :

Class I : To find a number N which being divided by two given numbers (a,b) will leave two given remainders (R_1, R_2).

Thus we have :

$$N=ax+R_1=by+R_2$$

---

1. तद्वर्गान्तरमाद्ये तदन्तरं चान्तरोद्धृतयुतोनम् ।
वर्गान्तरं विभक्तं द्वाभ्यां शेषे ततोद्युगणः । *BrSpSi*, XVIII, 97

Hence $by - ax = R_1 - R_2$

Putting $c = R_1 \backsim R_2$

we get $by - ax = \pm c$

the upper or lower sign being taken according as R_1 is greater than or less than R_2.

Class II : To find a number (x) such that its product with a given number (α) being increased or decreased by another given number (δ) and then divided by a third given number (β) will leave no remainder.

This means that in other words, we shall have to get the solution of :

$$\frac{\alpha x \pm r}{\beta} = y$$

in positive integers.

Class III : Here we have to deal with an equation of the form :

$$by \div ax = \pm c$$

Kuṭṭaka, Kuṭṭākāra and *Kuṭṭa* : These are the three terms which Brahmagupta has used in regards to the subject of indeterminate analysis of the first degree. Āryabhaṭa I has also described this method in brief, but he does not use the word *kuṭṭaka*. In the *Mahābhāskarīya* of Bhāskara I we have the terms *kuṭṭākāra* and *kuṭṭa* (522 A.D.) *MBh.* I. 41,49). These words have been translated into English as *pulveriser* or *grinder*. According to Datta and Singh, the Hindu method of solving the equation $by - ax = \pm c$ is essentially based on a process of deriving from it successively other similar equations in which the values of the coefficients (a,b) become smaller and smaller. Thus the process is indeed the same as that of breaking a whole thing into smaller pieces, and this accounts for its name *kuṭṭaka* or '*pulveriser*'.

In the problems of the Class I, the quantities (a and b) are called' divisors' *bhāgahāra*, *bhājaka*, *cheda* etc.) and R_1 and R_2 as 'remainders' (*agra* or *śeṣa* etc.). while in a problem of the Class II; β is ordinarily called the 'divisor' (*bhāgahāra* or *bhājaka*) and γ the 'interpolator' *kṣepa*, *kṣepaka* etc.) ; here α is called the 'dividend' (*bhājya*), the unkown quantity to be found (x) is called the 'multiplier' or (*guṇaka* or *guṇakāra* etc) and y the

quotient or *phala*. In later years, Mahāvīra has called the unknwn number (x) as *rāśi*.

Preliminary Operations in Kuṭṭaka-Karma

Usually it has been suggested that in order that an equation of the form

$$by-ax=\pm c \text{ or } by+ax=\pm c$$

may be amenable to solution, the two numbers a and b must not have a common divisor; for otherwise, the equation would be absurd, unless the number c had the same common divisor. So before the rules which we shall give hereafter, could be applied, the numbers a, b. c must be made prime (*dṛḍha* or firm; *niccheda* or having no divisor, or *nirapavarta* , meaning irreducible to each other.

In this connection Bhāskara I writes :

> The dividend and divisor will become prime to each other on being divided by the residue of their mutual division. The operation of the pulveriser should be considered in relation to them.[1]

Similarly we find in the writings of Brahmagupta :

> Divide the multiplier and the divisor mutually and find the last residue; those quantities being divided by the residue will be prime to each other.[2]

Āryabhaṭa's Rule : Āryabhaṭa I is probably the first Indian writer on this subject, but the operation given by him is rather obscure. His disciple Bhāskara I has given the solution of indeterminate equations of the first degree in more satisfactory language. We shall give here the translation of Āryabhaṭa's verse from the *Āryabhaṭīya*, as rendered by Bibhutibhusan Datta, because other translations of this verse do very often confuse the sense:

> Divide the divisor corresponding to the greater remainder by the divisor corresponding to the smaller remain-

1. भूदिनेष्टगणान्योन्य भक्तशेषेण भाजितौ ।
   हारभाज्यौ दृढौ स्यातां कुट्टाकारं तयोर्विदुः —*MBh*, I. 41
2. हृतयोः परस्परं यच्छेषं गुणकारभागहारकयोः ।
   तेन हृतौ निश्छेदौ तावेव परस्परं हृतयोः । —*BrSpSi*. XVIII. 9.

Hence $by-ax=R_1-R_2$

Putting $c=R_1 \backsim R_2$

we get $by-ax=\pm c$

the upper or lower sign being taken according as R_1 is greater than or less than R_2.

Class II : To find a number (x) such that its product with a given number (α) being increased or decreased by another given number (δ) and then divided by a third given number (β) will leave no remainder.

This means that in other words, we shall have to get the solution of :

$$\frac{ax \pm r}{\beta}=y$$

in positive integers.

Class III : Here we have to deal with an equation of the form :

$$by \div ax = \pm c$$

Kuṭṭaka, *Kuṭṭākāra* and *Kuṭṭa* : These are the three terms which Brahmagupta has used in regards to the subject of indeterminate analysis of the first degree. Āryabhaṭa I has also described this method in brief, but he does not use the word *kuṭṭaka.* In the *Mahābhāskarīya* of Bhāskara I we have the terms *kuṭṭākāra* and *kuṭṭa* (522 A.D.) *MBh.* I. 41,49). These words have been translated into English as *pulveriser* or *grinder.* According to Datta and Singh, the Hindu method of solving the equation by-$ax= \pm c$ is essentially based on a process of deriving from it successively other similar equations in which the values of the coefficients (a,b) become smaller and smaller. Thus the process is indeed the same as that of breaking a whole thing into smaller pieces, and this accounts for its name *kuṭṭaka* or '*pulveriser*'.

In the problems of the Class I, the quantities (a and b) are called' divisors' *bhāgahāra*, *bhājaka*, *cheda* etc.) and R_1 and R_2 as 'remainders' (*agra* or *śeṣa* etc.). while in a problem of the Class II ; β is ordinarily called the 'divisor' (*bhāgahāra* or *bhājaka*) and γ the 'interpolator' *kṣepa*, *kṣepaka* etc.) ; here α is called the 'dividend' (*bhājya*), the unkown quantity to be found (x) is called the 'multiplier' or (*guṇaka* or *guṇakāra* etc) and y the

quotient or *phala*. In later years, Mahāvīra has called the unknwn number (x) as *rāśi*.

Preliminary Operations in Kuṭṭaka-Karma

Usually it has been suggested that in order that an equation of the form

$$by-ax=\pm c \text{ or } by+ax=\pm c$$

may be amenable to solution, the two numbers a and b must not have a common divisor; for otherwise, the equation would be absurd, unless the number c had the same common divisor. So before the rules which we shall give hereafter, could be applied, the numbers a, b. c must be made prime (*dṛḍha* or firm; *niccheda* or having no divisor. or *nirapavarta* , meaning irreducible to each other.

In this connection Bhāskara I writes :

> The dividend and divisor will become prime to each other on being divided by the residue of their mutual division. The operation of the pulveriser should be considered in relation to them.[1]

Similarly we find in the writings of Brahmagupta :

> Divide the multiplier and the divisor mutually and find the last residue; those quantities being divided by the residue will be prime to each other.[2]

Āryabhaṭa's Rule : Āryabhaṭa I is probably the first Indian writer on this subject, but the operation given by him is rather obscure. His disciple Bhāskara I has given the solution of inde- terminate equations of the first degree in more satisfactory langu- age. We shall give here the translation of Āryabhaṭa's verse from the *Āryabhaṭīya*, as rendered by Bibhutibhusan Datta, because other translations of this verse do very often confuse the sense:

> Divide the divisor corresponding to the greater remain- der by the divisor corresponding to the smaller remain-

1. भूदिनेष्टगणान्योन्य भक्तशेषेण भाजितौ ।
हारभाज्यौ दृढौ स्यातां कुट्टाकारं तयोर्विदुः —*MBh*, I. 41

2. हृतयोः परस्परं यच्छेषं गुणकारभागहारकयोः ।
तेन हृतौ निश्छेदौ तावेव परस्परं हृतयोः । —*BrSpSi*. XVIII. 9.

> der. The residue (and the divisor corresponding to the smaller remainder) being mutually divided, the last residue should be multiplied by such an optional integer that the product being added(in case the number of quotients of the mutual division is even) or subtracted (in case the number of quotients is odd) by the difference of the remainders (will be exactly divisible by the last but one remainder. Place the quotients of the mutual division successively one below the other in a column; below them the optional multiplier and underneath it the quotient just obtained). Any number below .: . the penultimate) is multiplied by the one just above it and then added by that just below it. Divide the last number (obtained by doing so repeatedly) by the divisor corresponding to the smaller remainder; then multiply the residue by the divisor corresponding to the greater remainder and add the greater remainder. (The result will be) the number corresponding to the two divisors.[1]

There is an alternative rendering of this passage also as follows:

> Divide the divisor corresponding to the greater remainder by the divisor corresponding to the smaller remainder. The residue (and the divisor corresponding to the smaller remainder) being mutually divided (until the remainder becomes zero), the last quotient should be multiplied by an optional integer and then added (in case the number of quotients of the mutual division is even) or subtracted (in case the number of quotients is odd) by the difference of the remainders. (Place the other quotients of mutual division successively one below the other in a column; below them the result just obtained and underneath it the optional integer). Any

1. अधिकाग्रभागहारं छिन्द्यादूनाग्रभागहारेण ।
शेषपरस्परभक्तं मतिगुणमग्रान्तरे क्षिप्तम् ॥
अध उपरि गुणितमन्त्ययुगूनाग्रच्छेद भाजिते शेषम् ।
अधिकाग्रच्छेदगुणं द्विच्छेदाग्रमधिकाग्रयुतम् । —*Ārya. II.* 32-33

number below (i.e. the penultimate) is multiplied by the one just above it and then added by that just below it. Divide the last number (obtained by doing so repeatedly) by the divisor corresponding to the smaller remainder; then multiply the residue by the divisor corresponding to the greater remainder and add the greater remainder. (The result will be) the number corresponding to the two divisors.

Āryabhaṭa's problem may be enunciated thus :

To find a number (N) which being divided by two given numbers (a, b) will leave two given remainders (R_1, R_2).

This gives :

$$N=ax+R_1=by+R_2$$

(where R_1 is a greater remainder and R_2 lesser remainder, and a is the divisor corresponding to greater remainder and b the divisor corresponding to the lesser remainder.)

Denoting as before by c the difference between R_1, and R_2, we get

(i) $by=ax+c$, if $R_1>R_2$

(ii) $ax=by+c$, if $R_2>R_1$

the equation being so written as to keep c always positive.

Hence the problem now reduces to making either

$$\frac{ax+c}{b} \text{ or } \frac{by+c}{a}$$

according as $R_1>R_2$ or $R_2>R_1$, a positive integer. So Āryabhaṭa says : Divide the divisor corresponding to the greater remainder etc."

Now we shall proceed with the details of the operation as proposed by Datta and Singh in his *History of Hindu Mathematics, Part II. Algebra* :

Suppose $R_1>R_2$; then the equation to be solved will be

$$ax+c=\text{by} \qquad \text{...(i)}$$

a, b being prime to each other.

Let

$$b)\ a\ (q$$
$$\underline{bq}$$
$$r_1)\ b\ (q_1$$
$$\underline{r_1q_1}$$
$$r_2)\ r_1\ (q_2$$
$$\underline{r_2q_2}$$
$$r_3$$
$$\underline{\ldots}$$
$$r_{m-1})\ r_{m-2}\ (q_{m-1}$$
$$\underline{r_{m-1}\ q_{m-1}}$$
$$r_m)\ r_{m-1}\ (q_m$$
$$\underline{r_mq_m}$$
$$r_{m+1}$$

Then we get (when $a<b$, we shall have $q=0$, $r_1=a$)

$$a=bq+r_1$$
$$b=r_1q_1+r_2$$
$$r_1=r_2q_2+r_3$$
$$r_2=r_3q_3+r_4$$
$$\ldots \quad \ldots \quad \ldots$$
$$r_{m-2}=r_{m-1}\ q_{m-1}+r_m$$
$$r_{m-1}=r_mq_m+r_{m+1}$$

Now, substituting the value of a in the given equation (1), we get

$$by=(bq+r_1)x+c$$

Therefore

$$y=qx+y_1$$

where

$$by_1=r_1x+c$$

In other words, since $a=bq+r_1$, on putting

$$y=qx+y_1 \qquad \text{(ii)}$$

the given equation (i) reduces to

$$by_1=r_1x+c \qquad \text{(iii)}$$

Again, since $b=r_1q_1+r_2$

putting similarly $x=q_1y_1+x_1$
the equation (iii) can be further reduced to

$$r_1x_1=r_2y_1-c \qquad \text{(iv)}$$

and so on.

Writing down the successive values and reduced equations in columns, we have

(1) $y=qx+y_1$	(I.1) $by_1=r_1x+c$
(2) $x=qy_1+x_1$	(I.2) $r_1x_1=r_2y_1-c$
(3) $y_1=q_2x_1+y_2$	(I.3) $r_2y_2=r_3x_1+c$
(4) $x_1=q_3y_2+x_2$	(I.4) $r_3x_2=r_4y_2-c$
(5) $y_2=q_4x_2+y_3$	(I.5) $r_4y_3=r_5x_2+c$
(6) $x_2=q_5y_3+x_3$	(I.6) $r_5x_3=r_6y_3-c$
....	....
$(2n-1)$ $y_{n-1}=q_{2n-2}\,x_{n-1}+y_n$	(I. $2n-1$) $r_{2n-2}\,y_n=r_{2n-1}\,x_{n-1}+c$
$(2n)$ $x_{n-1}=q_{2n-1}\,y_n+x_n$	(I. $2n$) $r_{2n-1}\,x_n=r_{2n}\,y_n-c$
$(2n+1)$ $y_n=q_{2n}\,x_n+y_{n+1}$	(I. $2n+1$) $r_{2n}\,y_{n+1}=r_{2n+1}\,x_n+c$

Now the mutual division can be continued either (i) to the finish or (ii) so as to get a certain number of quotients and then stopped. In either csse the number of quotients found, neglecting the first one (q). as is usual with Āryabhaṭa, may be even or odd.

Case (i) First suppose that the mutual division is continued until the zero remainder is obtained. Since a, b are prime to each other, the last one remainder is unity.

Subcase (*i*.1.). Let the number of quotients be even. We then have

$$r_{2n}=1,\ r_{2n-1}=0,\ q_{2n}=r_{2n-1}$$

The equations (1,2n) and (I.2n+1), therefore become

$$y_n=q_{2n}\,x_n+c$$

and

$$y_{n+1}=c$$

respectively. Giving an arbitrary integral value (t) to x_n we get an integral value of y_n. From that we can find the value of x_{n-1} by the equation ($2n$). Procceding backwards step by step we ultimately find the values of x and y in positive integers. So that the equation (I) is solved.

Subcase (*i*. 2) : If the number of quotients be odd, we shall have

$$r_{2n-1}=1,\ r_{2n}=0,\ q_{2n-1}=r_{2n-2}.$$

The equations $(2n+1)$ and $(I. 2n+1)$ will then be absent and the equations (I. 2n—1) and (I. 2n) will be reduced respectively to

$$x_{n-1}=q_{2n-1}\, y- c$$

and $x_n=-c$

Giving an arbitrary integral value (t') to y_n we get an integral value of x_{n-1}. Then proceeding backwards as before we calculate the values of x and y.

Case (ii) : Next suppose that the mutual division is stopped after having obtained an even or odd number of quotients.

Subcase (*ii*.1) : If the number of quotients obtained be *even* the reduced form of the original equation is

$$r_2 \; y_{+1}=r_{2n+1}\, x_n+c$$

or $$y_{n+1}=\frac{r_{2u+1}\, x_n+c}{r_2}$$

Giving a suitable integral value (t) to x_n as will make

$$y_{n+1}=\frac{r_{2n+1}\, t+c}{r_{2n}}=\text{an integral number},$$

we get an integral value for y_n by $(2n+1)$. The values of x and y can then be calculated by proceeding as before.

Subcase (*ii*.2) : If the number of quotients be *odd* the reduced form of the quotient is

$$r_{2n-1}\, x_n=r_{2n}\, y_n-c$$

or $$x_n=\frac{r_{2n}\, y_n-c}{r_{2n-1}}$$

Putting $y_n=t'$, where t' is an integer, such that

$$x_n=\frac{r_{2n}\, t'-c}{r_{2n-1}}=\text{a whole number},$$

we get an integral value of x_{n-1} by $(2n)$. Whence can be calculated the values of x and y in integers.

If $x=\alpha$ and $y=\beta$ be the least integral solution of $ax+c=by$, we shall have

$$a\alpha+c=b\beta$$

Therefore $a(bm+\alpha)+c=b\,(am+\beta)$,
m being any integer. Therefore, in general,

$$x=bm+\alpha$$

But we have calculated before that

$$x = q_1 y_1 + x_1 ;$$

$$\therefore \; q_1 y_1 + x_1 = bm + \alpha$$

Thus it is found that the minimum value α of x is equal to the remainder left on dividing its calculated value by b. whence we can calculate the minimum value of N $(= a\alpha + R_1)$. This will explain the *rationale* of the operations described in the latter portion of the rule of Āryabhaṭa I.

Bhāskara I and Kuṭṭaka Operation

In Chapter I of the *Mahābhāskarīya*, Bhāskara I has described the preliminary operation to be performed on the divisor and dividend of a pulveriser. We shall quote it from the edition of K.S, Shukla :

> The divisor (which is "the number of civil days in a *yuga*) and the dividend (which is "the revolution number of the desired planet") become prime to each other on being divided by the (last non-zero) residue of the mutual division of the number of civil days in a *yuga* and the revolution number of the desired planet. The operations of the pulveriser should be performed on them (i. e. on the abraded divisor and abraded dividend). So has been said.[1]

An indeterminate equation of the first degree of the type

$$\frac{ax - c}{a} = y$$

(with x and y unknown) is known in Hindu mathematics by the name of "pulveriser"—*kuṭṭākāra*). In this equation, a is called the "dividend" (*bhājya*), b the "divisor" (*bhāgahāra*), c the interpolator (*kṣepa*), x the "multiplier" (*guṇakāra*), and y the "quotient" (*labdha*).

In the pulveriser contemplated in the above stanza :

a=revolution number of a planet.
b=civil days in a *yuga*,
c=residue of the revolutions of the planet (Śeṣa)

1. भूदिनेष्टगणान्योन्य भक्तशेषेण भाजि
हारभाज्यौ दृढौ स्यातां कुट्टाकारं तयोर्विदुः । —*MBh.* I. 41

x=*ahargaṇa* ,

and y=complete revolutions performed by the planet.

The text says that as a preliminary operation to the solution of this pulveriser, a and b. i.e., civil days in *yuga* and revolution-number of the planet, should be made prime to each other by dividing them out by their greatest common factor, That is to say, in solving a pulveriser, one should always make use of abraded divisor and abraded dividend.

The interpolator, i.e., the residue, should also be divided out by the same factor. (This instruction is not given in the text, but it is implied that the residue should be computed for the abraded dividend and abraded divisor).

> Set down the dividend above and the divisor (*hāra*) below that. Divide them mutually and write down the quotients (*labdha*) of division one below the other (in the form of a chain). (When an even number of quotients is obtained) think out by what number the (last) remainder be multiplied so that the product being diminished by the (given) residue be exactly divisible (by the divisor corresponding to that remainder). Put down the chosen number called *mati* below the chain and then the new quotient underneath it. Then by the chosen number multiply the number which stands just above it, and to the product add the quotient (written below the chosen number). (Replace the upper number by the resulting sum and cancel the number below). Proceed afterwards also in the same way (until only two numbers remain). Divide the upper number (called the "multiplier") by the divisor by the usual process and the lower one (called the "quotient") by the dividend : the remainders (thus obtained) will respectively be the *ahargaṇa* and the revolutions etc. or what one wants to know.[1]

We shall illustrate the operation by taking a problem from the *Laghu-Bhāskarīya* (VIII. 17) :

> The sum, the difference, and the product increased by one, of the residues of the revolution of Saturn and Mars—each is a perfect square. Taking the equations

furnished by the above and applying the method of such quadratics, obtain the (simplest) solution by the substitution of 2, 3 etc. successively in the general solution). Then calculate the *ahragaṇa* and the revolutions performed by Saturn and Mars in that time together with the number of solar years elapsed.[1]

Let x and y denote the residues of the revolution of Mars and Saturn respectively. Then we have to find out two numbers x and y such that each of the expressions $x+y$, $x-y$ and $xy+1$ may be a perfect square.

Let $x+y=4P^2$ and $x-y=4Q^2$, so that

$$x=2P^2+2Q^2$$
$$y=2P^2-2Q^2$$

and therefore $xy+1=(2P^2-1)^2+4(P^2-Q^4)$

Hence the condition that $xy+1$ be a perfect square is that $P^2=Q^4$. Substituting these values, we have

$$x=2(Q^4+Q^2)$$
$$y=2(Q^4-Q^2)$$

where Q may possess any of the values 2, 3, 4,......but not 1. (We neglect the case when x or y is zero).

---

1. भाज्यं न्यसेदुपरि हारमधश्च तस्य ।
खण्डयात्परस्परमधो विनिधाय लब्धम् ।
केनाऽऽहतोऽयमपनीय यथाऽस्य शेषं ।
भागं ददाति परिशुद्धमिति प्रचिन्त्यम् ॥

आप्तां मतिं तां विनिधाय वल्ल्यां
नित्यं ह्यधोऽधः क्रमशश्च लब्धम् ।
मत्या हतं स्यादुपरिस्थितं य
ल्लब्धेन युक्तं पातश्च तद्वत् ॥

हारेणभाज्यो विधिनोपरिस्थो
भाज्येन नित्यं तदधः स्थितश्च ।
अहर्गणोऽस्मिन् भगणादयश्च
तद्वा भवेद्यस्य समीहितं यत् ॥ —*MBh*, I, 42-44

2. शेषौ मण्डलजौ यमक्षितिजयोः संयुक्तविश्लेषिता
वन्योन्याहतविग्रहौ च पददौ रूपेण संयोजितौ ।
एवं साधु विचिन्त्य वर्गविधिना द्वित्रिक्रमाद्वत्स रैः ।
संगण्या द्युगणार्कजक्षिति सुताः कालेन कालोद्भवाः ॥ —*LBh.* VIII. 17

Putting $Q=2$, we get $x=40$ and $y=24$, which is the least solution.

Assuming now that the residues of the revolution (*maṇḍalaja-śeṣa*) of Saturn and Mars are 24 and 40 respectively, we have to obtain the *ahargaṇa* (which means the number of mean civil days elapsed since the beginning of Kaliyuga, or, in fact, any epoch).

The revolution-number of Saturn is 146564, and the number of civil days in a *yuga* is 1,577,917,500. In the present problem, these are respectively the dividend and the divisor. Their H.C.F. is 4, so that dividing them out by 4 we get 36641 and 394,479,375 as the abraded dividend and abraded divisor respectively. We have, therefore, to solve the pulveriser

$$\frac{36641x-24}{394479375}=y$$

where x and y denote the *ahargaṇa* and the revolutions respectively made by Saturn.

Mutually dividing 36641 and 394479375, we get

36641) 394479375 (10766
394477006

2369) 36641 (15
35535

1106) 2369 (2

157) 1106 (7
1099

7) 157 (22
154

3) 7 (2
6

$1\times27-24=3$)3(1
3

0

We have chosen here the number 27 as the optional number (*mati*). In fact, *mati* may be chosen at any stage after an even number of quotients are obtained.

Writing down the quotients one below the other as prescribed in the rule, we get the chain

10766
15
2
7
22
2
(*mati*) 27
1

Reducing the chain, we successively get

10766	10766	10766	10766	10766	10766	3108044439 (multiplier)
15	15	15	15	15	288689	288689 (quotient)
2	2	2	2	18665	18665	
7	7	7	8714	8714		
22	22	1237	1237			
2	55	55				
(*mati*) 27	27					
1						

(it would be seen in this reduction of chain that *mati* or 27×2 plus 1 is 55; 55×22 plus 27 is 1237; 1237×7 plus 55 is 8714; 8714×2 plus 1237 is 18665; 18665×15 plus 8714 is 288689; and finally 288689×10766 plus 18665 is 3108044439 which is the multiplier).

Dividing 3108044439 by 394479375, and 288689 by 36641, we obtain 346688814 and 32202 respectively as remainders, (This division is performed only when the multiplier and quotient are greater than the divisor and dividend respectively). These are the minimum values of x and y satisfying the above equation.

Therefore, the required *ahargaṇa*=346688814 and the revolutions performed by Saturn=32202.

To obtain the *ahargaṇa* and the revolutions of Mars, one has to solve the equation :

$$\frac{191402\,z-40}{131493125}=w$$

where z and w denote the *ahargaṇa* and the revolutions performed by Mars respectively.

The general solution of this equation is

$$z = 131493125\, s + 118076020$$
$$w = 191402\, s + 171872$$

where $s = 0, 1, 2, 3, \ldots\ldots$ When $s = 0$, we have the least solution.

Brahmagupta's Rules Concerning Indeterminate Analysis of the First Degree

For the solution of Āryabhaṭa's problem, Brahmagupta gives the following rule :

> What remains when the divisor corresponding to the greater remainder is divided by the divisor corresponding to the smaller remainder—that (and the latter divisor) are mutually divided and the quotients are severally set down one below the other. The last residue (of the reciprocal division after an even number of quotients has been obtained) is multiplied by such an optional integer that the product being added with the difference of the (given) remainders will be exactly divisible (by the divisor corresponding to that residue). That optional multiplier and then the (new) quotient just obtained should be set down (underneath the listed quotients). Now, proceeding from the lower-most number (in the column), the penultimate is multiplied by the number just above it and then added by the number just below it. The final value thus obtained (by repeating the above process) is divided by the divisor corresponding to the smaller remainder. The residue being multiplied by the divisor corresponding to the greater remainder and added to the greater remainder will be the number in view.[1]

1. अधिकाग्रभागहारादूनाग्रच्छेद भाजिताच्छेषम् ।
यत् तत् परस्परहृतं लब्धमधोऽधः पृथक् स्थाप्यम् ॥
शेषं तदेष्टगुणितं यथाऽग्रयोरन्तरेण संयुक्तम् ।
शुध्यति गुणकः स्थाप्यो लब्धं चान्त्यादुपान्त्यगुणः ॥
स्वोर्ध्वोऽन्त्य युतोऽग्रान्तो हीनाग्रच्छेदभाजितः शेषम् ।
अधिकाग्रच्छेदहत मधिकाग्रयुतं भवत्यग्रम् ॥ —*BrSpSi. XVIII*, 3-5

Brahmagupta further observes:

> Such is the process when the quotients (of mutual division) are even in number. But if they be odd, what has been stated before as negative should be made as positive, or as positive should be made negative.[1]

Regarding the direction for dividing the divisor corresponding to the greater number by the divisor corresponding to the smaller remainder, Pṛthūdaka Svāmī (860A.D.) observes that it is not absolute, rather optional; so that the process may be conducted in the same way by starting with the division of the divisor corresponding to the smaller remainder by the divisor corresponding to the greater remainder. But in this case of inversion of the process, he continues, the difference of the remainders, must be negative.

That is to say, the equation

$$by = ax + c$$

can be solved by transforming it first to the form

$$ax = by - c$$

so that we shall have to start with the division of b by a,

For the details of the "Theory of the pulveriser" as applied to the problems in Astronomy, the reader is referred to the writings of Bhaṭṭa Govind, translated by K.S. Shukla, and given as an Appendix to the edition of the *Laghu-Bhāskarīya*. For the *rationale* of the rules in relation to *kuṭṭaka* or the pulveriser operation, one may also refer to the chapters by Datta and Singh in the *History of Hindu Mathematics: Algebra*.

Solution of $by = ax \pm 1$.

This simple indeterminate equation has a special use in astronomical calculations and therefore, Indian algebraists have paid special attention to it. In fact, this equation is solved exactly in the same way as the equation $by = ax \pm c$; it is a parti-

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1. एवं समेषु विषमेष्वृणं धनं धनमृणं यदुक्तं तत् ।
ऋणधनयोर्व्यस्तत्वं गुण्य प्रक्षेपयोः कार्यम् ॥ —*BrSpSi.* XVIII. 13.

cular case only of the more general latter equation. Of course, there is a little justification also for treating it separately, since both the types of equations represent two different physical conditions of the astronomical problems. In the case of $by=ax\pm c$, the conditions are such that the value of either y or x, more particularly of the latter, has to be found and the rules for solution formulated with that objective. But in the case of the equation $by=ax\pm 1$, the physical conditions require the values of both y and x.

The equation $by=ax\pm 1$ is usually known by the name *sthira-kuṭṭaka*, literally meaning the '*constant pulveri*ser' Pṛthūdaka Svāmī also names it as *dṛḍha-kuṭṭaka* meaning firm-pulveriser. Later on this term *dṛḍha*-was confined to another sense, equivlent to *nicched* (having no divisor) or *nirapavarta* (irreducible), The origin of the name *sthira-kuṭṭaka* or constant pulveriser has been explained by Pṛthūdaka Svāmī as being due to the fact that the interpolator (± 1) is here invariable.

For the solution of this equation, we shall quote Bhāskara I's rule and the rule by Brahmagupta, Bhāskara I writes in this connection as follows :

> The method of the pulveriser is applied also after subtracting unity, The multiplier and quotient are respectively the numbers above and underneath. Multiplying those quantities by the desired number divide by the reduced divisor and dividend; the residues are in this case known to be the (elapsed) days and (residues of) revolutions respectively[1].

The pulveriser

$$\frac{ax-c}{b}=y \qquad \dots (1)$$

may be written as

$$\frac{aX-1}{b}=Y \qquad \dots (2)$$

where $x=cX$ and $y=cY$. If $X=\alpha$, $Y=\beta$ is a solution of (2), then $x=c\alpha$, $y=c\beta$ will be a solution of (i). Hence the above rule.

1. रूपमेकमपास्यापि कुट्टाकारः प्रसाध्यते ।
गुणकारोऽथ लब्धं च राशी स्यातामुपर्यधः ॥ —*MBh. I.* 45

Brahmagupta's Rule in this connection is as follows :
Solution of $by=ax-1$:

> Divide them (i.e., the abraded coefficient of the multiplier and the divisor) mutually and set down the quotients one below the other. The last residue (or the reciprocal division after an even number of quotients has been obtained) is multiplied by an optional integer such that the product being diminished by unity will be exactly divisible (by the divisor correponding to that residue). The (optional) multiplier and then this quotient should be set down (underneath the listed quotients). Now proceeding from the lower most term to the uppermost, by the penultimate multiply the term just above it and then add the lowermost number. (The uppermost number thus calculated being divided by the reduced divisor, the residue (is the quantity required. This is the method of the constant pulveriser[1].

Solution of

$$by+ax=\pm c$$

Indian algebraists usually transformed this equation as $by=-ax+c$, so that it appeared as a particular case of $by=ax+c$, in which a was negative. Brahmagupta has been the first person to solve this equation, but the rule given by him is obscure :

> The reversal of the negative and positive should be made of the multiplier and interpolator.[2]

Pṛthūdaka Svāmī has tried to explain it, but he too is not very clear. He says :

---

1. हतयोः परस्परं यच्छेषं गुणकार भागहारकयोः ।
तेन हतौ निश्छेदौ तावेव परस्परं हतयोः ॥
लब्धमधोऽधः स्थाप्यं तथेष्ट गुणकारसङ्गुणं शेषम् ।
शुद्ध्यति यथैकहीनं गुणकः स्थाप्यः फलं चान्त्यात् ॥
अग्रान्तमुपान्त्येन स्वोर्ध्वो गुणितोऽन्त्य संयुतो भक्तम् ।
निःशेषभागहारेणैवं स्थिरकुट्टकः शेषम् ॥ —*BrSpSi.* XVIII. 9-11

2. एवं समेषु विषमेष्वृणं धनं धनमृणं यदुक्तं तत् ।
ऋणधनयोर्व्यस्तत्वं गुण्यप्रक्षेपयोः कार्यम् ॥ *BrSpSi* XVIII. 13

If the multiplier be negative, it must be made positive; and the additive must be made negative : and then the method of the pulveriser should be employed.

Pṛthūdaka Svāmī, however, does not indicate how to derive the solution of the equation .

$$by = -ax + c \qquad ...(1)$$

from that of the equation

$$by = ax - c \qquad ...(2)$$

The method, however, seems to have been this :

Let $x = \alpha$, $y = \beta$ be the minimum solution of (2). Then we get

$$b\beta = a\alpha - c$$

or $$b(a - \beta) = -a(\alpha - b) + c$$

Hence $x = \alpha - b$, $y = a - \beta$ is the minimum solution of (1). This rule is very clearly indicated by Bhāskara II and others.

We shall give two examples from Bhāskara II (*Bījagaṇita*) to illustrate the rule :

Example I.

$13y = -60x + 3$

By the method described before, we find that the minimum solution of

$$13y = 60x + 3$$

is $x = 11$, $y = 51$. Subtracting these values from their respective abraders, namely 13 and 60, we get 2 and 90. Then by the maxim : "In the case of the dividend and divisor being of different signs, the results from the operation of division should be known to be so", making the quotient negative we get the solution of

$$13y = -60x + 3$$

as $x = 2$, $y = -9$. Subtracting these values again from their respective abraders (13, 60), we get the solution of

$13y = -60x - 3$

as $x = 11$, $y = -51$.

Example II.

$11y = 18x + 10$

Proceeding as before, we find the minimum solution of

$$11y=18x+10$$

to be $x=8$, $y=14$. These will also be the values of x and y in the case of the negative divisor but the quotient for the reasons stated before should be made negative. So the solution of

$$-11y=18x+10$$

is $x=8$, $y=-14$. Subtracting these (i.e., their numerical values) from their respective abraders, we get the solution of

$$-11y=18x-10$$

as $x=3$, $y=-4$,

> "When the divisor is positive or negative the numerical values of the quotient and multiplier remain the same : when either the divisor or the dividend is negative, the quotient must always be known to be negative"[1].

One Linear Equation in More Than Two Unknowns

Whenever a linear equation involves more than two unknown's the Indian algebraists used to assume arbitrary values for all the unknowns except two and then to apply the method of *kuttaka* or "pulveriser". In this connection, Brahmagupta says :

> The method of the pulveriser (should be employed if there be present many unknowns (in any equation)[2],

1. Bhāskara II gives the following rule :

> "Those(the multiplier and quotient)obtained for a positive dividend being treated in the same manner give the results corresponding to a negative dividend."
>
> The treatment alluded to in this rule is that of subtraction from the respective abraders. He has further elaborated it thus :
>
> The multiplier and quotient should be determined by taking the dividend, divisor and interpolator as positive. They will be the quantities for the additive interpolator. Subtracting them from their respective abraders, the quantities for a negative interpolator are found. If the dividend or divisor, be negative, the quotient should be stated as negative, the quotient should be stated as negative.
>
> —*Bījagaṇita*

1. आद्याद्वर्णादन्यान् वर्णान् प्रोह्याद्यमानमाद्यहृतम् ।
सदृशच्छेदावसकृद् द्वौ व्यस्तौ कुट्टको बहुषु ॥ — *BrSpSi. XVIII.* 51

We shall take up one of the problems posed by Brahmagupta concerning astronomy and leading to the equation :[1]

$$197x-1644\,y-z=6302.$$

Hence

$$x=\frac{1644\,y+z+6302}{197}$$

The commentator assumes $z=131$. Then

$$x=\frac{1644\,y+6433}{197};$$

hence by the usual method of the pulveriser

$$x=41;\ y=1.$$

General Problem of Remainders

A certain type of simultaneous indeterminate equations of the first degree arise out of the general problem of remainders which may thus be stated : To find a number *N* which being severally divided by $a_1, a_2, a_3 \ldots\ldots a_n$, leaves as remainders $r_1, r_2, r_3, \ldots\ldots r_n$ respectively.

While dealing with such a case, we shall have the following series of equations :

$$N=a_1x_1+r_1=a_2x_2+r_2=a_3x_3+r_3=\ldots\ldots=a_n\,x_n+r\ .$$

We have reasons to believe that the method of solution of these equations was known to Āryabhaṭa I. In the translation of the verse in the *Āryabhaṭīya*, II. 32-33 (the translation of which we have already given), the term *dvicchedāgram* should be translated as "the result will be the remainder corresponding to the product of the two divisors", instead of "the result will be the number corresponding to the two divisors." (the last line of the translation). This explanation is in fact given by Bhāskara I, the direct disciple and earliest commentator of Āryabhaṭa I. Such a rule is clearly stated by Brahmagupta[2].

---

1. अंशकशेषेण युतात् लिप्ताशेषात्तदन्तरादथवा ।
भानोर्द्दिने कुगणं यः कथयति कुट्टकज्ञः सः ॥ —*BrSpSi.* XVIII. 55

2. स्वोर्ध्वोऽन्त्ययुतोऽग्रान्तो हीनाग्रच्छेदभाजितः शेषम् ।
अधिकाग्रच्छेदहतमधिकाग्रयुतं भवत्यग्रम् ॥ —*BrSpSi. XVIII. 5*

The rationale of this method is not difficult. I shall quote it from the book of Datta and Singh: Starting with the consideration of the first two divisors, we have

$$N=a_1x_1+r_1=a_2x_2+r_2.$$

By the method described before, we can find the minimum value α of x_1 satisfying this equation. Then the minimum value of N will be $a_1\alpha+r_1$. Hence the general value of N will be given by

$$N=a_1\ (a_2t+\alpha)+r_1$$
$$=a_1a_2\ t+a_1\alpha+r_1$$

where t is an integer. Thus $a_1\alpha+r_1$ is the remainder left on dividing N by $a_1\ a_2$ as stated by Ārybhaṭa I and Brahmagupta, Now taking into consideration the third condition, we have

$$N=a_1a_2t+a_1{}^{\alpha}r_1=a_3x_3+r_3$$

which can be solved in the same way as before. Proceeding in this way successively, we shall ultimately arrive at a value of N satisfying all the conditions ;

Pṛthūdaka Svāmī remarks :

> Wherever the reduction of two divisors by a common measure is possible, there 'the product of the divisors' should be understood as equivalent to the product of the divisor corresponding to the greater remainder and quotient of the divisor corresponding to the smaller remainder as reduced (i.e. divided) by the common measure.[1] When one divisor is exactly divisible by the other, then the greater remainder is the (required) remainder and the divisor corresponding to the greater remainder is taken as 'the product of the divisors'. (The truth of) this may be investigated by an intelligent mathematician by taking several symbols.

As an illustration we shall take up a problem quoted by Bhāskara II in his *Bījagaṇita*, and which in its solution follows the method of Āryabhaṭa 1. Pṛthūdaka Svāmī while commenting on serveral verses from Brahmagupta (*BrSpSi.* XVIII. 3–6)

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1. i.e., if p be the L.C.M. of a_1 and a_2, the general value of N satisfying the above two conditions will be

$$N=pt+a_1\alpha+r_1$$

instead of $\quad N=a_1a_2t+a_1\alpha+r_1.$

observes that such problems were very popular amongst the ancient Indian mathematicians.

Problem : To find a number N which leaves remainders 5, 4,3,2 when divided by 6,5,4,3 respectively.

That is to solve the equations :

$N=6x+5=5y+4=4z+3=3w+2.$

We have since $N=6x+5=5y+4$,

$$x=\frac{5y-1}{6}$$

But x must be integral, so $y=6t+5$, $x=5t+4$

Hence $N=30t+29$

Again $N=30t+29=4z+3$

$$\text{Therefore, } t=\frac{2z-13}{15}$$

Since t must be integral, we must have $z=15s+14$; hence $t=2s+1$. Therefore

$N=60s+59.$

The last condition is identically satisfied. The method given here is the one followed by Pṛthūdaka Svāmī.

Thus when $N=60s+59=6x+5$

$$x=\frac{60s+54}{6}=10s+9 \qquad ...(1)$$

Again, when $N=60s+59=5y+4$,

$$y=\frac{60s+55}{5}=12s+11$$

Again when $N=60s+59=4z+3$

$$z=\frac{60s+56}{4}=15s+14$$

Lastly, when $N=60s+59=3w+2$,

$$w=\frac{60s+57}{3}=20s+19,$$

Varga Prakṛti or Kṛti Prakṛti or Square-Nature

The word *varga-prakṛti* (literally meaning 'square-nature') has been given by Indian algebraists to the indeterminate quadratic equation

$Nx^2 \pm c=y^2$

Here in this equation the absolute number c should be *rūpa* (or unity), which means the equation

$$Nx^2 \pm 1 = y^2$$

or it may be any absolute number. The most fundamental equation of this class has been regarded as

$$Nx^2 + 1 = y^2$$

where N is a non-square integer.

This branch of mathematics has originated from the number which is the *prakṛti* of the square of *yāvat*, etc. (the unknown x etc.), and therefore, it is called *varga- prakṛti. The quantity* N of *the above equation is known as Prakṛti*. Brahmagupta uses the term GUṆAKA (*multiplier*) for the same purpose[1].

This term *guṇaka* together with its variation *guṇa* appears occasionally also in the writings of later authors. For example, Śrīpati (*Siddhānta-śekhara*. XIV. 32) employs the term *guṇaka* where as Bhāskara II and Nārāyaṇa use the term *guṇa* in their *Bījagaṇitas*.

In this connection, we would now like to quote from Pṛthūdaka Svāmī (863 A.D.) from his commentary on the *Brāhmasphuṭasiddhānta* :

> Here are stated for ordinary use the terms which are well known to people. The number whose square, multiplied by an optional multiplier and then increased or decreased by another optional number, becomes capable of yielding a square-root, is designated by the term the "lesser root" *kaniṣṭha pada* or the "first root" *ādya-mūla*). The root which results, after those operations have been performed is called by the name the "greater root" (*jyeṣṭha pada*) or the "second root" (*anya-mūla*). If there be a number multiplying both these roots, it is called the "augmenter" (*udvartaka*); and on the contrary, if there be a number dividing the roots, it is called the "abridger" (*apavartaka*)[2]

Thus in the equation

$$Nx^2 \pm c = y^2,$$

---

1. मूलं द्विघेष्ट वर्गाद् गुणक गुणादिष्टयुत विहीनाच्च ।
आद्यवधो गुणकगुणः सहान्त्यघातेन कृतमन्त्यम् ॥ —*BrSpSi*. XVIII. 64

2. *BrSpSi. XVIII*. 64 (Com.)

x is known as the lesser root, y is the greater root, N is the multiplier (*guṇaka*) and c is interpolator or *kṣepaka*. Bhāskara II has used the word "*hrasvamūla*" for *kaniṣṭha pada* or *ādya-mūla* literally meaning "lsser root". The earlier terms, the "first root" (*ādyamūla*) for the value of x and the "second root" or the "last root" *antya-mūla* for the value of y are quite free from ambiguity Their use is found in the algebra of Brahmagupta. The later terms appears in the works of his commentator Pṛthūdaka Svāmī.

Brahmagupta uses the term *kṣepa*, *prakṣepa* or *prakṣepaka* in the sense of "interpolator." Again, when negative, the interpolator is sometimes distinguished as the "subtractive" or *śodhaka* and the positive interpolator is then called "the additive."

Lemmas of Brahmagupta

Prior to our giving the general solution of the Square-nature or *Varga-Prakṛti*, it would be better to give two Lemmas established by Brahmagupta. We have the following in the *Brāhmasphuṭasiddhānta* :

> Of the square of the optional number multiplied by the *guṇaka* and increased or decreased by an other optional number, *iṣṭa*, (extract) the square root. (Proceed) twice. The product of the first roots multiplied by the *guṇaka* together with the product of the second roots will give a (fresh) second root; the sum of their cross-products will be a (fresh) first root. The (corresponding) interpolator will be equal to the product of the (previous) interpolators.[1]

There is a little difficulty in ascertaing the real sense of the rule given in these lines since the word *dvidhā* (twice) has two implications. Firstly, it may mean that the earlier operations of finding roots are made on two optional numbers with two optional interpolators, and with the results thus obtained the subse-

1. मूलं द्विधेष्टवर्गाद् गुणक गुणादिष्टयुत विहीनाच्च ।
आद्यवधो गुणकगुणः सहान्त्यघातेन कृतमन्त्यम् ॥
वज्रवधैक्यं प्रथमं प्रक्षेपः क्षेपवध तुल्यः ।
प्रक्षेपशोधकहृते मूले प्रक्षेपके रूपे ॥ —*BrSpSi. XVIII* 64-65

quent operations of their composition are performed. Secondly, it may also mean that the earlier operations are made with one optionally chosen number and one interpolator, and the subsequent ones are carried out after the repeated statement of those roots for the second time. It is also implied that in the composition of the quadratic roots, their products may be added together or subtracted from each other.

In other words, if $x=\alpha$, $y=\beta$ be a solution of the equation :

$$Nx^2+k=y^2,$$

and $x=\alpha'$, $y=\beta'$ be a solution of

$$Nx^2+k'=y^2,$$

then according to the above

$$x=\alpha\beta'\pm\alpha'\beta,\ y=\beta\beta'\pm N\alpha\alpha'$$

is a solution of the equation

$$Nx^2+kk'=y^2.$$

In other words, if

$$N\alpha^2+k=\beta^2$$
$$N\alpha'^2+k'=\beta'^2$$

then

$$N(\alpha\beta'\pm\alpha'\beta)^2+kk'=(\beta\beta'\pm N\alpha\alpha')^2 \qquad \text{(I)}$$

In particular, taking $\alpha=\alpha'$, $\beta=\beta'$ and $k=k'$, Brahmagupta finds from a solution $x=\alpha$, $y=\beta$ of the equation

$$Nx^2+k^2=y^2$$

a solution $x=2\alpha\beta$, $y=\beta^2+N\alpha^2$ of the equation

$$Nx^2+k=y^2$$

That is, if

$$N\alpha^2+k=\beta^2$$

then

$$N(2\alpha\beta)^2+k^2=(\beta^2+N\alpha^2).^2 \qquad \text{(II)}$$

This result will be hereafter called *Brahmagupta's Corollary.*

Thus *Brahmagupta's First Lemma* says that if two solutions of the equation (of the Square-nature) $Nx^2+1=y^2$ are known, then any number of other solutions can be found. For example if two solutions of the Square—nature are (a, b) and also (a',b'), then two other solutions will be :

$$x=ab'\pm a'b,\ y=bb'\pm Naa'.$$

We can compose this solution with the previous ones, and get another solution, and thus proceed on to innumerable solutions. From *Brahmagupta's Corollary to First Lemma* we get another set of solutions. If (a, b) be solution of the Square-nature, then another solution of it is

$$x=2ab, \text{ and } y=b^2+Na^2$$

Thus even if we have only one solution, we can get the other solution also (since N is known), and thus we can get any number of solutions one after the other by this Principle of Composition.

Brahmagupta's Lemmas have been described by Bhāskara II (1150 A.D.) in the following words :

> Set down successively the lesser root (*hrasva*), greater root (*jyeṣṭha*) and interpolator (*kṣepaka*); and below them should be set down in order the same or an another (set of similar quantities). From them by the Principle of Composition (Bhāvanā) can be obtained numerous roots. Therefore the Principle of Composition will be explained here. (Find) the two cross-products (*vajrābhyāsa*) of the two lesser and the two greater roots; their sum is a lesser root. Add the product of the two lesser roots multiplied by the *prakṛti* to the product of the two greater roots, the sum will be a greater root. In that (equation) the interpolator will be the product of the two previous interpolators. Again the difference of the two cross-products is a lesser root. Subtract the product of the two lesser roots multiplied by the *prakṛti* from the product of the two greater roots; (the difference) will be greater root. Here also the interpolator is the product of the two (previous) interpolators.[1]

1. ह्रस्वज्येष्ठ क्षेपकान् न्यस्य तेषां तानन्यान् वाऽधो निवेश्य क्रमेण ।
साध्यान्येभ्यो भावनाभिर्बहूनि मूलान्येषां भावना प्रोच्यतेऽतः ॥
वज्राभ्यासौ ज्येष्ठलघ्वोस्तदैक्यं ह्रस्वं लघ्वोराहतिश्च प्रकृत्या ।
क्षुण्णा ज्येष्ठाभ्यास युग् ज्येष्ठमूलं तत्राभ्यासः क्षेपयोः क्षेपकः स्यात् ॥
ह्रस्वं वज्राभ्यासयोरन्तरं वा लघ्वोर्घातो यः प्रकृत्या विनिघ्नः ।
घातो यश्च ज्येष्ठयोस्तद्वियोगो ज्येष्ठं क्षेपोत्रापि च क्षेपघातः ॥

Bhāskara *II*, *Bījagaṇita*, *VargaPrakṛti*.2-4

Principle of Composition

The above results have been technically known amongst Indian algebraists as *Bhāvanā* (demonstrated or proved, hence theorem or lemma). The word *bhāvanā* also means "composition or combination" in algebra. Bhāvanā may be of two types: *Samāsa Bhāvanā* (or addition Lemma, or additive composition) and *Antara Bhāvanā* (or subtraction Lemma or subtractive composition), Whenever, again, the *bhāvanā* is made with two equal sets of roots and interpolators, it is technically named as *Tulya Bhāvanā* (or composition of equals), and when with two unequal sets of values then it is known as *Atulya Bhāvanā* (or composition of unequals).

Proof of Brahmagupta's Lemmas

It is significant to be indicated that Brahmagupta's Lemmas were rediscovered by Euler in 1764 and by Lagrange in 1768, and a considerable importance was attached to them. Kṛṣṇa, (1580 A.D.) the commentator on the *Bījagaṇita* of Bhāskara II gives the following proof of Brahmagupta's Lemmas:

Let (α,β) and $(\alpha,'\beta')$ be the two solutions of the equation $nx^2+k=y^2$.

we have

$$N\alpha^2+k=\beta^2$$
$$N\alpha'^2+k'=\beta'^2$$

Multiplying the first equation by β'^2, we get
$$N\alpha^2\beta'^2+k\beta'^2=\beta^2\beta'^2$$

Now, substituting the value of factor $\beta^{2\prime}$ of the interpolator from the second equation, we get

$$N\alpha^2\ \beta'^2+k\ (N\alpha'^2+k')=\beta^2\beta'^2$$

or $N(\alpha^2\beta'^2+Nk\alpha'^2+kk'=\beta^2\beta'^2$

Again, substituting the value of k from the first equation in the second term of the left-hand side expression, we have
$$N\alpha^2\beta'^2+N\alpha'^2(\beta^2-N\alpha^2)+kk'=\beta^2\beta'^2$$

or $N(\alpha^2\beta'^2+\alpha'^2\beta^2)+kk'=\beta^2\beta'^2+N^2\alpha^2\alpha'^2$

Adding $\pm 2N\alpha\beta\alpha'\beta'$ to both sides, we get
$$N(\alpha\beta'\pm\alpha'\beta)^2+kk'=(\beta\beta'\pm N\alpha\alpha')^2$$

Brahmagupta's Corollary also follows at once from the above by putting $\alpha'=\alpha$, $\beta'=\beta$ and $k'=k$.

$$N\,(2\alpha\beta)^2+k^2=(\beta^2\pm N\alpha^2)^2$$

Thus the roots are $x=2\alpha\beta$ and $y=\beta^2\pm N\alpha^2$ which is the Corollary.

It would be seen that modern historians of mathematics are incorrect when they say that Fermat (1657) was the first to state that the equation $Nx^2+1=y^2$, where N is a non-square integer has an unlimited number of solutions in integers. For this assertion, history takes us to the early Seventh Century A.D. when Brahmagupta wrote his classical treatise, the *Brāhmasphuṭasiddhānta,* and gave the well known two Lemmas and the Corollary to the first Lemma.

Second Lemma of Brahmagupta

In the *Brāhmasphuṭa siddhānta*, we find another important Lemma by Brahmagupta stated as follows :

> On dividing the two roots (of a square- Nature) by the square-root of its additive or subtracrive, the roots for interpolator unity (will be found).[1]

This Lemma when expressed in the modern language of algebra would mean that if $x=\alpha, y=\beta$ be a solution of the equation.

$$Nx^2+k^2=y^2$$

then $x=\alpha/k$, $y=\beta/k$ is a solution of the equation

$$Nx^2+1=y^2.$$

This rule, at another place, has been re-enunciated as follows :

> If the interpolator is that divided by a square then the roots will be those multiplied by its square-root.[2]

1. प्रक्षेपशोधक हृते मूले प्रक्षेपके रूपे ।

—*BrSpSi.* XVIII. 65

2. वर्गच्छिन्ने क्षेपे तत्पदगुणिते तदा मूले ।

—*BrSpSi.* XVIII. 70

This rule may be expressed in terms of symbols as follows. Suppose the *Varga-prakṛti* (Square-nature) to be

$$Nx^2 \pm p^2 d = y^2,$$

so that its interpolator (*kṣepa*) $p^2 d$ is exactly divisible by the square p^2. Then, putting therein $u = x/p$, $v = y/p$, we derive the equation

$$Nu^2 \pm d = v^2$$

whose interpolator is equal to that of the original Square-nature divided by p^2. It is clear that the roots of the original equation are p times those of the derived equation.

Rational Solution

Indian algebraists have usually suggested the following method to obtain a first solution of $Nx^2 + 1 = y^2$:

> Take an arbitrary small rational number, α, such that its square multiplied by the *guṇaka* N and increased or diminished by a suitably chosen rational number k will be an exact square.

In other words, we shall have to obtain empirically a relation of the form

$$N\alpha^2 \pm k = \beta^2$$

where α, k, and β are rational numbers. Let us call this relation as the *Auxiliary Equation.* Then by Brahmagupta's Corollary, we get from it the relation

$$N(2\alpha\beta)^2 + k^2 = (\beta^2 + N\alpha^2)^2,$$

or

$$N\left(\frac{2\alpha\ \beta}{k}\right)^2 + 1 = \left(\frac{\beta^2 + N\alpha^2}{k}\right)^2$$

Hence, one rational solution of the equation $Nx^2 + 1 = y^2$ is given by

$$x = \frac{2\alpha\beta}{k}, \quad y = \frac{\beta^2 + N\alpha^2}{k}$$

Work on the rational solution of the Square-nature has been also done by Śrīpati. In fact, his solution, given in 1039 A.D. is of historical significance. He derives the rational solution without the aid of the "auxiliary equation." He gives the following rule :

> Unity is the lesser root. Its square multiplied by the *prakṛti* is increased or decreased by the *prakṛti* combined with an (optional) number whose square-root will be the greater root. From them will be obtained two roots by the Principle of Composition[1]

Thus if m^2 be the rational number optionally chosen, one shall have the identity :

$$N.1^2+(m^2-N)=m^2,$$

or

$$N.1^2-(N-m^2)=m^2$$

Then by applying Brahmagupta's Corollary we get

$$N(2m)^2+(m^2 \backsim N)^2=(m^2+N)^2$$

$$\therefore N\left(\frac{2m}{m^2 \backsim N}\right)^2+1=\left(\frac{m^2+N}{m^2 \backsim N}\right)^2$$

Hence

$$x=\frac{2m}{m \backsim N},\ y=\frac{m^2+N}{m^2 \backsim N}$$

where m is any rational number, is a solution of the equation $Nx^2+1=y^2$.

This rationol solution of the *varga-prakṛti* which was used by Śrīpati in 1039 A.D. was rediscovered in Europe by Brouncker in 1657.

We shall close this discussion by taking an illustration from Bhāskara II :

> *Problem :* Tell me, O mathematician, what is that square which multiplied by 8 becomes, together with unity, a square; and what square multiplied by 11 and increased by unity, becomes a square.

This means that we have to solve the equations :

$$8x^2+1=y^2 \quad ......(i)$$

$$11x^2+1=y^2 \quad ......(ii)$$

In the second example, let us assume 1 as the lesser root. Following the method of Śrīpati, let us multiply its square by the *prakṛti* (here in eq. ii, prakṛti is 11), then let us subtract 2 (an optional number) and then extracting the square-roots we

1. Śrīpati, *Siddhānta-śekhara* XIV. 33

get the greater root as 3. Hence the statement for the composition is

$m=11 \quad l=1 \quad g=3 \quad i=-2$

$\qquad\quad l=1 \quad g=3 \quad i=-2$

Here m=multiplier (*guṇaka* or *prakṛti*), l=lesser root (*kaniṣṭha-mūla*), g=greater root (*jyeṣṭha-mūla*) and i=interpolator (*kṣepa*).

Here we have set down successively the lesser root, greater root and interpolator, and below them again set down the same (See Brahmagupta's Lemmas described by Bhāskara II). Now proceeding as before we obtain the roots for the additive 4 :

$l=6,\ g=20,$ (for) $i=4.$

Then by the rule :

> "If the interpolator (of a *varga-prakṛti* or Square-nature) divided by the square of an optional number be the interpolator (of another Square-nature), then the two roots (of the former) divided by that optional number will be the roots (of the other). Or, if the interpolator be multiplied, their roots should be multiplied."[1]

are found the roots for the additive unity

$l=3,\ g=10$ (for) $i=1.$

Whence by the Principle of Composition of Equals, we get the lesser and greater roots : $l-60,\ g=199$ (for) $i=1$. In this way an infinite number of roots can be deduced.

Alternative method:–Bhāskara II has given another method for finding the two roots for the additive unity :

> Or divide twice an optional number by the difference between the square of that optional number and the *prakṛti*. This (quotient) will be the lesser root (of a Square-nature) when unity is the additive. From that (follows) the greater root.[2]

1. इष्टवर्गहृतः क्षेपः क्षेपः स्यादिष्टभाजिते ।
मूले ते स्तोऽथवा क्षेपः क्षुण्णः क्षुण्णे तदा पदे ॥

Bījagaṇita II. 5.

2. *Siddhānta-śekhara*, XIV. 32.

Let us solve the first example $8x^2+1=y^2$. We assume the optional number to be 3. Its square is 9; the *prakṛti* of multiplier is 8, their difference is 9–8=1. Dividing by this twice the optional number (2×3, i.e. 6), namely 6, we get the lesser root for the additive unity as 6. Whence proceeding as before, we get the greater to be 17, Thus here $x=6$ and $y=17$.

Let us use this method for the equation $11x^2+1=y^2$. Let the optional number be 3. Its square is 9: multiplier or *prakṛti* is 11; the difference is $11-9=2$; dividing by this twice the optional number (2×3), namely 6, we get $6/2=3$, which is the lesser root. Consequently the greater root would be 10, Thus for this equation $x=3$ and $y=10$.

Solution in Positive Integers

The Indian algebraists usually aimed at obtaining solutions of the *varga-prakṛti* or Square-nature in positive integers or *abhinna*. The tentative methods of Brahmagupta and Śrīpati always did not furnish solutions in positive integers. These authors, however, discovered that if the interpolator of auxiliary equation in the tentative method be ±1, ±2 or ±4, an integral solution of the equation $Nx^2+1=y^2$ can always be found. Thus Śrīpati says :

> If 1, 2 or 4 be the additive or subtractive (of the auxiliary equation), the lesser and greater roots will be integral (*abhinna*)[1].

(i) If $k=\pm1$, then the auxiliary equation will be

$$N\alpha^2\pm1=\beta$$

where α and β are intergers. Then by Brahmagupta' Corollary we get

$$x=2\alpha\beta \text{ and } y=\beta^2+N\alpha^2$$

as the required first solution in positive integers of the equation $Nx^2+1=y^2$

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1. इष्टवर्गं प्रकृत्योर्यद्विवरं तेन वा भजेत् ।
द्विघ्नमिष्टं कनिष्ठं तद् पदं स्यादेक संयुतौ ।
ततो ज्येष्ठमिहानन्त्यं भावनाभिस्तथेष्टतः ॥

Bījagaṇita, Varga-Prakṛti, 5-6

(ii) Let $k=\pm 2$; then the auxiliary equation is

$$N\alpha^2 \pm 2 = \beta^2$$

By Brahmagupta's Corollary, we have

$$N(2\alpha\beta)^2+4=(\beta^2+N\alpha^2)^2$$

or $$N\ (\alpha\beta)^2+1=\left(\frac{\beta^2+N\alpha^2}{2}\right)^2$$

Hence the required first solution is

$$x=\alpha\beta,\ y=\tfrac{1}{2}(\beta^2+N\alpha^2)$$

Since $$N\alpha^2=\beta^2 \mp 2,$$

we have $\frac{1}{2}\ (\beta^2+N\alpha^2)=\beta^2 \mp 1=$ a whole number.

(iii) Now suppose $k=+4$: so that

$$N\alpha^2+4=\beta^2$$

With an auxiliary equation like this, the first integral solution of the equation $Nx^2+1=y^2$ is

$$x=\tfrac{1}{2}\alpha\beta$$
$$y=\tfrac{1}{2}(\beta^2-2);$$

if α is even; or

$$x=\tfrac{1}{2}\alpha(\beta^2-1)$$
$$y=\tfrac{1}{2}\ \beta\ (\beta^2-2);$$

if β is odd.

Thus we find Brahmagupta saying:

> In the case of 4 as additive the square of the second root diminished by 3, then halved and multiplied by the second root will be the (required) second root: the square of the second root diminished by unity and then divided by 2 and multiplied by the first root will be the (requircd) first root (for the additive unity).[1]

Datta and Singh has given the following *rationale* of this solution.

Since $N\ \alpha^2+4=\beta^2$ (i)

we have $N\ (\alpha/2)^2+1=(\beta/2)^2$, (ii)

Then by Brahmagupta's Corollary. we get

$$N\ (\alpha\beta/2)^2+1=\left(\frac{\beta^2}{4}+N\frac{\alpha^2}{4}\right)^2$$

---

1. चतुरधिकेऽन्त्यपदकृतिस्त्र्यूनादलिताऽन्त्यपद गुणाऽन्त्यपदम् ॥
अन्त्यपद कृतिर्व्येकाद्वि हताऽऽपघदाहताऽऽद्यपदम् ॥ —*BrSpSi*. XVIII. 67

Substituting the value of N in the right-hand side expression from (i), we have

$$N\left(\frac{\alpha\beta}{2}\right)^2+1=\left(\frac{\beta^2-2}{2}\right)^2 \qquad \text{(iii)}$$

Composing (ii) and (iii),

$$N\left\{\frac{\alpha}{2}(\beta^2-1)\right\}^2+1=\left\{\frac{\beta}{2}(\beta^2-3)\right\}^2$$

Hence $x=\frac{1}{2}\alpha\beta$, $y=\frac{1}{2}(\beta^2-2)$;
and $x=\frac{1}{2}\alpha(\beta^2-1)$, $y=\frac{1}{2}\beta(\beta^2-3)$;
are solutions of $Nx^2+1=y^2$.

If β be even, the first values of (x,y) are integral. If β be odd, the second values are integral.

(iv) Finally, suppose $k=-4$; the auxiliary equation is

$$N\alpha^2-4=\beta^2$$

Then the required first solution in positive integers of $Nx^2+1=y^2$ is

$$x=\tfrac{1}{2}\alpha\beta(\beta^2+3)(\beta^2+1)$$
$$y=(\beta^2+2)\{\tfrac{1}{2}(\beta^2+3)(\beta^2+1)-1\}.$$

Brahmagupta says:

> In the case of 4 as subtractive, the square of the second is increased by three and by unity; half the product of these sums and that as diminished by unity (are obtained). The latter multiplied by the first sum less unity is the (required) second root; the former multiplied by the product of the (old) roots will be the first root corresponding to the (new) second root.[1]

The rationale of this solution, as given by Datta and Singh is as follows:

$$N\alpha^2-4=\beta^2 \qquad \text{(i)}$$
$$N(\alpha/2)^2-1=(\beta/2)^2$$

Hence by Brahmagupta's Corollary, we get

$$N\left(\frac{\alpha\beta}{2}\right)^2+1=\left(\frac{\beta^2}{4}+N\frac{\alpha^2}{4}\right)^2$$

1. चतुरूनेऽन्त्यपद कृती त्र्येकयुते वधदलं पृथक्त्र्येकम् ।
त्र्येकाद्याहतमन्त्यं पदवध गुणमाद्यमान्त्यपदम् ॥ *BrSpSi. XVIII. 68*

$$=\{\tfrac{1}{2}(\beta^2+2)\}^2 \qquad \text{(ii)}$$

Again applying the Corollary, we get

$$N\ \{\tfrac{1}{2}\alpha\beta(\beta^2+2)\}^2+1=\{\tfrac{1}{2}(\beta^4+4\beta^2+2)\}^2 \qquad \text{(iii)}$$

Now by the Lemma we obtain from (ii) and (iii)

$$N\ \{\tfrac{1}{2}\alpha\beta(\beta^2+3)\ (\beta^2+1)\}^2+1$$
$$=[(\beta^2+2)\{\tfrac{1}{2}(\beta^2+3)\ (\beta^2+1)-1\}]^2$$

Hence $x=\tfrac{1}{2}\alpha\beta(\beta^2+3)\ (\beta^2+1)$,

$$y=(\beta^2+2)\ \{\tfrac{1}{2}(\beta^2+3)\ (\beta^2+1)-1\}$$

is a solution of $Nx^2+1=y^2$

This can be proved without difficulty that these values of x and y are integral. Since If β is even, β^2+2 is also even. And hence the above values of x and y are integral. On the other hand, if β is odd, β^2 is also odd; under these conditions β^2+1 and β^2+3 are even. In this also, therefore, the above values must be integral.

Putting $p=\alpha\beta$, $q=\beta^2+2$, we can write the above solution in the form

$$x=\tfrac{1}{2}p\ (q^2-1).$$
$$y=\tfrac{1}{2}q(q^2-3).$$

This was the form in which the solution was found by Euler.

Cakravāla or Cyclic Method

We have shown in the preceding articles that the most fundamental step in Brahmagupta's method for the general solution in positive integers of the equation

$$Nx^2+1=y^2$$

where N is a non-square integer, is to form an auxiliary equation of the kind

$$Na^2+k=b^2$$

where a and b are positive integers and $k=\pm1$, ±2 or ±4. From this auxiliary equation, by the Principle of Composition, applied repeatedly whenever necessary, one can derive, as we have already shown above, one positive integral solution of the original *Varga-prakṛti* or Square-Nature. And thence again, by means of the same principle, an infinite number of other solutions in integers can be obtained. How to form an auxiliary equation of

this type was a problem, write Datta and Singh, which could not be solved completely nor satisfactorily by Brahmagupta. In fact, Brahmagupta had to depend on trial. Success in this direction was, however, remarkably attained by Bhāskara II. He evolved a simple and elegant method which assisted in deriving an auxiliary equation having the required interpolator $\pm 1, \pm 2$, or ± 4, simultaneously with its two integral roots, from another auxiliary equation empirically formed with any simple integral value of the interpolator, positive or negative. This method has been technically known as *Cakravāla* or the *cyclic method*. This is so called because it proceeds as in a circle, the same set of operations being applied again and again in a continuous round. For the details of this method, our reader is requested to consult the Algebra of Bhāskara II and the narrative on this method as given by Datta and Singh under the title "Cyclic Method" in their *History of Hindu Mathematics: Algebra*, 1962 Edition, pp. 161-72.

Solution of Indeterminate Quadratic Equation

It is remarkable to see that Brahmagupta was the first algebraist in the history of mathematics to find a general solution of the indeterminate quadratic equation

$$Nx^2 \pm c = y^2$$

in positive integers. We have the following verse in the *Brāhmasphuṭasiddhānta* in this connection:

> From two roots (of a Square-nature or *varga-prakṛti*) with any given additive or subtractive, by making (combination) with the roots for the additive unity other first and second roots (of the equation having) the given additive or subtractive (can be found).[1]

Let us take the following two equations:

$a_1k = an + b$; and $b_1k = bn + Na$

From them we get: by eliminating n

$$a_1b - ab_1 = 1$$

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1. रूप प्रक्षेपपदे पृथगिष्टक्षेप्यशोध्यमूलाभ्याम् ।
कृत्वाऽन्याद्यपदे ये प्रक्षेपे ोऽने ॥ —*BrSpSi.* XVIII. 66

Hence $b_1 = \frac{a_1 b - 1}{a}$ = a whole number.

$$\text{Now } n^2 - N = \frac{(a_1 k - b)^2 - Na^2}{a^2}$$
$$= \frac{a_1^2 k^2 - 2bka_1 + k}{a^2}$$
$$= \frac{k(a_1^2 k - 2ba_1 + 1)}{a^2}$$

Therefore $\frac{k}{a^2}(a_1^2 k - 2ba_1 + 1)$ is a whole number.

Since a, k have no common factor, it follows that

$$\frac{a_1^2 k - 2ba_1 + 1}{a^2} = \frac{n^2 - N}{k} = k_1 = \text{an integer.}$$

$$\text{Also } k_1 = \frac{n^2 - N}{k} = \frac{a_1^2 k - 2ba_1 + 1}{a^2}$$
$$= \frac{a_1^2(b^2 - Na^2) - 2ba_1 + 1}{a^2}$$
$$= \left(\frac{a_1 b - 1}{a}\right)^2 - Na_1^2.$$

Thus having known a single solution in positive integers of the equation $Nx^2 \pm c = y^2$, says, Brahmagupta, an infinite number of other integral solutions can be obtained by making use of the integral solutions of $Nx^2 + 1 = y^2$. If (p,q) be a solution of the former equation found empirically and if (α, β) be an integral solution of the latter, then by the principle of Composition

$$x = p\beta \pm q\alpha; \; y = q\beta \pm Np\alpha$$

will be a solution of the former. Repeating the operations, we can easily deduce as many solutions as we like.

FORM $Mn^2x^2 \pm c = y^2$:

> In this connection, Brahmagupta says :
> If the remainder is that divided by a square, the first root is that divided by its root[1].

This seems to mean that if we have the equation

$$Mn^2x^2 \pm c = y^2 \qquad \text{(i)}$$

such that the multiplier (i.e. the coefficient of x^2) is divisible

1. वर्गच्छिन्ने गुणके प्रथमं तन्मूल भाजितं भवति । —*BrSpSi.* XVIII.70

by n^2, then we are justified in saying that if we put $nx=u$, the equation (i) becomes $Mu^2 \pm c = y^2$ (ii), and clearly the first root of (i) is equal to the first root of (ii) divided by n. The corresponding second root will be the same for both the equations.

FORM $a^2x^2 \pm c = y^2$:

We find Brahmagupta giving the following rule in this connection: This is a solution of a particular form of a *varga-prakṛti* or Square-nature.

> If the multiplier be a square, the interpolator divided by an optional number and then increased and decreased by it, is halved. The former (of these results) is the second root; and the other divided by the square-root of the multiplier is the first root.[1]

Thus the solutions of the equation

$$a^2x^2 \pm c = y^2$$

are :

$$x = \frac{1}{2a}\left(\frac{\pm c}{m} - m\right)$$

$$y = \frac{1}{2}\left(\frac{\pm c}{m} + m\right)$$

where m is an arbitrary number.

Bhāskara II and Nārāyaṇa have also given the same solutions as proposed by Brahmagupta.

Rational Geometrical Figures

In the days of the *Taittirīya Saṁhitā* and the *Śatapatha Brāhmaṇa*, Indian mathematicians got familiarity with the solution of such equations

$$x^2 + y^2 = z^2$$

and the results were arrived geometrically on the basis of the law of rectangle as propounded by Baudhāyana in the Śulba Sūtras and which goes by his name. The reader is referred to the Chapter on Baudhāyana, the first Geometer in the author's "*Founders of Sciences in Ancient India*". Baudhāyana (c. 800 B.C.) gave a

1. वर्गे गुणके क्षेपः केनचिदुद्धृतयुतोनितो दलितः ।
प्रथमोऽन्यमूलमन्यो गुणकारपदोद्धृतः प्रथमः ॥ —*BrSpSi*. XVIII. 69

method of transforming a rectangle into a square, which is equivalent to the algebraic identity :

$$mn=\left(m-\frac{m-n}{2}\right)-\left(\frac{m-n}{2}\right).$$

where m, n, are any two arbitrary numbers.

Brahmagupta in connection with the solution of rational triangles says :

> The square of the optional (*iṣṭa*) side is divided and then diminished by an optional number; half the result is the upright, and that increased by the optional number gives the hypotenuse of a rectangle.

We shall put these statements of Brahmagupta in the algebraic language thus : If m, n be any two rational numbers, then the sides of a right-angled triangle will be

$$m,\ \tfrac{1}{2}\left(\frac{m^2}{n}-n\right),\ \tfrac{1}{2}\left(\frac{m^2}{n}+n\right)$$

This Sanskrit term *iṣṭa* may either mean "given" or "optional". With the former meaning the rule would imply the method of finding rational right angles having a given leg.

Brahmagupta was the first to give a solution of the equation $x^2+y^2=z^2$ in integers. His solution is

$$m^2-n^2,\ 2mn,\ m^2+n^2.$$

m and n being two unequal integers.[2]

Thus if $m=7$ and $n=4$, then $m^2-n^2=33$, $2mn=56$ and $m^2+n^2=65$; then the three numbers 33, 56 and 65 bear the relation $33^2+56^2=65^2$.

Mahāvīra (850 A.D.) also states

> The difference of the squares (of two elements) is the upright, twice their product is the base and the sum of their squares is the diagonal of a *generated* rectangle.[2]

Isosceles Triangles with Integral Sides : The following statement of Brahmagupta in this connection is very significant :

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1. इष्टस्य भुजस्य कृतिर्भक्तो नेष्टेन तद्दलं कोटिः ।
आयतचतुरस्रस्य च त्र्यस्येष्टाधिका कर्णः ॥ —*BrSpSi*. XII. 35

2. *GSS*. VII. $90\frac{1}{2}$

> The sum of the squares of two unequal numbers is the side; their product multiplied by two is the altitude, and twice the difference of the squares of those two unequal numbers is the base of an isosceles triangle.[1]

Thus if m,n be two integers such that m is not equal to n, the sides of all rational isosceles triangles with integral sides are given by

$$m^2+n^2,\ m^2+n^2,\ 2(m^2-n^2)$$

and the altitude of the triangle is $2mn$.

This method was also followed by Mahāvīra and other Indian mathematicians. In fact, their solutions are based on the juxtaposition of two rational right triangles, equal so that they have a common leg. It is remarkably a powerful device, for every rational triangle or quadrilateral may be formed by the juxtaposition of two or four rational right triangles.

Isosceles Triangles with a Given Altitude

Here we have a rule given by Brahmagupta for finding out all rational isosceles triangles possessing the same altitude :

> The (given) altitude is the producer (*karaṇī*). Its square divided by an optional number is increased and diminished by that optional number. The smaller is the base and half the greater is the side.[2]

Thus if m be any rational number then for a given definite altitude a, the sides of the rational isosceles triangles are $\frac{1}{2}\left(\frac{a^2}{m}+m\right)$ each and the base is $\frac{a^2-m^2}{m}$. We shall illustrate it by an example taken from the commentary of Pṛthūdaka Svāmī The given altitude is 8; let us take any rational number $m=4$ then the two equal sides of the isosceles are given by $\frac{1}{2}\left(\frac{8^2+4^2}{4}\right)=$ 10 each and the base is $\frac{8^2-4^2}{4}=12$. Thus the three sides of the

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1. कृति युतिर सदृशराश्योर्बाहुर्घातो द्विसंगुणो लम्बः ।
कृत्यन्तरमसदृशयोर्द्विगुणं द्विसमत्रिभुज भूमिः ॥ —*BrSpSi*. XII. 33

2. करणी लम्बस्तत्कृतिरिष्टहृतेष्टोन संयुताऽल्पा भूः ।
अधिको द्विहृतो बाहुः संच्येो यद्वषो कर्णः ॥ —*BrSpSi*. XII. 37.

rational isosceles triangle with altitude 8 are (10,10, 12).

Rational Scalene Triangles: Brahmagupta lays down the following rule in the case of rational scalene triangle ;

> The square of an optional number is divided twice by two arbitrary numbers; the moieties of the sums of the quotients and (respective) optional numbers are the sides of a scalene triangle; the sum of the moities of the differences is the base.[1]

In other words, if m, p, q are any rational numbers, then the sides of a rational scalene triangle are :

$$\frac{1}{2}\left(\frac{m^2}{p}+p\right),\ \frac{1}{2}\left(\frac{m^2}{q}+q\right),$$

$$\frac{1}{2}\left(\frac{m^2}{p}-p\right)+\frac{1}{2}\left(\frac{m^2}{q}-q\right)$$

Here the altitude (m), area and segments of the base of this triangle are all rational.

Thus putting $m=12$, $p=6$, and $q=8$ in Brahmagupta's general equation, Pṛthūdaka Svāmi derives a scalene triangle with sides (13,15) and (14) altitude (12), area (84 and the segments of the base (5) which are all integral numbers.

$$\frac{1}{2}\left(\frac{m^2}{p}+p\right)=\frac{1}{2}\left(\frac{12^2}{6}+6\right)=15;$$

$$\frac{1}{2}\left(\frac{m^2}{q}+q\right)=\frac{1}{2}\left(\frac{12^2}{8}+8\right)=13$$

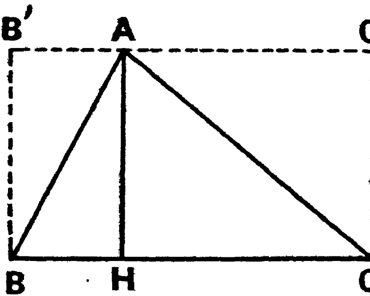


Fig. 19

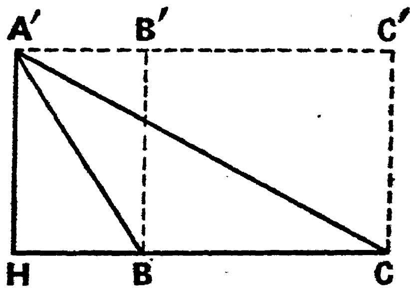


Fig. 20

1. इष्टद्वयेन भक्तो द्विघेष्ट वर्गं फलेष्टयोगार्धे ।
विषमत्रिभुजस्य भुजाविष्टोनफलार्धयोगो भूः ॥

—*BrSpSi*. XII, 34.

Thus the two sides of the rational scalene triangle are 15 and 13. The base is.

$$\tfrac{1}{2}\left(\frac{12^2}{6}-6\right)+\tfrac{1}{2}\left(\frac{1^2}{8}-8\right)=9+5=14$$

The altitude is $m=12$; area is equal to $\frac{\text{base}\times\text{altitude}}{2}$

$=\frac{14\times 12}{2}=$ and the segments are $\sqrt{13^2-12^2}=5$ and $\sqrt{(15^2-12^2)}=9$. Thus they are all integers.

Rational Isosceles Trapeziums

Brahmagupta has given us a method of obtaining such isosceles trapeziums whose sides, diagonals, altitude, segments and area are all rational numbers. His rule is as follows:

The diagonals of the rectangle (generated) are the flank sides of an isosceles trapezium; the square of its side is divided by an optional number and then lessened by that optional number and divided by two; (the result) increased by the upright is the base and lessened by it is the face.[1]

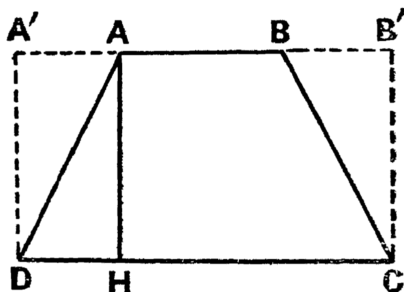


Fig. 21

Here in the figure, we have the isosceles trapezium ABCD of which C D is the base and A B is known as the fase. According to Brahmagupta's rule, we have (p being the optional number).

$$CD=\tfrac{1}{2}\left(\frac{4m^2n^2-p}{p}\right)+\left(m^2-n^2\right) \quad \text{(base)}$$

$$AB=\tfrac{1}{2}\left[\frac{4m^2n^2}{p}-p\right]-\left[m^2-n^2\right] \quad \text{(face)}$$

$$DH=(m^2-n^2) \quad \text{(upright)}$$

1. आहतकर्णौ बाहू भुजकृतिरिष्टेन भाजितेष्टोना ।
द्विहृता कोट्यधिका भूर्मुखमूना द्विसमचतुरस्रे ॥ —*BrSpSi*. XII. 36

$AD = BC = m^2+n^2$ (the sides of the trapezium)

$HC = \text{base}-\text{upright} = \frac{1}{2}\left[\frac{4m^2n^2}{p} - p\right]$ (segment)

$AC = BD = \left[\frac{4m^2n^2}{p} + p\right]$ (diagonal)

$AH = 2\,mn$ (altitude)

$ABCD = mn\left[\frac{4m^2n^2}{p} - p\right]$ (area)

By chosing the values of m n and p suitably, the values of all the dimensions of the isosceles trapezium can be made integral. Pṛthūdaka Svāmī starts with the rectangle (5, 12, 13) and suitably takes p as 6; then he calculates out the dimensions of the trapezium : flank sides (AD and BC) = 13, base =14, and base = 4. altitude (AH) = 12, segments of base (DH and HC) = 5, and 9, diagonals (AC and BD) = 15, area ABCD = 108. All these values are integers.

In this example, the rectangle chosen is (5, 12, 13) which is AA' DH, where $AD = m^2 + n^2 = 13$

and $DH = m^2 - n^2 = 5$

whence by adding the two we have

$2m^2 = 18$

This gives the value of $m = 3$, and hence $n = 2$. Pṛthūdaka Svāmī has taken the value of $p = 6$ by choice. Putting these values of m, n and p, the values for the dimensions of the isosceles trapezium follow from the expressions given by Brahmagupta.

$$CD = \frac{1}{2}\left(\frac{4.3^2.2^2}{6} - 6\right) + \left(3^2-2^2\right) = 9+5 = 14 \text{ (base)}$$

Face = 9−5=4

Sides $AD = BC = 3^2+2^2 = 13$

and so on for the other dimensions.

Rational Trapeziums With Three Equal Sides

This problem is very much the same as one of the rational isosceles tpapezium with the only difference that in this case one of the parallel sides is also equal to the slant sides. We

have the following solution of this problem from Brahmagupta :

> The square of the diagonal (of a *generated* rectangle) gives three equal sides; the fourth (is obtained) by subtracting the square of the upright from thrice the square of the side (of that rectangle). If greater, it is the base; if less, it is the face.[1]

As before, the rectangle generated from m, n is given by $(m^2-n^2, 2mn, m^2+n^2)$, that is these are the three sides of the right triangle, which correspond to the two sides and the diagonal of the rectangle generated by them. Let us suppose, we have a trapezium ABCD whose sides AB, BC and AD are equal, then

$$AB = BC = AD = (m^2+n^2)^2$$

$$CD = 3(2mn)^2 - (m^2-n^2)^2 = 14\, m^2n^2 - m^4 - n^4$$

$$\text{or } CD = 3(m^2-n^2)^2 - (2mn)^2 = 3m^4+3n^4 - 10\, m^2n^2.$$

Pṛthūdaka Svāmī has taken an illustration, where $m=2$, $n=1$ and he deduces two rational trapeziums with three equal sides (25, 25, 25, 39) and (25, 25, 25, 11).

The segment (CḤ), altitude (AH), diagonals (AC, BD) and area of this trapezium are also rational, and given by :

$$CH \text{ (segment)} = 6\, m^2n^2 - m^4 - n^4$$

$$AH \text{ (altitude)} = 4\, mn\, (m^2-n^2)$$

$$AC = BD \text{ (diagonals)} = 4\, mn\, (m^2+n^2)$$

$$ABCD \text{ (area)} = 32m^3n^3\, (m^2-n^2).$$

Rational Inscribed Quadrilaterals

We find in the *Brāhmasphuṭasiddhānta* a remarkable proposition formulated by Brahmagupta :

> To find all quadrilaterals which will be inscribable within circles and whose sides, diagonals, perpendiculars, segments (of sides and diagonals by perpendiculars from vertices as also of diagonals by their intersection), areas, and also the diameters of the

1. कर्णकृतिस्त्रिसम भुजास्त्रयस्चतुर्थो विशोध्य कोटि कृतिम् ।
बाहुकृतेस्त्रिगुणाया यद्यधिको भूमुखं हीनः ॥ —*BrSpSi*. XII. 37

circumscribed circles will be expressible in integers. Such quadrilaterals we shall call as *Brahmagupta Quadrilaterals.*

The solution of this formidable problem has been given by Brahmagupta as follows :

> The upright and bases of two right-angled triangles being reciprocally multiplied by the diagonals of the other will give the sides of a quadrilateral of unequal sides : (of these) the greatest is the base, the least is the face, and the other two sides are the two flanks.[1]

Taking Brahmagupta's integral solution, the sides of the two right triangles of reference are given by :

(1) m^2-n^2, $2\,mn$, m^2+n^2;

(ii) p^2-q^2, $2\,pq$, p^2+q^2;

where m, n, p, q are integers. Then the sides of the *Brahmagupta Quadrilateral* are.

$$(m^2-n^2)(p^2+q^2),\ (p^2-q^2)(m^2+n^2),$$
$$2mn(p^2+q^2),\ 2pq(m^2+n^2) \qquad \text{(Arrangement } A)$$

Pṛthūdaka Svāmī has illustrated the rational inscribed quadrilateral by taking an example of the right angle triangles.

(i) (3,4,5) ($m^2-n^2=3$, $m^2+n^2=5$, whence $m=2, n=1$)

(ii) (5,12,13)($p^2-q^2=5$, $p^2+q^2=13$, whence $p=3, q=2$)

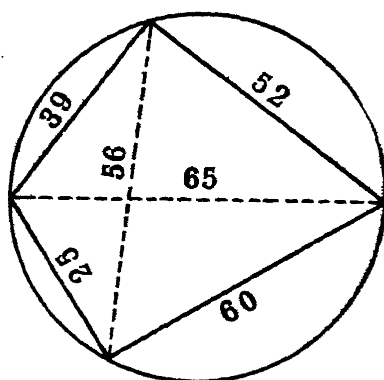


Fig. 22

Substituting these values in the above equations, we get the sides of the quardilateral as (39, 25, 52 and 60).[2]

1. जात्यद्वय कोटिभुजाः परकर्णगुणा भुजाश्चतुर्विषमे ।
अधिको भूमुं खह्रीनो बाहुद्वितयं भुजाक्न्यौ ॥ —*BrSpSi*. XII. 38

2. The diagonals of this quadrilateral are given by Bhāskara II as 56 (=3.12+4.5) and 63 (=4.12+3.5). (Cont. on page 268)

Put in other words, this means that one has to solve the following equations :

$$\text{(i)} \quad 5x - 25 = y^2$$

$$\text{(ii)} \quad 10x - 100 = y^2$$

$$\text{(iii)} \quad 83x - 7635 = y^2$$

Pṛthūdaka Svāmī, the commentator on the *Brāhmasphuṭa-siddhānta* proceeds to solve these equations as follows :

(1.1) Suppose $y = 10$; then $x = 125$. Or put $y = 5$; then $x = 10$.

(2.1) Suppose $y = 10$; then $x = 20$.

(3.1) Assume $y = 1$; then $x = 92$.

He then remarks that by virtue of the multiplicity of suppositions there will be an infinitude of solutions in every case, But no method has been given either by Brahmagupta or his commentator to obtain the general solution.

Double Equations of the First Degree

Perhaps we have the earliest reference of the simultaneous indeterminate quadratic equations of the type

$$x \pm a = u^2$$

$$x \pm b = v^2$$

in the *Bhakaśālī Manuscript* (Folio 59, recto).

Brahmagupta gives the solution of such simultaneous indeterminate quadratic equations of a general case as follows :

> The difference of the two numbers by the addition or subtration of which another number becomes a square, is divided by an optional number and then increased or decreased by it. The square of half the result diminished or increased by the greater or smaller (of the given number) is the number (required).[1]

Expressed in the language of algebra, shall have :

$$= \tfrac{1}{2} \left\{ \frac{1}{2} \left(\frac{a-b}{m} \pm m \right) \right\}^2 \mp a$$

1. याम्यां कृतिरधिको नस्तदन्तरं हृत युतो न मिष्टेन ।
तद्दल कृतिरधिकोनाऽधिकयो रधिको न यो राशिः ॥ —*BrSpSi*. XVIII. 74

$$\text{or } x=\left\{\tfrac{1}{2}\left(\frac{a-b}{m}\mp m\right)\right\}^2\mp b$$

where m is an arbitrary number.

Datta and Singh has given the *rationale* of this method as follows :

$$u^2=x\pm a;\ v^2=x\pm b,$$

From them, we have $u^2-v^2=\pm a\mp b$

Therefore $u-v=m$

$$\text{and } u+v=\frac{\pm a\mp b}{m},$$

where m is arbitrary. Hence

$$u=\tfrac{1}{2}\left(\frac{\pm a\mp b}{m}+m\right)=\pm\tfrac{1}{2}\left(\frac{a-b}{m}\pm m\right)$$

Sincc it is obviously immaterial whether u is taken as positive or negative, we have

$$u=\tfrac{1}{2}\left(\frac{a-b}{m}\pm m\right)$$

$$\text{Similarly } v=\tfrac{1}{2}\left(\frac{a-b}{m}\mp m\right)$$

$$\text{Therefore } x=\left\{\tfrac{1}{2}\left(\frac{a-b}{m}\pm m\right)\right\}^2\mp a,$$

$$\text{or } x=\left\{\tfrac{1}{2}\left(\frac{a-b}{m}\mp m\right)\right\}^2\mp b,$$

where m is an arbitrary number.

Now we shall take up another particular case, for which Brahmagupta has given a rule :

> The sum of the two numbers tne addition and subtraction of which make another number (severally) a square, is divided by an optional number and then diminished by that optional number. The square of half the remainder increased by the subtractive number is the number (required)[1].

In the algebraic notations, we shall express it as follows :

1. यैरूनो यैश्च युतो रूपैर्वर्गस्तदैक्यमिष्ट हृतम् ।
इष्टोनं तद्दल कृतिरूनाऽभ्यधिका भवति राशिः ।। —*BrSpSi. XVIII. 71*

$$y=\frac{1}{a}\left(\frac{ad+bc}{m}+b.\right)$$

if $b>c$ and $m>\frac{ad+bc}{m}$. If these conditions be reversed then x and y will have their values interchanged.

Datta and Singh have given the following *rationale* of these solutions :

$$axy=bx+cy+d,$$

or $$a^2xy-abx-acy=ad,$$

or $$(ax-c)\ (ay-b)=ad+bc.$$

Suppose $ax-c=m$, a rational number;

then $ay-b=\frac{ad+bc}{m}$.

Therefore

$$x=\frac{1}{a}(m+c)$$

$$y=\frac{1}{a}\left(\frac{ad+bc}{m}+b\right)$$

Or, we may put $ay-b=m$;

in that case, we shall have $ax-c=\frac{ad+bc}{m}$;

whence $x=\frac{1}{a}\left(\frac{ad+bc}{m}+c\right)$,

$$y=\frac{1}{a}(m+b)\ .$$

Brahmagupta's own rule.

Whilst the rule given above is ascribed to an unknown author, Brahmagupta's own rule for the solution of a quadratic indeterminate equation involving a factum is as follows :

> With the exception of an optional unknown, assume arbitrary values for the rest of the unknowns, the product of which forms the factum. The sum of the product of these (assumed values) and the (respective) coefficients of the unknowns will be absolute quantities. The continued products of the assumed values and of the coefficient of the factum will be the coefficient of the optionally (left out) unknown. Thus the solution

is effected without forming an equation of the factum Why then was it done so ?[1]

Datta and Singh think that the reference in the latter portion of this rule is to the method of the unknown author :

"*Kiṁ kṛtaṁ tadataḥ*" ? The principle underlying Brahmagupta's method is to reduce, like the Greek Diophantus (c.275 A.D.), the given indeterminate equation to a simple determinate one by assuming arbitrary values for all the unknowns except one. So undoubtedly it is inferior to the earlier method.

We now take an illustrative example from Brahmagupta :

> On subtracting from the product of signs and degrees of the Sun, three and four times (respectively) those quantities, ninety is obtained. Determining the Sun within a year (one can pass as a proficient) mathematician.

If we presume x to denote the signs and y the degrees of the Sun, then the equation would be :

$$xy - 3x - 4y = 90$$

Pṛthūdaka Svāmī solves it in two ways :

(i) Let us assume the arbitrary number to be 17. then

$$x = \frac{1}{1}\left(\frac{90.1+3.4}{17} + 4\right) = 10$$

$$y = \frac{1}{1}\ (17+3) = 20$$

(ii) Let us assume arbitrarily $y=20$. On substituting this value of y in the above equation, we get

$$20x - 3x = 170$$

whence $x=10$.

1. भावितके यद्घातो विनष्टवर्णेन तत्प्रमाणानि ।
कृत्वेष्टानि तदाहत वर्णैक्यं भवति रूपाणि ॥
वर्णं प्रमाणभावित घातो भवतीष्ट वर्णं संख्यैवन् ।
सिध्यति विनाऽपि भावित-उमकरणात् किं कृतं तदतः ॥ —*BrSpSi. XVIII. 62-63*

2. भानो राश्यंशवधात् त्रिचतुर्गुणितान् विशोध्य राश्यंशान् ।
नवतिं दृष्ट्वा सूर्यं कुर्वन्नावत्सराद् गणकः ॥ —*BrSpSi. XVIII. 61.*

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Reference

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CHAPTER X

Arabic and Indian Divisions of the Zodiac

I It has long been a debated question whether the Indian and Arabian divisions of the zodiac had a common origin. Sir William Jones thought that they had not; but Colebrooke holds a contrary view. The coincidence in the two systems of division is so exact that he thinks, it could not be due to chance. Colebrooke has discussed this point in details in one of his Papers entitled "On the Indian and Arabian divisions of the zodiac", *Asiatic Researches* Vol. ix.. p. 323-376, reproduced in the *Miscellaneous Essays*, Vol. II., p. 321-373, 1872.

1. *Aśvini*, now the first *nakṣatra*, but anciently the last but one, probably obtained its present situation at the head of the asterisms, when the beginning of the zodiacwas referred to the first degree of Meṣa (the Ram). As measuring a portion of the zodiac, it occupies the first 13°20′ of Meṣa; and its beginning follows immediately after the principal star in the last *nakṣatra* Revatī, reckoned by some exactly, by others nearly, opposite to the very conspicuous one, which forms the fourteenth asterism. As a constellation, Aśvini comprises three stars (Aries α, β, γ) figured as a horse-head; and the principal, which is also the northern one, is stated by all ancient authorities, in 10°N and 8°E. from the beginning of the Meṣa.

According to Arabs, the first manzil or lunar mansion is entitled *Sheratan* (by Persians, *Sheratain*), and comprises two stars of the third magnitude on the head of Aries. in lat. 6°36′ and 7°51′ N and long. 26°13′ and 27°7′. With the addition of a

third, also in the head of the Ram, the asterism is denominated *Āshrait*. The bright star of the second or third magnitude which is out of the figure of the Ram, according to Ulugh Beg, but on the nose according to Hipparchus, cited by this author from Ptolemy, is determined *Nātih* : It is placed in lat. 9°30'N and long. 1 0° 43', and is apparently the same with the principal star of the Indian asterism; for Muhammad of Tizin, in his table of declination and right ascension, expressly terms it the first star of the *Sheratain*.

2. *Bharaṇī*, the second asterism, comprises three stars (35, 39, 41 Aries) figured by the *yoni* or *pudendum muliebre* and the principal and southern star of this nakṣatra is placed in 12°N. On the Arabian system, the second manzil, entitled *Butain* is placed by Ulugh Beg in lat. 1°12′ and 3°12′, and this cannot possibly be reconciled with the Indian constellation. But Muhammad of Tizin assigns to the bright star of *Butain* a declination of 23°N exceeding by nearly 2° the declination allotted by him to *Nātih* or his first star in *Sheratain*. This agrees with the difference between the principal stars of *Aśvinī* and *Bharaṇī*; and it may be inferred, that some among the Mohammadan astronomers have concurred with the Hindus, in referring the second constellation to stars that form Musca.

3. *Kṛttikā*, now the third, formerly the first, *nakṣatra* consists of six stars figured as knife or razor, and the principal and southern star is placed in 4½ or 5°N and in 65 sixths of degrees (or 10°50′) from its own commencement (cf. the *Sūryasiddhānta*). or 37° 28′ to 38° from the beginning of the Meṣa (the *Siddhānta-Śiromaṇi* or the *Graha Lāghava*) respectively. This longitude of the circle of declination corresponds nearly with that of the bright star in the Pleiades, which is 40° of longitude distant from the principal star of *Revatī*.

The stars indicated by Ulugh Beg for *Thurayyā*, also correspond exactly with the Pleiades.

4. *Rohiṇī*, is the fourth *nakṣatra*, the Arabic name for the fourth mansion is *Debarān* (or with the article *Aldebarān*). It corresponds to the bright star called the Bull's eye, and which is unquestionably the same with the principal and eastern star of *Rohiṇī*, placed in 4½° or 5°S and 49½°E by the Hindu writers on Astronomy. This *nakṣatra* is

figured as a wheel cart, and comprises five stars, out of the seven which the Greeks named the Hyades. The Arabs, however, like the Hindus, reckon five stars only in the asterism. Sir William Jones supposes them to be in the head and neck of the Bull; they probably are α, ρ, γ, δ, ε Tauri, agreeably to Mons. Bally's conjecture.

5. *Mṛgaśirā*, the fifth *nakṣatra*, represented by an antelope head, contains three stars; the same which constitute the fifth lunar mansion *Hakāh*; for the distance of 10°S assigned to the northern star of this *nakṣatra*, will agree with no other but one of the three in the head of Orion. The difference of longitude (24° to 25½°) from Kṛttikā corresponds with sufficient exactness; and so does the longitude of its circle of declination (62° to 63°) from the end of Rewatī; since the true longitude of λ Orionis, from the principal star in Revatī (ζ piscium) is 63¼°.

6. *Ārdrā*, the sixth *nakṣatra*, consists of a single bright star, described as a gem, and placed in 9°S (by some in 11°) and at the distance of 4⅔ to 4° in longitude from the last asterism. This indicates the star in the shoulder of Orion (α orionis). The sixth lunar mansion is named by the Arabs as *Hanāh*; and comprises two stars in the feet of the second twin, according to Ulugh Beg, though others make it to be a shoulder. Mohammad of Tizin allots five stars to this constellation; and the Kāmūs, among various meanings of Hanāh, says, that it is a name for five stars in the left arm of Orion; remarking also, that the lunar mansion is named *Tahāyi*, comprising three stars called Tahyāt. Obviously here the Indian and Arabian asterisms are irreconcileable.

7. *Punarvasū* (used in a dual number) is the seventh *nakṣtra*, and is represented by a house, or even a bow, and it includes four stars, among which the principal and eastern one is 30° or 32° from the fifth asterism; but has been placed by all authorities in 6°N. This agrees with (β Geminorum) one of the two stars in the heads of the Twins, which together constitute the seventh lunar mansion *zirāā*, according to Mohammad of Tus and Mohammad of Tizin and other Arabian authorities. The seventh lunar mansion of Arabs is named *zirāā ul ased* according to Jauhari and other cited by Hyde in his Commen-

tary on Ulugh Beg. and that the Kāmūs makes this term to be the name of eight stars in the form of a bow."

8. *Puṣya*, the eighth asterism, is described as an arrow, and consists of three stars, the chief of which being, also the middle most, has no latitude, and is 12° to 13° distant from the seventh asterism, being placed by Hindu astronomers in 106° of longitude. This is evidently δ Cancri; and does not differ widely from the eighth lunar mansion *Nethrah*, which according to Ulugh Beg and others consists of two stars, including the nebula of Cancer. The Indian constellation comprises two other stars besides δ Canceri, which are perhaps γ and β of the same constellation.

9. *Aśleṣā*, the ninth asterism, contains five stars figured as a potter's wheel, and of which the principal or eastern one is placed in 7°S, and according to different tables, 107,° 108° or 109° E. This appears to be intended for the bright star in the southern claw of Cancer (α Canceri), and cannot be reconciled with the lunar mansion *Tarf* or *Tarfah*, which comprises two stars near the lion's (simha) eye, the northernmost being placed by Mohammad of Tizin in 24° of N. declination.

10. *Maghā*, the tenth asterism, contains like the last, five stars, but which are figured as a house. The principal of the Southern one has no latitude; and according to all authorities, has 129° longitude. This is evidently Regulus (α Leonis) : which is exactly 129⅔° distant from the last star in *Revati*. The tenth lunar mansion of Arabians is *Jebhah*, which comprises three (some say, four) stars, nearly in the longitude of the lion's heart. In this instance, therefore, the Indian and Arabian divisions of the zodiac coincide. This *nakastra* consists of α γ ζ η and ν Leonis.

11. *Pūrva-Phālguni* is the eleventh *nakṣatra* and is represented by a couch or bedstead; it consists of two stars determined by the place of the chief star (the northernmost, according to the *Sūrya-Siddhānta*) in 12°N and 144°E, or according to Brahmagupta, the *Śiromaṇi* and the *Grahalāghava* 147° or 148° E. They are probably δ and θ Leonis. The Arabian name for this lunar mansion is *zubrah* or *Khertān*.

It may be mentioned here that Brahmagupta and Bhāskara selected the southern for the principal star; while the *Sūrya-Siddhānta* took the northern. Hence the latitude stated by several Hindu authorities is the mean between both stars; and the difference of longitude, compared to the preceding and subsequent asterisms, may be exactly reconciled upon this supposition.

12. *Uttara-Phālgunī*, which is the twelfth *nakṣatra*, consists of two stars, and is figured as a bed or cot. These stars are ascertained by the place of one of them (the northernmost) 13°N. and 155° E. This indicates β Leonis; the same which singly constitutes the Arabian Lunar mansion *Serfah*, though Mohammad of Tīzīn seems to hint that it consists of more than one star.

13. *Hasta*, the thirteenth *nakṣatra*, has the name and figure of a hand; and is suitably made to contain five stars. The principal one towards the west, next to the north-western star, is placed according to all authorities in 11° and 170° E. This can only belong to the constellation Corvus ; and accordingly five stars in that constellation (α, β, γ, δ and ε Corvi). The thirteenth lunar mansion of Arabs is *Awwā*, which is also described to contain five stars, situated under Virgo and so disposed as to resemble the letter *Alif*. They are placed by Ulugh Beg in the wing. Here obviously, there is nothing common between the Hindu and Arabian specification of the asterism. The agreement is only in the number of stars and in the longitude.

14. *Citrā*, the fourteenth *nakṣatra*, is figured as pearl. It is placed by the *Sūrya-Siddhānta* in 2° S and 180° E. and by Brahmagupta, the *Śiromaṇi* and *Grahalāghava* in 1¾ or 2°S and 183°E. This agrees with the Virgin's spike (α Virginis). The same star constitutes the fourteenth lunar mansion of the Arabs named from it *Simāc ul aāzi*.

15. *Svāti*, the fifteenth *nakṣatra*, is represented by a coral bead. The *Sūrya-Siddhānta*, Brahmagupta, the *Śiromaṇi* and *Grahalāghava*, all concur in placing it at 37°N. They differ one degree in longitude of its circle of declination, three of them

making it 199° and the other 198°. The Indian asterism totally disagrees with the lunar mansion *Ghafr* which is the fifteenth Arabian mansion. and which consists of three stars in the Virgin's (*Kanyā*) foot, according to Ulugh Beg. but in or near the balance (*Tulā*), according to others.

16. *Viśākhā*, the sixteenth *nakṣatra*, consists of four stars described as a festoon. All the authorities place the principal and northernmost star in 1°, 1°20′ or 1°30′ S and in 212°, 212°5′ or 213° E. The latitude seems to indicate the bright star in the Soutehrn Scale (α Librae), though the longitude disagrees (suggesting possibly a remote star κ Librae). Colebrooke suggests the four stars to be α ν ι Librae and γ Scorpii. The sixteenth lunar mansion according to Arabs is *Zubanah* or *Zubāniyah* according to Mohammad of Tīzīn, the bright star in the northern scale (β Librae).

17. *Anurādhā*, the seventeenth *nakṣatra*, consists of four stars and is described as a row of oblations in a right line. Its chief or middlemost star is placed in 3°, or 2° or 1°45′ S and in 224° or 224°5′E, thus placing it near the head of the Scorpion (*Vṛścika*) (δ Scorpionis) and the asterism comprises β, δ, π, and ρ Scorpionis. The seventeenth lunar mansion of Arabs is called *Iklīl* or *Iklīlu'l-jebhah*, which is said to contain 4, 3, or 6 stars lying in a straight line. Those assigned by Ulugh Beg for this mansion are β, δ, ν and π Scorpionis. Thus here the Indian and Arabian astronomers both concur exactly.

18. *Jyeṣṭha*, the eighteenth *nakṣatra*, comprises three stars figured as a ring. The principal and middlemost star is placed in 4°,3½° or 3° S and in 229°,229°5′ or 230°E; this position indicates Antares or the Scorpion's heart (α Scorpionis), which is also the eighteenth lunar mansion, named *Kalb* or *Kalbul'ākrab*. The three stars of Indian asterism may be α, σ and τ Scorpionis.

19. *Mūla*, the nineteenth *nakṣatra*, is represented by a lion's tail, and it contains eleven stars, of which the characteristic one, the easternmost, is placed in 9°, 8½° or 8° S and in 241° or 242° E. This probably (not exactly) indicates ν Scorpionis. This agrees with the eighteenth lunar mansion of Arabs known as *Shaulah*, consisting of two stars near the Scorpion's

sting. The Hindu asterism probably includes all the stars in the Scorpion's tail (ε , μ, ζ, η, θ, ι, κ, λ, υ and ν Scorpionis).

20. *Pūrva-Āṣāḍha*, the twentieth *nakṣatra*, is figured as an elephant's tooth or as a couch, and it consists of two stars, of which the most southern one is placed in 5½°, 5⅓ or 5° S and 254° or 255° E. This corresponds well with δ Sagittarii, and which also corresponds with the twentieth lunar mansion of Arabs called *Nāaim*. The Arabian mansion consists of four, or according to some eight, stars. The Indian *nakṣatra* corresponds to δ and ε Sagittarii.

22. *Uttara-Āṣāḍha*, the twenty-first *nakṣatra*, is represented by a couch or by an elephant's tooth. The principal or the most northerly star is placed in 5° S and 260° or 261° E, agreeing with a star in the body of Sagittarius (τ Sagittarii), and the other star is perhaps the one marked ζ. The Arabian lunar mansion corresponding to it is *Baldah*, consisting of six stars, two, of which are placed by Mohammad of Tīzīn in declination 21° and 16°. One of these must be a star in the head of Sagittarius. Some authors, on the contrary, describe the lunar mansion as destitute of stars. Here the Arabs and Hindus do not show reconciliation.

22. *Abhijit*, the twenty-second asterism, consists of three stars figuring as a triangle or as a nut of floating Trapa (in modern Indian astronomy, it does not occupy an equal portion of the ecliptic with other *nakṣatras*). Its brightest star is very remote from the zodiac, being in 60° or 62° N. The longitude of its circle of declination is 265°, 266° 40′ or 268° according to different authorities. The corresponding lunar mansion of Arabs is *Zābih*, consisting of two stars (according to some, four) in the horns of Capricorn. This totally disagrees with Indian asterism.

20. *Śravaṇa*, the twenty-third *nakṣatra*, is represented by three footsteps, and contains three stars of which the middlemost is placed in 30° N (all authorities agree), and longitude 280° (*Sūrya-Siddhānta*) or 278° (Brahmagupta and *Śiromaṇi*), or 275° (*Grahalāghava*). The assigned latitude indicates the bright star in the Eagle, whence the three may be inferred to be α, β

and γ Aquilae. According to Arabs, the twenty-third lunar mansion is *Balā*, which consists of two stars in the left hand of Aquarius. Here again Arabian and Hindu divisions are at variance.

24. *Dhaniṣṭhā*, the twenty-fourth *nakṣatra*, is represented by a drum or tabor. It comprises four stars, the westernmost of which is placed in 36° N and according to Brahmagupta, *Śiromaṇi* and the *Śūrya-Siddhānta* in 290° E (*Grahalāghava* gives 286°). This longitude of the circle of declination and the distance of the star on it from the ecliptic indicate the Dolphin : and the four stars are α, β, γ and δ Dolphini. The corresponding lunar mansion of Arabs is *Sāud*, which comprises two stars in Aquarius (β and ζ Aquarii). Here again the two divisions disagree completely.

24. *Śatahbiṣak*, the twenty fifth *nakṣatra*, is a cluster of 100 stars figured by a circle. The principal or the brightest has no latitude; or only a third, or at utmost half, a degree of south latitude; and longitude 320°. This best corresponds with λ Aquarii. According to Arabs, the twenty-fifth lunar mansion is known as *Akhbiyah* which consists of three stars only, placed in the wrist of the right hand of Aquarius. However, it appears from Ulugh Beg's tables, as well as from Mohammad of Tīzīn's, that four stars are assigned to this mansion. The Indian and Arabian systems of division differ considerably but less widely according to some.

26. *Pūrva-Bhādrapada*, the twenty-sixth *nakṣatra*, consists of two stars represented by a couch or bed. or else by a double headed figure, one of which is placed in 24° N and 325° or 326° E. The only conspicuous star nearly in that position is the bright star in Pegasus (α Pegasi) and the other may be the nearest considerable star in the same constellation (ζ Pegasi). The twenty-sixth Arabian lunar mansion is *Mukaddim*, consisting of two brightest stars in Pegasus (α and β). Here the Indian and Arabian divisions show concurrence.

27. *Uttar-Bhādrapada.* the twenty-seventh *nakṣatra*, consists of two stars, figured as a twin or a person with double face, or else as a couch. The position of the most northerly of the two

is in 26° or 27°N and 337° E. which probably indicates the bright star in the head of Andromeda, and the other star to be the one in the extremity of the wing of Pegasus (γ Pegasi). This exactly agrees with the twenty-seventh lunar mansion of Arabs named as *Muakkher*. Ulugh Beg assigns those stars to it.

28. *Revatī*, the twenty-eighth *nakṣatra*, comprises thirty-two stars figured as a tabor. The principal star is the southernmost one, it has no latitude, and two of them assert no longitude, but some make it ten minutes short of the origin of the ecliptic, viz. 359° 50'. This clearly marks the star on the ecliptic in the string of the Fishes (ζ Piscium). The ascertainment of this star is important in regard to the adjustment of the Hindu sphere. The Arabic name for this mansion is *Rishā*, signifying a cord. But the constellation as described by Jauhari and cited by Golius, consists of a multitude of stars in the shape of a fish and termed *Betnu'lhūt*; in the navel of which is the lunar mansion. Mohammad of Tīzīn also makes this lunar mansion to be the same with *Betnu'lhūt*, which appears, however, to be the bright star in the girdle of Andromeda (β Andromedae) though others describe it as the northern fish, extending, however, to the horns of Ram. The lunar mansion and the Indian asterism, therefore, are not reconcileable in this last instance.

I leave it to the readers to draw an inference as to the concurrence of the divisions of zodiac in Indian and Arabian systems. I would personally agree with Sir William Jones that the agreements are by chance. Arabs derived the idea of dividing zodiac in 27 or 28 mansions from Indians, or may have got it from Greeks, and then they proceeded in their own way for details. I do not agree with those scholars who sometimes state that the Hindus took the hint of dividing the ecliptic from Greeks. The *Atharvaveda* devotes a number of Sūktas or hymns on Nakṣatras, and I have shown elsewhere that inspired by these hymns, Gārgya was the first Ṛṣi who detailed out the *nakṣatras*. This happened much before Greeks developed even their first notions of astronomy. While the concept of 27 *nakṣatras* is Vedic and most ancient and of purely Indian origin the concept of 12 Rāśis (signs) or twelve constellations is probably inspired from Greeks. [The names Kanyā, (virgo), Tulā

(Libra), Vṛścika (Scorpio), Dhanu, (Sagittarius), Makara, (Capricorn), Kumbha (Aquarius), Mīna (pisces), Meṣa (Aries), Vṛṣa (Taurus), Mithuna (Gemini), Karka (Cancer), and Siṁha (Leo) were not used for Rāśis or signs in the Vedic times]. I shall conclude this description with a passage from Colebrooke :

> The result of comparison shows, I hope satisfactorily, that the Indian asterisms, which mark the divisions of the ecliptic, generally consist of nearly the same stars, which constitute the lunar mansions of the Arabians : but in a few instances, they essentially differ. The Hindus have likewise adopted the division of the ecliptic and zodiac into twelve signs or constellations, agreeing in figure and designation with those of the Greeks; and differing merely in the place of the constellations, which are carried on the Indian sphere a few degrees further west than on the Grecian. That the Hindus took the hint of this mode of dividing the ecliptic from the Greeks, is not perhaps altogether improbable; but if such be the origin of it they have not implicitly received the arrangement suggested to them, but have reconciled and adapted it to their own ancient distribution of the ecliptic into twenty-seven parts.
>
> In like manner, they may have either received or given the hint of an armillary sphere as an instrument for astronomical observation ; but certainly they have not copied the instrument which was described by Ptolemy, for the construction differs considerably.

Names, Shapes, and Number of the Stars of the Nakṣatras

The *Muhūrta-cintāmaṇi* provides a list of shapes associated to the nakṣatras (*MuC.* II. 59-60), In this list we are giving the number of stars as indicated by Varāhamihira, Brahmagupta and Lalla. The identification given here is as indicated by E. Burgess, in his Translation of the *Sūrya-Siddhānta* 1935, p. 378. (Calcutta). This table has been reproduced here from the *Mahābhāskarīya* of Bhāskara I, edited by K.S. Shukla.

Nakṣatra	Shape	Number of stars			Identification
		Varāha	Brahma	Lalla	
Aśvinī	Head of a horse	3	2	3	α,β,γ Aries
Bharaṇī	Yoni	3	3	3	35,39,41 Aries
Kṛttikā	Razor	6	6	6	η Tauri etc. (Pleiades)
Rohiṇī	Cart	5	5	5	α,θ,γ,δ,ε Tauri (Hyades)
Mṛgaśirā	Head of a deer	3	3	3	λ,$\phi_1\phi_2$ Orionis
Ārdrā	Jewel	1	1	1	α Orionis
Punarvasū	House	5	2	4	β,α,ι,υ,μ Geminorum
Puṣya	Arrow-head	3	1	3	θ,δ,γ Cancri
Āśleṣā	Wheel	6	6	5	ε,δ,σ,η,ρ Hydrae
Maghā	House	5	6	5	α,η,γ,ζ,μ,ε Leonis
P-Phālgunī	Mañca	8	2	2	δ,θ Leonis
U-Phālgunī	Cot	2	2	2	β, 93 Leonis
Hasta	Hand	5	5	5	δ,γ,ε,α,β corvi
Citrā	Pearl	1	1	1	α Virginis (Spica)
Svātī	Coral bead	1	1	1	α Bootis (Arcturus)
Viśākha	Arched doorway	5	2	4	ι,γ,β,α, Librae
Anurādhā	Heaps of offerings to gods	4	4	4	δ,β,π Scopionis
Jyeṣṭhā	Earpendent	3	3	3	α,σ,τ Scorpionis
Mūla	Tail of a lion	11	2	11	λ,ν,κ,ι,θ,η,ζ,μ,ε Scorpionis
P-Āṣāḍha	Tusk of elephant	2	4	2	δ,ε Sagittarii
U-Āṣāḍha	Mañca	3	4	2	σ,ξ Sagittarii
Śravaṇa	Three feet	3	3	3	α β,γ Aquilae
Dhaniāṣṭh	Drum	5	5	4	β,α,γ,δ Delphini
Satabhiṣak	Circle	100	1	100	λ Aquarii etc.
P-Bhādra.	Mañca	2	2	2	α.β Pegasi
U-Bhādra	Pair	8	2	2	γPegasi; α Andromedae
Revati	Drum	32	1	32	ζPiscium etc.

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CHAPTER XI

Brahmagupta's Astronomy : Its Highlights

Beginning or Starting Point

Very often in Indian astronomy, we come across a term *ahargaṇa* (literally meaning collection of days), which means the number of mean civil days elapsed at mean Sunrise at Laṅkā on a given lunar day (*tithi*), since the beginning of *Kaliyuga*. It is the beginning of *Kaliyuga*, which is taken as the starting point for the reckoning of *ahargaṇa*. This happened on Friday, February 18, B.C. 3102, at mean sunrise at Laṅkā, when the Sun, Moon, and the planets are supposed to have been in conjunction at the first point of the *nakṣatra Aśvinī* (which is a fixed point situated near the star ζ-Piscium). According to Āryabhaṭa and Bhāskara I, the duration of Kaliyuga is 1,080,000 solar years. Four times this (4,320,000) is the duration in solar years of a bigger unit called *Mahāyuga* or even *yuga*.

Laṅkā in Indian astronomy is a hypothetical place where the meridian of Ujjain (latitude 23° 11′ N, longitude 75° 52′ E from Greenwich) intersects the equator. It is one of the four hypothetical cities on the equator called Laṅkā. Romaka. Siddhapur and Yamakoṭi (or Yavakoṭi). The *Sūryq-siddhānta* describes Laṅkā as a great city (mahāpurī) situated on an island to the south of Bhāratavarṣa.[1] The present Ceylon is not the

1. समन्तान्मेरुमध्यात्तु तुल्यभागेषु तोयधेः ।
द्वीपेषु दिक्षु पूर्वादिन्नगर्यो देवनिर्मिताः ॥
भूवृत्त पादे पूर्वस्यां यवकोटीति विश्रुता ।
भद्राश्व वर्षे नगरी स्वर्णप्राकारतोरणा ।
याम्यायां भारतेवर्षे लङ्का तद्वन्महापुरी ॥

(*Cont. on page* 290)

astronomical Lankā, as it is about six degrees to the north of equator. The astronomical Laṅkā is mentioned by Brahmagupta in the beginning of his very first Chapter[1].

According to Brahmagupta all the four yugas of a *Caturyuga* or *mahāyuga* are not of the equal duration :

> *Kaliyuga* is of 432,000 years. *Dvāpara* of 864,000 years, *Tretā* of 1,296,000 years and *Kṛtayuga* of 1,728,000 years; total of the four is 4,320,000 years. Āryabhaṭa regards all *yugas* of equal duration, 1,080,000 years[2].

The Saka era, which is usually used in Indian astronomy for the reckoning of years commenced 3179 years after the beginning of *Kaliyuga.*

The number of lunar months in a *yuga* does not coincide with the number of solar months. Thus we have the conception of the *Intercalary months* : the number of intercalary months in a *yuga* denotes the excess of the number of lunar months in a *yuga* over the number of solar months in a *yuga*. Thus in a *yuga* we have

Lunar months	53,433,336
Solar months	51,840,000
Intercalary months	1,593,336
Lunar days	1,603,000,080
Civil days	1,577,917,500
Omitted lunar days	25,082,580

The number of omitted lunar days in a *yuga* is equal to the number of lunar days in a *yuga* minus the number of civil days in a *yuga*.

(*Cont. from page 289*)

पश्चिमेकेतुमालाख्ये रोमकाख्या प्रकीर्तिता ।
उदक्सिद्धपुरी नाम कुरुवर्षे प्रतिष्ठिता ॥ —*Surya*. XII. 36-39

1. चैत्रसितादेरुदयाद्भानोर्दिनमासवर्षयुगकल्पाः ।
सृष्ट्यादौ लंकायां समं प्रवृत्ता दिनेऽर्कस्य ॥ —*BrSpSi*. I. 4

2. युगदशभागो गुणितः कृतं चतुर्भिस्त्रिभिर्गुणस्त्रेता ।
द्विगुणो द्वापरमेकेन संगुणः कलियुगं भवति ॥
युगपादानार्यभटश्चत्वरि समानि कृतयुगादीनि ।
यदभिहितवान् न तेषां स्मृत्युक्तसमानमेकमपि ॥ —*BrSpSi*. I. 8-9

Units of time

For the measurements of durations, it is necessary to have units of time. Brahmagupta gives the following units :[1]

6 prāṇas or Asus	=	1 Ṛkṣa-vināḍikā or nakṣatra-vighaṭikā or one *pala* (24 seconds)
60 palas	=	1 ghatikā (24 minutes)
60 ghaṭikās	=	1 divasa or dina (day) (24 hours)
30 dinas	=	1 māsa (month)
12 māsas	=	1 varṣa or year

Ṣimilar to the divisions of time, we have the divisions of an arc :[2]

Vikalā (or viliptā or viliptikā) = second of arc.

60 vikalās	=	1 kalā (minute of arc)
60 kalās	=	1 aṁśa (degree of arc)
30 aṁśas	=	1 rāśi
12 rāśis	=	1 bhagaṇa (complete circle, 360°)

Unlike Āryabhaṭa and others, who take kali, dvāpara, tretā, and kṛta of equal number of years, Brahmagupta regards kali consisting of 432,000 years, dvāpara twice of it, consisting of 864,000 years, tretā thrice of Kali consisting of 1,296,000 years and kṛta four times of kali conisting of thus 1,728,000 years, all the four to be making a *yuga* of 4,320,000 years.[3] Further in the beginning of kṛta there is a *sandhyā* of 1728000/12 years (=144,000 years). and at the end of Kṛta, there is a saṇdhyāṁśa of 144,000 years; similarly in the beginning of tretā, we have a

1. प्राणैर्विनाडिकार्क्षी षड्भिर्घटिका षष्ट्या ।
घटिका षष्ट्या दिवसो दिवसानां त्रिंशता मासाः ॥ —*BrSpSi*. I. 6

2. मासा द्वादशवर्षं विकलालिप्तांशराशिभगणांतः ।
क्षेत्र विभागस्तुल्यः कालेन विनाडिकाद्येन ॥ —*BrSpSi*. I. 6
वर्षं द्वादश मासास्त्रिंशद्दिवसो भवेत्समासस्तु ।
षष्टि नाड्यो दिवसष्षष्टिस्तु विनाडिका नाडी ॥ —*Ārya*. III. 1
गुर्वक्षराणि षष्टिर्विनाडिकार्क्षी षडेव वा प्राणाः ।
एवं काल विभागः क्षेत्र विभागस्तथा भगणात् ॥ —*Ārya*, III. 2

3. स्वचतुष्टयरदवेदा रवि वर्षाणां चतुर्युगं भवति ।
सन्ध्या सन्ध्यतांशैः सह चत्वारि पृथक् कृतादीनि ॥
युगदशभागो गुणितः कृतं चतुर्भिस्त्रिभिर्गुणस्त्रेता ।
द्विगुणो द्वापरमेकेन संगुणः कलियुगं भवति ॥ —*BrSpSi*. I. 7. 8

sandhyā of 1,296,000/12; i. e. 108,000 years and at the close of tretā a sandhyāṁśa of 108,000 years. Again, in the beginning of dvāpara we have a sandhyā of 864,000/12, i. e. 72,000 years and at the close of dvāpara a sandhyāṁśa of 72000 years; and similarly at the heginning a sandhyā and at the close a sandhyāṁśa of 432,000/ 1, i. e. of 36,000 years in the case of kali. In this respect Brahmagupta appears to follow Manu. the first author or giver of law. He regards further the following divisions of time :[1]

71 yugas =1 manu
14 manus =1 kalpa

Again, in the beginning, at the middle and at the close of each manu, there are sandhis, each equal to the measure of kṛta. Thus, taken as a whole

1 kalpa $=71\times14$ yugas $+15$ sandhyā-sandhyāṁśa
$=994$ yugas $+15\times$ duration of kṛta
$=994$ yugas $+15\times(4\times432{,}000)$ years
$=994$ yugas $+ 6$ yugas $=1000$ yugas
$=$ 1 Brahma-dina (Brahmā's day)

Thus Brahmā's day is regarded as 1 kalpa or one thousand caturyugis or 1000 *yugas* or the same as 1000 *mahāyugas*).

Āryabhaṭa regards a manu to consist of 72 yugas and therefore a kalpa according to him would be of 14×72 yugas, or 1008 yugas.[2] Since in the foreign Siddhāntas like Romaka, there is no reference to yuga, manu and kalpa, Brahmagupta regards these systems to be unauthoritative.[3]

We have said that our starting point was the beginning of Kaliyuga, Friday February 18, B.C. 3102, at mean rise at Laṅkā, when the Sun, Moon and the planets are supposed to have been in conjunction at the first point of the Nakṣatra Aśvinī. This type of conjunction would again happen after a period of *kalpa.*

1. मनुरेकसप्ततियुगः कल्पो मनवश्चतुर्दश मनूनाम् ।
आद्यन्तरान्त सन्धिषु कृतकालोऽस्माद्युग सहस्रम् ॥ —*BrSpSi.* I. 10

2. दिव्यं वर्षं सहस्रम् ग्रहसामान्यं युगं द्विषट्क गुणम् ।
अष्टोत्तरसहस्रं ब्राह्मो दिवसो ग्रहयुगानाम् ॥ —*Ārya.* III. 8

3. युगमन्वन्तरकल्पाः कालपरिच्छेदकाः स्मृतावुक्ताः ।
यस्मान्नरोमके ते स्मृतिबाह्यो रोमकस्तस्मात् ॥ —*BrSpSi.* I- 13

We shall have the same type of conjunction of *grahocca, mandocca śīghrocca* and *pāta* after a complete cycle of kalpa as we had in the beginning of creation. This is a natural observable cycle which is recognised in Indian astronomy and in no other foreign system; and hence only the Indian system recognises the time measure of *kalpa.*

Ucca or apex is of two kinds: *mandocca* (apex of the slowest motion) and *śīghrocca* (apex of the fastest motion). The *mandocca* is that point of a planet's orbit which is at the remotest distance and where the motion of the planet is slowest. In the case of the Sun and the Moon, it is the apogee; and in the case of other planets, it is the apogee or aphelion, the geocentric longitude of the apogee being equal to the helio-centric longitude of the aphelion. The *śīghrocca* of a superior planet (Mars, Jupiter and Saturn) is defined as the mean Sun; that of an inferior planet Mercury or Venus) *śīghrocca* is an imaginary body which is supposed to move in such a way that its direction from the earth is always approximately the same as that of the actual planet from the Sun.

The *bhagaṇas* or the revolution numbers of a planet have been given by Āryabhaṭa and Brahmagupta[1] both: they mean the number of revolutions that a planet performs in a certain period, say a kalpa of 4,320,000,000 years.

The *bhagaṇas* of planets are given as follows:

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1. कल्पेऽर्कबुधसितानां भगणाः शून्यानि सप्त रदवेदाः ।
प्राग्व्रजता कुजगुरुशनि शीघ्रोच्चानां स्वकक्षासु ॥
पञ्चाम्बराणि गुण-गुण पञ्चमुनि स्वशरैर्मिताः शशिनः ।
भौमस्य द्वियमशराष्टपक्षवसुरसनवद्वियमाः ॥
कृतवसुनवाष्टनद-नवषट्त्रि नवागेन्द्वोज्ञशीघ्रस्य ।
जीवस्य शरेषूदधि षट्पक्षद्वि कृतरसरामाः ॥
सितशीघ्रस्य यमलगोवेदनवाष्टाग्निपक्षयमखनगाः ।
अष्टनवपक्ष मुनि रसशररस मनवोऽर्कपुत्रस्य ॥
खाष्टाब्धयो वसुशरवसुपञ्चखचन्द्रवसुवसुसमुद्राः ।
द्विनवयमा द्वित्रिगुणाः शरेषु वसवस्त्रि पञ्चरसाः ॥
शशिवेदा मन्दानामर्कादीनां विलोमपातानाम् ।
वसुरसरुद्रेन्दुगुणा द्वित्रियमाः सप्तरसपक्षाः ॥
शशियमशरा गुणारसास्त्रिनन्दवसवः समुद्रवसु विषयाः ।
चन्द्रादीनां पश्चात् व्रजतोऽश्विन्यादि भगणस्य ॥ *BrSpSi.* I. 15-21

Planet or a body	Bhagaṇas
Ravi or Sun	4,320,000,000
Budha or Mercury	4,320,000,000
Śukra or Venus	4,320,000,000
Candra or Moon	57,753,300,000
Kuja or Bhauma or Mars	2,296,828,522
Budha-śīghrocca	17,936,998,984
Bṛhaspati or Jupiter	364,226,455
Śukra-śighrocca	7,022,389,492
Śani or Saturn	146,567,298
Arka or Ravi-mandocca	480
Candra mandocca	488,105,858
Kuja or Bhauma mandocca	292
Budha-mandocca	332
Bṛhaspati or Jīva-mandocca	855
Śukra-mandocca	653
Śani-mandocca	41
Candra-pāta	232,311,168
Kuja or Bhauma-pāta	267
Budha-pāta	521
Bṛhaspati or Guru-pāta	63
Śukra-pāta	893
Śani-pāta	584

By pāta is meant the ascending node of a planet's orbit (on the ecliptic).

In a kalpa, the number of *bha-bhramas* (sidereal days) or also known as *bha-parivartas* is 51,040,000,000. If we subtract out from this number the *bhagaṇa* of the Sun, we get what is known as *ku-dinas* or *Sāvana* days or the solar or sacrificial days. (51,040,000,000—4,320,000,000=46,720,000,000 Sāvana days or kudinas).

In a kalpa, the number of Ravi-bhagaṇas also correspond to the number of solar years (Saura-varṣas). i.e., 4,320,000,000; this number multiplied by 12 gives the number (i.e. 51,840,000,000) of solar months.

The difference between the candra-bhagaṇas and the Ravi-bhagaṇas in a kalpa gives the number of lunar months (Cāndra-

māsa) in a kalpa (57,753,300,000-4,320,000,000=53,433,300,000 lunar months).

By subtracting the number of solar months from the number of lunar months in a kalpa, one gets the number of *adhi-māsas* (additional-months) :. 53,433,300,000-51,840,000,000= 1,593,300,000 adhimāsas. This multiplied by 30 gives the number of lunar days (śaśi-divasa) in a kalpa ; 53.433,300,000 × 30= 1,602,999,000,000 lunar days. The difference between the lunar days and *kudinaṣ* in a kalpa gives the number of *avama-dinas* in a kalpa : 1,602,999,000,000-46,720,000,000=1,556,279,000,000.[1]

Brahmagupta calculates out the sṛṣṭi-saṁvatsara or the Creation Era during his year of composition of the Treatise. He says : Six manus have gone in the kalpa ; the seventh manu is now running of which have lapsed 27 caturyugis ; of the twenty eighth caturyugī, the three yugas, kṛta, dvāpara and tretā have gone by and also of the present kaliyuga 3179 years have lapsed. The total period thus lapsed on calculation comes to be 1,972,947,179 years :[2]

Total Period=6 manus+7 manu−sandhis+27 yugas +kṛta+dvāpara+tretā+3179 years of kali.
=(6 × 71 × 4,320,000 years) +(7 × 4 × 432,000 years)+ (27 × 4,320,000 years)+(1,728,000+1,296,000+864,000)+ 3,179=1,972,947,179 years.
=1,840,320,000+12,096,000+116,640,000+3,888,000+ 3,179=1,972,947,179 years.

Calculation of Ahargaṇa : The method of calculating ahargaṇa (number of days elapsed since the beginning of kaliyuga)

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1. परिवर्त्ताः स्वचतुष्टय गराब्धि रसगुणयमद्विवसुतिथयः ।
रवि भगणोना भानोः सावनदिवसाः कुदिवसास्ते ॥
रवि भगणारव्यब्दा द्वादशगुणिता भवन्ति रविमासाः ।
भगणान्तरं रवीन्द्वोः शशिमासाः सूर्यमासोनाः ॥
अधिमासाः शशिमासास्त्रिशद्गुणिता भवन्ति शशिदिवसाः ।
शशिसावनदिवसान्तरमवमानि तिथिः शशांकदिनम् ॥ —*BrSpSi*. I. 22-24

2. कल्पपरार्द्धमनवः षट्कस्य गताश्चतुर्युगत्रिघनाः ।
त्रीणिकृतादीनिकलेर्गोऽगैक गुणाः शकान्तेऽब्दाः ॥
नवनगशशि मुनिकृत नव यमनगनन्देन्दवः शकनृपान्ते ।
सार्धमतीतमनूनां सन्धिभिराद्यन्तरान्तगैः ॥ *BrSpSi. I.* 26-27

has been given by Brahmagupta and Bhāskara I is almost identical. The rule given in the *Brāhmasphuṭasiddhānta*[1] may be compared with the following given by Bhāskara I in the *Laghu-Bhāskarīya*:

> Add 3179 to the (number elapsed) years of the Śaka era, (then) multiply (the resulting sum) by 12, and (then) add the (number of lunar) months (expired) since the commencement of Caitra. Set down (the result thus obtained) at (two) separate places; multiply (one) by (the number of) intercalary months in a *yuga*, which are 1,593,336 in a yuga : and divide (the product) by 5,184 × 10,000 (i.e.) by 51,840,000). Add the (resulting complete) intercalary months to the result placed at the other place. Then multiply (that sum) by 30 and (to the product) add the (lunar) days (i.e. *tithis*) expired of the current month. Set down (the result thus obtained) in two places; multiply (one) by the (number of) omitted lunar days in a *yuga* i.e. by 25,082,580 and divide by 1,603,000,080. The resulting (complete) omitted lunar days when subtracted from the result put at the other place give the (required) *ahargaṇa*. The remainder obtained on dividing (the *ahargaṇa*) by 7 gives the day beginning with Friday at sunrise (at Laṅkā)[2]

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1. कल्पगतान्द द्वादशघातश्चैत्रादिमास युक्तोऽधः ।
गुणितो युगाधिमासै रवि मासाप्ताधिमास युतः ॥
त्रिंशद्गुणास्तिथियुत्य पृथग् युगावमगुणो युगेन्दु दिनैः ।
भक्तः फलावमोनोऽर्के सावनाहर्गणोऽर्कादिः ॥ — *BrSpSi*. I. 29-30

2. नवाद्र्येकाग्नि संयुक्ताः शकाब्दा द्वादशहताः ।
चैत्रादिमास संयुक्ताः पृथग् गुण्या युगाधिकैः ॥
ते च षट् त्रिकरामाह्नित नव भूतेन्दवो युगे ।
भागहारोऽब्धि वस्त्येक शरास्युर युताहताः ॥
अधिमासान्पृथक्स्थेषु प्रक्षिप्य त्रिंशताहते ।
युक्तवादिनानि यातानि प्रतिराश्य युगावमैः ॥
संगुणाब्धाम्बराष्टेषुद्व्यष्टशून्यशराश्विभिः ।
छेदः खष्टवियद् व्योमख खाग्नि खरसेन्दवः ॥
लब्धान्यवमराठाशि तेषु शुद्धे ष्वहर्गणः ।
वारः सप्तहृते शेषे शुक्रादिर्भास्कारोदयात् । —*LBh. I.* 4-8

Ādendum : The mean lunar day (*madhyama tithi*) may, however, differ from a true lunar day (*spaṣṭa tithi*) by one, so that the *ahargaṇa* obtained by the above process may sometimes be in excess or defect by *one*. To test whether the *ahargaṇa* (obtained by the above process) is correct, it is divided by seven and the remainder counted with Friday. If this leads to the day of calculation, the *ahargaṇa* is correct; if it leads to the preceding day, the *ahargaṇa* is in defect; and if that leads to the succeeding day, the *ahargaṇa* is in excess. When the *ahargaṇa* is found to be in defect. it is increased by *one*; when it is found to be in excess, it is diminished by *one*. (K.S. Shukla : *MBh*. p. 4–5)

Example—Calculate the *ahargaṇa* on October 1,1965.

From Indian Calendar we find that October 1,1965 falls on Friday. 7th lunar day (tithi) in the light half of the 7th month Āśvina in the Saka year 1887 (elapsed). Let us proceed as follows :

Adding 3,179 to 1,887. we get 5,066. (1)

Multiplying this by 12 and adding 6 (i. e. the number of lunar months elapsed since the beginning of Caitra) we get 60,798. ... ... (2).

Multiplying this by 1,593,336 and dividing the product by 51,840,000, we get 1,868 as quotient. (The remainder is discarded as unnecessary) (3)

Adding this number (i.e. 1,868) to the previous one (i.e.) 60,798) we get 62,666. (4)

Multiplying this by 30 and adding 6 (i.e. the number of lunar days elapsed since the beginning of the current month) to the product, we get 1,879,986. (5)

Multiplying this by 25,082,580 and dividing the product by 1,603,000,080, we get 29,416 as the quotient. (The remainder is discarded as not necessary). (6)

Subtracting this number (i.e. 29,416) from the previous one (i.e. 1,879,986) we get 1,850,570. (7)

This is the required *ahargaṇa*. Since division by 7 leaves

1 as the remainder. we subtract one from it, and get 1,850,569 as the correct *ahargaṇa* for the day.

An Alternative Rule for Ahargaṇa

Both Bhāskara I and Brahmagupta give an alternative rule for calculating out *ahargaṇa*[1] :

> Multiply the number of (solar months) elapsed since the beginning of kaliyuga by the number of lunar months (in a *yuga*) and divide by the number of solar months (in a *yuga*). Reduce the quotient to days (and add the number of lunar days elapsed since the beginning of the current lunar month); then multiply by the number of civil days (in a *yuga*) and divide by the number of lunar days (in a *yuga*); the quotient denotes the *ahargaṇa*.

Mean Longitude of a Planet

(i) The mean longitude of a planet in *revolutions* is given by the expression : (Brahmagupta[2] and also Bhāskara[3]).

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1. शशांकमासैरभिताडितान् हरेदतीतमासानथ वार्कसम्भवैः ।
दिनीकृतान् भूमिदिनैर्हतान् दिनैर्विभज्य लब्धशशिजैरहर्गणः ॥ *MBh. I. 7*
युगगतशशिमासवधाद्रविमासाप्तं दिनीकृतं सदिनम् ।
भूदिनगुणितं शशिदिनहृतमाप्तमहर्गणः सैकः ॥ —*BrSpSi*. XIII. 18

2. इष्टग्रह भगण गुणादहर्गणात् कल्पसावन द्यु हृतात् ।
भगणादि फलं मध्यो लंकायां भास्करौदयिकः ॥ *BrSpSi. I. 31*

3. उद्धारितान् यान् भगणान् क्षमादिनैर्लभामहे कान् कलियातवासरैः ।
इति प्रलब्धा भगणास्ततः क्रमाद् गृहांशलिप्ता विकलाः सतत्पराः ॥ —*MBh. I.* 8
पर्ययाहर्गणाभ्यासो ह्रियते भूदिनैस्ततः ।
लभ्यन्ते पर्ययाः शेषाद्राशि भागकलादयः ॥
भास्करैस्त्रिशता षष्ट्या सङ्गुणय्य पृथक् पृथक् ।
तेनैव भागहारेण लभ्यन्तेऽर्कोदयावधेः ॥ —*LBh. I.* 15-17

(Divide the product of the revolution-number of a planet and the *ahargana* by the (number of) civil days (in a *yuga*); thus are obtained the (number of) revolutions (performed by that planet). From the (successive remainders multiplied respectively by 12,30 and 60 and divided by the same divisor (i.e. the number of civil days in *yuga*) are obtained the signs, degrees and minutes etc. (of the mean longitude of that planet) for (mean) sunrise (at Lanka).

$$\text{Mean longitude} = \frac{\text{revolution number of planet} \times \textit{ahargaṇa}}{\text{civil days in a } \textit{yuga}}$$

Similar expression is given by more recent Indian astronomers also.

(ii) Mean longitude of desired planets in minutes

$$= \frac{\text{(mean longitude of the known planet in revolutions etc. reduced to minutes)} \times \text{(revolution number of the desired planet)}}{\text{revolution number of the known planet.}}$$

This rule is common to Brahmagupta[1] and Bhāskara I[2].

(iii) An alternative rule for deriving the mean longitude of the Moon from that of the Sun and vice versa has been given by Bhāsakara I and Brahmagupta both.

> Multiply the *ahargaṇa* by the number of intercalary months in a yuga and divide (the product) by the number of civil days (in a yuga) : the result is in the terms of revolutions etc. Add that to thirteen times the mean longitude of the Sun. (This is the process) to obtain the mean longitude of the Moon[3].

Mean longitude of the Moon

$$= \frac{\text{(intercalary months in a yuga)} \times \textit{ahargaṇa}}{\text{civil days in a } \textit{yuga}} \text{ revolutions}$$

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1. ज्ञातभगणादिभुक्तं सविकलमिष्टयुग भगणसंगुणितम् ।
ज्ञात युगभगणभक्तं मध्यो भगणादि फलमिष्टः ॥ —*BrSpSi*. XIII. 27

2. निशाकरं वाग्रहमुच्चमेव वा कलीकृतं तत्स्वहृतमण्डलैः ।
यथेष्ट नक्षत्रगणैर्हतं हरेत् तदीयनक्षत्र गणैस्ततः कला ॥ *MBh*. I. 10

The (mean) longitude of the Moon, the planet, or the *Ucca* (whichever is known) together with the revolutions performed should be reduced to minutes. The resulting minutes should then be multiplied by the revolution-number of the desired planet and (the product obtained should be) divided by the revolution-number of that (known) planet. The result is (the mean longitude of the desired planet) in minutes.

3. द्युगणं युगाधिमासैर्गुणितं युग भूदिनैर्भजेल्लब्धम् ।
भगणादि मध्यमार्कं त्रयोदश गुणाधिकं चन्द्रः ॥ —*BrSpSi*. XIII. 33

युगाधिमासैर्द्युगणं हतं हरेत् क्षमादिनैर्वा भगणादि लभ्यते ।
त्रयोदशघ्ने सवितर्यथा क्षिपेन्निशीथिनीनां पतिचारसिद्धये ॥ —*MBh*. I. 11

+13 (Sun's mean longitude)

This expression may be rearranged to get the mean longitude of the Sun from the mean longitude of the Moon[1].

Mean longitude of the Sun

$$= \frac{1}{13}\left[\text{mean longitude of the Moon} - \frac{(\text{intercalary months in a yuga}) \times \textit{ahargaṇa}}{\text{civil days in a yuga}} \text{revolutions}\right]$$

Calculating the Mean Longitudes of the Sun and the Moon without using Ahargaṇa

Bhāskara I follows the method of Āryabhaṭa I and the same method more or less has been adopted by Brahmagupta in calculating the mean longitudes of the Moon and the Sun without the use of *ahargaṇa.* The method may be described thus :

> Reduce the years elapsed since the beginning of kaliyuga to months and add to them elapsed months of the current year. Then multiply the sum by 30 and add the product to the number of lunar days elapsed since the beginning of the current month. Multiply that sum by the number of intercalary months in a *yuga* and divide by the number of solar months in a *yuga* reduced to days; the quotient denotes the number of intercalary months elapsed. The remainder is the *adhimāsaśeṣa.* Multiply the complete intercalary months thus obtained by 30 and to the product add the number of solar days elapsed since the beginning of kaliyuga[2] : then multiply that sum by the number of omitted lunar days in a *yuga* and divide by the number of lunar days in a *yuga* ; the remainder obtained is the *avamaśeṣa* called *āhnika*. Then multiply the *avamaśeṣa*

1. कुसुद्वतीनां सुहृदोऽथवाऽऽगतं विशोध्य शेषस्य लवस्त्रयोदशः ।
स मध्यमार्को गणकैर्निरूप्यते गुरुप्रसादात्प्रति बुद्ध बुद्धिभिः ॥ *MBh.* I. 11-12

2. By the number of solar days here is meant the number obtained above by reducing the years elapsed since the beginning of kaliyuga to months, then adding to them the number of months elapsed since the beginning of the current year, then multiplying the sum by 30, and then adding to the product thus obtained the number of lunar days elapsed of the current month.

(also called *āhnika*) by the number of intercalary months in a *yuga* and divide by the number of civil days (in a *yuga*). Add the resulting quotient to the *adhimāsaśeṣa* and divide the sum by the number of lunar months in a *yuga* : this gives degrees etc. (This is the total *adhimāsaśeṣa*). Next multiply again the *avamaśeṣa* called *āhanika* by 60 and divide by the number of civil days in a *yuga* : the result is in minutes, seconds, thirds etc. The number of months elapsed (since the beginning of Caitra) are to be taken as signs and the number of lunar days elapsed of the current month as degrees. The sum of these signs and degrees and the minutes, seconds etc. corresponding to the avamaśeṣa is the *grahatanu*. From thirteen times and from one time that *grahatanu* severally subtract the degrees, minutes etc. corresponding to the total *adhimāsaśeṣa* : the remainders thus obtained are the mean longitudes of the Moon and the Sun respectively[1].

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1. गुणिताद्युगाधिमासैर्युगभूदिवसैर्हृतादवमशेषात् ।
फलयुक्तमधिकमासकशेषं मध्यावतोऽर्केन्दू ॥
अधिमासावमशेषे युगशशि भूदिनहृते पृथग्लब्धेः ।
मासदिनाद्ये स्थाप्ये गतमासदिनानि चैत्रादेः ॥
अवमासशेषलब्ध्या सहितानि पृथक् त्रयोदश गुणानि ।
अधिमास शेषलब्ध्या हीनानि पृथक् रविशशांकौ ॥ —*BrSpSi*. XIII. 20-22
विनाद्युराशेरपि चन्द्रभास्करौ प्रकुर्वतो वा विधिरेव कथ्यते ।
समासु मासीकृतविग्रहासु ये ह्यतीतमासा विनियोज्य तान् पुनः ॥
खरामनिघ्नान् दिवसेषु योजयेद् गतेषु मासस्य ततोऽधिमासकैः ।
निहत्य सर्वं विभजेत् सर्वदा युगार्कमासैर्दिवसत्वमागतैः ॥
भवन्ति लब्धास्त्वधिमासकाः पुनस्ततोऽपनीयाशु च भागहारकम् ।
भजेत शेषं शशिमास संख्यया ततोऽशलिप्ता विकलाः स तत्पराः ॥
ततोऽधिमासान् प्रणिहत्य खाग्निभिर्नियोज्य सम्यग्गतवासरैः क्रमात् ।
युगावमघ्नाञ्छशिवासरैर्हरेत् तमत्र शेषं प्रवदन्ति चाह्निकम् ॥
हत्वाऽधिमासैरवमस्य शेषं छित्वा धराया दिवसैः प्रलब्धम् ।
संयोज्य नित्यं त्वधिमासशेषे कार्यं पुनस्तत् करणैर्यथोक्तम् ॥
युगप्रसिद्धैर्धरणी दिनैर्हरेन्निहत्य षष्ट्या यावमशेषमाह्निकम् ।
कलाविलिप्ताः क्रमशस्ततत्परास्त्वतीतमासा दिवसा गृहांशकाः ॥
त्रयोदशघ्नादपि रूपताडिताद्विशोधयेद्यत्त्वधिमासशेषजम् ।
निशाकरार्कौ गणकैः प्रकीर्तितौ भट प्रणीताविति बुद्धिमत्तमैः । —*MBh*. I. 13-19

(Here verse 17 should follow verse 15—*K.S. Shukla*)

K. S. Shukla has provided the following rationale to the rule cited above :

The fraction of the intercalary month (obtained in the rule) $= \dfrac{\text{adhimāsaśeṣa}}{\text{solar days in a } yuga}$, in mean lunar months.

$= \dfrac{\text{adhimāsaśeṣa}}{\text{lunar days in a } yuga}$, in mean solar months. (i)

The fraction of the omitted lunar day (obtained in the rule)

$= \dfrac{\text{avamaśeṣa or āhnika}}{\text{lunar days in a } yuga}$, in mean civil days.

$= \dfrac{\text{avamaśeṣa}}{\text{civil days in a } yuga}$, in mean lunar days.

$= \dfrac{\text{avmaśeṣa} \times 60}{\text{civil days in a } yuga}$, in mean lunar *ghaṭis*. (ii)

The fraction of the intercalary month corresponding to the above fraction of the omitted lunar day

$= \dfrac{(\text{intercalary months in a yuga}) \times (\text{avamaśeṣa})}{(\text{lunar days in a } yuga) \times (\text{civil days in a } yuga)}$,

in mean solar months. (iii)

Adding (i) and (iii) and multiplying by 30, the total fraction of the intercalary month

$$= \left\{ \frac{\text{adhimāsaśeṣa}}{\text{lunar months in a } yuga} + \frac{(\text{intercalary months in a } yuga) \times (\text{avamaśeṣa})}{(\text{lunar months in a } yuga) \times (\text{civil days in a } yuga)} \right\}$$

in mean solar days, (iv)

Suppose that m lunar months and d lunar days have elapsed since the beginning of Caitra. Then, treating them as mean lunar months and mean lunar days, m months and d days denote the time elapsed since the beginning of mean Caitra up to the beginning of the current lunar day (treated as mean lunar day). As (ii) is the interval, in mean lunar *ghaṭis*, between the beginning of the current lunar day and the mean sunrise on that day, therefore

m months $+ d$ days $+$ (ii)

denotes the time in mean lunar months, days, ghaṭīs[1] elapsed

1. 1 hour $= 2\frac{1}{2}$ ghaṭīs; 1 ghaṭī $=60$ vighaṭīs; 1 vighaṭī $=60$ pravighaṭīs.

since the beginning of mean Caitra up to the mean sunrise on the current lunar day.

Like wise

m months $+ d$ days $+$ (ii) $-$ (iv)

denotes the time in mean solar months, days, ghaṭīs etc. elapsed since the beginning of the current mean solar year up to the mean sunrise on the current lunar day[1].

Let M, D, G, V, and P denote respectively the mean solar months, mean solar days, mean solar ghaṭīs mean solar vighaṭīs and mean solar pravighaṭīs elapsed since the beginning of the current mean solar year up to the mean sunrise on the current lunar day. Then evidently mean longitude of the Sun

= M signs, D degrees, G minutes, V seconds and P thirds.

= (m signs and d degrees) + [minutes, seconds etc. corresponding to (ii)] − [degrees, minutes etc. corresponding to (iv)].

and mean longitude of the Moon

= 13 [m signs and d degrees + (minutes, seconds, etc. corresponding to (ii)] − [degrees, minutes etc. corresponding to (iv)]

because

[(1/12) mean longitude of the Moon − mean longitude of the Sun.

= m signs + d degrees + (minutes, seconds etc. corresponding to (ii)]

(This equality is based on the fact that the left hand side denotes the mean lunar date also known as *madhyama tithi*).

A similar rule of these calculations of the mean longitude

1. Because (iv) is equal to fraction of a lunar month between the beginning of Caitra and the beginning of the current mean solar year fraction of an intercalary month corresponding to the tithis elapsed up to the beginning of the current mean lunar day since the beginning of Caitra fraction of an intercalary month corresponding to the avamaśeṣa, i.e., the lunar portion between the beginning of the current lunar date and the following sunrise.

of the Sun and the Moon without basing on *ahargaṇa* has also been given by Brahmagupta in the *Khaṇḍakhādyaka*[1].

Concordance of Working Rules

There has been a good deal of agreement on various rules of astronomical constants from the time of Āryabhaṭa I (499 A. D.) to the Bhāskara II (1150 A. D.) or even later to the days of Munīśvara (1620 A, D). Earliest concepts were formulated during the days of the Vedāṅga-Jyautiṣa and the Siddhāntas of Indian and the western origin, for example of Brahma, Vasiṣṭha, Pitāmaha, Romaka and Puliśa. We in this section are giving some important concordances which we find common in the writings of Brahmagupta and his predecessors, contemporaries and successors as listed below. The list is not exhaustive. Only a a few illustrations have been cited.

1. Ārya.—*Āryabhaṭīya*. Āryabhaṭa I, 499 A. D.
2. BrSpSi. —*Brāhmasphuṭasiddhānta*, Brahmagupta, 628 A. D.
3. K. K.—*Khaṇḍakhādyaka*, Brahmagupta, 628 A. D.
4. KKu.—*Karṇa-kutūhala*, Bhāskara II, 1150 A. D.
5. LBh.—*Laghu-Bhāskarīya*, Bhāskara I, 522 A. D.

MBh.—*Mahā-Bhāskarīya*, Bhāskara I, 522 A. D.
MSi.—*Mahā-siddhānta*, Āryabhaṭa II, 950 A. D.
PSi.—*Pañcasiddhāntikā*, Varāhamihira, 505 A. D.
ŚiDVṛ.—*Śiṣyadhīvṛddhida*, Lalla, 598 A. D.
SiSā.—*Siddhāntasārvabhauma*, Munīśvara, 1620 A. D.
SiŚe—*Siddhāntaśekhara*, Śripati, 1039 A. D.
SiŚi.—*Siddhānta-Śiromaṇi*, Bhāskara II, 1150 A. D.
SūSi.—*Sūryasiddhānta*, Modern, 6th or 7th Century.

1. Rule for finding the mean longitudes of the Sun, Mercury and Venus : *BrSpSi*. I. 44.

Also *MBh*. 1. 31. *MSi* I. 26 ; SiŚe II. 42, 43 ; *SiŚi*. I i, (d). 15 ; *SiSā* I. 105 ; *KKu* I. 7.

2. Rule for finding the mean longitude of the Moon's ascending node : *BrSpSi*, XXV. 35.

1. दिनवत्सभक्तमवमावशेषमाप्त दिनादि तत्सहितात् ।
अधिमासशेषकाच्च त्रिंशद् गुणितादतुखदिग्भिः ॥
मासदिन प्रथमैक्यं पृथक् त्रयोदशगुणं द्वितीयोनौ ।
द्वाक्येवं मध्यौ राश्याद्य स्वर्कचन्द्रौ वा ॥ =*KK*. I. 11–12

Also *MBh.* I. 33 ; *ŚiDVṛ.* I. i. 52 (ii)

3. Rule for finding the mean longitude of the *Śīghrocca* of Venus and also giving the additives for the *Śīghrocca* of Mercury and Moon : *BrSpSi.* XXV. 36.

Also *MBh.* I. 35 ; *ŚiDVṛ.* I, i, 57 (ii)

4. Rule for finding the mean longitude of the *Śīghrocca* of Mercury : *BrSpSi.* XXV. 34.

Also *MBh.* I. 36 ; *ŚiDVṛ.* I. i. 50 (ii)

5. Rule for finding the mean longitude of Saturn : *BrSpSi.* XXV. 35.

Also *ŚiḌVṛ.* I. i. 52 (i) ; *MBh.* I. 37.

6. Rule for finding the mean longitude of Mars : *BrSpSi.* XXV. 33.

Also *ŚiDVṛ* I. i. 50 (i) *MBh.* I. 38.

7. Rule for finding the mean longitude of Jupiter : *BrSpSi.* XXX. 35.

Also *MBh.* I. 39 ; *ŚiDVṛ.* I. i. 51 (i).

8. Rule for finding the distance of a place from the prime meridian : *BrSpSi.* I. 36.

Also *MBh.* II. 3-4 ; *LBh.* I. 25-26 ; *ŚiDVṛ.* I. 57-58 (i) ; *SiSā.* I. 143-144.

9. Rule for finding the directions : *BrSpSi.* III. 1.

Also *MBh.* III. 2 ; *SūSi.* III. 1-4 ; *LBh.* III. 1; *SiDVṛ.* I. iii. 1 ; *MSi.* IV. 1-2 ; *SiŚe.* IV 1-3 ; *SiŚi.* I. iii. 8-9.

Alternative rule : *BrSpSi.* III. 2.

Also *MBh.* III. 3 ; *PSi.* XIV. 14-16 ; *ŚiDVṛ.* I. iii. 2 ; *SiŚe.* IV. 4.

10. Rule for finding the latitude and colatitude and the zenith distance and altitude of the Sun : *BrSpSi.* III. 10.

Also *MBh.* III 5; *SūSi* III. 13-14; *LBh.* III 2-3 *ŚiDVṛ* I. iii. 4-5 ; *SiŚe.* IV. 7; *SiŚi* I. iii. 18.

11. Rule for determining the declination, day—radius, earth sine and ascensional difference (for the Sun or a point on the ecliptic) : *BrSpSi.* II. 55.

Also *SūSi* II. 28 ; *LBh.* II. 16; . I. ii *ŚiDVṛ.* 17; *ṢiŚe.* III.

63-64 ; *SiŚi*. I. ii. 47 (ii) (For RSine of the Declination).

BrSpSi. II. 56 ; also *Ārya*. IV 24 ; *MBh*. III, 6; *LBh*. II. 17 ; *ŚiDVṛ*. I. ii. 18 ; *SiŚe*. III. 66 ; . *SiŚi* I. ii. 48 (For day-radius).

BrSpSi. II. 57-58 ; also *MBh*. III. 7 ; *LBh*. II. 18 ;

SūSi .II. 61; *ŚiDVṛ*. I. ii. 18 ; *SiŚe* III. 67 ; *SiŚi*. I. ii. 49 (i) (For the ascensional difference).

12. For finding the times of rising of the sāyana signs at the equator : *BrSpSi*. III. 15.

Also *MBh*. III. 9 ; *SūSi*. III. 42–43 : *ŚiDVṛ*. I. iii. 8 ; *SiŚe*. IV. 15 ; *SiŚi* I. 11. 51.

13. Rule for finding the ascensional differences of the Sāyana signs Aries. Taurus and Gemini : *KK*. 1. 21.

Also *MBh*. III. 8 ; *PSi*. III. 10 ; *ŚiDVṛ*. 1, XIII. 9 ; *SiŚi*. I. ii. 50-51.

14. Rule for the determination of the meridian zenith distance and meridian altitude of the Sun with the help of the Sun's declination and the latitude of the place ; *BrSpSi*. III, 47.

Also *MBh*. III. 11 ; *LBh*. III. 27 ; *ŚiDVṛ*. I. iii. 16 ;*SiŚe*. IV. 42.

15. Rule for determination of the latitude with the help of the Sun's meridian zenith distance and declination :

BrSpSi. : III. 13.

Also *MBh*. III. 17: *LBh*. III. 34; *SūSi*. III. 15-16; *SiŚe*. IV. 51,

16. Rule for finding out the Rsine of the Sun's altitude for the given time in *ghaṭīs* : *BrSpSi*. III. 25-26 Also *Ārya* IV. 28; *MBh*. III. 18-20; *LBh*. III. 7-10: *ŚiDVṛ*. I. iii. 24-25; *SiŚe*. IV. 32,34; *SiŚi*. I. iii. 53-54.

17. Rule for finding out the Sun's altitude : RSin $\alpha =$

$$\frac{M \times \text{day radius}}{R} \times \frac{\text{gnomon}}{\text{hypotenuse of equinoctial midday shadow}}$$

where M=R Sin (given *ghaṭīs*∓asc. diff.) Rsin (asc. diff.), the upper or lower sign being taken according as the Sun is the northern or southern hemisphere, α is the Sun's altitude. *BrSpSi*. III. 27 (i).

Also *MBh.* III 24; *ŚiDVṛ.* I. iii. 27; *SiŚe* IV. 37

18. Rule for finding the Sun's altitude when the Sun's ascensional difference is greater than the given time: *BrSpSi.* III. 33:

Also *MBh.* III 25, *LBh.* III. 11; *ŚiDVṛ.* I. iii. 29 *SiŚe.* IV. 41.

19. Rule for finding the Sun's altitude in the night: *BrSpSi.* III. 63.

Also *MBh.* III. 26; *LBh.* III. 11; *SiŚe.* IV. 89.

The Sun's altitude for the night has been called *Pātāla Śaṅku* by Brahmagupta (*BrSpSi.* XV.9)

20. Rule for finding the longitude of the rising point of the ecliptic with the help of (i) the instantaneous sāyana longitude of the Sun and (ii) the civil time measured since sunrise, or with the help of (i) the Sun's sāyana longitude at sunrise and (ii) the sidereal time elapsed since sunrise: *BrSpSi* III. 18-20.

Also *MBh.* III. 30-32: *LBh.* III. 17-19; *SūSi.* III. 46-48; *ŚiDVṛ.* I. iii. 11-12: *SiŚe* IV. 18-19 (i): *SiŚi* I. iii. 2-4.

21. Rule for obtaining the civil time measured since sunrise with the help of (i) the Sun's instantaneous sāyana longitude and (ii) the sāyana longitude of the rising point of the ecliptic, or the sidereal time elapsed since sunrise with the help of (i) the Sun's sāyana longitude at sunrise and (ii) the sāyana longitude of the rising point of the ecliptic: *BrSpSi* III. 21-23.

Also *SūSi.* III.50-51; *MBh.* III. 34-36; *LBh.* III. 20; *ŚiDVṛ.* I. iii. 13; *SiŚe* IV. 19 (ii)—22 (i); *SiŚi* I. iii. 5-7. (i).

22. Rule for determining the R Sines of the Sun's prime vertical altitude: *BrSpSi* III. 52.

Also *Ārya.* IV; *MBh.* III.37-38; *LBh.* III. 52.

(An error created by Āryabhaṭa has been criticised by Brahmagupta.)

23. Construction of the locus of the end of the shadow of a gnomon: *BrSpSi.* III. 2-3.

Also *MBh.* III 52; *ŚiDVṛ.* I. iii. 3; *SiŚe,* IV. 5;

24. Rule for finding the Sun's mean anomaly: *BrSpSi,* II. 12 (i).

Also *MBh.* IV. 1; *SūSi.* II. 29 ; *ŚiDVr* I. ii. 10; *SiŚe.* iii. 12; *SiŚi.* I. ii. 18-19 (i).

25. Rule for finding the RSine (Reversed sine) of an arc (<90°) : *BrSpSi* II. 10.

Also *SūSi.* II. 31-32 ; *MBh.* IV. 3-14; *LBh.* II, 2 (11)-3 (i); *ŚiDVr.* I. ii. 12 ; *SiŚe.* III. 15; *SiŚi.* I, ii. 10 (ii)-11.

(We shall discuss it separately in the light of Brahmagupta formula.)

26. Rule for finding the Sun's equation of the centre: *BrSpSi..* II. 15 (ii);

Also *MBh.* IV. 4 (ii); . III *SiŚe.* 27

27. Rule for determining the Sun's true longitude: *BrSpSi.* XIV. 17-18.

Also *MBh,* IV. 21-23; *SiŚe.* III. 52.

28. Rule for finding the Sun's *bhujāntara* correction under the eccentric theory : *BrSpSi.* XIV. 19.

Also *MBh*.-IV. 24.

29. Rule for determining the *cara-saṁskāra* or *cara* correction : *KK.* I. 22.

30. Rule for finding the semi-durations of the day and night : *BrSpSi.* II. 60 ; *KK.* I. 23.

Also *SuSi.* II. 62-63 ; *ŚiDVr,* I. ii. 20-21 ; *SiŚe.* III. 70 ; *SiŚi.* I. ii. 52.

31. Rule for calculating the *tithi* : *BrSpSi,* II. 62 ; *KK.* I. 25.

Also *SūSi.* II. 66 ; *ŚiDVr* I. ii. 22 ; *SiŚe.* III. 71 ; *SiŚi.* I. ii. 66.

32. Rule for calculating the *Karaṇa* : *KK.* I. 27.

Also. *ŚiḌVr.* I. ii. 24 ; *SiŚe.* III. 77 ; *SiŚi.* I. ii. 66.

33. Rule for calculating *nakṣatra* : *BrSpSi.* II. 62 ; *KK.* I. 24.

Also *SūSi.* II. 64 ; *ŚiDVr.* I. ii. 23 (i) ; *SiŚe.* III. 75; *SiŚi.* I. ii. 67.

34. Rule pertaining to direct and retrograde motions of a planet : *BrSpSi.* II. 50-51.

Also *MBh.* IV. 56-57 ; *SiŚe.* III. 59 ; *ŚiDVṛ.* I. ii. 42 ;

35. A rule for converting true distances known in minutes into true distances into yojanas : for example : Sun's true distance in yojanas

$$= \frac{\text{Sun's mean distance in } yojanas \times \text{Sun's true dist. in minutes}}{\text{Radius}}$$

BrSpSi. XXI. 31 (ii).

Also *MBh.* V. 3 ; *ŚiDVṛ.* I. iv. 5 (i) ; *LBh.* IV. 3 ; *SiŚe.* V. 4 (ii) ; *SiŚi* I.v. 5 (i) ;

36. Rule for finding angular diameters of the Sun and the Moon : *BrSpSi.* XXI. 34 (ii) ;

Also *MBh.* V. 5 : *ŚiDVṛ.* I. iv. 8 ; *SiŚe.* V. 6 ; *SiŚi.* I. v. 7,

37. Formulae for the true (i. e. angular) diameters of the Sun, the Moon and the shadow in terms of the true daily motions of the Sun and the Moon (Here by shadow is meant the section of the cone of the Earth's shadow at the Moon's distance.) : *BrSpSi.* IV. 6 (i) : *KK.* IV. 2 (i).

Also *MBh.* V. 6–7 ; *ŚiDVṛ.* I. iv. 9 ; *MSi.* V. 5 (ii) ;
SiŚe V. 9 ; *SiŚi.* I. v. 8-9 ;

38. Rule for finding the *spaṣṭa-valana* (resultant *valana*) for the circle drawn with half the sum of the diameters of the eclipsed and eclipsing bodies as radius : *BrSpS..* IV. 18 (i).

Also *MBh.* V. 46 ; *ŚiDVṛ.* I. iv. 26.

39. Method for calculating the phase of the eclipse for the given time : *BrSpSi.* IV. 11-12.

Also *MBh.* V. 62-63 ; *ŚiDVṛ.* I. iv. 19-20 ; *SiŚe.* V. 14.

40. Rule for the determination of the diameter of the shadow i.e., the diameter of the Section of the Earth's shadow where the Moon crosses it : *BrSpSi.* XXIII. 8-9.

Also *MBh.* V. 71-73 ; *Āryc.* IV. 39-40 ; *ŚiDVṛ.* I. iv. 6 (ii)-7.

41. Process of successive approximations in connection with calculations of a lunar eclipse : *BrSpSi.* IV. 8-9.

Also *MBh.* V. 75-76 ; *LBh.* IV. 10-12 ; *ŚiDVṛ.* I. iv. 14-16 *SiŚe.* V. 12-13; *SiŚi.* I, v. 12-13.

42. Rule relating to the visibility-correction known as *akṣa-dṛkkarma* : *BrSpSi*. VI. 4.

Also *MBh*. VI. 1-2 ; *ŚiDVr*. I. vii. 3 (ii) ; *MSi*. VII. 4 ; *SiŚe*. IX. 7.

43. Rule relating to the visibility correction known as *ayanadṛkkarma* : *BrSpSi*. VI. 3 ; X. 17.

Slightly modified in *MBh*. VI. 2 (ii)-3 ; *ŚiDVṛ*. I. vii. 2-3 (i) · *SiŚe*. IX. 4-5 ; similar in *MSi*. VII. 2-3 ; more accurate in *SiŚi*. I. viii. 4-5.

44. Rule relating to the visibilily of moon : *BrSpSi*. VI. 6 ; X. 32.

Also *MBh*; VI. 4-5 (i) *PSi*. V. 3 : *ŚiDVṛ*. I. vii. 5 ; *SiŚe*. IX. 8 (i). 13.

45. Rule for calculating the phase of the Moon : *BrSpSi*. VII. 11 (ii)-12.

Also *MBh*. VI. 5 (ii)-7 ; *ŚiDVṛ*. I. ix. 12.

46. Rule for the determination of the Moon's true declination (i.e. the declination of the centre of the Moon's disc) : *BrSpSi*. VII. 5.

Also *MBh*. VI. 8 ; *ŚiDVṛ*. 1. viii. 2 ; *SiŚe*. X. 7. (these are approximate rules ; a more accurate rule occurs in *SiŚi*. I. vii. 3 and 13).

47. Graphical representation of the elevation of the lunar horns in the first quarter of the month at sunset : *BrSpSi*. VII. 7-10.

Also *MBh*. VI. 13-17 ; *ŚiDV*. I. ix ; *SiŚi*. I. ix.

48. Minimum distances of the planets from the Sun when they are visible : *BrSpSi*. vi 6 ; X. 32.

Also *MBh*. VI. 44 ; *ŚiDVṛ*. I. vii. 5 (i) ; *SiŚe*. IX. 8 (i). 12.

49. Rule relating to the determination of the time and the common longitude of two planets when they are in conjunction in longitude : *BrSpSi*. IX. 5-6.

Also *MBh*. VI. 49-51 ; *ŚiDVṛ*. I. x. 7-9 (i) ; *SiŚe*. XI. 12-12.

50. Rule relating to the distance between two planets

which are in conjunction in longitude : *BrSpSi*. IX. 11.

Also *MBh*. VI. 54 ; *ŚiDVṛ*. I. x. 11 ; *SiŚe*. XI. 10.

51. Rule For finding the *Bhujaphala* and *Koṭiphala* etc. without the use of the RSine-difference table : *BrSpSi*. XIV. 23-24.

Also *MBh*. VII, 17-19 ; *SiŚe*. III. 17.

52. To obtain the Sun's mean true longitude derived from the midday shadow of the gnomon : *BrSpSi*. XIV. 28; III. 61-62.

Also *MBh*. VIII. 5; *SiŚi* I. ii. 45.

53. Rule to find the arc corresponding to a given RSine : *BrSpSi* II. 11.

Also *MBh*. VIII. 6; *SūSi*. II. 33, *ŚiDVṛ*. I. ii. 13, *SiŚe*. III. 16, *SiŚi*. I. ii. 11 (ii)—12 (i).

For the concordance given here we express our indebtedness to the work of K.S. Shukla on the *Mahābhāskarīya*.

Tables of Constants

Some of the Tables of Constants have been given in an earlier chapter. We here give a few more tables which would indicate how far Brahmagupta introduced new concepts in evaluating these constants of greater accuracy and refinement.

TABLE I

Position of Planets for the Beginning of *kaliyuga*

In this Table are given the positions of the planets, including the Moon's apogee and ascending node, for the beginning of *Kaliyuga*. The calculations of Brahmagupta are different from those of the *Sūryasiddhānta* and of Āryabhaṭa I,

Planet	Positions *BrSpSi*.	according *Ārya*.	to *SūSi*
1	2	3	4
	s ° ′ ″	s ° ′ ″	s ° ′ °
Sun	0 0 0 0	0 0 0 0	0 0 0 0
Moon	0 0 0 0	0 0 0 0	0 0 0 0

1	2	3	4
	s ° ′ ″	s ° ′ ″	s ° ′ ″
Moon's apogee	4 5 29 46	3 0 0 0	3 0 0 0
Moon's asc. node	5 3 12 58	6 0 0 0	6 0 0 0
Mars	11 29 3 50	0 0 0 0	6 0 0 0
Mercury	11 27 24 29	0 0 0 0	0 0 0 0
Jupiter	11 29 27 36	0 0 0 0	0 0 0 0
Venus	11 28 42 14	0 0 0 0	0 0 0 0
Saturn	11 28 46 34	0 0 0 0	0 0 0 0

TABLE II

Diameters of the Sun, the Moon and the Earth in *yojanas* and the distances of the Sun and the Moon from the Earth

	BrSpSi	Bhāskara I	Śrīpati	Bhāskara II	Modern (in miles)
1	2	3	4	5	6
Sun's diameter in *yojanas*	6,522	4,410	6,522	6,522	86,400
Sun's distance in *yojanas* (midnight reck.)	689,358	459,585	684.870	689,377	92,900,000
Ratio		0·009596	0,009,523	009,461	00,093
Moon's diameter in *yojanas*	480	315	480	400	2,160
Moon's distance in *yojanas* (midnight reck.)	51,566	34,377	51,566	51,566	2,389,000
Ratio Earth's diameter in *yojanas*	1,581	0,009,163	0,009,308	009,308	0,009

TABLE III

Sidereal Revolutions of the Apogees of the Planets in a Kalpa

Apogee of	*BrSpSi.*	According to *Sūrya-Siddhānta*	*Āryabhaṭīya*
1	2	3	4
Sun	480	387	not given
Mars	292	204	
Mercury	332	368	
Jupiter	855	900	
Venus	653	535	
Saturn	41	39	

TABLE IV

Sidereal Revolutions of the Nodes of the Planets in a Kalpa

(Not given in the *Āryabhaṭīya*)		*Sūrya-Siddhānta*
Node of	*BrSpSi.*	
1	2	3
Mars	267	214
Mercury	521	488
Jupiter	63	174
Venus	893	903
Saturn	584	662

TABLE V

Peripheries of the Epicycles of the Planets

Planet	*BrSpSi.*		*Sūrya-Siddhānta*		*Āryabhaṭīya*	
	odd quad.	even quad.	odd quad.	even quad.	odd quad.	even quad.
1	2		3		4	

(a) *Manda* epicycles

Planet	BrSpSi. odd quad.	BrSpSi. even quad.	Sūrya-Siddhānta odd quad.	Sūrya-Siddhānta even quad.	Āryabhaṭīya odd quad.	Āryabhaṭīya even quad.
Sun	13°40′		13°40′	14°	13°30′	
Moon	31°36′		31°40′	32°	31°30′	
Mars	70°		72°	75°	63°	81°
Mercury	38°		28°	30°	31°30′	22°30′
Jupiter	33°		32°	33°	31°30′	36°
Venus	9°	11°	11°	12°	18°	9°
Saturn	30°		48°	49°	40°30′	58°30′

(b) *Śīghra* epicycles

1	2		3		4	
Mars	243°40′[1]		232°	235°	238°30′	229°30′
Mercury	132°		132°	133°	139°30′	130°30′
Jupiter	68°		72°	70°	72°	67°30′
Venus	263°	258°	260°	262°	265°30′	256°30′
Saturn	35°		40°	39°	40°30′	36°

1. In the middle of quadrants. it is 237°

TABLE VI

Mean Diameters of the Planets

Planet	*BrSpSi.*	*Sūrya-Siddhānta*	*Āryabhaṭīya*	Modern
1	2	3	4	5
Sun	32′31″	32′24″	33′ approx.	32′2·36″
Moon	32′ 1″ approx.	32′	31′30″	31′8″
Mars	4′46″	2′	1′17″	9′36″
Mercury	6′14″	3′	2′8″	6′68″
Jupiter	7′22″	3′30″	3′12″	3′14.72″
Venus	9′	4′	6′24″	16.8″
Saturn	5′24″	2′30″	1′36″	2′49.5″

TABLE VII

Inclination of the Orbits of the Planets to the Ecliptic

Planet	*BrSpSi.*	*Sūrya-Siddhānta*	*Āryabhaṭīya*	Modern (Jan.00,195°)
1	2	3	4	5
Moon	4°30′	4°30′	4°30′	5°8′40″
Mars	1°50′	1°30′	1°30′	1°51′0″
Mercury	2°32′	2°	2°	7°0′14″
Jupiter	1°16′	1°	1°	1°18′21″
Venus	2°16′	2°	2°	2°23′39″
Saturn	2°10′	2°	2°	2°29′25″

TABLE VIII

Longitudes of the Junction Stars according to Different Authorities

Junction-star of	Longitude (polar) according to		Longitude according to		
	BrSpSi.KK. SiŚi.	*SiŚe.SūSi*	*MBh.*	*LBh.*	*SiDVṛ.*
1	2	3	4	5	6
Aśvinī	8°	8°	8°	8°	8°
Bharaṇī	20°	20°	27°	26°30°	20°
Kṛttikā	37°28′	37°30′	36°	36°	36°
Rohiṇī	49°28′	49°30′	49°	50°	49°
Mṛgaśirā	63°	63°	62°	62°	62°
Ārdrā	67°	67°20′	70°	70°	70°
Punarvasū	93°	93°	92°	92°	92°
Puṣya	106°	106°	105°	105°	105°
Āśleṣā	108°	109°	114°	114°	114°
Maghā	129°	129°	128°30′	128°30′	128°
P-Phālgunī	147°	144°	141°	141°	139°20′
U-Phālgunī	155°	155°	154°	154°	154°
Hasta	170°	170°	173°	173°	173°
Citrā	183°	180°	185°	185°	184°20′
Svāti	199°	199°	197°	197°	197°
Viśākhā	212°5′	213°	212°	212°	212°
Anurādhā	224°5′	224°	222°	222°	222°
Jyeṣṭhā	229°5′	229°	228°	228°	228°
Mūla	241°	241°	241°	241°30′	241°
P-Āṣāḍhā	254°	254°	254°	254°30′	254°

1	2	3	4	5	6
U-Āṣāḍhā	260°	260°	267°	266°30′	267°20′
Śravaṇa	278°	280°	285°	284°30′	284°10′
Dhaniṣṭhā	290°	290°	296°	295°30′	296°20′
Śatabhiṣak	320°	320°	307°	307°	313°20′
P-Bhādra.	326°	326°	328°	328°	327°
U-Bhādra	337°	337°	345°	345°	335°20′
Revatī	0°	359°50′	360°	360°	359°

TABLE IX

Celestial Latitudes of the Junction-Stars

Junction star of	Polar latitude given in			Latitude given in		
	BrSpŚi.KK. SiŚe.	*SūSi.*	*SiŚi*	*MBh.*	*LBh.*	*ŚiDVr.*
1	2	3	4	5	6	7
Aśvinī	10°*N*	10°*N*	10°*N*	10°*N*	10°*N*	10°*N*
Bharaṇī	12°*N*	12°*N*	12°*N*	12°*N*	12°*N*	12°*N*
Kṛttikā	4°31′*N*	5°*N*	4°30′*N*	5°*N*	5°*N*	5°*N*
Rohiṇī	4°33′*S*	5°*S*	4°30′*S*	5°*S*	5°*S*	5°*S*
Mṛgaśirī	10°*S*	10°*S*	10°*S*	10°*S*	10°*S*	10°*S*
Ārdrā	9°*S*	9°*S*	9°*S*	9°*S*	9°*S*	9°*S*
Punarvasū	6°*N*	6°*N*	6°*N*	6°*N*	6°*N*	6°*N*
Puṣya	0	0	0	0	0	0
Āśleṣā	7°*S*	7°*S*	7°*S*	7°*S*	7°*S*	7°*S*
Maghā	0	0	0	0	0	0
P-Phālgunī	12°*N*	12°*N*	12°*N*	12°*N*	12°*N*	12°*N*
U-Phālguni	13°*N*	13°*N*	13°*N*	13°*N*	13°*N*	13°*N*

1	2	3
Hasta	11°*S*	11°*S*
Citrā	1°45′*S*	2°*S*
Svāti	37°*N*	37°*N*
Viśākhā	1°23′*S*	1°30′*S*
Anurādhā	1°44′*S*	3°*S*
Jyeṣṭhā	3°30′*S*	4°*S*
Mūla	8°30′*S*	9°*S*
P-Āṣāḍhā	5°20′*S*	5°30′*S*
U-Āṣāḍhā	5°*S*	5°*S*
Śravaṇa	30°*N*	30°*N*
Dhaniṣṭhā	36°*N*	36°*N*
Śatabhiṣak	18′*S*	30′*S*
P-Bhādra	24°*N*	24°*N*
U-Bhādra	26°*N*	26°*N*
Revatī	0	0

backing to the west) in one day. It is sufficient to postulate the existence of only one Sun, one Moon and twenty-seven nakṣatras to explain the astronomical phenomena.[1]

3. Brahmagupta differs from Āryabhaṭa I in the length of the four *yugas.* Ārvabhaṭa regards all the four *yugas* of equal lengths, i. e. 1,080,000 years; the *caturyuga* being of 4,320,000 years. Brahmagupta regards *Kaliyuga* to be of 432,000 years, *Dvāpara* to be twice of it, *Tretā* to be thrice of it and *Kṛtayuga* of four times of the length of the *Kaliyuga.* Both have the *caturyuga* of the same length.[2]

4. Āryabhaṭa was not clear with respect to the number of civil days (*sāvana dina*) in a *yuga* ; in one of his treatises he gives this number to be 1,577,917,800 and in the other 1,577,917, 500 with a difference of 300 days. though in both the treatises, Āryabhaṭa I regards the number of solar years to be 4,320,000 in a *Caturyuga* or *Mahāyuga.* Why is this difference ? asks Brahmagupta.[3]

5. Āryabhaṭa regards *mandocca* (the apogee) and *pāta* (the ascending node of the orbit on the ecliptic) as constant or stationary; then how could he propound a *sphuṭa-yuga* or the concept of true *yuga* with the concurrence of year, month and day on the Caitra Śukla Pratipadā (the first day of bright half of the month Caitra) at the same time as indicated by Āryabhaṭa in his *Laghvāryabhaṭiya Tantra.*[4]

Āryabhaṭa was not clear in respect to the variance in the pāta. In the Āryāṣṭa-śata (in the Aryabhaṭiva which has 108 Āryā verses), Āryabhaṭa states that the *pāta* of all the planets

1. मानिचतुष्पञ्चाशद्द्वौ द्वावर्कैन्दवौ जिनोक्तं यत् ।
भ्रमतस्त्यस्यावर्त्तौ भवति यतोऽन्धा ततस्तदसत् ॥ *BrSpSi.* XI. 3

2. आर्यभटो युगपादांस्त्रीन् यातानाह कलियुगादौ यत् ।
तस्य कृतान्तर्यस्मात् स्वयुगाद्यन्तौ न तत् तस्मात् ॥ —*BrSpSi.* XI. 4

3. युगरविभगणाः ख्युघृति यत्प्रोक्तं तत् तयोर्युगं स्पष्टम् ।
त्रिशती रव्युदयानां तदन्तरं हेतुना केन ॥ —*BrSpSi.* XI. 5

4. युगवर्षादीन् वदताचैत्रसितादेः समं प्रवृत्तान् यत् ।
तदसत् यत: स्फुटयुगं तत् स्थैर्यान्मन्दपातानाम् ॥ —*BrSpSi.* XI. 6

show variance of movement, but in the Daśagītikā (a chapter of ten Āryā verses), he states that with the exception of the *pāta* of the *Moon*, the *pāta's* of all other planets are stationary or constant. Brahmagupta points out this anomaly in the concept of Āryabhaṭa.[1]

6. Brahmagupta points out a self-contradiction in Āryabhaṭa. At one place he says that the Moon covers the Sun during the solar eclipse and similarly the shadow of the Earth covers the Moon during the lunar eclipse (and he does not mention Rāhu) in this connection (*Āryabhaṭiya*, Gola. 37). At the same time it is said that Āryabhaṭa was familar with the movement of "*eight*" planets, and thus postulating the presence of Rāhu; in fact, the *pātas* of planets are responsible for their eclipse, and the eighth planet Rāhu is not present.[2]

7. Āryabhaṭa gives measures to Manus. Yugas and Kalpas different from what have been given in the recognised *Smṛtis*.[3]

8. Āryabhaṭa regards *Guruvāra* or Thursday to be the first day of the *Kalpa*, and not Sunday, which is wrong according to Brahmagupta.[4]

9. Brahmagupta unnecessarily criticises Āryabhaṭa in respect to the order of days. The motion of the planets decreases in the following order : Moon, *Budha* (Mercury), *Śukra* (Venus), Sun, *Kuja* (Mars), *Guru* (Jupiter) and *Śani* (Saturn). Āryabhaṭa in one of his verses states that starting from the Sun and proceeding in the increasing order every fourth is the *dinapati* or the "lord of the day" (*Āryabhaṭiya*, Kāla. 16) ; this gives the order : Sun, Moon. Mars, Mercury, Venus and Saturn and hence the order of days as *Ravivāra* (Sunday); *Candravāra* (Monday,)

1. आर्य्याष्टशते पाता भ्रमन्ति दशगीतिके स्थिराः पाताः ।
मुक्त्वेन्दु पातमपमण्डले भ्रमन्ति स्थिरा नातः ॥ —*BrSpSi*. XI. 8

2. आर्यभटो जानाति ग्रहाष्टगतिं यदुक्तवांस्तदसत् ।
राहुकृतं न ग्रहणं तत्पातो नाष्टमो राहुः ॥ —*BrSpSi*. XI. 9

3. समामनुयुगकल्पाः कल्पादिगतं कृतादियातं च ।
स्मृत्युक्तैरार्यभटो नातो जानाति मध्यगतिम् ॥ —*BrSpSi*. XI. 10

4. ओङ्कारो दिनवारो गुरुरौदयिकोऽस्य भवति कल्पादौ ।
न भवत्यर्को यस्मादोङ्कारो विस्तरस्तस्मात् ॥ —*BrSpSi*. XI. 11

Maṅgalavāra (Tuesday), (*Budhavāra*) (Wednesday), *Guruvāra* (Thursday) Sukravāra (Friday) and Śanivāra (Saturday). Thus Āryabhaṭa gives the same order of days as other authorities and there is no reason why he should be criticised.

Certainly what is Sunday for Laṅkā, may not be Sunday at the same time for Siddhapura; and Āryabhaṭa should have emphasised that the day (Monday, Tuesday etc.) is not constant for all the places.[1]

10. Brahmagupta expresses surprise why Āryabhaṭa, in two of his treatises propounds two different systems of reckoning one from the Sunrise in Laṅkā and the other from the Midnight in Laṅkā.[2] This causes a difference of one-fourth of the daily-motion in the two reckonings of the motion of planets.[3]

11. Brahmagupta criticises Āryabhaṭa on the point of diameter of the Earth. In the *Gītikāpāda*, 5 and 6, Āryabhaṭa states that one yojana=8,000 × puruṣa, and 1 puruṣa=4 hasta, thus 1 yojana=32,000 puruṣas, and the diameter of the Earth is 1050 yojanas. Brahmagupta further says that an error in the diameter of the Earth would cause an error in deśāntara or longitude and thus also in the true *tithi* and consequently in the calculation of eclipses also.[4]

12. Āryabhaṭa has rightly stated that the Earth is in motion and the *Bhagaṇas* are stationary. Brahmagupta's objection is that if the Earth is in motion, birds would not be able to return to their nests, and if the Earth's motion is upside-down,

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1. सूर्य्योदयश्चतुर्थो दिनवारा यदुवाच तदसदार्यभटः ।
लङ्कोदयो यतोऽर्कं स्यास्तमयं प्राह सिद्धपुरे ॥ —*BrSpSi*. XI. 12

2. अधिकैः शतैश्चतुर्भिर्वर्षसहस्रैश्चतुर्दशभिरेकः ।
युगपादैर्दिनवारान्तर मौदयिकार्धं रात्रिकयोः ॥ —*BrSpSi*. XI. 13.

3. औदयिकाद्दिनमुक्तेस्तुर्यांशो नार्धं रात्रिको भवत्यूनः ।
कतरं स्फुटं न निश्चितमनयोः स्फुटमेकमपि नातः ॥ —*BrSpSi*. XI. 14

4. षोडशगाक्योजनरिधिं प्रतिभूव्यासं पुलावदता ।
आत्मज्ञानं रव्याप्तिमनिश्चयस्तनि कृतकन्यात् ॥
भूव्यासस्याज्ञानाद् व्यर्थं देशान्तरं तदज्ञानात् ।
स्फुटतिथ्यज्ञानं तिथिनाशाद् ग्रहणयोर्नाशः ॥ —*BrSpSi*. XI. 15-16

then the roof and hills would come down, which is contrary to our observation.[1] Obviously Brahmagupta is not justified in his criticism.

13. Brahmagupta points out to the differences in his calculations and the calculations of Āryabhaṭa in the peripheries of the *manda* and *śīghra* epicycles of planets in the odd and even quadrants. (This difference we have shown in Table V, p. 313)[2]

14. Āryabhaṭa I and Bhāskara I have both given a rule for the determination of the *dṛkkṣepajyās* of the Sun and the Moon :

> Take the product of the Sun's or Moon's own *madhyajyā* and *udayajyā*, then divide the product by the radius and then take the square of the quotient. Subtract that from the square of the own *madhyajyā* ; the square-root of that difference is known as the Sun's or Moon's *dṛkkṣepajyā*.[3]

The Sun's *dṛkkṣepajyā* is the Rsine of the zenith distance of that point of the ecliptic which is at the shortest distance from the zenith (this point is called nonagesimal or the central ecliptic point). The Moon's dṛkkṣepajyā is the Rsine of the zenith distance of that point of the Moon's orbit which is at the shortest distance from the zenith. The rule given above is only approximate and has been criticised by Brahmagupta.[4]

15. In the *Āryabhaṭīya*, there is a rule in the Golapāda for finding the Rsine of the *agra* of the true Sun; and also for the

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1. प्राणेनैति कलां भूर्यदि तर्हि कुतो व्रजेत् कमध्वानम् ।
आवर्त्तनमुर्व्याश्चेन्न पतन्ति समुच्छ्रयाः कस्मात् ॥ —*BrSpSi*. XI. 17

2. औदयिको यः परिधिर्विषमेऽन्योमेऽन्यः समे भुजस्य गुणः ।
तदसद्विषमान्तफलं यतो न युग्मादि फलतुल्यम् ॥
विषमेऽन्योऽन्यो युग्मे परिधिगुणकः क्रमोत्क्रमज्यानाम् ।
चक्रार्धे फलनाशो न भवति यस्मादसत् तदपि । —*BrSpSi*. *XI*. 18-19

3. स्वमध्यज्योदयाभ्यासं विष्कम्भार्धाप्तवर्गितम् ॥
मध्यज्यावर्गतोऽपास्य स्वदृक्क्षेपं पदं विदुः ॥ —*Mbh*. *V*. 19

4. वित्रिभलग्ने दृक्क्षेपमण्डलं तदपमण्डलयुतौ ज्या ।
मध्यादृक्क्षेपज्या नार्यभटोक्ताऽनया तुल्या ॥
दृक्क्षेपज्याऽतोऽसत् तन्नाशादवनतेर्नाशः ।
अवनतिनाशात् ग्रासस्योनाधिकता रविग्रहणे ॥ —*BrSpSi*. XI. 29-30

Rsine of the Sun's prime vertical altitude.[1] Bhāskara also gives the rule in his *Mahābhāskarīya* :

> Multiply the Rsine of the (Sun's) greatest declination by the Rsine of the Sun's true (*sāyana*) longitude; then divide (the product) by the Rsine of the colatitude, the result is (the Rsine of) the *agra* of the true Sun. When that (*agra*) is less than the latitude and when the Sun is also in the northern hemisphere, multiply (the Rsine of the Sun's *agra*) by (the Rsine of) the colatitude; the result is the Rsine of the Sun's prime vertical altitude.[2]

The condition laid down in the rule that the "Sun's *agra* should be less than the latitude" is incorrect. The error was originally comitted by Āryabhaṭa and Bhāskara followed it. This error was noticed by Brahmagupta[3]. Bhāskara I, however, corrected the error in the *Laghu-Bhāskarīya*. There he gives the correct conditions. It is not the *agra* that should be less than the latitude, it is the Sun's declination (or rather the Rsine of the Sun's northern declination as we have in the *Laghu-Bhāskarīya*), which should be less than the latitude (or rather the Rsine of the latitude). This condition is necessary for the existence of the prime vertical shadow of the gnomon.

It may be pointed out that the commentators of Āryabhaṭa I have interpreted the rule given by Āryabhaṭa I as conveying the correct meaning; they say that Āryabhaṭa also meant declination when he used the term *agra*.

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1. परमापक्रमजीवामिष्टज्यार्धाहतां ततो विभजेत् ।
ज्यालम्बकेन लब्धार्काग्रा पूर्वापरे क्षितिजे ॥
सा विषुवज्ज्योना चेद् विषुवदुदग्लम्बकेन संगुणिता ।
विषुवज्ज्यया विभक्ता लब्धः पूर्वापरे शंकुः ॥ — *Ārya*. V. 30-31

2. स्फुटरविभुजनिघ्नां यां परां क्रांतिजीवां ।
हरतु समवलम्बज्या कलापेन भूयः ॥
स्फुट दिवस कराग्रा सा यदाऽक्षांशहीना ।
रविरपि यदिगोले चोत्तरे लम्बकघ्नाम् ॥
अक्षज्यया हरेद् भूयः शंकुः स्यात् सममण्डले ।
तद् वर्गं व्यास कृत्योर्यद् विश्लेषं तत्पदं प्रभा ॥ —*MBh*. III. 37-38

3. उत्तरगोलेऽग्रायां विषुवज्ज्यातो यदुक्तमूनायाम् ।
सममण्डलमस्तदसत् क्रान्तिज्यायां यतो भवति ॥ —*BrSpSi*. XI. 22

Usually by *agra*, we mean the arc of the celestial horizon lying between the east point and the point where a heavenly body rises; or between the west point and the point where a heavenly body sets. Declination is *krānti*.

16. Brahmagupta has criticised Āryabhaṭa and his group for their expressions for determining *lambana* (i. e. the difference of the parallaxes, in longitude, of the Sun and the Moon), and the rule for determining the *avanati* or *nati* (i.e. the difference in parallaxes, in latitude of the Sun and Moon).[1]

Lambana is obtained with the help of the five Rsines : (i) *madhya-jyā*, (ii) *udaya-jyā*, (iii) *dṛk-kṣepa-jyā*, (iv) *dṛg-jyā*, and (v) *dṛg-gati-jyā*.

(i) The *madhyajyā* is the Rsine of the zenith distance of meridian ecliptic point :

madhyajyā=Rsin ($\phi \pm$ declination of the meridian ecliptic point).[2]

In this expression ϕ is the latitude of the place, and by R sin is meant R $\times$ sine, R being the radius of the celestial sphere.

(ii) The *udayajyā* is the Rsine of the arc of the horizon intervening between the equator and the ecliptic, and is given by :

$$udayajy\bar{a} = \frac{R \sin L \times R \sin \varepsilon}{R \cos \phi}$$

where L is the longitude of the horizon ecliptic point in the east and ε the obliquity of the ecliptic.

(iii) The *dṛkksepajyā* is the R sine of the zenith distance of the central ecliptic point[3], and is given by :

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1. व्यासार्धेन विभक्ता दृग्नति जीवा चतुर्गुणा लब्धम् ।
लम्बननाड्यः पञ्चदशगुणितया त्रिज्यया भक्ता ॥
दृक्क्षेपज्या भुक्त्यन्तराहता लब्धमवनतिर्भवति ।
स्फुटयोजनकर्णाभ्यां भूव्यासेन च विना स्पष्टे ॥
आर्यभटेनास्मिन् सति लघुनि किमर्थं महत् कृतं कर्म ।
गणिता ज्ञानाज्जाड्यं विजानता यदि ततः सुतराम् ॥ —*BrSpSi*. XI. 23-25

2. The meridian ecliptic point is the point of the ecliptic on the meridian.

3. The central ecliptic point is the central point of the portion of the ecliptic lying above the horizon.

$$\textit{dṛkkṣepajyā} = \left[(\textit{madhyajyā})^2 - \left\{ \frac{\textit{udayajyā} \times \textit{madhyajyā}}{R} \right\}^2 \right]^{\frac{1}{2}}$$

where R is the radius of the celestial sphere.

(iv) The *dṛgjyā* is the Rsine of the zenith distance (of the Sun) and is given by :

$$\textit{dṛgjyā} = \left[R^2 - \left\{ \frac{\textit{dṛggatijyā} \times R \sin (L-\theta)}{R} \right\} \right]^{\frac{1}{2}}$$

where L is the longitude of the horizon ecliptic in the east and θ the longitude of the Sun.

(v) The *dṛggatijyā* is the Rsine of the altitude of the central ecliptic point, and is given by :

$$\textit{dṛggatijyā} = [R^2 - (\textit{dṛkkṣepajyā})^2]^{1/2}$$

where R is the radius of the celestial sphere.

In the *Mahābhāskarīya*[1], the expression for the Sun's *dṛggatijyā* is :

$$(\text{Sun's } \textit{dṛggatijyā})^2$$
$$= (\text{Sun's } \textit{dṛgjyā})^2 - (\text{Sun's } \textit{dṛkkṣepajyā})^2$$

and similar is the expression for the the Moon's *dṛggatjyā*.

Now *lambana*, which is the difference of the parallaxes, in longitude, of the Sun and the Moon, is given by the expression :

Lambana=Moon's *lambana*—Sun's *lambana*.

Sun's *lambana*

$$= \frac{\text{Sun's } \textit{dṛggatijyā} \times \text{Earth's semidiameter}}{\text{Sun's true distance in yojanas}}$$

Moon's *lambana*

$$= \frac{\text{Moon's } \textit{dṛggatijyā} \times \text{Earth's semi-diameter}}{\text{Moon's true distance in yojanas}}$$

These *lambanas* are in terms of minutes of arc etc[2].

1. स्वदृग्दृक्क्षेप गुणयोर्वर्गं विश्लेषजे पदे ।
दृग्गतिज्ये भवेतां ते भास्करामृत तेजसः ॥ —*MBh. V*, 23

2. स्वदृग्गतिघ्ना व्यास भेद संवर्ग संभवम् ।
स्फुटयोजन कर्णाप्तं लिप्ताद्यं लम्बनं विदुः ॥

(Cont. on Page 225)

Thus *lambana* is given by subtracting the Sun's *lambana* from Moon's *lambana.*

This *lambana* is also expressed in the following way.

Lambana

$$= \left[\frac{\{(dṛgjyā)^2-(dṛkkṣepajyā)^2\}^{1/2} \times 18}{\text{Moon's true distance}} - \frac{\{(dṛgjyā)^2-(dṛkkṣepajyā)^2\}^{1/2} \times 18}{\text{Sun's true distance}} \right]$$

in minutes.

$= \frac{60}{d} \times$ (*lambana* calculated in minutes) is the *lambana* in *ghaṭīs*, where *d* denotes the difference between the daily motions of the Sun and the Moon.

Āryabhaṭa I has given his description of the determination of *lambana* and *avanati* in the Golapāda 33, 34 of the *Āryabhaṭīya*[1], and Bhāskara has followed his rules in the *Mahābhāskarīya*[2]. Brahmagupta criticises them in his *Brāhmasphuṭasiddhānta*[3].

(vii) We shall now take up *nati* or *avanati* (both the terms mean the same). *Nati* is the difference of the parallaxes in *latitude*, of the Sun and the Moon and is given by :

$$nati = \left[\frac{dṛkkṣepajyā \times 18}{\text{Moon's true dist.}} - \frac{dṛkkṣepajyā \times 18}{\text{Sun's true dist.}} \right]$$

minutes.

(Cont. from Page 324)

तद्विशेषो हतः षष्ट्या स्फुटभुक्त्यन्तरोद्धृतः ।
घटिकादिस्तिथेः प्राहणे शुद्धिः क्षेपोऽपरे मतः ॥
दिनार्धकालनिष्पन्नं लम्बनं शोध्यते तिथेः ।
उदगिन्दूदयज्यायां दीयते तत्र दक्षिणे ॥
एवं पुनः पुनः कर्म यावत्तदविशिष्यते ।
तिथिवच्चन्द्रतीक्ष्णांशू सञ्चार्यावेव पण्डितैः ॥ —*MBh.* V. 24-27

1. मध्यज्योदयजीवासंवर्गे व्यासदलहृते यत् स्यात् ।
तन्मध्यज्याकृत्योर्विश्लेषमूलं स्वदृक्क्षेपः ॥
दृग्दृक्क्षेप कृति विशेषितस्यमूलं स्वदृग्गतिः कुवशात् ।
क्षितिजे स्व दृक् छाया भूव्यासार्धं नभोमध्यात् ॥ —*Arya.* IV. 33-34

2. loc. cit. *MBh.* V. 24-27

3. loc. cit. *BrSpSi.* XI. 23-25

(viii) Moon's true latitude=Moon's latitude × *nati*.

The present Sūryasiddhānta and Brahmagupta both utilise the following expressions for *lambana* and *nati* which give more accurate values :

$$lambana = \frac{\text{Rsin}\,(M - \odot) \times dṛggatijyā}{\{\text{Rsin}\,(30^\circ)\}^2} \text{ ghaṭis}$$

where M and $\odot$ denote the longitudes of the meridian ecliptic and the Sun respectively.

$$nati = \frac{dṛkkṣepajyā \times d}{15 \times R}$$

where R is the radius of the celestial sphere and d denotes the difference between the daily motions of the Sun and the Moon[1].

Brahmagupta has raised objections to the Āryabhaṭa system regarding *lambana* (XI. 26-28), *dṛkkṣepa* (XI. 30-31) *ayanadṛk-karma* (XI. 35), elevation of Moon's horns (*śṛṅgonnati*) (XI. 39) and similar several other points. He is so vehemently opposed to Āryabhaṭa that finally he declares :

> "It is beyond my capacity to enumerate all the defects of Āryabhaṭa. Only a few have been given here as illustration. Intelligent people can easily find out others[2].

He also says :

> Āryabhaṭa is neither conversant with the Gaṇita (mathematics), nor Kāla (time calculations) nor Gola (celestial or spherical calculations). It is difficult to enumerate separately the fallacies committed by him in the respective chapters of the *Gaṇitapāda*, *Kālakriyāpāda* and *Golapāda*[3].

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1. loc. cit. *BrSpSi*. XI. 23.
2. आर्यभटदूषणानां संख्या वक्तुं न शक्यते यस्मात् ।
   तस्मादयमुद्देशो बुद्धिमताऽन्यानि योज्यानि ॥ —*BrSpSi*. XI. 44
3. जानात्येकमपि यतो नार्यभटो गणितकालगोलानाम् ।
   न मया प्रोक्तानि ततः पृथक् पृथग् दूषणान्येषाम् ॥ —*BrSpSi*. XI. 43.

Brahmagupta and Śrīṣeṇa

In Varāhamihira's *Pañcasiddhāntikā* we have a critical review of the five *Siddhāntas* or five systems of astronomical study : Puliśa Siddhānta, Romaka Siddhānta, Vasiṣṭha Siddhānta, Sūrya Siddhānta and Brāhma Siddhānta. Colebrooke in his Paper "*On the notion of the Hindu Astronomers concerning the precession of the equinoxes and motions of the planets*", published in the *Asiatic Researches*, vol. xii. p. 209-250, Calcutta. 1816,4 to, reproduced in the *Miscellaneous Essays*. Vol. II. 1872, says the following in regards to the authorship of these schools of astronomy :

> All these books are frequently cited in the astronomical compilations and are occasionally referred to their real or supposed authors. The first is everywhere assigned to Puliśa, whose name it bears. The *Romaka Siddhānta* is ascribed by the scholiast of Brahmagupta and by a commentator of the *Sūrya Siddhānta* to Śrīṣeṇa. The Vāsiṣṭha Siddhānta is by the same authority given to Viṣṇucandra. Both these authors are repeatedly mentioned with censure by Brahmagupta ; and it is acknowledged that they are entitled to no particular deference.
>
> The *Brāhmṇa Siddhānta*, which is the basis of Brahmagupta's work, is not anywhere attributed to a known author ; but referred to in all quotations of it which have fallen under observation, either to the *Viṣṇudharmottara Purāṇa*, of which it is considered as forming a part, or to Brahmā (also called Pitāmaha) who is introduced into it as the speaker in a dialogue with Bhṛgu, or it is acknowledged to be the work of some unknown person. The true author it may be now impracticable to discover, and would be vain to conjecture.
>
> The *Sūrya Siddhānta* (if the same which we now possess) is in the like manner ascribed to no certain author unless in the passage cited by my colleague Mr. Bently (*Asiatic Researches*, vol. vi. p. 572) who says that "in the commentary of the *Bhāsvatī*, it is declared, that

> Varāha was the author of the *Sūrya Siddhānata*", and who adds, that "Satānanda, the author of the *Bhāsvatī* was a pupil of Varāha under whose directions, he himself acknowledges, he wrote that work".
>
> This concluding remark alludes to the following verse of the *Bhāsvatī Karaṇa* : "Next I will propound succinctly., from Mihira's instruction, (the system) equal to the *Sūrya Siddhānta*[1], (*Miscellaneous Essays*, p. 388-90) (The word 'Mihira' has double meaning : it might be an abbreviation of *Varāhamihira*, or it *may* mean sun or *Sūrya*).

Thus on the authority of Colebrooke, Srīṣeṇa may by regarded as the initiator of the Romaka system. Brahmagupta himself mentions in one of his passages the name of Srīṣeṇa in connection with the Romaka system, and further the conceptions of the Romaka system came down as Vāsiṣṭha system through Viṣṇucandra,[2] Lāṭadeva also derived from Srīṣeṇa the concepts of the mean motions of the Sun, the Moon, the Moon's apogee and her node and the mean motions of Mars. Mercury's. *Śighra*, Jupiter, Venus' *śigrha* and Saturn. I have indicated elsewhere, which is also the view of Sankara Bālakṛṣṇa Dīkṣita, that the original Romaka and Pauliśa Siddhāntas were introduced to Indians by Lāṭadeva, and the latter Romaka Siddhānta by Srīṣeṇa (Original Romaka Siddhānta was prevalent before Śaka 427 and this is the one which is mentioned by Varāhamihira who makes no reference to Srīṣena and Viṣṇucandra in the *Pañcasidhāntikā*, and the latter Romaka Siddhānta was introduced by Śrīṣeṇa as is indicated by Brahmagupta. Thus we have two Vāsīṣṭha Siddhāntas and two Romaka Siddhāntas). My personal view is that Lāṭadeva, Śrīṣeṇa and possibly Viṣṇucandra also, were naturalised Greeks, settled in India and they had adopted themselve to Indian life. They were conversant in Greek and Indian Astronomy both and had contributed substantially to Indian astronomy. Brahmagupta was opposed to any of these f oreign influences dominating Indian

1. अथ प्रवक्ष्ये मिहिरोपदेशात् तत्सूर्यसिद्धान्त समं समासात् ॥

—*Bhāsvatī Karaṇa*

2. श्रीषेणेन गृहीत्वा रत्नोच्चयरोमकः कृतः कन्था ।
एतानेव गृहीत्वा वासिष्ठो विष्णुचन्द्रेण ॥ —*BrSpSi*. XI. 50

systems, and he very much resented such interferences in pure academic life of this country. He was opposed to Āryabhaṭa for a different reason. Āryabhaṭa was universally regarded as an authority in this country, and the conservativism was so deep that even where it could be shown by direct observation or on valid theoretical grounds, that a particular concept was erroneous or less accurate, people still chose to adhere to it, since they had the backing of Āryabhaṭa's authority. Brahmagupta was against this nonscientific attitude. Needless to say, Brahmagupta was not always fair to Āryabhaṭa in his criticism ; he overdid in enumerating the shortcomings of Āryabhaṭa's system, as if he was personally jealous of his wide popularity.

Brahmagupta's feelings against Lāṭadeva, Śrīṣeṇa, Viṣṇucandra and others would be seen from the following passage in the *Brāhmasphuṭasiddhānta* :

> From the fact that Śrīṣeṇa, Viṣṇucandra, Pradyumna Āryabhaṭa, Lāṭa, and Siṁha contradict one another regarding eclipses and siṁilar topics, their ignorance, is proved daily. The criticisms which I have passed on Āryabhaṭa are, with the requisite modifications, to be applied to the doctrines of each of these teachers as well. I will, however, make some further critical remarks on Śrīṣeṇa and others.
>
> Srīṣeṇa took from Lāṭa the rules concerning the mean motions of the Sun, and the Moon, the Moon's apogee and her node, and the mean motions of Mars, Mercury's Śīghra, Jupiter, Venus's Śīghra, and Saturn ; he took elapsed years and the revolutions of *yuga* (*yuga-yāta-varṣa-bhagaṇa*) from Vasiṣṭha and the *Pādakaraṇa* of Vijayānandi; further took from Āryabhaṭa the rules concerning the apogee, epicycles and nodes, and those referring to the true motions of the planets and thus the Romaka Siddhānta which was (or is) a heap of jewels (as it were) has, by Śrīṣeṇa, been made into a patched rag (as it were)[1].

1. श्रीषेणविष्णुचन्द्र प्रद्युम्नार्यभटलाटसिंहानाम् ।
ग्रहणादिविसंवादात् प्रतिदिवसं द्विगुणमज्ञत्वम् ॥

[*Cont. on Page 330*]

Brahmagupta very emphatically says about his system that so long as people would be finding concordance between the observed and theoretical results *(dṛggaṇitaikyam)* in respect of solar and lunar eclipses, his Brāhma Siddhānta would be held in esteem[1].

In other systems, whatever concordance appears to be between the observation and calculation, of eclipses etc., it is, Brahmagupta says, merely accidental or by chance, as the maxim of letters bored by an insect in wood or paper[2].

[*Cont. from Page 329*]

युक्तयाऽऽर्यभटोक्तानि प्रत्येकं दूषणानि योज्यानि ।
श्रीषेणप्रभृतीनां कानि चिदन्यानि वक्ष्यामि ॥

लाटात् सूर्यशशांकौ मध्याविन्दूच्च चन्द्रपातौ च ।
कुजबुधशीघ्रबृहस्पति सितशीघ्र शनैश्चरान् मध्यान् ।।

युगयातवर्षभगणान् वासिष्ठाद्विजयनन्दि कृतपादात् ।
मन्दोच्च परिधिपातस्पष्टीकरणाद्यमार्यभटात् ॥

श्रीषेणेन गृहीत्वा रत्नोच्चयरोमकः कृतः कन्था ।
एतानेव गृहीत्वा वासिष्ठो विष्णुचन्द्रेण ॥ —*BrSpSi*. XII. 46-50

2. चन्द्ररवि ग्रहणेन्दुच्छायादिषु सर्वदा यतो ब्राह्मे ।
दृग्गणितैक्यं भवति स्फुटसिद्धान्तस्ततो ब्राह्मः ॥ —*BrSpSi*. XI. 61

3. अनयोर्न कदाचिदपि ग्रहणादिषु भवति दृष्टिगणितैक्यम् ।
यद्भवति तद् घुणाक्षरमतोऽस्फुटाभ्यां किमेताभ्याम् ॥ —*BrSpSi*. XI, 51.

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CHAPTER XIII

Brahmagupta and Astronomical Instruments

The Twenty-second Chapter of the *Brāhmasphuṭasiddhānta* is known as the *Yantrādhyāya* or a chapter on instruments. There is a description of seventeen types of time-reckoning instruments (*Kāla-yantra*)[1] :

1. Dhanuryantra—Bow instrument.
2. Turyagolaka yantra—Quadrant (one-fourth sphere)
3. Cakra yantra=wheel or circle.
4. Yaṣṭi yantra—a pole or staff instrument.
5. Śaṅku yantra—Gnomon.
6. Ghaṭikā yantra—a clock or pot instrument.
7. Kapāla yantra—Bowl or potsherd instrument.
8. Karttarī yantra—Scissor or knife ; cutter.
9. Pīṭha yantra=Pedastal or seat instrument.
10. Salila yantra—Water-leveller.
11. Brahma or Śāṇa yantra—For describing circles.
12. Avalamba Sūtra—Threads with plumbs (Plumb lines).
13. Karṇa or chāyā-karṇa—A set of squares for diagonals.
14. Chāyā or śaṅku-chāyā—Sundial.

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1. सप्तदश कालयन्त्राण्यतो धनुस्तुर्यगोलकं चक्रम् ।
यष्टिः शंकुर्घटिका कपालकं कर्त्तरी पीठम् ॥
सलिलं भ्रमीऽवलम्बः कर्णश्छाया दिनार्धमर्कोऽक्षः ।
नतकालज्ञानार्थं तेषां संसाधनान्यष्टौ ॥ —*BrSpSi. XXIII*, 5-6

15. Dinārdha yantra—Midday measure instrument.
16. Arka yantra—Sun-instrument.
17. Akṣa or Palānśa yantra—Small degree measure arc instrument.

Salila yantra is used for levelling; since a liquid such as water seeks its own level, it can be utilised to know whether a surface has been levelled or not.[1] Bhrama or *Śāṇa* is used for drawing circles. Avalambaka or plambline is used for adjusting vertical line. *Karṇa* is used in connection with angles and diagonals. From S*alila* (no. 10) to the last (no. 17); these eight are used for adjustments and are basically important.

The *dhanuryantra* is used for *nata* and *unnata* kāla *ghaṭikās*.

On the *paridhi* or the circumference of the *cakra-yantra* are indicated the twelve *rāśis*. ending up to Mīna (XXII. 18). Brahmagupta has described the *yaṣṭi yantra* and shown how it could be used to give time at different parts of the day, and from its shadow *dṛgjyā* and other characteristics can be calculated. This instrument can also be used for ascertaining the solar-lunar differences, and for fixing up the directions. It can be used for determining various heights and altitudes.

The *karttarī yantra* is of the shape of a pair of scissors with two semi-circular blades, fastended to a string at the centre; at the centre is fixed a pin or a pole which casts shadows.

Setting up of the Gnomon

Here it would be interesting to describe the setting of a gnomon, which K.S. Shukla has given in details while commenting on the *Mahābhāskarīya* (IV. 1):

> After having tested the level of the ground by means of water, draw a neat circle with a pair of compasses (*karkaṭa*) (At the centre of that circle, set up a vertical gnomon). The gnomon should be large, cylindrical, massive, and tested for its perpendicularity by means of four threads with plumbs (*avalmbaka*) tied to them.

1. सलिलेन समं साम्यं भ्रमेण वृत्तमवलम्बकेनोर्ध्वम् ।
तिर्यक् कर्णोनान्यैः कथितैश्च नव प्रवक्ष्यामि ।। —*BrSpSi* XXII. 7.

Bhāskara I in his commentary on the *Āryabhaṭīya* tells us that there was a difference of opinion amongst astronomers in his time regarding the shape and size of gnomon (also called style). Some astronomers prescribed a gnomon with its one-third in the bottom of the shape of a prism on a square base (*caturasra*), one-third in the middle of the shape of a cow's tail (*go-pucchākāra*). and one-third at the top of the shape of a spear-head (*Śūlākāra*) and some others prescribed a square prismoidal (*samacaturasra*), gnomon. The followers of Āryabhaṭa I, he informs us, prescribed the use of a broad (*pṛthu*), massive (*guru*), and large (*dīrgha* cylindrical gnomon, made of excellent timber and free from any hole, a scar or knot on its body. In the above stanza, Bhāskara I prescribes this last kind of gnomon : the other two kinds he proves in the commentary to be defective and so he rejects them.

For getting the shadow-end easily and correctly the cylindrical gnomon was surmounted by a fine cylindrical iron or wooden nail fixed vertically at the centre of the upper end. The nail was taken to be longer than the radius of the gnomon, so that its shadow was always seen on the ground.

Certain writers, Bhāskara I tells us in the commentary, prescribed a gnomon of half a cubit (=12 *aṅgulas*) in length and having twelve divisions. But according to Bhāskara I (although it was the usual custom) there was no such hard and fast rule. The gnomon could be of any length and any number of divisions. The gnomon should, however, be large enough, so that the rings of graduation on the gnomon may be clearly seen on the shadow. A broad and massive gnomon was preferred because it was unaffected by the wind.

Brahmagupta describes gnomon which at the bottom is two *aṅgulas* wide, pointed as a needle., 12 *aṅgulas* in length, and full of holes from the basic circular part to the pointed extremity. (*BrSpSi*. XXII. 39).

As regards testing the level of the ground, Bhāskara I observes :

> When there is no wind, place a jar (full) of water upon a tripod on the ground which has been made plane by means of eye or thread, and bore a (fine) hole (at the bottom of the jar) so that the water may

have continuous flow. Where the water falling on the ground spreads in a circle, there the ground is in perfect level ; where the water accumulates after departing from the circle of water, it is low ; and where the water does not reach, there it is high. (Bhāskara's Commentary on the *Āryabhaṭīya*, II. 13).

After the ground was levelled, a prominently distinct circle was drawn on the ground as stated in the text (*MBh.* III. 1). In the time of Sankaranārāyaṇa (869 A.D.), there it seems that all lines were drawn on the ground with sandal paste (candanākṣodārdra). The above circle having been thus drawn and coated with sandal paste, another small concentric circle was drawn with the radius of the gnomon. The gnomon was then placed vertically with the periphery of its base in coincidence with that circle. The gnomon was thus set up exactly in the middle of the bigger circle. The verticality of the gnomon was tested by means of four plumb lines hung on the four sides of the gnomon

Gnomon Used for Finding the Directions

The rule in this connection has been described by Brahmagupta in *BrSpSi*. III. 1. The same rule in other words has been described by Bhāskara I in *MBh.* III. 2. In the *Vāsanā Bhāṣya*, Pṛthūdaka Svāmī describes the details of determining the directions. The level of the ground is ascertained by means of water and a gnomon of 12 aṅgulas is set up. Find out two points where the shadow of the gnomon enters into and passes out of the circle. Bhāskara prescribes drawing out a fish figure with these points. The thread line which goes through the mouth and tail of the fish figure indicates the north and south directions with respect to the gnomon. Brahmagupta says that if the Sun is on the eastern side, then where the shadow-point enters circle (in the forenoon) that point would be the west, and the point where it emerges out (in the afternoon) is the east.

As the Sun moves along the ecliptic, its declination changes. By the the time the shadow moves between the forenoon and afternoon points as given above, the Sun traverses some distance of the ecliptic and, so, theoretically speaking, its

declination gets changed. It follows, therefore, that the East-West line in the above determination is not the true position of the actual East-West line. Brahmagupta (628 A. D.) *was the first Hindu astronomer who prescribed the determination of the East-West line with proper allowance for the change in the Sun's declination.* (Shukla) The details of the method intended by him have been supplied by his commentator Pṛthūdaka Svāmī (860 A. D.).

Bhāskara and Brahmagupta both give another method of determining directions : (*BrSpSi.* III. 2 ; *MBh.* III. 3) : With the three points (at the ends of the three shadows of the gnomon) corresponding to (any three) different times (in the day), draw two fish-figures (each with two of the three points) in accordance with the usual method. From the point of intersection of the lines passing through the mouth and tail (of the two fish-figures), determine the north and south directions. (*MBh.* III. 3).

Brahmagupta in his rule is more precise :

> The point where the lines passing through the two fish-figures, which are drawn by means of three shadow ends (of the gnomon), intersect each other is for places in the northern hemisphere, the south direction, (if the midday shadow falls to the north of the foot of the gnomon). If the midday shadow falls towards the south of the foot of the gnomon, it is the north direction. (*BrSpSi.* III. 2).

This rule is obviously based on the assumption that the the locus of the end of the shadow of the gnomon is a circle. In fact the locus for places whose latitude is less than (90°—the obliquity of the ecliptic), this locus is a hyperbola.

Brahmagupta has made numerous uses of gnomon. He and Bhāskara, for example, both give the rules for finding the latitude and colatiude and the zenith distance and altitude of the Sun by finding out the length of the shadow and the length of the gnomon (*BrSpSi.* III. 10 ; *MBh.* III. 5) ; also rule for the determination of the latitude with the help of the Sun's meridian zenith distance and declination (*BrSpSi.* III. 13 ; *MBh.*

III. 17); also rule for finding the Sun's altitude (*BrSpSi*, III. 27; *MBh*. III. 24) (The Sun's altitude for the night has been called by Brahmagupta as *pātāla-śaṅku*, *BrSpSi*. XV. 9).

Golayantra or Armillary Sphere

The first mention of the Golayantra or the armillary sphere is in the *Aryabhaṭīya* (Golapāda. 22)[1] which was a uniformly round circle made of wood or of bamboo and which was ot uniform weight or density alround. It was levelled with mercury, oil or water. A śalākā or pin (or rod) was fixed in it in the south-north direction. Its description from the commentary *Bhaṭadīpikā* of Paramādīśvara is given here :

> A sphere of wood. uniformly round on all sides and with uniform density, and also light is made to revolve round an iron axis fixed north-south without friction (oil may be introduced to avoid friction). To the backside of the sphere, is fixed a *nālaka* full of water which has the length equal to the circumference of the sphere: and which has a hole at the bottom.
>
> Now a thread, connected to the hook of the wooden ball (on the top side) passing over another small ball (in the same axis of the wooden ball) is attached to the mercury lobe by its other end. The mercury lobe is placed on the level of water and water is allowed to flow through the bottom hole and with water mercury lobe also goes down. The time in which the above hook of ball comes to bottom (180°) is noted. The experiment is repeated with oil. The use of this mechanism is to revolve the ball by water or oil[1]

1. काष्ठमयं समबृत्तं समन्ततस्सम गुरु लघुं गोलम् ।
पारतं तैलजलैस्तं भ्रमयेत्स्वधिया च कालसमम् ॥ *Arya. IV. 22*

काष्ठमयं वंशादि काष्ठेन निर्मितं समवृत्तं सर्वतोवृत्तं समन्ततस्सम गुरुं सर्वावयवेषु समं गुरुत्वं यथा भवति तथा कृतं । लघुमगुरं एवं भूतं गोलं कृत्वा पारतादिभिस्तं स्वधिया च कालसमं भ्रमयेत् । अयमर्थः । भूमिष्ठ दक्षिणोत्तरस्तम्भयोरुपरि गोलप्रोतायश्शलाकाया अग्रे स्थापयेत् । गोलदक्षिणोत्तराच्छिद्रे च तैलेन सिञ्चेत् यथा निस्संङ्गो गोलो भ्रमति । गोलस्यापरतो गोलपरिधिसंमित दैर्घ्यं साधश्छिद्रं जलपूर्णं नलकं निदध्यात् ततो गोलस्यापरस्वस्तिक कीलकं निधाय तस्मिन्सूत्रस्यैक मग्रं बद्ध्वादो विषुवन्मण्डलपृष्ठेन प्राङ्मुखं नीत्वा तदग्रबद्धं पारतपूर्णमलाबु जलपूर्णे नलके निदध्यात् ततो नलकस्याध

[*Cont. on Page 337*]

In the Arabic epitome of the Almagest entitled *Tahriru'l mejesti*. the armillary sphere, *Za ul halk*, is thus described :

> Two equal circles are placed at right angles, the one representing the ecliptic, the other the solstitial colure. Two pins pass throught the poles of the ecliptic and two other pins are placed on the poles of the equator. On the first two pins are suspended a couple of circles moving, the one within, the other without, the first mentioned circles, and representing two secondaries of the ecliptic. On the two other pins a circle is placed, which encompasses the whole instrument, and within which the different circles turn; it represents the meridian. Within the inner secondary of the ecliptic, a circle is fitted to it, in the same plane and turning in it. This is adapted to measure latitudes. To this internal circle, two apertures or sights, opposite to each other, and without its plane are adapted like the sights of an instrument for altitudes. The armillary sphere is complete when consisting of these six circles. The ecliptic and secondaries are to be graduated as minutely as may be practicable. It is best to place both secondaries, as by some directed, within the ecliptic (instead of placing one of them without it), that the complete revolution of the outer secondary may not be obstructed by the pins at the poles of the equator. The meridian likewise should be doubled, or made to consist of two circles; the external one graduated and the internal one moving within it. Thus the pole may be adjusted at its proper elevation above the horizon of any place. The instrument so constructed consists of seven circles.

It is remarked that when the circle representing the meridian, is placed in the plane of the true meridian, so

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श्छिद्रं विकृतं कुर्यात् तेन जलं निस्स्रवति। नलकस्य जलमधो गच्छति। तद्वशाच्च तन्नस्थमलावु पारतपूर्त्यां गुरुत्वज्जलेन सहाधो गच्छद गोलं प्रत्यङ्मुखमाकर्षति। एवं त्रिंशद् घटिकाभिरर्धसंमितं यथा जलं भवति गोलस्य चार्धं भ्रमति तथा स्वबुद्ध्या जलनिस्रावो योज्यः। इति।

अमृतस्रावयोगेन कालभ्रमण साधनम्।
गुणबीजसमाकृष्टं गोलयंत्रं प्रकल्पयेत्॥ *SuSi. XIII, 16-17*

that it cuts the plane of the horizon at right angles, and one of the poles of the equator is elevated above the horizon conformably with the latitude of the place; then the motions of all the circles round the poles represent the motions of the universe.

After rectifying the meridian, if it be wished to observe the Sun and Moon together, the outer secondary of the ecliptic must be made to intersect the ecliptic at the Sun's place for that time: and the solstitial colure must be moved until the place of intersection be opposite to the Sun. Both circles are thus adjusted to their true places; or if any object but the Sun, be observed, the colure is turned until the object be seen in its proper place, on that secondary referred to the ecliptic : the circle representing the ecliptic being at the same time in the plane of the true ecliptic and in its proper situation. Afterwards, the inner secondary is turned towards the Moon (or to any star intended to be observed), and the smaller circle within it, bearing the two sights is turned, until the Moon, (or to any star intended to be observed), and the smaller circle within it, bearing the two sights, is turned, until the Moon be seen in the line of the apertures. The intersection of the secondary circle and ecliptic is the place of the Moon in longitude: and the arc of the secondary, between the aperture and the ecliptic, is the latitude of the Moon on either side (North or South). (From Colebrooke's *Miscellaneous Essays*).

The same instrument, as described by Montucla from the text of Ptolemy (1. 3. c. 2) consists of six circles : first a large circle representing the meridian; next four circles united together, representing the equator, ecliptic and two colures, and turning within the first circle on the poles of the equator, lastly a circle turning on the poles of the ecliptic, furnished with sights and nearly touching, on its concave side, the circumference of the ecliptic.

The armillary sphere described by the Arabian epitomiser, differs, therefore; from Ptolemy's in omitting the equator and

equinoctial colure, and adding an inner secondary of the ecliptic, which as well as the meridian, is doubled.

According to Lalande, the astrolobe of Ptolemy, from which Tycho Brahe derived his equatorial armillary, consisted only of four circles: two placed at right angles to represent the ecliptic and solstitial colure; a third turning on the poles of the ecliptic and serving to mark longitudes; and a fourth, within the other three, furnished with sights to observe celestial objects and measure their latitudes and longitudes.

Whether the ancient Greeks had any more complicated instrument formed on similar principles, and applicable to astronomical observations, is perhaps uncertain. We have no detailed description of the instrument which Archimedes is said to have devised to represent the phenomena and motions of the heavenly bodies; nor any sufficient hint of its construction; nor does Cicero's account of the sphere exhibited by Posidonius suggest a distinct notion of its structure.

Among the Arabs, no addition is at present known to have been made to the armillary sphere; between the period when the Almagest was translated and the time of Alhazen, who wrote a treatise of optics, in which a more complicated instrument than that of Ptolemy, is described; Alhazen's armillary sphere is stated to have been the prototype of Tycho Brahe's; but neither the original treatise, nor the Latin translation of it, are procurable and one is therefore unable to ascertain whether the sphere, mentioned by the Arabian author, resembled that described by Indian astronomers. At all events, says Colebrooke, he is more modern than the oldest of the Hindu writers.

Here we give the literal translation of the passage on armillary sphere or *Golayantra* occurring in the *Sūrya-Siddhānta* :

> Let the astronomer frame the surprising structure of the terrestitial and celestial spheres.
>
> Having caused a wooden globe to be made (of such size) as he pleases; to represent the Earth : with a staff for the axis passing through the centre, and exceeding the globe at both ends; let him place the supporting hooks, as also the equinoctial circle.
>
> Three circles must be prepared, (divided for signs and degrees), the radius of which must agree with the

respective diurnal circles, in proportion to the equinoctial: the three circles should be placed for the Ram (*Meṣa*) and following signs. respectively, at the proper declination in degrees N. or S. ; the same answer contrariwise for the Crab (*Karkaṭa*) and other signs. In like manner three circles are placed in the southern hemisphere, for the Balance (*Tulā*) and the rest, and contrariwise for Capricorn (*Mṛga*) and remaining signs. Circles are similarly placed on both hoops for the asterisms in both hemispheres, as also for *Abhijit* and for the *Seven Ṛṣis*, *Agastya*, *Brahmahṛdaya* and other stars.

In the middle of all these circles is placed the equinoctial. At the intersection of that and supporting hoops, the distant from each other half the signs, the two equinoxes should be determined; and the two solstices, at the degrees of obliquity from the equinoctial; and the the places of the Ram (*Meṣa*) and the rest, in the order of the signs, should be adjusted by the strings of the curve. Another circle thus passing from equinox to equinox, is named the ecliptic; and by this path, the Sun illuminating worlds, for ever travels. The Moon and other planets are seen deviating from their nodes in the ecliptic to the extent of their respective greatest latitudes (within the zodiac).[1]

1. भूलोकस्य रचनां कुर्यादाश्चर्यकारिणीम् ।
अभीष्टं पृथिवीगोलं कारयित्वा तु दारवम् ॥
दण्डं तन्मध्यगं मेरोरुभयत्र विनिर्गतम् ।
आधारकक्ष्याद्वितयं कक्ष्यां वैषुवतीं तथा ॥
भगणांगुलैः कार्या दलितास्तिस्र एव ताः ।
स्वाहोरात्रार्धकर्णैश्च तत्प्रमाणानुपाततः ॥
क्रान्तिविक्षेपभागैश्च दलिता दक्षिणोत्तरा ।
स्वैस्स्वरपक्रमैः कार्या मेषादं नामपक्रमात् ॥
कक्ष्याः प्रकल्पयेत्ताश्च कर्क्यादीनां विपर्ययात् ।
तद्वत्तिस्रस्तुलादीनां मृगादीनां विलोमतः ॥
याम्यगोलाश्रिताः कुर्यात् कक्ष्याधारद्वयोपरि ।
याम्योदग्भाग संस्थानां भानामभिजितस्तथा ॥
सप्तर्षीणामगस्त्यस्य ब्रह्मादीनां प्रकल्पयेत् ।
मध्ये वैषुवती कक्ष्या सर्वासामेव संस्थिता ।

[Cont. on page 341]

The author of the *Sūrya-Siddhānta* then proceeds to notice the relation of the great circles before mentioned to the horizon, and observes that whatever place be assumed for the apex of the sphere, the middle of the heaven for that place is its horizon. He concludes by showing, that the instrument may be made to revolve with regularity, by means of a current of water; and hints, that the appearance of spontaneous motion may be given, by a concealed mechanism, for which quicksilver is to be employed. There is a hint of secrecy also in one of the lines, and it has, therefore, been stated that the construction and the mechanism of working should be learnt under the guidance of a teacher.

How to Observe Places of Stars

Details are not available in this connection. The *Sūrya-Siddhānta* only hints "that the astronomer should frame a sphere and examine the apparent longitude and latitude (*sphuṭavikṣepa and sphuṭadhruvaka*)". The commentators, however, describe the manner of making the observation. They direct a spherical instrument (*Golayantra*) to be constructed as described above. This instrument is very much similar to the armillary sphere. An additional circle graduated for degrees and minutes, is directed to be suspended on the pins of the axis as pivots. It is named as *Vedhavalaya* or intersecting circle, and appears to be a circle of declination. After noticing this addition to the instrument, the instructions proceed to the rectifying of the *Golayantra* or armillary sphere which is said to be placed, so that the axis shall point to the pole; and the horizon be true by a water level.

The instrument being thus placed, the observer is instructed to look at the star *Revatī* through a sight fitted to an orifice at the centre of the sphere; and having found the star, to adjust by it the end of the sign Pisces on the ecliptic. The observer is then to look through the sight, at the *yoga* star of *Aśvinī*, or at

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तदाधारयुतेः भार्धमयने विषुवद्वये ।
अयनादयने चैव कक्ष्या तिर्यक्तथाऽपरा ॥

क्रान्तिसंज्ञा तया सूर्यः सदा सदापर्येति भासयन् ।
चन्द्राद्याश्च स्वकैः पातैपमण्डलमाश्रितैः ॥

ततोऽपकृष्यादृश्यन्ते विक्षेपाग्रेष्वपक्रमात् । *SuSi. XIII. 3-12*

some other proposed object; and to bring the moveable circle of declination over it. The distance in degrees, from the intersection of this circle and ecliptic, to the end of *Mīna* or Pisces, is its longitude (*dhruvaka*) in degrees; and the number of degrees on the moveable circle of declination, from the same intersection to the place of the star, is its latitude (*vikṣepa*) North or South.

The commentators have rightly remarked that the "latitude so found is *sphuṭa* or apparent, being the place intercepted between the star and the ecliptic, on a circle passing through the poles; but the true latitude (*asphuṭa*) is found on a circle hung upon the poles of the celestial sphere as directed in another place". (From Colebrooke's Paper on the Indian and Arabian Divisions of the Zodiac. *Miscellaneous Essays*, Vol. II, 324-326).

For the details of the *Golayantra*, readers are requested to refer to the description in the *Siddhānta-Śiromaṇi* of Bhāskara II.

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Reference

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K.S. Shukla : The *Mahābhāskarīya*.
Bhāskara I : Commentary on the *Āryabhaṭīya*.
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॥ श्रीगणेशायनमः ॥[1]

अथ ब्राह्मस्फुट सिद्धान्तस्य

पूर्वादशाध्याय्यां मध्यमाधिकारः

जयति प्रणतसुरासुरकिरीटरत्नप्रभाच्छुरितपादः ।
कर्ता जगदुत्पत्तिस्थितिविलयानां महादेवः ॥१॥

ब्रह्मणोक्तं ग्रहगणितं महता कालेन यत् खिलीभूतम् ।
अभिधीयते स्फुटं तज्जिष्णुसुतब्रह्मगुप्तेन ॥ २ ॥

ध्रुवताराप्रतिबद्धं ज्योतिश्चक्रं प्रतिक्षणगमादौ ।
पौष्णाश्विन्यन्तस्थैः[1] सह ग्रहैर्ब्रह्मणा सृष्टम् ॥ ३ ॥

चैत्र[4]सितादेरुदयाद्भानोर्दिन[1]मासवर्ष युगकल्पाः ।
सृष्ट्यादौ लंकायां समं[3] प्रवृत्ता दिनेऽर्कस्य[2] ॥ ४ ॥

प्राणैर्विनाडिकार्क्षी षड्भिर्घटिका विनाडिका षष्ट्या ।
घटिका षष्ट्या दिवसो दिवसानां त्रिंशता मासाः ॥ ५ ॥

(ग) १. श्री नमः ॥ परमात्मने । श्री रामाय सीतालक्ष्मणसहिताय: ॥ श्री गुरुभ्यो नमः ॥ for (श्री··········मध्यमाधिकारः)

(च) १. "ॐ नमः परमात्मने श्रीरामाय सीतालक्ष्मणसहिताय श्री गुरुभ्यो नमः । for (श्री·········मध्यमाधिकारः)"

३. (ग) १. पौष्णाश्विनांतरस्थैः for (पौष्णाश्विन्यन्तस्थैः)

(च) १. पौष्णाश्विन्यंतरास्थैः for (पौष्णाश्विन्यन्तस्थैः)

४. (ग) १. द्दिन (च) for (दिन)

२. ऽर्क्कस्य for (ऽर्कस्य) (ख) दिनेर्कस्य for (दिनेऽर्कस्य)

(क) श्लोक उपलब्ध नहीं

(ख) ३. समप्रवृत्ता for (समं प्रवृत्ता)

(च) ४. चित्र for (चैत्र) २. दिनेऽर्क्कस्य for (दिनेऽर्कस्य)

५. (क) श्लोक उपलब्ध नहीं ।

मासा[1] द्वादशवर्षं विकलालिप्तांशराशिभगणांतः[2]
क्षेत्रविभागस्तुल्यः कालेन विनाडिकाद्येन[3] ॥ ६ ॥
स्वचतुष्टयरदवेदा[1] रविवर्षाणां चतुर्युगं[2] भवति । ४३२००००
सन्ध्या सन्ध्यांशै[3] सह चत्वारि पृथक्कृतादीनि ॥७॥
युगदशभागो[1] गुणितः कृतं[2] चतुर्भिस्त्रिभिर्गुणस्त्रेता[3] ।
द्विगुणो[4] द्वापरमेकेन संगुणः कलियुगं भवति ॥ ८ ॥
१७२८०००।१२९६०००।[5]८३४०००।४३२०००
युगपादानार्यभटश्चत्वारि[1] समानि[2] कृतयुगादीनि ।[5] १००००००
यदभिहितवान्[4] न तेषां स्मृत्युक्तसमानमेकमपि[5] ॥ ९ ॥

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६. (ख) १. मास for (मासा)
२. भगणांत for (भगणांतः)
३. द्येवम् for (द्येन)

(च) २. भगणांताः for (भगणांतः)

७. (ग) १. खचतुष्टय for (स्वचतुष्टय) (क) (ख) (च)
(क) २, संख्या लुप्त है। टीका में उपलब्ध है।
(ख) ३. संध्यांशैः for (सन्ध्यांशै)

८. (ग) १+१०+(च)
२+४+(च)
३+३+(क) गुणोत्रेता for (गुणस्त्रेता) (च) +३+
४+२+(च)
५ ८६४००० for (८३४०००) (क) टीका में उपलब्ध है। (च) ८६४०००

(क) संख्याएं लुप्त हैं, परन्तु टीका में दी हुई हैं। (ख)

९. (घ) १. नार्यः for (नार्य) (क) नार्यभट्ट for (नार्यभट)
(ग) २. समानिष्ट (ख) सभाति (च) समानिष्ट for (समानि)
(क) ३. संख्या लुप्त है।
४. हतवान्न for (हितवान् न)
५. समानामेकमपि (च) for (समानमेकमपि)

मनुरेक सप्ततियुगः[२] कल्पो[३] मनवश्चतुर्दश मनूनाम् ।
आद्यंतरांतसंधिषु[५] कृतकालोऽस्माद्युगसहस्रम्[४] [६] ॥ १० ॥[१]
४३२००००००

आद्य[४] तरातसंधिषु कल्पमनूनां[५] कृताब्दसमकालम्[६] ।
नेच्छंति ये षड्नूनं[१] तेषां कल्पो युगसहस्रम्[१] ॥ ११ ॥
४२९४०८००००[२]

मनुसंधियुगमिच्छत्यार्यभटस्तन्मनुर्यतस्खयुगः[५] [१] [७] ।
कल्पश्चतुर्युगानां[६] [२] सहस्रमष्टाधिकं[२] तस्य ॥१२॥
४३५४५६००००[४]

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१०. (घ) २. ४३२००००००० for (४३२००००००००) (क) संख्या लुप्त है। टीका में अंकित है।
(ग) २+७१+(च)
३ कल्पो नवचतुर्दश १४ (च) for (कल्पोमनवश्चतुर्दश)
४ +१५+(ख) कृतकल्पो for (कृतकालो) (च)+१५+
(ख) ५. अद्यंतगतसंधिषु for (आद्यंतरांतसंधिषु)
६. स्मुद्युगसहस्रम् for (स्माद्युगसहस्रम्)

११. (घ) १. ड्नूनं for (षड्नूनं) (च) षड्नूनां for (षड्नूनं)
२. ४२६४०८०००० for (४२९४०८००००) (क) संख्या लुप्त है
(क) ३. युगसहश्र for (युगसहस्रम्)
(ख) ४. अद्यंतरांत for (आद्यंरांत)
५. कल्पमनुना for (कल्पमनूनां)
६. कृताब्दाः for (कृताब्द)

१२. (घ) १. (अस्पष्ट)
२. चतुर्यगाणां for (चतुर्युगानां)
(ग) ३. सहश्रमष्टाधिकं for (सहस्रमष्टाधिकं) (ख)
४. संख्या लुप्त है।
(ख) ५. कृतमिच्छात्यार्य for (युगमिच्छत्यार्य)
६. कल्पाश्चतुर्गुणां for (कल्पश्चतुर्युगानां)
(च) ७. +७२+

युगमन्वन्तरकल्पाः काल[2]परिच्छेदकाः स्मृतावुक्ताः ।
यस्मा[1]न्न रोमके ते स्मृति[3] बाह्यो रोमकस्तस्मात् ॥ १३ ॥
काल[1]र्क्षदेशयोगाद्भू[2]यो [5]ग्रहमन्दशीघ्रपातानाम् ।
कल्पेन यतो योगस्तत[3]ः स्फुटं ग्रहयुगं[4] कल्पः ॥ १४ ॥
कल्पेऽर्कबुध[1] सितानां भगणाः[4] शून्यानि सप्तरदवेदाः ।
प्राग्व्रजता[2] कुजगुरुशनिशीघ्रोच्चानां स्वकक्षासु[5] ॥ १५ ॥
[3]
४३२०००००००

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१३. (घ) १. न रोमके ते (च) न रौनुके ते for (न्न रोमके ते)

(ख) २. कलापरिच्छेदकाः for (कालपरिच्छेदकाः)

(च) ३. वि० इस प्रति में "......परिच्छे" के पश्चात् लेखक ने भूल से फिर "मनुरेक सप्तति युग" से लिखना आरंभ कर दिया । इस प्रकार ५⅓ पंक्तियां पुनः लिखी गई ! उसके पश्चात् फिर क्रमशः लिखता गया ।
४. स्मृतबाह्यो for (स्मृतिबाह्यो)

१४. (घ) १. कालर्क्ष्य (ख) कालक्ष (च) कालक्ष्य for (कालर्क्ष)
२. दूद्भूयो (च) for (द्भूयो)
३. तत (च) for (ततः)
४. ग्रहयुगकल्पः (ग) ग्रहयुतं कल्पः for (ग्रहयुगं कल्पः)

(ग) ५. ग्रहशीघ्रमंद पातानां (क) (ख) for (ग्रहमन्द शीघ्रपातानां)

(च) ४. ग्रहयुग कल्पः for (ग्रहयुगं कल्प.)

१५. (घ) १. बुध· (च) for (बुध)
२. व्रजनां (ग) व्रजती (ख) व्रजतां for (व्रजता)

(क) २. प्रागव्रजतां for (प्रागव्रजता)
३. संख्या लुप्त है । टीका में अंकित है ।

(ख) ४. भगणः for (भगणाः)
५. सा for (सु) (च) स्व कक्षासु for (स्व कक्षासु)

पंचांबराणि[3] गुणरामपंच[4] सप्तस्वरेषवः शशिनः ।

५७७५३३००००० [1]

भौमस्य द्वियमशराष्टपक्षवसुरसनवह्नियमाः[5] ॥ १६ ॥

२२९६८२८५२२ [2]

१ ४
९३६९९८९८४

कृतवसुनवाष्टनवनव[1] षड्गनवागेन्द्रवो[2] ज्ञशीघ्रस्य ।

१७९३६९९८९८४ [5]

जीवस्य शरेषूदधि षडयक्षि[3] द्विकृतरसरामाः ॥ १७ ॥

३६४२२६४५५ [6]

सितशीघ्रस्य यमलगो[1] वेदनवाष्टाग्नि[6] पक्षयमखनगाः ।

७०२२३८९४९२ [4]

अष्टनवपक्षमुनिरसशररसमनवोऽर्कपुत्रस्य[2][3] ॥ १८ ॥

१४६५६७२९८ [5]

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१६. (क) १. संख्या लुप्त है। टीका में अंकित है।
२. संख्या लुप्त है। टीका में अंकित है।
(ख) ३. पंच वाराणि for (पंचांबराणि)
४. गुणरामं for (गुणराम)
(च) ५. वृद्धि for (वह्नि)

१७. (घ) १. १७९३६९९८९४ for (१७९३६९९८९८४) (च)
२. वांगे (ग) षड्त्रिनव (क) षट्त्रिन (ख) षट्त्रिनवा for (षड्गनवागेन्द्वो)
३. पद्यक्ष (ग) षट्द्वयक्षि (क) षट्पक्ष (ख) षष्ट्यक्ष for (षडपक्षि)
(ग) ४. +२२९६८२८५२२ (क) 'ग' में अंकित संख्या १६वें श्लोक की टीका के अन्त में है।
(क) ५. संख्या मूल में नहीं, टीका में अंकित है।
६. संख्या मूल में नहीं, टीका में अंकित है।
(ख) ७. वसू for (वसु)
(च) २. षड्नवांगेदवो for (षड्गनवांगेवो) ३ पद्यक्ष for (षडयक्षि)

१८. (घ) १. लागो for (लगो) (च) यमलागो for (यमलगो)
२. यक्ष for (पक्ष)
३. ऽक्कं (ग) ऽक्कं for (ऽर्क)
(क) ४. मूल में संख्या लुप्त है। टीका में अंकित है।
५, मूल में संख्या लुप्त है। टीका में अंकित है।
(च) ६. चाष्टाग्नि for (वाष्टाग्नि)

खाष्टाब्धयो[1] ४८० वसुशर[7] वसुपंचखचन्द्रवसुवसुसमुद्राः ।
४८८१०५८५८[8]

द्विनवयमा[4] २९२ द्वित्रिगुणा[5] ३३२ शरेषुवसव[9] ८५५
स्त्रिपञ्चरसाः[2] । १९ ॥ ६५३[6] ॥ १९ ॥

शशिवेदा ४१ मन्दानामर्कादीना[1] विलोमपातान्तम्
वसुरसरुद्रेन्द्रगुण द्वित्रियमा[2] २३२३१११६८[3] सप्तरसपक्षाः
२६७[4] ॥ २० ॥

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१९. (घ) १. षष्ठौदधया (ग) खाष्टोदधयो for (खाष्टाब्धयो)
२. स्त्रिपंचसाः (च) स्त्रिपंचरसाः (स्त्रिपञ्चरसा)
(वि० चिह्नित संख्याएं यहां उपलब्ध नहीं हैं)

(ग) ४. द्विनवयमाः for (द्विनवयमा)
५. द्वित्रिगुणाः for (द्वित्रिगुणा)

(क) १. खाष्टोदधयो for (खाष्टाब्धयो)
६. +शशिवेदाः+
बि० श्लोकांकित कोई भी संख्या मूल में नहीं है। हाँ, टीका में विद्यमान है।

(ख) खाष्टोदधयो for (खाष्टाब्धयो)

(च) १. षाष्टोदधयो for (खाष्टाब्धयो)
७, संख्या लुप्त ८. संख्या लुप्त ९. शरेषुवस for (शरेषुवसव)
वि० श्लोकांकित संख्याएं लुप्त हैं।

२०. (घ) यहाँ श्लोक में निर्दिष्ट संख्याएं लुप्त हैं।

(ग) १. मर्क्कादीनां (क) चद्रादीनां (च) for (मर्कादीना)
२. द्वित्रियमाः (क) (ख) द्वित्रियशः for (द्वित्रियमा)

(क) ३. संख्या लुप्त है, परन्तु ठीका में अंकित है। (ख)
४. संख्या लुप्त है, परंतु टीका में अंकित है। (ख)

(च) वि० श्लोकांकित संख्याएं लुप्त हैं।
२ द्वित्रियमाः for (द्वित्रियमा)

शशियमशरा ५२१[4] गुणरसा ६३ स्त्रिनंदवसवः[3]
८९३[4] समुद्रवसुविषयाः ५८४[5] ।
चन्द्रादीनां पश्चात् व्रजतो[1]ऽश्विन्यादिभगणस्य ।। २१ ।।[2]
परिवर्त्ता[3] खचतुष्टय शराब्धि[5]रसगुणयम द्विवसु
तिथयः । १५८२२३ । ६४५००००[1]
रविभगणोना भानोः सावन दिवसाः कुदिवसास्ते[2] ।। २२ ।।
[3]४३२०००००००
१५७७९१६४५००००

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२१. (घ) १. व्रजनोश्विन्यादि for (व्रजतोऽश्विन्यादि)

२. (१९, २०. तथा २१ श्क्षोकों के अन्तर्गत आई हुई संख्याएं यहाँ एक ही स्थान पर दे दी गई हैं)

(ग) ३. स्त्रिनंदवसव for (स्त्रिनंदवसवः)

४. संख्या मूल में लुप्त हैं, परन्तु टीका में अंकित हैं ।

५. संख्या मूल में लुप्त हैं, परन्तु टीका में ५८५ अंकित हैं ।

(च) वि० श्लोकांकित संख्याएं लुप्त हैं ।

१. (१९, २०, तथा २१ वें श्लोकों के अन्तर्गत आई हुई संख्याएं यहाँ एक ही स्थान पर अंकित हैं यथा ४८०, ४८८१०५८५८ २९२ ३३२ ८५५ ६५३ ।। ४१ : २३२३१११६८ २६७ ।। ५२१, ६३ ८९३, ५८४ ।

२२. (घ) १. १५८२२३ ।। ६४५०००० (च) १५८२२३ ।। ६४५०००

२. सावा (ग) सा वा (ख) (च) दिवसां वा for (दिवसास्ते)

(ग) ३. परिवर्त्ताः (च) for (परिवर्त्ता)

४. यह संख्या यहाँ नहीं दी गई है ।

(क) ५. शरब्धि for (शराब्धि)
वि० मूल की तीनों संख्याएं लुप्त हैं, परन्तु टीका में क्रमशः अंकित हैं ।

रविभगणा रव्यब्दा द्वादशगुणिता भवन्ति रविमासाः ।
५१०४०००००००[4]

भगणांतरं[2] रवींद्वोः[3] शशिमासाः ५३४३३३००००००[1]
सूर्यमासोनाः ॥ २३ ॥

अधिमासाः १५९३३००००० शशिमासास्त्रिंशद्गुणिता
१६०२९९९००००००[1] भवन्ति शशिदिवसाः ।

शशिसावनदिवसान्तरमवमानि तिथिः शशांकदिनम् ॥ २४ ॥
२५०८२५५०००[2]

सावन[1]मुदयादुदयो[5] भानां चार्क्षं[2] नृवत्सरोर्का[3]श्च ।
पितृदिवसाः[4] शशिमासा दिव्यानि दिनानि रविभगणाः ॥ २५ ॥

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२३. (घ) १. यह संख्या यहाँ श्लोक की समाप्ति के उपरांत रक्खी गई हैं। (ग) (च)
(क) २. भगणांतर (च) for (भगणांतरं)
३. रवींदोः for (रवींद्वोः)
४. संख्या मूल में लुप्त है, परन्तु टीका में अंकित है।
१. मूल में संख्या लुप्त है, परन्तु टीका में अंकित है।
(च) ३. रविंदोः for (रवींद्वोः)
(ख) "रविभगणारव्यब्दा द्वादशगुणिता भवंति।
रविमासाः भगणांतरे रवींद्वोः शशिमासाः सूर्यमासो ना ॥ २३ ॥"
यह श्लोक अधिक है।
(ङ) यह श्लोक अंकित है।

२४. (घ) १. यह संख्या यहाँ पहली पंक्ति के तमाप्त होने पर लिखी गई हैं (ग) (च)
२. २५०८२५५०००० for (२५०८२५५०००)
(क) मूल की तीनों संख्याएं लुप्त हैं, टीका में क्रमशः निम्नांकित हैं —
५३४३३००००००, १६०२९९९००००००, २५०८२५५००००

२५. (घ) १. सवन (च) for (सावन)
२. चार्क्ष्यं (ग) (क) वार्क्षं (ख) वक्षा for (चार्क्षं)
३. कर्ब्दः (ग) (क) (ख) कर्ब्दः for (कर्श्च)
(ग) ४. पितृदिवसा for (पितृदिवसाः)
(क) ५. दुदयं for (दुदयो)
(च) २. चार्क्ष्यं for (चार्क्षं) ३ क्रश्चः for (कर्श्च)

कल्प परार्धमनवः षट्कस्य गताश्चतुर्युगत्रिघनाः ।
त्रीणि कृतादीनि कालो गोगैकगुणाः शकान्तेऽब्दाः ॥ २६ ॥
१८५२८४१६०००,११६६४००००,३१७९

२६. (घ) १. परार्द्धं (ग) कल्पापरार्द्ध ४३२०००००००००००००००००००००००००० for (परार्धमनवः)
२. घ्यता (ग) घनः ११६६४०००० (क) घनः (ख) त्रिघनम् for (घनाः)
३. काले (ग) कले (क) कलौ (ख) कलेर्गोगैकगुणाः for (कालो गोगैकगुणाः)
४. गोगैः (ग) र्गोगैक गुणाः ३१७९ for (गोगैकगुणाः)
५. अतिरिक्त संख्या + ३८८८००० +
(ग) ६. १८५२४१६०० for (१८५२४१६०००)
७. गताश्वचतुर्युग for (गताश्चतुर्युग)
८. +३८८८०००+
(वि० —उपर्युक्त संख्याएं 'ग' में श्लोक के अन्तर्गत ही हैं)
(क) १. परार्द्धं for (परार्ध)
९. ऽन्धः for (ऽब्दाः) (ख) सकनृपांते ऽब्दाः for (शकान्ते ऽब्दाः)
वि० मूल में संख्याएं लुप्त हैं, टीका में क्रमशः हैं—
१०००००००००००००००००, २७, १७२८०००, ३१२९६०००,
८६४०००, ३१७९.
(ख) १. कल्पपरार्द्ध for (कल्पपरार्ध)
(च) १. परार्द्धं ७, गताश्चतुर्युगत्रिघ्नत for (गताश्चतुर्युगत्रिघनाः)
३. काले for (कालो) ४ गोगैः कगुणाः for (गोगैकगुणाः) ९ शकांतेऽब्दाः for शकांतेऽब्दाः)
(घ) ग्रहनक्षत्रोत्पत्ति ब्रह्मदिनादौ दिनक्षये प्रलयः ।
यस्मात्कल्पस्तस्माद्ग्रहगणिते कल्पयाताब्दाः ॥ २७ ॥
(वि०) (यह श्लोक १९०२ ई० में प्रकाशित 'ब्राह्मस्फुट सिद्धान्त' में नहीं है। यह संस्करण क्वींस कालेज के प्रोफेसर महामहोपाध्याय सुधाकर द्विवेदिकृत नूतन-तिलक समेत 'मैडिकल हाल प्रैस में मुद्रित हुआ— ब्राह्मस्फुट सिद्धान्त के साथ इसमें ध्यानग्रहोपदेशाध्याय' भी प्रकाशित हैं)
(वि०) यह श्लोक (ग) तथा (क) पांडुलिपियों में निम्नांकित पाठान्तरों के साथ उपलब्ध है—
(ग) १. ग्रहः for (ग्रह); (क) २. +स्युः+

नवनगशशिमुनिकृतनवय[1] नगनन्देन्दवः[4]
[2]१६७२६४७१७६ शकनृपांते ।।
[5]सार्धमतीव[3] मनूनां सन्धिभिराद्यन्तरान्तगतैः ।। २७[6] ।।
[4]अधिकः स्मृत्युक्तमनोरार्यभटोक्तश्चतुर्युगेन मनुः ।
अधिकं विशांश[2] युतैस्त्रिभिर्युगैस्तस्तस्य[1] कल्पगतम् ।। २८ ।।
[3]१८६१२७१६
कल्पगताब्द[1]द्वादशघात[2]श्चैत्रादिमासयुक्तोऽधः[4] ।
गुणितो युगाधिमासै रविमासाप्ताधिमासयुतः[3] ।। २९ ।।

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२७. (घ) १. यमांगतांदेन्दव (ग) यमाग (ख) यमागनंदेदवः for (यनगनन्देन्दवः)
२. यह संख्या यहाँ श्लोक के अन्त में दी है, (ग)
(ग) ३. सार्ध प्रतीत (ख) सार्धमतीत (च) सार्द्धमतिव for (सार्धमतीव)
(क) १. यमागणंदेदंवः for (यनगनन्देन्दवः)
२. यह संख्या मूल में लुप्त है। टीका में उपलब्ध है।
(च) १. यमांगतं for (यनगनन्)—"देन्दवः" उत्तरार्ध का आरंभ है
४. उत्तरार्ध का आरंभ—देंदवः for (देंदवः)
५. +शकनृपांते+
६. +१६७२६४७१७६+

२८. (घ) १. युगैस्तस्य कल्पगतम् for (युगैस्तस्तस्य कल्पगतम्) (ग) (क) (ख)
(ग) २. विंशांक (क) (विशांश)
३. १६८६१२३१७६ for (१८६१२७१६)
(क) ३. यह संख्या मूल में लुप्त है, टीका में निम्नाँकित है—१६८६१२३७६
(ख) ४. अधिकस्मृत्युक्त for (अधिकः स्मृत्युक्त)
(च) ३. स्मृत्युत्त for (स्मृत्युक्त)

२९. (घ) १. ब्दा for (ब्द) (च) कल्पगताब्दा for (कल्पगताब्द)
२. घाता for (घातश्) (क)
(ग) ३. युताः (for युतः)
(क) ४. युक्तोऽध । (ख) युक्तोघ (च) युक्तोधः for (युक्तोऽधः)
(च) २. द्वादशघातश्चित्रादि for (द्वादशघातश्चैत्रादि)

त्रिंशद्गुणस्तिथियुतः[४] पृथग्युगावमगुणो[६] युगेंदुदिनैः ।
भक्त[५]फला[१]वमोनो[६]ऽर्कसावना[२]हर्गणो[३]ऽर्कादिः[६] ॥ ३० ॥
इष्टग्रहभगण[३]गुणादहर्गणात्[२] [४] कल्पसावनद्युहृतात्[५] ।
भगणादि फलं मध्यो लंकायां भास्करौदयिकः[१] ॥ ३१ ॥
आनयति दिवसवारं स्मृत्यविरोधेन मध्यमानथवा ।
ब्राह्मा[२]दन्यैस्तन्त्रैरार्यभटाद्यैर्न्न[१] कश्चिदपि ॥ ३२ ॥
जगति तमोभूते[१]ऽस्मिन् सृष्ट्यादौ भास्करादिभिः स्पृष्टैः[२] ।
यस्माद्दिनप्रवृत्ति दिन वारो[३]ऽर्कोदयात्तस्मात्[४] ॥ ३३ ॥

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३०. (घ) १. विमानो (च) for (वमोनो)
२. सावनोः (ग) सावनो (क) सावनो (ख) (च) for (सावना)
३. हर्ग्रणो (ग) (क) ऽहर्गणो (च) for (हर्गणो)
(ग) ४. +३०+
५. भक्तः (क) (ख) for (भक्त)
६. ऽर्कादि for (ऽर्कादिः)
(क) ४. त्रिशत् गुणास्तिथियुतः for (त्रिंशद्गुणस्तिथियुतः)
(ख) ५. मगुणे for (भक्तफला)
(च) ६. ऽर्क्क for (ऽर्क) ६ ऽर्क्कादिः for (ऽर्कादिः)

३१. (घ) १. भास्करोदायिकः । (ग) (च) for (भास्करौदयिकः)
(ग) २. बधादहर्गणात् for (गुणादहर्गणात्)
(क) १. भास्करोदयिकः for (भास्करौदयिक.)
(ख) ३. इष्टग्रहणभगणा for (इष्ट ग्रहभगण)
(च) ४. दर्गणात् for (दहर्गणात्)
५. द्युहृता for (द्युहृतात्)

३२. (ग) १. नं कश्चदपि for (र्न्न कश्चिदपि) (क) (ख) नं for (र्न्नं)
(क) २. ब्रह्मा (ख) for (ब्राह्मा)

३३. (घ) १. तसोभूते for (तमोभूते) (ख) तमोभूतो for (तमोभूते)
२. सृष्टैः (ग) (क) (च) for (स्पृष्टैः)
(ग) ३. दिनवारो (ख) for (दिनवारो)
(ख) ४. ऽर्कोदयस्तस्मात् for (ऽर्कादयात्तस्मात्)
(च) १. तसोभूते for (तमोभूते) ३. द्दिनवारोर्क्का for (दिनवारोऽर्का)

लङ्कासमयाम्योत्तररेखायां[1] भास्करोदये मध्याः ।
देशान्तरोनयुक्ता रेषा[2] प्रागपरदेशेषु ।। ३४ ।।
दिनवारादिः पश्चादुज्जयनी दक्षिणोत्तरायाः[1] प्राक ।
देशान्तरघटिकाभिः पश्चात्प्राक्[2] भवति रव्युदयात् ।। ३५ ।।
भूपरिधिः[4] खखखशरारेखा स्वाक्षान्तरांश[6] संगुणिताः[5] ।
५००००[1]
भगणांश ३६०[2] हृता फलकृतिहीनो[3] देशान्तरस्य कृतिः ।। ३६ ।।[7]
शेषपदगुण[1]भुक्तिर्भूपरिधि हृता[2] कलादि[3] लब्धमृणम् ।
उज्जयनी याम्योत्तर रेखायाः[4] प्राग्धनं[5] पश्चात् ।। ३७ ।।

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३४. (य) १. रेषायाँ for (रेखायां)
(ग) २. रेखा (क) (ख) for (रेषा)

३५. (घ) १. दक्षणोत्तरायाः for (दक्षिणोत्तरायाः) (च)
२. प्राग्भवति (ग) (क) (च) for (प्राक्भवति)

३६. (घ) १. ५००० (ग) for (५००००)
२. 'हृता' से पूर्व दी गई ३६० की संख्या यहाँ 'हृता' के पश्चात् दी गई है ।
(ग) (ख) हृल (च)
(ग) ३. हीना (क) (ख) for (हीनो)
(क) ४. परिधि for (परिधि)
५. संगुणिता for (संगुणिताः)
वि० श्लोकान्तर्गत संख्याएं लुप्त हैं । (ख)
(ख) ६. स्वक्षांतरांस for (स्वाक्षांतरांश)
(च) ३. हिनो for (हीनो)
७. क्रमसंख्या लुप्त

३७. (घ) १. गुणा (ग) (क) (च) for (गुण)
२. परिधिताकलादि for (परिधि हृताकलादिं)
(ग) ३. कलादिलब्धमृणम् for (कलादिं लब्धमृणम्)
(क) ४. रेखाया for (रेखायाः)
५. प्रागृणं धनं (ख) for (प्राग्धनं)
(च) ३. कलादिलब्धमृणं for (कालादिंलब्धमृणम्)

मध्यग्रहे[1] स्फुटे[2] वा भूपरिधिहृतात्पदाद्[5] गुणात् षष्टचा[7]।
लब्धं घटिकाद्यथवा[3] कर्म तिथि[6] ऋण[4] धनं ग्रहवत् ॥ ३८ ॥
कल्पगताब्दा गुणिता रूपाष्टजिनैर्नवाग्निसतगैः[1][3]

२४८१७७३९ ।

खखरसनवभि ९६००[2] भक्ता[4] दिनावमान्यंशकाः[5] शेषाः ॥ ३९ ॥
तद्दिकगुणा[1] १० योगादर्धिस्त्रिशता[3] धृताल्लब्धम्[2] ।
शेषास्तिथयः शुद्धिदिनानि[4] विकलं दिनांशेभ्यः ॥ ४० ॥

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३८. (घ) १. मध्ये (ग) (च) for (मध्य)
२. स्फटे (च) for (स्फुटे)
(क) ३. 'द्य' लुप्त है—'छूट गया' का चिह्न है, आगे 'थावा' है।
४. मृण for (ऋण)
(ख) ५. भूपरिहृतात् for (भूपरिधिहृतात्)
६. तिथिषु for (तिथि)
(च) ७. +॥ ६ ॥

३९. (घ) १. जनैर्नवाग्नि for (जिनैर्नवाग्नि) (ग) जिनै २४२४८१
२. यह संख्या यहाँ 'भक्ता' के पश्चात् अंकित है।
(ग) ३. सप्तनगैः ७७३९ (क) सप्तनगैः (ख) for (सतगैः)
४. यहाँ 'भक्ता' से आगे ९६०० की संख्या है।
(क) ५. मानांशकाः for (मान्यंशकाः)
(च) १. रूपाथजनैर्नवाग्नि for (रूपाष्टजिनैर्नवाग्नि)

४०. (घ) १. गुणाः for (गुणा १०) (ग) तद्दिग्गुणा १० ब्द for (तद्दिकगुणा १०)
२. हृता (ग) (क) हृताल्लब्धां (ख) हताल्लब्धम् for (धृताल्लब्धम्)
(ग) ३. दधिमासास्त्रिशता (क) (ख) दधिमासा for (दर्धिस्त्रिशता)
(क) १. तद्दशगुणाब्दयोगा for (तद्दिकगुणा १० योगा)
(ख) १. तद्दिग्गुणाब्द for (तद्दिकगुणा १०)
४. र्दिनानि for (दिनानि)
(च) १. तद्दिकगुणाः for (तद्दिकगुणा)
२. द्धताल्लब्धं for (धृताल्लब्धं)

कल्पगता[3]क्षदिनयुतैः सूर्या[1]द्योऽ[6]ब्दाधिपो[2] गताब्दभगणवधः ।
कल्पाब्द[4]भूतो ग[5]णादिमध्यमः सूर्यभगणान्ते ॥ ४१ ॥
चैत्रसिताद्यास्तिथयः शुद्धिविहीनाः पृथ[1]ग्गुणा रुद्रैः[3] ।
अवमांशेभ्यो यमनवरस ६९२ गुणिते[2]भ्यो विभक्तेभ्यः ॥ ४२ ॥
स्व[5]छेनफलयुता हृतास्त्रि[1]खागैः ७९३[2] फला[3]वमविहीनाः ।
रवि[4]मेषादि द्युगणो मुनि[6]हृत् शेषोब्दपत्यादिः ॥ ४३ ॥

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४१. (घ) १. सूर्यो (च) for (सूर्या)
  २. योगताब्द for (पोगताब्द) (ग) ऽब्दभगण (क) धियोऽब्दभगण for (धिपोगताब्दभगण)
 (ग) ३. गताब्ददिनयुतैः for (गताक्षदिनयुतैः) (क) गताब्द for (गताक्ष)
  ४. हृतो (क) (ख) हृतो for (भूतो)
  ५. भगणादि (क) (ग) भगणादि for (गणादि)
 (ख) ३. कल्पगताब्ददिनयुतैः for (कल्पगताक्षदिनयुतैः)
  २. धिपोब्धभगणवधः for (धिपोगताब्द भगणवधः)
 (च) ६. अवग्रहचिह्नलुप्त

४२. (घ) १. प्रथगुणा (च) for (पृथग्गुणा)
 (ग) २. गुणिते विभक्तेभ्यः for (गुणितेभ्यो विभक्तेभ्यः)
 (क—यहां के मूलपत्र उपलब्ध नहीं हैं)
 (च) ३. रुद्रै for (रुद्रैः)

४३. (घ) १ त्रिखगैः for (त्रिखागैः) (ख) हृतास्त्रिखागैः for (हृतास्त्रिखागैः)
  २. ७०३ (ग) for (७९३)
  ३. फलाऽवम for (फलावम)
  ४. मेखादि (ग) (च) for (मेषादि)
 (ग) ५. स्वच्छेदेन ९६०० (ख) स्वछेदन for (स्वछेन)
 (क) (क—यहां का मूलपत्र उपलब्ध नहीं है)
 (ख) ६. मुनिहत for (मुनिहृत्)
 (च) १. हृतास्त्रखगैः for (हृतास्त्रिखागैः) ३ फलाइवमविहीनाः for (फलावमविहीनाः)
  ६. मुहृत for (मुनिहृत्)

द्युगणात्स[३]पत्यंशं स्वनवार्कांशाधिकं[१] १२९ विशो[४]ध्यांशाः ।
मध्याः सूर्यबुधसिता[२]: शीघ्रोच्चं कुजगुरुशनीनाम् ॥ ४४ ॥
त्रिगुणमवमा[२]शेषं विभजेद्द्यु[५]ग[१]णसप्त[४]शशि: १७३ ।
पृथगधिकोऽर्को[६] रविगु[३]णतिथ्यंशैः संयुतश्चन्द्रः ॥ ४५ ॥
एकादशलिप्तां[२]शा भौमः शरसप्तवसु[३]भिरिन्दुयमैः ।
कृतगुणितोध[४] द्युगणोशा[१]: पंचरसै[५] षट्क बुधशीघ्रम् ॥ ४६ ॥

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४४. (ग) १. यहाँ '१२९' संख्या नहीं दी गई ।
(क) क—यहाँ का नूलपत्र उपलब्ध नहीं है ।
(ख) २. सिता for (सिताः)
(च) ३. सप्रत्यंशं for (सपत्यंशं) ४ वशोध्यांशाः for (विशोध्यांशा)

४५. (घ) १. सप्तशशिराप्तांशैः (ग) सप्तशशिभिराप्तांशैः for (सप्तशशिः १७३)
(ग) २. भावशेषं (च) for (भाशेषं)
(क) (क—यहाँ का मूल पत्र उपलब्ध नहीं है ।
(ख) १. सप्तशशिभिराप्तांशैः for (सप्तशशिः १७३)
३. रविगुणातिथ्यंशैः for (रविगुणातिथ्यंशैः)
(च) १. सप्तशशिभिः for (सप्तशशिः १७३)
४. +सप्तांशैः+
५. 'ण' लुप्त
६. र्क्का for (ऽर्को)
३. रविगुणतिथ्यशै for (रविगुणतिथ्यंशैः)

४६. (घ) १. गणांशाः for (गणोशाः) (ख) द्युगणांशाः for (द्युगणोशाः)
(ग) २. लिप्तांशाः (ख) लिप्ताशन् for (लिप्तांशा)
३. ८७५ रिपुयमैः ॥ २१ ॥ for (रिन्दुयमैः)
४. गुणितो द्युगणोंशाः for (गुणितोवद्युगणोशाः) (ख) कृतगुणिता for (कृतगुणितोध)
५. रसैः ६५ (ख) रसैः (च) for (रसैं)
(क) (कि—यहां का मूलपत्र उपलब्ध नहीं है)
(च) ३. रिन्दुयमैं ११ for (रिंदुयमैः)
१. द्युगणोंशाः for (द्युगणोशाः)

द्यु[6]गणेषु बधो लिप्ताजीवः कृतशरगुणे[1]ः शरका[2]लोनः ॥
भागकलाः सितशीघ्रं[4] विषयै[5]र्वसवो द्विषष्टचाष्टौ[3] ॥ ४७ ॥
द्विगुणाः[1] कलाः[2] दिनगणस्तिथिरामैर्द्धे[3] काल[6] च सूर्यसुतः ।
नवभिर्भागैः साग[4] ११२१ खशून्यवेदैश्च[7]न्द्रोच्च[5]म्[8] ॥ ४८ ॥

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४७. (ग) १. गुणैः (ख) (च) for (गुणेः)

२. कलोनः । ३५४ । ५ ॥ for (कालोनः) (ख) शरकलोनः for (शरकालोनः)

३. ष्टौ ।८।८। for (ष्टौ) (ख) द्विषष्टमासौ for (द्विषष्टचाष्टौ) ।५।६२

(क) (कि—यहां का मूलपत्र उपलब्ध नहीं है ।

(ख) ४. शित for (सित)

५. विषवै for (विषयै)

(च) ६. द्युगणेशु for (द्युगणेषु) ३ द्विषष्टचष्टौ for (द्विषष्टचाष्टौ)

४८. (घ) १. द्विगुणः for (द्विगुणाः)

२. कला for (कलाः) (ख) कलादिनगणास् for (कलादिनगणास्) (च) कला for (कलाः)

३. द्धें कले । ३१५ । २ । for (द्धें काल)

४. सागर—for (साग ११२१) (यहां कोई संख्या नहीं दी गई है) (ख) सागर

५. + । ६ । १ । ४००४ । १० । +

(क) (क यहां का मूलपत्र उपलब्ध नहीं है)

(ख) ६. कले for (काल)

७. श्चचन्द्रोचः for (श्चन्द्रोच्चम्)

(च) ८. +१११+

भागो नन्दशशांकैः[५] ११९८ शशिशून्य[७] ८७५२१ स्वरयामै[१]

२७।९४००४।०११

रविमंडलांतिकयुता मध्य[२] भगणान्ति[६] ३५६[३] काशेषाः[८] ॥ ४९ ॥

पादार्द्धं विपाददिनै[१] राव्यर्द्धास्तमयदिनदलौदयिकाः । ३१५ ।

ऊनीकृत्वा तिथयो देशान्तरनाडिकानयुताः[२] ॥ ५० ॥

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४९. (घ) १. यमैश्च शशिपातः (ग) यमैश्च ७७०१ शशिपातः for (यामै २७। ९४००४।०११)

२. मध्या (ग); (ख) for (मध्य)

३. ३५८ for (३५६) (ग) यहां यह संख्या नहीं दी गई।

(ग) ४. भोगानन्द for (भागोनन्द)

५. १९ for (११९८)

६. भगणांतिका शेषाः for (भगणान्ति ३५६ का शेषाः)

(क) (क—यहां का मूलपत्र उपलब्ध नहीं है।)

(ख) ७. सूर्य for (शून्य)

१. यमैश्च शशिपातः for (यामै २७। ९४००४।०११)

(च) १. स्वरयामैश्च शशिपातः for (स्वरयामै)

३. ३५६।५। for (३५६)

८. काः for (का)

५०. (ग) १. दलोदयिकाः for (दलौदयिकाः)

२. नाडिकोनयुताः for (नाडिकानयुताः) (ख) नाडिकेन for (नाडिकान)

(क) (कि -यहां का मूलपत्र उपलब्ध नहीं है)

(ख) १. दिनदलौदयिक्ता for (दिनदलौदयिकाः)

कलिगतशुद्धिः[1] प्राग्वच्छुक्राद्योब्धाधिपोक्षभगण[7] वध्यतक्षितिजस्य।[1][2][3]
खत्रिचाष्ट[4] रससप्त[5] वसुरवाग्निवेदयुतात्[8] ।। ५१ ।।

४३०८७६८००००

बुधशीघ्रस्य खरवांबर रसनन्द[1] दृष्टोष्ट[3] वसुयमो दधिभिः।

४२८८८६६००[4]

खचतुष्टययमशरगुण शशिवेदैः ४३१३५२००००[4]

सुरेन्द्रगुरोः ।। ५२ ।।

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५१. (घ) १. ब्दा for (क्ष) (ग) ब्द भगणबधात् for (क्षभगणवध्यत) (ख) ब्द for (क्ष)
२. वध्यत् for (वध्यत) (पहली पंक्ति का अन्तिम शब्द) (ख) वधात् for (वध्यत)
३. 'क्षितिजस्य' दूसरी पंक्ति का आरम्भिक पद। (ग) (ख)
४. खत्र (ग) खत्रयाष्ट (ख) खत्रयाष्ट for (खत्रिचाष्ट)

(ग) ५. रसप्त for (रससप्त)

(क) (क—यहां का मूलपत्र उपलब्ध नहीं है।)

(ख) ६. शुधि for (शुद्धिः)
७. द्दधियो for (ब्दाधिपो)

(च) ७. छुक्राद्योब्दाधियो for (छुक्राद्योब्धाधिपो)
२. वध्यत् for (वध्यत)
४. खत्रचाष्ट for (खत्रिचाष्ट)
८. दैदयुतात् for (वेदयुतात्)

५२. (घ) १. रसनं दृष्टो (च) for (रसनन्द दृष्टो)
२. यह संख्या यहाँ श्लोक के अन्त में दी है। (ग) (च)

(ग) ३. नन्दाष्टाष्ट (क) (ख) नन्दाष्टा for (नन्ददृष्टोष्ट)
४. ४२८८८६६००० for (४२८८८६६००)

(क) ४. मूल में संख्या लुप्त है। टीका में ४२८८८६६००० अंकित है।
२. मूल में संख्या लुप्त है, टीका में ४३१३५२००० अंकित है।

भार्गव[1]शीघ्रस्यांबर खखाष्टं[3] वेदाब्धि[5]वेदखाग्नि[6] कृतैः ४३०४४४८०००
भास्कर[7] सुतस्य खत्रय रविगुणशर[2]खगुण[4] समुद्रैः ॥ ५३ ॥
४३०५३१२०००

शून्य[7]चतुष्टय पक्षेदुं[2] रामगुण नवभिरर्कमंदस्य । ६३३१२००००
इन्दोः[3] खमय[1] यमशरनव[4] पंचव्योम[6] शरचन्द्रैः[5] ॥ ५४ ॥ १५०५६२०००
खत्रय यमनवपंचाष्टरामधृतिभिः शशांकपातस्य । १८३८५६२०००
कल्पगतभगण[1]घातात् कुजादिमंदोच्चपातानाम् ॥ ५५ ॥

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५३. (घ) १. भाग्रव (च) for (भार्गव)
२. शरखद for (शरखगुण) (ख) शरखदहन सुमुद्रैः for (शरखगुणसमुद्रैः)
(ग) ३. खखाष्ट for (खखाष्टं) (क) (ख) खाखाष्ट for (खखाष्टं)
४. दहनसमुद्रैः (क) for (खगुणसमुद्रैः)
(ख) ५. वेदाश्च for (वेदाब्धि)
६. वेदखाब्दि for (वेदखाग्नि)
७. भागस्कर for (भास्कर)
(च) ३. खखाष्ट for (खखाष्टं)
४. खद for (रवगुण)

५४. (घ) १. त्रयं for (खमय) (ख) त्रयमशर for (खमययमशर) (च) खत्रये for (खमय)
(ग) २. पक्षेन्दु (क) (च) for (पक्षेदुं)
३. चन्द्रसमः शून्यत्रय for (इन्दोः खमय)
४. यमशनवशरखशरचन्द्रैः for (यमशरनवपंचव्यो मशरचन्द्रैः)
५. १५०५६५२००० (च) for (१५०५६२०००)
(क) ३. चंद्रमसः शून्यत्रय for (इन्दोः खमय)
६. शरख for (पंचव्योम)
वि० मूलांकित दोनों संख्याएँ मूल में नहीं है। टीका में अंकित हैं।
(ख) ७. सून्य for (शून्य)

५५. (क) मूल में संख्या उपलब्ध नहीं। टीका में अंकित है।
(ख) १. गणोघ्ययातात्कुंजादि for (गणघातात् कुजादि)

भगणादिकल्पवर्षै लब्धं रविमंडलान्तिकामध्या ।
मेषादिद्यु गुणफलाधिका भवन्तीष्टदिनमध्याः ॥ ५६ ॥
शुद्धीश ११ बधे शुद्धे देवमशेषात् सावनद्यु गण शुद्धिः ।
व्येकावमं गृहीत्वा गुणस्वमुने युतान्न शुध्यति चेत् ॥ ५७ ॥

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५६. (घ) १. लब्धम् for (लब्धं) (ग) (क) (ख) लब्ध for (लब्धं)

२. मेखादि for (मेषादि)

३. द्युगण (ग) (क) for (द्युगुण)

(क) ४. मध्याः (ख) मध्यः (च) मध्य for (मध्या)

(ख) ५. वर्षैः for (वर्षै)

६. लान्तिको for (लान्तिका)

(च) १. ब्धं for (लब्धं) ३ वक (द्यु) गण for (द्युगुण)

५७. (घ) १. शुद्धेऽवशेषा (ग) शुद्धेऽवमशेषात् (ख) शुद्धेवमशेषात् for (शुद्धेदेवमशेषात्)

२. व्येकामवं (ख) एकावमं for (व्येकावमं)

३. खमुने (क) खमुनि for (स्वमुने)

(ग) शुद्धीश के पश्चात् ११ की संख्या नहीं दी गई है। (क)

(क) १. ऽवमशेषोत्सावन for (देवमशेषात्सावन)

४. सिद्धिः (ख) सुद्धिः for (शुद्धिः)

(ख) ५. युतानि for (युतान्न)

६. सुध्यति for (शुध्यति)

(च) १. शुद्धेइवमशेषात् for (शुद्धेदेवमशेषात्)

२. व्येकामवं for (व्येकावमं)

चैत्रसिताद्योब्द पतिद्धूनाया दिनाब्दरूपयुतेः ।
तद्युगणादिनवारान् मुहुर्मध्यमा प्राग्वत् ॥ ५८ ॥
अकृतार्यभटः शीघ्रगमिन्दुच्चं पातमल्पगं स्वगतेः ।
तिथ्यन्तग्रहाणानां घुणाक्षरं तस्य संवादः ॥ ५९ ॥

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५८. (घ) १. शुद्धचूनाया for (पतिद्धूनाया) (ग) (क) पतिः शुद्धचूनाया for (पतिद्धू-नाया)
२. वारन् (ग) वारः (क) वारः (ख) वारः for (वारान्)
३. मध्यमा (ग) (क) मध्यमा for (मंध्यमा)
४. मुह्यू (शुद्धचू) (ग) शुद्धचूना (क) शुद्धचवमा for (मुहुर्मध्यमा)
(ग) ५. चैत्रसिताद्योद्योब्दपतिः for (चैत्रसिताद्योब्दपति)
(क) ६. तद्युगणात् for (तद्युगणा)
(ख) १. पतिः शुध्यूनाया for (पतिद्धूनाया)
४. शुध्यूना for (मुहुर्मध्यमा)
(च) १. पतिः शुद्धचूनाया for (पतिद्धूनाया)
६. तत् द्युगणा for (तद्युगणा)
३. मध्यमाः for (मध्यमा)

५९. (घ) १. स्वगतैः (ख) स्वगते for (स्वगतेः)
२. घुणाक्षरं (च) for (घुणाक्षरं)
(ग) ३. दूच्चं (क) (ख) दूवं for (दुच्चं)
(क) ४. ग्रहणानां (ख) (च) for (ग्रहाणानां)
५. मल्यगं for (मल्पगं)
६. 'संवादः' पद लुप्त है ! श्लोक तो 'तस्य' पर समाप्त है।
(च) ७. शिघ्र for (शीघ्र)

(घ) खखखार्क १२००० हृताब्देभ्यो, गतगम्याल्पाः खशून्ययमल २०० हृताः।
लब्धं त्रि ३ सायक ५ हतं कलाभिरूनौ सदार्केन्दू ॥ ५९ ॥
शशिवत् जीवे द्वि २ हतं, चन्द्रोच्चे तिथि १५ हतं तु सितशीघ्रे ।
द्वीषु ५२ हतं च बुधोच्चे, द्वि २ कु १ वेद ४ हतं च पात कुजशनिषु ॥ ६०
वि० उपर्युक्त दोनों श्लोक १९०२ ई० में प्रकाशित ब्राह्मस्फुटसिद्धान्त में "अतिरिक्त" हैं।

मध्यगतिज्ञं वीक्ष्य[१] श्री षेणार्यभटविष्णु[५]चन्द्रज्ञाः[४]।
सदसि न भवन्त्यभिमुखाः सिंहं दृष्ट्वा[२] यथा हरिणाः[६] ॥ ६० ॥
युगभगणमान याता[५]हर्गण[१] दिनवारमध्यमाद्येषु ।
मध्यमगति द्विषष्टचार्याणां[२] प्रथमकृतो[३] है[४] ॥ ६१ ॥

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६०. (ग) १. वीक्ष for (वीक्ष्य)
२. दिष्ट्वा for (दृष्ट्वा)
(क) ३. श्रीहर्षेणार्य for (श्रीषेणार्य)
(ख) ५. विभुचन्द्राद्या for (विष्णुचन्द्रज्ञाः)
६. हरिणः for (हरिणाः)

६१. (घ) १. हर्ग्रण for (हर्गण)
२. द्विषष्ट्यार्यणां (ग) द्विषष्ट्यार्यां (क) द्विषष्ट्यार्याणां for (द्विषष्ट्यार्याणां)
३. प्रथमः कृतोध्यायः (ग) (क) प्रथमाः for (प्रथमकृतो है)
(ग) वि०+इति श्री ब्रह्मसिद्धाते मध्यमाधिकारः प्रथमः+
(ख) ५. यतो for (याता)
२. द्विषष्ट्यार्याणां for (द्विषष्ट्यार्याणां)
(ख) की दृष्टि से ६३ श्लोक हैं, २३ वां अधिक है।
(च) ३. प्रथमः for (प्रथम)
४. कृतोध्यायः for (कृतोहै)

।। श्रीगणेशायनमः ।।[५]

यस्मान्न मध्य[४]तुल्यः प्रतिदिवसं दृश्यते ग्रहो भगणे ।
तस्माद्[१] कल्पकरं वक्ष्ये[३] मध्यस्फुट[२]करणम् ।। १ ।।
अर्धंज्याभूयमला[१] मुनियमवेदा वसुऽनलषट्का[२] ।
रसकृतवसवः शशिपंचखेन्दवश्चन्द्रशरसूर्याः[३] ।। २ ।।
षट्दधि[५]मनवो भूवाग्नि[३]रसशशांका मुनींद[४]वसुचन्द्राः[६] ।
इन्दुनवनन्दचन्द्रा[७] रसतिथय[१] यमला रविस्त्रियमाः[२] ।। ३ ।।

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१. (घ) १. सस्माद्दृ for (तस्माद्) (ग) तस्माद्दृक् तुल्यकरं (क) तस्माद्दृक् तुल्यकरं for (तस्माद्कल्पकरम्)
२. स्फुटं for (स्फुट) (ग) स्फुटीकरणम् (क) स्फुटीकरणम् for (स्फुटकरणम्)
(ग) ३. वक्षे for (वक्ष्ये)
(क) ४. मध्यम for (मध्य)
(ख) १. तस्माद्दृक् तुल्यकरं for (तस्माद् कल्पकरं)
२. स्फुटीकरणम् for (स्फुटकरणम्)
(च) ५. "मंगलसूचक शब्द" लुप्त है !
१. तस्मात् दृ for (तस्माद्) २ स्फुटं for (स्फुट)

२. (घ) १. मनुयमला for (भूयमला (ग) (क) अर्धंज्यामनुयमला for (अर्धंज्या-भूयमला)
२. वसुज्वलखट्काः (ग) (क) वसुज्वलनषट्काः for (वसुऽनलखट्का)
(ख) १. अर्धंज्यामनुयमला for (अर्धंज्याभूयमला)
२. वसुज्वलनषट्काः for (वसुऽनलखट्का)
३. चन्द्रममूर्या for (चन्द्रशरसूर्याः)
(च) १. अर्द्धंज्यामनुयमला for (अर्धंज्याभूयमाला)
२. वसुज्वलनषट्काः for (वसुऽनलषट्का)

३. (घ) १. तिथिय for (तिथय) (ग) (क) रसतिथि (ख) रसतिथि for (रसतिथय)
२. यम्नाः for (यमाः) (ख) for (यमाः)
(ग) ३. भूताग्नि (क) (ख) (च) for (भूवाग्नि)
४. मुनींदु (क) (ख) (च) for (मुनींद)
(क) ५. षडवब्धि for (षट्दधि)
६. चन्द्रा for (चन्द्राः)
(ख) ७. चन्द्राः for (चन्द्रा)   (च) १. तिथि for (तिथय)

ऋतुनवखगुरणः[3] नवशरचन्द्रगुरणाः[1] सप्रशून्ययमदहना[4] ।
द्विजिनगुरणा स्त्रिरसरदा[5] खस[2] प्रयम छिद्रेषु[6] जिनाः ॥ ४ ॥[7]

४ (घ) १. चन्द्रागुरणा (च) for (चन्द्रगुरणाः)
२. सप्त for (सप्त) (ग) सप्तयम वह्नयो व्यस्ताः ॥ ५ ॥ for (सप्रयम-छिद्रेषु जिनाः ॥ ४ ॥)

(ग) ३. गुरणा for (गुरणः)
४. दहनाः for (दहना)
५. रदाः for (रदा)

(क) 'क' में अंकित नहीं। इसके स्थान में दूसरा श्लोक अंकित है जो अगले पृष्ठ पर दिया है।

(ख) यहां यह श्लोक अंकित नहीं है।

(च) २. सप्त for (सप्र)
६. छिद्रेशु for (छिद्रेषु)
७. क्रमसंख्या लुप्त ।

(क. ख. ग.) में अतिरिक्त श्लोक—

छिद्रेषु जिना कृतनव पंचयमा[1] दं[2] नंद चन्द्रमुनि पक्षाः ।
दन्ताष्ट्[5]यमागुरण[6] रामनवयमाः शशिख[3] रामाः ॥ ४ ॥
ऋतुनव खगुरणा नवशरचंद्रगुरणाः सप्तशून्ययमदहनाः ।
द्विजिन[4] गुरणास्त्रिरसरदाः खसप्तयम वह्नयो व्यस्ताः[7] ॥ ५ ॥

(क) १. यमाः for (यमा)
२. 'दं' लुप्त पद है। (ख)
३. शशियमखरामाः ॥ ४ ॥ (ख) शिशिगुरणखराम for (शशिखरामाः)
४. जित for (जिन)

(ख) ५. दताष्ट for (दन्ताष्ट)
६. यमगुरण for (यमागुरण)
७. व्यास्ताः for (व्यस्ताः)

(च) वि० इस स्थान पर यह श्लोक लुप्त हैं।
पृष्ठ ८b पर नीचे की ओर अन्य लेख में "ऋतुनव..........से-खसप्रयम" तक विद्यमान है। इस पर क्रम संख्या कोई नहीं।

कृतनव पंचयमा[2] नन्द चन्द्र[3] दन्ताष्ट यमगुण[1] रामनवयमाः[4] ।
शशियम खरामाः[5] मुनिपक्षाः वह्नयो व्यस्ताः ॥ ५ ॥
मुनयोष्टयमास्त्रिरसा रुद्र[4] शशांकाः समुद्रमु[1]निचन्द्राः ।
नववेदयमामुनिगुणा[3] हुताशना[2] वसुगुणसमुद्राः ॥ ६ ॥
रूपेन्द्रियेषवोरसनगर्तं[1]वश्चन्द्रशीतकरवसवः ।
वसुशरनन्दाः[3] सागररुद्रशशांकाः[2] नवागार्काः[4] ॥ ७ ॥
त्रिविषयवेदशशांकाःपंचत्रि[4]रसेंदवोब्धियमधृतयः ।
अतिधृतिस्व[2]यमानवशशियमपक्षा[3] सागर द्विजिना[1] ॥ ८ ॥

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५. (घ) १. यमा (च) for (यम)
(ग) वि० यहां चौथे और पांचवें श्लोक की चारों पंक्तियों को कुछ भिन्न प्रकार से लिखा हे । (क)
(क) १. क+षट् छिद्रेषु जिना २४५६+
२. यमाः+२५६४+for (यमा)
३. चन्द्रमुनिपक्षाः २७१६ for (चन्द्रदन्ताष्ट)
१. यमाः+२८३२ for (यम) । इसके पश्चात् दूसरी पंक्ति प्रारम्भ
४. +२६३३+
५. +३०२१+
(ख) यहां पर यह श्लोक 'लुप्त' है ।

६. (ग) ३. गुण (च) for (गुणा)
(क) ४. रुद्राः for (रुद्र)
(च) २. कुताशना for (हुताशना)

७. (घ) १. त्र्वेवश्चन्द्र for (र्तवश्चन्द्र)
(क) २. शशांका (च) for (शशांकाः)
(ख) ३. नन्दा for (नन्दाः)
४. नवागार्का for (नवागार्काः)

८. (घ) १. द्विजिनाः (ग) (च) for (द्विजिनाः)
२. स्व (क) (च) for (स्व)
(ग) ३. पक्षाः (क) for (पक्षा)
(ख) ४. भि for (त्रि)
(वि० देखिए पृष्ठ २६—सारणी के लिए)

रदरसयमला गुणवेदवसुयमाः षट्क विषय[३]शून्यगुणाः ।
खमुनि[१]रसा व्यासार्द्धं नवरदचन्द्रा जिनां[४]शय्याः ॥ ६ ॥ [२]२४।१३।२६

२१४	[१]१८८७	२९३३	७	५५१	१८२४
४२७	१९९१	३०२१	२८	६७६	२०१९
६३८	२१५६	३०९६	६३	८११	२२१९
८४६	२३१२	३१५९	१११	९५८	२४२४
१०५१	२४५९	३२०७	१७४	१११४	२६७२[३]
१२५१	२५९४	३२४२	२४९	१२७९	२८४३
१४४६	[२]२७१४	३२६३	३३७	१४५३	३०५६
१६३५	२८३२	३२७०	४३८	१६३५	३२७०

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६. (घ) १. रदा (ग) रदा (क) (च) for (रसा)

२. २४ ॥ १३२९ for (२४।१३।२६) ॥ (ग) १३२९+॥ २१४[१] ॥ ४२७[२] ॥ ६३८[३] ॥ ८४६[४] ॥ १०५१[५] ॥ १२५१[६] ॥ १४४६[७] ॥ १६३५[८] ॥ १८१७[९]॥ ॥ १९९१[१०] ॥ २१५६[११] ॥ २३१२[१२] ॥ २४५९[१३] ॥ २५९४[१४] ॥ २७१९[१५] ॥ ॥ २८३२[१६] ॥ २९३३[१७] ॥ ३०२१[१८] ॥ ३०९६[१९] ॥ ३१५९[२०] ॥३२०७[२१]॥३२४२[२२]॥ ॥ ३२६३[२३] ॥ ३२७०[२४] ॥ एतेक्रमस्थाः ॥ अत उत्क्रमस्थाः ॥ ७[१] ॥ २८[२] ॥ । ६३[३] । १११[४] । १७४[५] । २४९[६] । ३३७[७] । ४३८[८] । ५५१[९] । ६७६[१०] । ८११[११] । । ९५७[१२] । १११४[१३] । १२७९[१४] । १४५३[१५] । १६३५[१६] । १८२४[१७] । २०१९[१८] । । २२१९[१९] । २४२४[२०] । २६३२[२१] । २८४३[२२] । ३०५६[२३] । ३२७०[२४] । उत्क्रमज्या इति ॥+

(ख) ४. जिनांशज्या for (जिनांशय्याः)

(सारणी) (घ) १. १८१७ (ग) (च) for (१८८७)
२. २७१९ (ग) (च) for (२७१४)
३. २६३२ (ग) (च) for (२६७२)

(क) यहां यह सब लुप्त हैं ।

लिप्तास्तत्त्वयमहृता[५] २२५ लब्धं द्याषष्ट्यंतराहृता[१] च्छेषात् ।
तिथिकृति २२५ हृत्फलयुता[६][२] लब्धषष्ट्या[७][३] द्वा[४] ग्रहणमेवम्[८] ॥ १० ॥
ज्यां प्रोह्य[७] शेषगुणितास्तत्त्वयमा[६][३] ज्यांतरा धृतालब्धम्[१][४] ।
क्षेप्यं[८] विशुद्धजीवासंख्यातिथि[२] कृतिवधे[५] चापम् ॥ ११ ॥

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१०. (घ) १. ज्याष्ट्यांतरा (ग) ज्याज्यांतरा (क) ज्याज्यांतरा (च) for (द्याषष्ट्यांतरा)
२. हृतात् (क) for (हृत्)
३. ष्ट्या (ग) ज्या (क) (ख) षष्ट for (षष्ट्या)
४. ज्या (ग) ज्या (क) (ख) ज्या for (द्वा)

(ग) ५. मलहृता (ख) यमाहुता for (यमहृता)
६. २२५ हृतात्फल for (हृत्फल)
७. लब्वं for (लब्ध)

(क) २. हृतात्फलयुतात् for (हृत्फलयुता)

(ख) १. लब्धद्याघृचां for (लब्वद्याषष्ट्यां)
८. ग्रहणमेव for (ग्रहणमेवम्)

(च) ६. २., २२५ हृतात्फलयुता for (२२५ हृत्फलयुता)
३. ष्ट्या for (षष्ट्या)
४. छा for (द्वा)

११. (घ) १. ज्यांतरो (क) ज्यांतरोद्धृता (च) ज्यांतरोधृता for (ज्यांतराधृता)
२. संक्ष्या for (संख्या)

(ग) ३. गुणितात्तत्वयमा २२५ for (गुणितास्तत्त्वयमा)
४. +न+
५. +२२५+

(क) ६. सेष (ख) सेष for (शेष)

(ख) ७. प्रयोज्यय for (प्रोह्य)
८. क्षेपं for (क्षेप्यं)

(च) ७. प्रोज्य for (प्रोह्य) ८. क्ष्येप्यं for (क्षेप्यं)

मध्याद्विशोध्य मंदं शीघ्रात्संशोध्य मध्यमं केन्द्रम् ।
[1]अयुतिगता यया यो[3] युति पदे[4]ऽन्यथा बाहुकोटिज्ये ।। १२ ।।
[4]त्रिज्याहृता भुजज्या [5]२२७० युगयुक्परिधि [1]द्व्यांतर [2]गुणाप्त्या ।
[7]युग्मांत [3]परिधिरधिको हीनो[6]ऽधिकः [8]हीनोधिकः स्पष्टः ।। १३ ।।
तद्गुणितेज्ये भांशैः ३६२ [2]हृते फले कोटिफलयुता त्रिज्या ३२७० ।
आद्यन्तयोर्[1]निहीनो पदयोर्द्वि[3]तृतीययोः कोटिः ।। १४ ।।

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१२. (घ) १. व्ययुयगतयेयोर्युजि (ग) अयुजिगतयेयोर्युजि for (अयुतिगतायययायो युति)

(क) १. अयुजिगतैर्योज्ययोर्युजि for (अयुतिगतायययायोयुति)

(च) १. अयुतिगतं for (अयुतिगता) २ या for (यो) ३ युँति for (युति)

४. अवग्रहचिह्नलुप्त

१३. (घ) १. द्वयांतर (ग) द्वयांर (क) द्वयांतर (ख) द्व्ध्वयांतर for (द्व्यांतर)

२. गुणात्प्त्या (ग) गुणप्त्या for (गुणात्प्या)

३. परिधिको हीनो हीनाधिकः for (परिधिरधिको हीनोऽधिकः हीनोऽधिकः)

(ग) ४. ३२७० हृता (क) त्रिज्याहृता (च) for (त्रिज्याहृता)

५. यह संख्या अंकित नहीं ।

६. 'ऽधिकः' शब्द अंकित नहीं (क)

(क) ७. 'युग्मांतर for (युग्मांत)

(ख) ६. 'हीनोऽधिकः' पद लुप्त हैं

८. हीनाधिकः for (हीनोधिकः)

(च) ५. २७७० for (२२७०) २+८+

३. परिधिकोहीनो for (परिधिरधिको हीनोऽधिकः)

१४. (घ) १. विहीना (ग) विहीना (क) विहीना for (निहीनो)

(ग) २. हृँते (क) for (हृते)

३. द्वित्रितीययोः for (द्वितृतीययोः)

(ख) १. विहीनो for (निहीनो)

(च) १. विहीना for (निहीनो)

तद्भुजफल कृतियोगान्मूलं कर्णः[1] पदेष्वयुग्युक्षु[5] ।
स्वपरिधिगुणा[2] क्रमोत्क्रमजीवा[5] भांशै[3] ३६० हृतान्मन्दे[4] ॥ १५ ॥
क्षयधनधनक्षयास्तत्फलानि शीघ्रेऽन्यथा धनं धनयोः ।
ऋणमृणयोर्योगान्तरमृणधनयोस्तुल्ययोः[1][2][3] शून्यं ॥ १६ ॥
तच्चापं मन्दफलं फलयोगान्तरवशाद्धनमृणं[3] वा ।
शीघ्रफलं तद्गुणितादव्यासार्द्धात्[1][2] कर्णलब्धधनुः ॥ १७ ॥ ३२७०
देशान्तरे खमध्ये[1] भुजफलचापे भुजांतरे च कृते ।
उन्मण्डलेऽर्के[2] चन्द्रौ स्पष्टौ रविचरदले क्षितिजे ॥ १८ ॥
अर्कोदयास्तमययोर्विना[1] चरार्द्धेन रात्रिदिनदलयोः[2] ।
न स्फुटमार्यभटोक्तं स्पष्टीकरणं स्फुटोक्तिरतः ॥ १९ ॥

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१५. (घ) १. कर्ण पटेष्वग्युक्षुः for (कर्णः पदेष्वयुग्युक्षु)
२. गुणाः (च) for (गुणा)
३. स्यांशे for (भांशै ३६०) (ग) हृताफलं मंदे for (हृतामन्दे)
४. मांदैः (क) हृतामांदो (ख) हृतामन्दे for (हृतान्मन्दे)
(क) ५. पदेष्वयुक् युक् स्यात् for (पदेष्वयुग्युक्षु)
(ख) ६. क्रमोक्रमजीवा for (क्रमोत्क्रमजीवा)
(च) १. कर्णपदेष्वयुक्षः for (कर्णः पदेष्वयुग्युक्षु)
३. ज्यां (भां) शै for (भांशै) ४ हृतामंदै for (हृतान्मन्दे)
१६. (घ) १. घनयोः for (धनयोस्)
(ग) २. योगोन्तर for (योगान्तर)
३. तुल्ययो for (तुल्ययोः)
१७. (घ) १. गुणुता for (गुणिताद्)
(ग) २. व्यासार्द्धत् (क) व्यासोर्द्धात् for (व्यासार्द्धात्)
(क) ३. मृणंवति for (मृणंवा)
(च) १. तद्गुणितोद् for (तद्गुणिताद्)
१८. (घ) १. स्वमध्यो (ग) स्वमध्यै (क) स्वमध्यौ (ख) स्वमध्यो for (खमध्ये)
(च) १. स्वमध्यो for (खमध्ये)
२. र्क्को for (ऽर्के)
१९. (ख) १. अर्कोदयास्तममयोर्विना for (अर्कोदयास्तमययोर्विना)
२. राभि for (रात्रि)
(च) १. अर्क्कोदयास्तमययोर्विना for (अर्कोदयास्तमययोर्विना)

सूर्यस्य मनुद्वितयं त्रिंशोनं[४] दिनदलेन तस्य प्राक् । $\frac{१३}{४०}$[१]
तिथि[२]घटिकाभिस्त्रयंशा[३]धिकोनमूनाधिकं पश्चात्[५] । $\frac{०}{२०}$ ॥ २० ॥
द्यु[८]दले जिनलिप्तोनं दशनद्वितयं ($\frac{३१}{३६}$)[५] द्विशर[६] ५२ कलोनु[१] प्राक्[२] ।
पश्चाद्युतोनमिंदोः[३] सूर्यवहृण[७] धन परिध्यंशाः[४] ॥ २१ ॥

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२०. (घ) १. $\frac{१३}{४०}$।$\frac{१३}{४०}$ (ग) for ($\frac{१३}{४०}$)

२. तिथि +१५+(ग) for (तिथि)

३. त्र्यंशा (ग) स्त्रियशाधिकोन ।१४।०॥१३।२०॥ for (स्त्रयंशाधिकोन)

(ग) ४. त्र्यंशोनं (क) for (त्रिंशोनं)

५. पश्चात् व for (पश्चात्)

(च) २. +१५+   १ संख्या लुप्त

३. त्र्यं $\frac{१३}{४०}$॥$\frac{१३}{४०}$॥ शाधिको for (त्रयंशाधिको)

२१. (घ) १. कलोनं (ग) (क) (ख) कालोनं for (कलोनु)

२. यहां '५२' संख्या जो 'द्विशर' के बाद अंकित है, लिखी है ।

३. मंदोः for (मिंदोः)

(ग) ५. संख्या अंकित नहीं है ।

६. संख्यां अंकित नहीं है ।

(क) ७. सूर्याहृण for (सूर्यवहृण)

(ख) ८. द्युदलेतिन for (द्युदलेजिन)

(च) ६. संख्यालुप्त   १ कलोनं for (कलोनु)

२. +५२+   ७ सूर्यवहृण for (सूर्यवहृण)

[३]तद्यु दलपरिध्यंतर गुणा[१]कृता त्रि[२]ज्यया स्वनतजीवा ।
ऊने धनमृणमधिके[४] दिनार्द्ध परि[६]धौ स्फु[५]टः परिधिः ॥ २२ ॥
भुजफलचापं केन्द्रे षड्रा[१]श्यूने खावृणं मध्ये ।
स्वभुज[२]बलचापमिन्दौ षड्रा[३]श्यधिके धनं भवति ॥ २३ ॥
देशान्तराद्यमेवं स्पष्टीकरणं दिनार्द्धपरिधिभ्याम् ।
कृत्वा तत्तिथ्य[१]न्त स्फुटपरिधिभ्यां स्फुटावसकृत् ॥ २४ ॥

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२२. (घ) १. हृता (ग) (क) (च) for (कृता)

२. तृज्यया for (त्रिज्यया) (क) त्रिज्ययाश्च नतजीवा for (त्रिज्यया स्वनत-जीवा)

(ग) यहां निम्नांकित संख्या अधिक है—

३१	३१	५२	३०	३२	३०
३६	३६		४४	२८	४४
				८	

(क) ३. तत्

४. मधिका for (मधिके)

(ख) ३. तद्युदलं for (तद्युदल)

(च) ६. परिधो for (परिधौ)

२३. (घ) १. षड्राशून्ये (च) for (षड्राश्यूने)

२. फल (च) for (बल)

(ग) ३. षड्राशधिके (क) षड्रास्यधिके (ख) षड्राश्याधिके for (षड्राश्यधिके)

२४. (क) १. तत्तिथ्यन्तः (ख) तत्तिथ्यन्तं for (तत्तिथ्यन्त)

प्राक् पश्चाद्वा याभिर्घटिका[४]भिर्दिनदलान्नतः[३] सूर्यः ।
तिथ्यंते तद्रहिते[१] त्रिंशत्[२] घटिकावशेषाभिः[५] ॥ २५ ॥
विपरीतमर्धरात्राच्चन्द्रग्रहणे[२] शशी रविग्रहणे ।
सूर्योयतस्ततस्[१]ताभिरेव[३] घटिकाभिरिन्दुरपि ॥ २६ ॥
दिनदल[१] परिधि स्फुट तिथिनतकेन्द्रज्यावधो[२] गुणोर्केन्दोः[३] ।
इंदू[४] धृति धृतिभि १६१ नवनववेदै[८] ४६६ व्यासार्द्धकृति[७]र्भक्तः[५] ॥ २७ ॥
१०६६२६००[६]

२५. (घ) १. तद्रहिव for (ग) (तद्रहिते) (ग) तद्रहितस्त्रिशद् for (तद्रहिते त्रिंशत्)(क) तद्रहितं for (तद्रहिते)
२. श्यंशद् (क) त्रिदशत for (त्रिंशत्)
(ग) ३. नतसूर्यः for (नतः सूर्यः)
(ख) ४. घटिकाभि for (घटिकाभि)
५. त्रिंशदधिकावशेषाभिः for (त्रिंशत्घटिकावशेषाभिः)
(च) ३. द्दिनदलान्नत् सूर्यः for (दिनदलान्ततः सूर्यः)
२. त्रिंशद् for (त्रिंशत्)
२६. (घ) १. यतस्वषः for (यतस्ततस्)
२. चन्द्रग्रहणे (क) चन्द्रग्रहादिनिग्रहाणः for (चन्द्रग्रहणे)
३. रेवमथ for (रेव)
(च) २. चन्द्रग्रहणो for (चन्द्रग्रहणे)
२७. (घ) १. दज for (दल)
२. व्या for (ज्या) (क) ज्यावाधो for (ज्यावधो)
३. कॅन्द्वोः (ग) (ख) कॅन्द्रो for (कॅन्दोः)
४. इंद्वतिधृतिभि (ग) (क) इंदुविधृतिभि for (इंदूधृतिधृतिभि)
५. भक्तः for (र्भक्तः) (ग) (ख) कृतिभक्ति for (कृतिर्भक्तः)
६. १०६६ ॥ २६०० for (१०६६२६००)
(ग) ७. व्यासार्द्धकृति (क) व्यासार्द्धकृते for (व्यासार्द्धकृति)
वि० रेखाङ्कित दोनों संख्याएं "वेदै" के पश्चात् एक स्थान पर हैं। (१६१, ४६६)
(क) ३. गुणौर्केस्तः for (गुणोर्केन्दोः)
८. नवनववेदै (च) for (नवनववेदै)
वि० संख्याएं मूल में लुप्त हैं।
(च) ३. कॅद्वोः for (कॅन्दोः) ५. भक्तः for (र्भक्तः)

फलविकला[४] वा सूर्ये[५] प्रागृणमसकृन्नते[६] धनं पश्चात् ।
केन्द्रफलमृणं[७] चन्द्रेऽन्यथा[३] धनं[१] चेहृणं[२] स्पष्टौ ॥ २८ ॥
अर्कफलभुक्तिघाताद्भगणकलाप्तं[५] [१] भुजांतरं[२] रविवत् ।
स्फुटभुक्तिरतीतैष्य[४] ग्रहान्तरं वर्तमानेऽह्नि[३] ॥ २९ ॥
क्षयधनहानिधनानि[१] प्राक् पश्चादन्यथा खेरिंदोः ।
प्राग्वत्पश्चात्स्वगतौ[३] धनक्षयक्षयधनानि प्राक्[२] ॥३०॥
ब्रह्मोक्तमध्यरविशशिलदुच्चतत्परिधिभिः स्फुटीकरणम्[४] ।
कृत्वैन[१] स्पष्टतिथिर्दू[२]रभ्रष्टा[३]न्यतंत्रोक्तैः[५] ॥ ३१ ॥

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२८. (ग) १. धननं for (धनं)
२. चेहृणं (क) मे ऋणं (ख) चेहृणं for (चेहृणं)
(क) ३. चा प्रात्यपा for (चन्द्रेऽन्यथा)
(ख) ४. विकल for (विकला)
५. सूर्यो for (सूर्ये)
६. मासत्कृते for (मसकृन्नते)
७. धृतिभिर्नवनववेदौ for (केन्द्रफलमृणं)
(च) २. चेहृणं for (चेहृणं)

२९. (घ) १. भरणे for (भगण)
२. +२१६०+(च)+२१६००+
(क) ३. ह्निः for (ह्नि)
(ख) ४. रतीतैष्यद् for (रतीतैष्य)
३. ऽह्नि for (ऽह्नि)
(च) ५. अर्क्क for (अर्क)
४. रतीतैष्टचद्ग्रहांतरं for (रतीतैष्य ग्रहान्तरं)
३. ह्निः for (ऽह्नि)

३०. (क) १. 'धनानि' पद लुप्त है ।
२. प्राग्वत् for (प्राक्)
(ख) ३. +च+

३१. (घ) १. कृत्वैवं (ग) (क) (च) for (कृत्वैनं)
२. स्पष्टतिथे for (स्पष्टतिथि)
३. च for (भ्र)
(क) ४. स्फुटाकरणम् for (स्फुटीकरणम्)
५. कृत्रोक्तो for (तंत्रोक्तैः)

स्वदिनार्द्धं परिधिभुजफलचापं मध्यार्[2]कचन्द्रयोः कृत्वा ।
पूर्ववदन्यत्स्पष्टं[1] संव्यवहारार्थमेवं वा ।। ३२ ।।
आर्यभटस्याज्ञानान्मध्यममन्दोच्चशीघ्रपरिधिना[1] ।
न[2] स्पष्टा भौमाद्याः[3] स्पष्टा[4] ब्रह्मोक्तमध्याद्यैः ।। ३३[5] ।।
मंदोच्चनीचवृत्तस्य परिधिभागाः सितस्य विषमांते ।
नव ९ युग्मांते रुद्राः[4] ११ शीघ्रौ[3] जान्तेऽग्निरसयमलाः[5] ।।[1] २६३ ।।३४।।[2]
युग्मांतेष्ट[4]शरयमाः[5] २५८ मंदफलात्[1]मध्यमः[2] स्फुटो मध्यः ।
शीघ्रफलात्स्पष्टो सकृदेवं स्वफलैर्ज्ञगुरुसौराः[3] ।। ३५ ।।

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३२. (घ) १. स्पष्टो (ग) स्पष्टौ (क) स्पष्टौ for (स्पष्टं)
(च) २. मध्यार्क्क for (मध्यार्क)

३३. (घ) १. परिधीनाम् (ग) (क) (च) for (परिधिना)
२. त for (न)
३. भौमाद्या for (भौमाद्याः)
(क) ४. स्पष्ट for (स्पष्टा)
(च) २. ते for (न) ३ भौमाद्या for (भौमाद्याः)
५. क्रमसंख्या लुप्त

३४. (घ) १. यमला: (च) for (यमलाः)
२. ३४।२६३ for (२६३।३४) (क) संख्या लुप्त है।
(क) ३. शीघ्रो (च) for (शीघ्रौ)
(ख) यह श्लोक यहां ३० वें श्लोक के पश्चात् है। यद्यपि इस प्रति में श्लोक संख्या नहीं दी गई है।
(च) ४. विसर्गलुप्त ५. अवग्रहचिह्न लुप्त

३५. (घ) १. फलान् (ग) (क) (ख) मंदफला for (मंदफलात्)
(ग) २. मध्यम for (मध्यमः)
(क) ३. सौरः for (सौराः)
(ख) ४. युग्मांतिष्ठ for (युग्मांतेष्ट)
५. शरयमा for (शरयमाः)
(च) १. फलान् for (फलात्)

बुधमंदपरिधिभागावसुरामाः ३८ सुरगुरोस्त्रयस्त्रिशत् ।
रविजस्यशून्यरामा ३० सशीघ्रपरिधिद्विगुणचन्द्राः ॥ ३६ ॥
देवगुरोरष्टरसा ६८ भास्कर पुत्रस्य शरगुणाः ३५ स्पष्टाः ।
कुजशीघ्रकेन्द्रपदगत ये अल्पज्याभिभागोनैः ॥ ३७ ॥

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३६. (घ) १. बुमंदपरिधि for (बुधमंदपरिधि)

२. +३३+(ग) (च)

३. ज्ञ (ग) (क) (ख) (च) for (स)

४. द्विगुण (ग) for (द्विगुण)

५. +१३२+(ग) (च)

(ग) ६. रामा for (रामाः)

(क) वि० मूल में अंकित संख्याएं यहां लुप्त हैं ।

(ख) ७. रंशा for (भागा)

८. त्रयस्त्रिशत् for (त्रयस्त्रिशत्)

९. चन्द्रा for (चन्द्राः)

(च) १०. रामाः for (रामा)

३७. (घ) १. रस्य (क) रस for (रसा)

२. शरगुणा स्पष्टाः । ३५ for (शरगुणाः ३५ स्पष्टाः)

३. याल्पज्या (ग) (क) for (अल्पज्या)

४. त्रि (ग) (क) (च) for (त्रि)

५. नौः for (नैः)

(च) २. शरगुणस्पष्टाः ३५ for (शरगुणाः ३५ स्पष्टाः)

३. याल्पद्या for (अल्पज्या)

सप्तभिरंशैर्गुणिता[1] ६।४०[6] दिवर्द्ध[7] राशिज्यया हृताप्तांशैः[8] ।
२३१[1]
अधिकोन[3]कुजमंदो मृगकर्कादौ[9] स्फुटौ[4] भवतीति[5] ॥ ३८ ॥
तत्स्फुट[8]परिधिः[9] खनगाः ७०[1] शीघ्रस्फुटपरिधिराप्त[6]भागोनाः[4] ।
वेद[7]जिनास्त्रिंशोनाः[5] २४३।३०[2] स्फुटीकरणं[3] कुजस्यैवम् ॥ ३९ ॥

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३८. (घ) १. र्गुणिताः (च) for (र्गुणिता)
२. २३१२ (ग) (च) for (२३१)
३. नः (ग) (क) (च) for (न)
४. स्फुटो (ग) (क) (ख) (च) for (स्फुटौ)
५. भवति (ग) (क) भवंति (ख) भवति (च) for (भवतीति)

(ग) ६. यहाँ यह संख्या नहीं है (च) '४०' संख्या लुप्त

(क) ७. दिवार्द्धं for (दिवर्द्धं)
वि० मूल में दी गई संख्याएं लुप्त हैं ।

(ख) ८. हताप्ताशः for (हृताप्तांशैः)
९. ष्टगकवचादौ for (मृगकर्कादौ)

(च) ९. मृगकर्क्कादौ for (मृगकर्कादौ)

३९. (घ) १. ७०४० (च) for (७०)
२. २४३।४० (ग) (च) for (२४३।३०)
३. स्पटीकरणं (ग) स्पष्टीकरणं (ख) for (स्फुटीकरणं)

(ग) ४. राप्तभागोना for (राप्तभागोनाः)
५. स्त्रिशोनाः (ख) स्त्रांशोना for (स्त्रिंशोनाः)

(क) ६. भागाः स्पष्टाः । (कुजशीघ्रस्फुट परिधिभागाभवंति)
७. दूसरी पंक्ति—के ते वेदस्त्रंशोना एते $\frac{२४३}{५०}$ परं आप्तं भागोनाः ॥
वि० ऐसा प्रतीत होता है कि लिपिकार मूल श्लोक लिखना भूल गया ।
केवल टीका उपलब्ध है ।

(ख) ६. राप्तो ना for (राप्तभागोनाः)

(च) ८. तेत्सुट् for (तत्स्फुट) ९ परिधिः for (परिधि)
५. स्त्र्यंशोनाः for (स्त्रिंशोनाः)

मन्दफलं[५] मध्येऽर्द्धं[८] तच्छीघ्र[९]फल[१] च मध्यमे सकले[२]।
मध्ये सकृत्[३] क्षितिसुतः[६] स्पष्टो भुक्ति[४] स्फुटाग्रहवत्[७] ॥ ४० ॥
ग्रहकेन्द्र[१]भुक्तिज्याकर[२]गुणिताद्यजीवया[४] भक्ता[५] २१४।
लब्धं स्फुट[६] परिधिगुणं भगणांशहृतं कलाभिस्तु[३] ॥ ४१ ॥

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४०. (घ) १. फलं (ग) (क) (ख) फलस्य for (फल)

२. सकलो (ख) (च) for (सकले)

३. मध्येऽसकृत् (क) मध्यशकृत for (मध्येसकृत्)

४. भुक्तिः (ग) (च) for (भुक्ति)

६. क्षितिसुते (ख) for (क्षितिसुतः)

७ स्फुटौ for (स्फुटा)

(ख) ८. र्घा (च) र्द्ध for (ऽर्द्धं)

(च) ९. तत्शीघ्र for (तच्छीघ्र)

४१. (घ) १. ग्रहमंदकेन्द्र (ग) (क) ग्रहमंद्रकेंद्रा (ख) ग्रहमंदकेन्द्र for (ग्रहकेन्द्र)

२. ज्यतिर (ग) ज्यांतर (क) ज्यतिर (ख) ज्यांतर for (ज्याकर)

३. फलकबाभिः। (ग) (क) फलकलाभिः for (कलाभिस्तु)

(ग) ४. द्युजीवया (क) (ख) गुणिताद्या for (द्यजीवया)

(ख) ५. भक्ताः for (भक्ता)

६. स्फुटि for (स्फुट)

३. फलकलाभि for (कलाभिस्तु)

(च) १. ग्रहमंदकेंद्र for (ग्रहकेन्द्र)

२. ज्यांतर for (ज्याकर)

३. फलकबभिः for (कलाभिस्तु)

मृगकर्काद्यादूनाधिका स्वमध्यमगतिः स्फुटार्कदोः ।
शीघ्रगतिमंदफलस्फुटभुत्तच्युनां कुजादिना ॥ ४२ ॥
शीघ्रफलं भोग्यजीवागुणिता माघजीवया विभजेत् ।
फलगुणितं व्यासार्द्धं विभाजयेत् शीघ्रकरणेन ॥ ४३ ॥

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४२. (घ) १. मृगकर्यादादूना (ग) (क) मृगकर्काद्यदूनाधिका for (मृगकर्काद्यादूनाधिका)
२. स्फुटार्कद्वोः (ग) (क) स्फुटार्कदोः for (स्फुटार्कन्दोः)
३. शीघ्रगतिं (क) शीघ्रगतिः for (शीघ्रगति)
४. भक्तूनां (ग) भुक्तच्यूनां (क) भुत्तच्यूनां (ख) for (भुत्तच्युनां)
५. कुजादीनाम् । (ग) (क) (ख) कुजादीनाम् for (कुजादिना)

(ग) ६. स्वमध्या for (स्वमध्यम)
७. मंदफल (ख) मदे for (मंदफल)

(ख) इस श्लोक का पूर्वार्ध लुप्त है—
८. शीघ्रगतिः for (शीघ्रगति)
९. 'फल' पद लुप्त है ।

(च) २. स्फुटार्क्कद्वोः for (स्फुटार्कदाः)
४. भुत्तच्यूनां for (भुत्तच्युनां)
५. कुजादीनां for (कुजादिना)

४३. (घ) १. शीघ्रफल (ग) (क) (ख) शीघ्रफल (च) for (शीघ्रफलं)
२. शृंगुणिता (ग) संगुणिता (क) संगुणिता (ख) for (गुणिता)
३. भजेत् for (विभजेत्)

(ग) ४. च्छीघ्र (च) for (त् शीघ्र)
५. विभजयेत् (ख) विभाजये (च) for (विभाजयेत्)

(ख) ६. व्यासाध्यं for (व्यासार्द्धं)
७. शीघ्रकरणेना for (शीघ्रकरणेन)

(च) २. शृंगुणिता for (गुणिता) ८. माद्य for (माघ)

लब्धोनाशीघ्रगति[1]स्फुटभुक्तिर्लब्ध[2]मधिकं चेत् ।
शीघ्रगतेः शीघ्रगतिः[3] लब्धा[4] संशोध्य[5] वक्रगतिः[6] ॥ ४४ ॥
देयमसुताय नेदं[5] शपथैरपि दत्तसुकृतनाशाद्यैः[3] ।
यात्रा[4]विवाहजातक[1] फलस्फुटत्वं यतः स्पष्टैः[2] ॥ ४५ ॥
मेषादितः प्रवृत्तानार्यभटस्य स्फुटाः[1] युगस्यादौ ।
श्रीषेणस्य कुजाद्याः सूर्याद्य[2]विष्णुचन्द्रस्य[3] ॥ ४६ ॥
दूरभ्रष्टाः[3] स्पष्टा[2] श्रीषेणार्य[4]भटविष्णुचन्द्रेषु[5] ।
यस्मात् कुजादयस्तेषु न विदुषामादरस्तस्मात् ॥ ४७ ॥

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४४. (घ) १. शीघ्रगतिः (ग) (क) गति (ख) शीघ्रगतिः (च) for (शीघ्रगति)
२. र्भवति लब्ध (ग) र्भवति लब्ध (ख) भवनि लब्ध for (र्लब्ध)
३. शीघ्रगति (ग) (क) (ख) शीघ्रगतं for (शीघ्रगतिः)
(क) ४. लब्वात् for (लब्धा)
(ख) ५. संसोध्य for (संशोध्य)
६. वक्तगतिः for (वक्रगतिः)
(च) २. +भवति+
३. शीघ्रगति for (शीघ्रगतिः)

४५. (घ) १. जातकं (ख) जातव for (जातक)
२. स्पष्टै for (स्पष्टैः)
(क) ३. नाशोचैः (ख) नशाद्यैः for (नाशाद्यैः)
४. यत्र for (यात्रा)
(च) ५. नेदशपंथै for (नेदं शपथै)

४६. (घ) १. स्फुटा (ग) (क) (ख) स्फुटा (च) for (स्फुटाः)
२. ज्या (ग) द्या (ख) द्याः for (द्य)
(ख) ३. विष्नचंद्रस्य for (विष्णुचन्द्रस्य)
(च) २. सूर्याद्या for (सूर्याद्य)

४७. (घ) १. (चट) for (भट)
(ग) २. स्पष्टाः (ख) for (स्पष्टा)
(ख) ३. दूरभ्यष्टः for (दूरभ्रष्टाः)
४. 'आर्य' लुप्त है
५. चन्देषु for (चन्द्रेषु)

अग्न्यष्टभि[1]रिषु[2]मनुभिः शरसूर्यैरिषु रसेंदु[4]भिस्त्रिभवैः ।
शीघ्रान्त्यकेन्द्रभागैर्भौमादीनां भवति वक्रम्[5] ।। ४८ ।।
वक्रांशकै[1]स्तदूनैः ३६० रनुवक्रं[2] तदधिकोन भागकलाः ।
मंदफलस्फुट भुक्त्यून[3] शीघ्रभुक्त्याहृता दिवसाः ।। ४९ ।।
शीघ्र[3]स्फुटा[1]ग्रहोना[4] छेषे[5] मध्यस्फुटांतरार्द्ध[6] वा ।
अधिकेधन[7]मृणमूने स्फुटग्रहा[2] मध्यमे कृत्वा ।। ५०[8] ।।

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४८. (ग) १. अग्निष्टिभि (क) अग्न्यष्टिभि (च) for (अग्न्यष्टभि)
२. रिषुमुनिभिः for (रिषुमनुभिः)
३. +भौ० व० कें० ।। ५ । १३ । ० ।। बु० व० कें० ।। ४ । २५ । ० । ० ।। बृ० व० कें० ।। ४ । ५ । ० । ० ।। शु० व० कें० ।। ५ । १५ । ० । ० ।। श० व० कें० ।। ३ । २३ । ० । ० ।। +

(ख) १. अग्न्याष्टिभि for (अग्न्यष्टभि)
४. रसेंद्रुभि for (रसेंदुभि)
५. क्रमं for (वक्रम्)

(च) २. रिषुमनुभि for (रिषुमनुभिः)

४९. (क) १. चक्रांशकै for (वक्रांशकैं)
(ख) २. वक्तं for (वक्रम्)
३. भुक्त्यान for (भुक्त्यून)

५०. (घ) १. स्फुट (ग) (क) for (स्फुटा)
२. ग्रहान् (ग) (क) ग्रहान् for (ग्रहा)
(क) ३. शीघ्रात् (ख) for (शीघ्र)
४. ग्रहोनात् for (ग्रहोना)
(ख) ५. च्छेषे for (छेषे)
६. स्फुटार्धं वा for (स्फुटांतरार्द्धं वा)
७. नष्टृणमूने for (नमृणमूने)
(च) २. स्फुटग्रहान् for (स्फुटग्रहा)
८. यहां क्रम संख्या भूल से "१५०" अंकित है।
वि० यहां पर जो सारणी दी गई है। वह मूल पाठ में ५२ वें श्लोक में दी गई है।

राशिषु चतुर्षु वक्रं[1] षट्स्वति[6] वक्रमनु[7]वक्रमष्टासु । ४[2] । ५ । ८
अप्राप्ता[3] प्रीतीतकाला भुक्त्या[8] सैवो[4]द्धृता दिवसाः[5] ॥ ५१ ॥
अष्टयमैः[4] कृतचन्द्रै[9]र्मु[10]नीन्दुभिर्भौमजीव[5] रविजानाम्[8] ।[6]
उदय[7]प्रागस्तमयस्तदू[11]नवक्रांशकं[1] पंचात्[2] ॥ ५२ ॥

५	४	४	४	३
१३	२५	५	१५	२३
०	०	०	०	०
०	०	०	०	०

[3]

५१. (घ) १. वंक्रं for (वक्रं)
२. ४ । ६ । ८ (ग) (च) for (४ । ५ । ८)
३. अप्राप्तातीतकला (ग) अप्राप्ताताऽकला (ख) अप्राप्तातीतकाला for (अप्राप्ताप्रीतीतकाला)
४. स्यैवौद्धृता (ग) (क) (ख) for (सैवोद्धृता)
(ग) ५. दिवसा (ख) (च) for (दिवसाः)
(क) ३. अप्राप्ताऽतीतकला for (अप्राप्ताप्रीतीतकाला)
(ख) ६. षटत्वति for (षट्स्वति)
७. 'नु' पद लुप्त है ।
८. भक्त्या for (भुक्त्या)
(च) ६. 'षट्स्व' लुप्त ० अप्राप्तातीतकला for (अप्राप्ताप्रीतीतकाला)

५२. (घ) १. वक्रांशकैः (ग) (क) चक्रांशकैः (ख) वक्तांशकैः for (वक्रांशकैं)
२. पश्चात् (ग) (क) (ख) पश्चात् for (पंचात्)
३. यहां यह तालिका ५०वें श्लोक के साथ है (ख) लुप्त है
(ग) ४. अष्टमैः (ख) अष्टयमै for (अष्टयमैः)
५. भौमजा (क) भौम for (भौम)
६. +२८ । १४ । १७ +
७. उदयः (ख) for (उदय)
३. यहां यह तालिका नहीं दी हुई है (क)
(क) ८. रविजानाम् for (रविजानाम्)
(ख) ९. कृतचन्द्रैः for (कृतचन्द्रैं)
१०. मुनिदुभौम for (मुनीन्दुभिर्भौम)
११. तादून for (तदून)
(च) १. वक्रांशकैः for (वक्रांशकैं) २ पश्चात् for (पंचात्)

खशरैर्जिनैर्ज्ञसितयोः २८ । १४ । १७ । ५० । २४ रिषुतिथिभिर्मुनिनगें-
द्रुभिः पश्चात् । १५५, ११७७
उदयास्तमयो व्यस्तौ मंडलभागैस्तदूनैः प्राक् ।। ५३ ।।
स्पष्टाद्युराभिदलयोरव्यूदयान्तमये यौ रविचरार्द्धात् ।
एष्यत्यधिके तीतादवक्रिते हीनौ ।। ५४ ।।

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५३. (घ) १ १५५११७७ (ग) १५५ । १७७ for (१५५, ११७७)
२. न्यस्तौ for (व्यस्तौ)
३. मंडभागैः for (मंडलभागै)
४. प्राकः for (प्राक्)

(ग) ५. ज्ञंसितयोः । ५० । २४।। (ख) ज्ञासितयो (च) for (ज्ञंसितयोः)
६. उदयास्तमयौ (क) (ख)
७. +३६०+

(क) वि० संख्याएँ मूल में नहीं दी गई हैं।

(ख) ८. स्वशरै जिनै for (खशरैर्जिनै)

५४. (घ) १. त्रि for (भि) (ग) (क) (ख) रात्रि for (राभि)
२. रव्युदयोस्तमययो (ग) रव्युदयास्तमययो (ख) for (रव्यूदयान्तमये यौ)
३. क्रितो (ग) (क) (च) for (क्रिते)
४. हीने (ग) (क) for (हीनौ)

(क) २. रव्युदयास्तमययो for (रव्यूदयान्तमये यौ)
५. +वक्रितो+

(ख) ६. रविचराघात् for (रविचरार्द्धात्)
७. एह्यात्यधिके for (एष्यत्यधिके)
८. तीतादेवक्रितो for (तीतादवक्रिते)

(च) २. रव्युदयास्तमये for (रव्यूदयान्तमये)

जिनभा[९]गज्या [१]गुणिता सू[७]र्याद्या व्यास[२]दलहृ[२]तालब्धम् । ३२७०[३]
[४]इष्टापक्रमजीवा विषु[५]वदुग् द[८]क्षिणा स[६]वितुः ॥ ५५ ॥
इ[६]ष्टापक्रमव[१]र्गमिज्याव[२]र्गा[५]द्विशोध्य १०६९१९०० शेषपदम् ।
विषुवदुदग्[७] द[३]क्षिणतः स्वाहोरा[४]त्र्यार्द्ध वि[८]ष्कंभः ॥ ५६ ॥

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५५. (घ) १. +१३२९+ (च)
२. +३२७०+ (ग) (च)
३. यह संख्या यहाँ पर 'हृता' के पश्चात् है ।
४. दृष्टा for (इष्टा)
५. विषुवदुदिग्दक्षिणा (ग) विषुवदुदिग्दक्षिणे for (विषुवदुग्दक्षिणा)
६. सवितु (ख) सवितु (च) for (सवितुः)

(ग) ७. +१३२९+ सूर्यज्या (क) सूर्याज्या (ख) सूर्यज्य for (सूर्याद्या)

(क) ८. दक्षिणे (ख) दक्षिण for (दक्षिणा)

(ख) ९. जिनभागाज्या for (जिनभागज्या)

(च) ५. विषुवदुदग्दक्षिणा for (विषुवदुग्दक्षिणा)

५६. (घ) १. वर्ग त्रिज्या (ग) (क) (ख) वर्गत्रिज्या for (वर्गमिज्या)
२. वर्ग्राद्विशोध्य (ख) वर्गाद्विशेषपदम् for (वर्गाद्विशोध्य)
३. दक्षणतः (च) for (दक्षिणतः)
४. स्वाहोरार्द्ध (ग) स्वाहोरात्रार्द्ध (क) स्वाहोरात्रार्द्ध for (स्वाहोरात्र्यार्द्ध)

(ग) ५. +१०६९२९००+

(ख) ६. इष्टमपक्रम for (इष्टापक्रम)
७. 'ग्' लुप्त
४. स्वाहोरात्रार्ध for (स्वाहोरात्र्यार्द्ध)
८. विष्कभ्रः for (विष्कंभः)

(च) १. वर्गं त्रिज्या for (वर्गमिज्या)
४. स्वाहोरार्द्धं for (स्वाहोरात्र्यार्ध)

क्रान्तिज्या विषुवच्छा[1]यया गुणा[6] द्वादशो[2] धृता क्षितिजा ।
स्वाहो[3]रात्रेऽनष्टा व्यासा[5]र्धेनाहता भक्ता[4] ॥ ५७ ॥
स्वाहोरात्रार्द्धेन क्षयवृद्धिज्याधनु[4]श्चरप्राणाः ।
षट्को[1]धृता विनाड्यो[3][5] विनाडिका[6] नाडिका षष्ट्या[2] ॥ ५८ ॥
चर[3]दलघटिका गुणिता भुक्तिः[6] षष्ट्याहता[7] कलाद्याप्तम्[1] ।
ऋण[4]मुदयेऽस्तमये[5] धनमुत्तर[8]गोले[2]ऽन्यथा याम्ये ॥ ५९ ॥

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५७. (घ) १. त्सायाया (ग) छायया (ख) विषुचछाया for (विषुवच्छायया)
२. द्धृता (ग) (ख) हृता for (धृता)
३. स्वाहोरात्रेनष्टा (ख) (क) स्वाहारात्रेनष्टा for (स्वाहोरात्रेऽनष्टा)
४. भक्ताः (ग) for (भक्ता)
(ग) ५. व्यार्द्धेनाहता (ख) सार्धेन हृता for (व्यासार्धेनाहता)
(ख) ६. गुण for (गुणा)
(च) २. द्धृता for (धृता) ३. स्वाहोरात्र for (स्वाहोरात्रे)
५. व्यासार्द्धे for (व्यासार्धे) ४. भक्ताः for (भक्ता)

५८. (घ) १. द्धृता (ग्र) (क) (ख) (च) for (धृता)
२. षष्ट्याः (ख) षष्टा for (षष्ट्या)
(ग) ३. विड्यो for (विनाड्यो)
(ख) ४. श्रर for (चर)
५. + भवंति नाड्यो +
६. ' डका' लुप्त है
(च) २. षष्ट्याः for (षष्ट्या)

५९. (घ) १. घाप्तम् (ग) घातम् (ख) द्यप्तम् for (द्याप्तम्)
२. गोलेन्यथा (ग) (च) for (गोलेऽन्यथा)
(ग) ३. पल for (दल)
४. ऋण for (ऋण)
५. ऽस्तसमये for (ऽस्तमये)
(क) ६. भुक्ति for (भुक्तिः)
७. हृता (च) for (हता)
८. मुत्तरं for (मुत्तर) (ख) धनुत्तरगोलेन्यथा for (धनमुत्तरगोलेऽन्यथा)
(च) ५. अवग्रहचिह्न लुप्त

दिनरात्रिमानघटिकाश्चरार्द्धनाडीभिरुत्तरगोले[1] ।
पंचदश १५[2] युक्त[4]हीना याम्ये[5] हीनाधिका[6] द्विगुणाः[3] ॥ ६० ॥
भान्यश्विन्यादीनि[5] ग्रहलिप्ता[6] खखवसु[1] ८००[2] द्धृताल्लब्धम् ।
भुक्तिहृते[5] गतगम्ये दिवसाः[3] दिवसा[3] षष्ट्याहते[8] घटिका ॥ ६१ ।
अर्कोन[8] चन्द्र लिप्ताः[1] खयम[6] स्वर[7] ७२०[4] भाजिता फलं तिथयः[5] ।
गतगम्ये षष्टिगुणे[1] भुक्त्यन्तर भाजिते घटिका[6] ॥ ६२ ॥

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६०. (ग) १. रुत्तरे (क) (ख) कत्तरे for (रुत्तर)
२. यह संख्या लुप्त है
३. यहां (:) लुप्त हैं (क)
(क) ४. युक्ति for (युक्त)
५. ६ 'याम्ये हीना' पद लुप्त हैं। (ख)
(च) १. रुत्तरे for (रुत्तर)

६१. (घ) १. खखवसूद्धृता (क) (ख) खखावस्तूद्धृता for (खखवसु ८०० द्धृता)
२. यह '८००' संख्या यहां न होकर 'लब्धम्' के पश्चात् है (ग)
३. 'दिवसा' इस प्रति में विद्यमान नहीं (क) (ख) विवसाः for (दिवसा)
(ग) ४. यह पद यहां लुप्त है (ख)
(क) ५. भान्यस्विन्यादीनि (ख) भन्याश्विन्यादीनि for (भान्यश्वन्यादीनि)
६. लिप्ताः for (लिप्ता)
(ख) ७. भुक्तिहृते for (भुक्तिहृते)
८. गुणे च्च घटिका for (षष्ट्याहते घटिका)
(च) १. वसूद्धृता for (वसुद्धृता)

६२. (घ) १. लिप्ता (क) for (लिप्ताः)
२. गुण (ग) for (गुणे)
३. घटिकाः (च) for (घटिका)
(ग) ४. यह संख्या 'भाजिता' और 'फलं' के बीच में है
५. तिथियः (ख) तिथ्ययः for (तिथयः)
(क) ६. खयमा for (खयम)
(ख) ७. खर for (स्वर)
(च) ८. अर्क्को for (अर्को) ४. संख्या लुप्त

रविचन्द्रयोगलिप्ताः खयमस्वरभाजिताः फलं योगः[1] ।।
गतगम्ये षष्टिगुणे भुक्तिसमासाद्धृते[2] नाड्यः ।। ६३ ।।
राश्यंश[4]कला विकलाः[5] स्फुटमासांते[3] लिप्तिका[6] विकला[1] ।
पक्षांते[8] तिथ्यंते समा रवीन्दोः[2] कला विकलाः[7] ।। ६४ ।।

६३. (घ) वि० यह श्लोक इस प्रति में उपलब्ध नहीं। न इस संख्या का कोई दूसरा श्लोक ही । ऐसा प्रतीत होता है कि लिपिकार द्वारा यह श्लोक लिखने से रह गया ।

(ग) यह श्लोक इस प्रति में भी उपलब्ध नहीं है।

(क) इस प्रति में उपलब्ध नहीं।

(च) १. योगा: for (योगः) २. समासाधृते for (समासाद्धृते)
वि० यह श्लोक इस प्रति में १५A पृष्ठ पर ऊपर की ओर किसी अन्य हाथ से लिखित है।

६४. (घ) १. विकलाः (ग) (क) (च) (विकला)
२. रवीन्द्वोः (ग) (क) रवीस्ताः (ख) रवीन्द्वोः (च) for (रवीन्दोः)

(ग) ३. मासांतेश (घ) (क) (ख) मासांतेशा for (मासांते)
वि० इसकी श्लोक संख्या ६३ है।

(क) ४. राश्यंश (ख) राशांश for (राश्यंश)

५. विकला for (विकलाः)

६. लिप्तिको for (लिप्तिका)

७. विवरलाश्चा for (विकलाः)
इसकी श्लोक संख्या ६३ है।

(ख) ८. पक्षातो for (पक्षांते)

(च) ३. मासांतेश for (मासांते)

कृष्णचतुर्दश्यन्ते[1] शकुनि[4] पर्वणि चतुष्पद[2]प्रथमे ।
तिथ्यर्द्धे[3]ते नागं[5] किंस्तुघ्नं[7] प्रतिपदाद्यर्द्धे[6] ॥ ६५ ॥
व्यर्कदु[7] कला भक्ताः[3] खरस[4]गुणैः ३६० लब्ध[5]मूनमेकेन ।
चल[8]करणानि ववा[9]दीन्यग[2] हृतशेषे तिथि[6]वदन्यत्[1] ॥ ६६[10] ॥

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६५. (घ) यह श्लोक इस प्रति में उपलब्ध नहीं है ।

(ग) १. र्द्दश्यंते शशकुनिः for (र्दश्यन्ते शकुनि) (ख) चतुर्दशांते for (चतुर्दश्यन्ते)
२. चतुष्पदं (क) (ख) (च) for (चतुष्पद)
३. तिथ्यर्द्धेत्येनागं (क) तिथ्यर्द्धेऽत्ये (ख) तिथ्यर्वेत्यनागः for (तिथ्यर्द्धेते नागं)

(क) ४. शकुनिः (ख) for (शकुनि)
५. मार्गं for (नागं)

वि० इसकी श्लोक संख्या ६४ है ।

(ख) ७. किस्तुघ्नप्रति for (किंस्तुघ्नं प्रति)

(च) ३. तिथ्यर्द्धेते for (तिथ्यर्द्धेते)

६६. (घ) १. वदन्यतः for (वदन्यत्)
इस श्लोक की क्रमसंख्या ६५ है। (ग) (क)

(ग) २. +७+(च)

(क) ३. भक्ता for (भक्ताः)
४. त्खर (स्व) स्वरस for (खरस)
५. लंब्ध (च) for (लब्ध)
६. तिथिन्यत् ॥ ६६ ॥ (ख) तिथि वदन्यात् for (तिथिवदन्यत्)

(ख) ७. व्यर्केंद्रकला for (व्यर्केंदुकला)
८. वल for (चल)
९. च for (व)

(च) १०. क्रमसंख्या ॥ ६५ for (६६)

इह नोक्तानि बहुत्वात्[2] स्पष्टगते[3]रुत्तरे[5]भिधास्यामि[4] ।
संक्रांतिभतिथि[1]करण[6] व्यतिपाताद्यंत[7] गणितानि ।। ६७ ।।[8]
ज्या[5] परिधि[8] स्पष्टीकरण[6] दिनगतिचरार्द्ध[7] करणेषु[1] ।
स्फुटगतिरध्याय[2] सप्तषष्टिरार्या द्वितीयोऽयम्[3] ।। ६८ ।।
इति ब्रह्मगुप्ते २योऽध्यायः ।।[4]

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६७. (घ) १. थिमकरण for (भतिथिकरण)
वि० इसकी श्लोक संख्या ६६ है । (ग) (क)

(क) २. बहुत्वत् for (बहुत्वात्)
३. स्पष्टगंते for (स्पष्टगते)
४. ऽभिधास्यामि for (भिधास्यामि)
६. 'करण' पद लुप्त है ।
७. व्यतीपाताद्य for (व्यतिपाताद्यंत)

(च) ४. वधास्यामि for (भिधास्यामि)
८. ।। ६६ ।। for (।।६७।।)

६८. (घ) १. +भतिथि+ (ग) (ख)
२. गति रध्यायः (ग) (क) (ख) गत्यध्यायः for (गतिरध्याय)
३. द्वितीयोयम् (ग) (च) for (द्वितीयोऽयम्)
इसकी श्लोक संख्या ६७ है । (च)
४. 'इति'—से 'अध्यायः' तक यहां अंकित नहीं इस अधिकार में केवल ६७ श्लोक हैं । (क)

(ग) ५. या for (ज्या)
६. करणं (ख) करणा for (करण)
७. दिनमानचरार्द्ध (ख) दिनरात्रिचरार्द्ध for (दिनगतिचरार्द्ध)
४. 'इति श्रीब्रह्मसिद्धान्ते स्फुटिकर्णाधिकारो द्वितियः' यह नोट और ही लेखनी का है, काग़ज़ के ऊपर दिया गया है ।

(क) ८. परिधिः for (परिधि)

(च) १. +भतिथि २. रध्यायः for (रध्याय)
४. 'इति' से 'अध्यायः' तक अंकित नहीं है ।

पूर्वापरयोर्विद्धो[1] तुल्य छायाग्रयो दिगपराद्याः[2] ।
पूर्वान्यः[5] क्रान्तिवशात्तन्मध्यात्[4] शंकुतलमितरे[3] ॥ १ ॥
नृछायाग्रगजमत्स्य[1] द्वयमध्यगसूत्रयोर्युति[2]र्यत्र[4] ।
सोत्तरगोले याम्या[5] शंकुतला[3] दक्षिणे सौम्या ॥२ ॥
छायाग्रभ्र[6]मरेखा सूत्रद्युते[1]र्वृंत[2]परिधिरग्रस्पृक् ।
मध्य[7]छायान्तरमुदगीतरं[3] वा[5] शंकुमण्डलयोः[4] ॥ ३ ॥

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१. (घ) १. विद्ध (ग) विंदू (क) बिन्दु (ख) विन्दू for (विद्धो)
२. द्विगपराधः (ग) दिगपरार्धः (क) दिगपराधः for (दिगपराद्याः)
(ग) ३. छंकुतलमितरे (क) (ख) for शंकुतलमितरे)
(क) ४: तन्मध्या (ख) तन्मध्य for (तन्मध्यात्)
(ख) २. दिग्पराद्यः for (दिगपराद्याः)
५. मूर्धन्याः for (पूर्वान्यः)
(च) २. द्विग for (दिग)
२. (घ) १. नृछायाग्रजमत्स्य (क) त्रिछायाग्रजमस्य (ख) त्रिछायाग्रजमत्स्य for (नृछाया-ग्रगजमत्स्य)
(ग) १. त्रिछायाग्रजमछय for (नृछायाग्रगजमत्स्य)
२. युति for (र्युति)
३. छंकुतला (क) कुंतला for (शकुंतला)
(क) ४. यत्र for (र्यत्र)
५. याम्यात् for (याम्या)
(क्षेप) क्षेपक तत्काले द्विवरं क्रान्त्यो लंबेन भाजितं गुणयेत् ।
तत्कर्णेन छायायाः प्राचीलब्धां गुणैरयनैः ॥ २ ॥ इतिक्षेपः
(ग) यह श्लोक इसी 'प्रति' में वह भी 'क्षेप' के नाम से उपलब्ध है।
(क) यह श्लोक इस प्रति में नहीं है।
(च) यह श्लोक इस प्रति में नहीं है।
३. (घ) १. युते (ग) (क) युते (ख) (च) for (द्युते)
२. वृंत्तस्पक् (ग) वृत्त (ख) वृत्त (च) for (वृंत)
३. सुदगितरं (ग) मुदगिरद्वा (क) मुदगितरथा for (मुदगीतरं)
४. मंडलयो (च) for (मंडलयोः)
(क) ५. 'वा' पद लुप्त है। (ख) द्वा
(ख) ६. 'भ्र' लुप्त है
७. मध्या for (मध्य)
३. मुद्गितर for (मुदगीतरं)

छायावृते[1]ऽर्काग्रा कर्णगुणा[5] व्यासदल हृतार्काग्रा[4] ।
विषुवच्छाया[2] याम्या तदंतरैक्यं भुजस्याग्रे[3] ।। ४ ।।
शंकु[5]प्राच्य[7]परा[1] या छाया भुजकृतिविशेषमूलं [2]नयत् ।
तत्प्राच्य[6]परछाया[3] भुजाग्रयो[4]रन्तरं[8] कोटिः[6] ।। ५ ।।
दिग्मध्ये[2] छायाग्रं कृत्वा शंकोर्यथादिशं[4] भ्रमणम् ।
दिग्मध्य[5]स्थितशंकोः[3] छायाग्रं भ्रमति[1] विपरीतम्[6] ।। ६ ।।

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४. (घ) १. वृत्तेर्काग्रा (ग) (ख) वृत्तेर्काग्र for (वृत्तेऽर्काग्रा)
२. विषुवछायाम्या (ग) विषुवछायायान्या for (विषुवच्छाया याम्या)
३. भुजोस्याग्रें (ग) भुजोस्याग्रे (क) भुजोस्याग्रो for (भुजस्याग्रे)
(ग) ५. कार्णनुणा for (कर्णगुणा)
(क) २. विषुवछाया for (विषुवच्छाया)
(ख) ४. हतार्काग्रा for (हृतार्काग्रा)
३. भुजोस्याग्रे for (भुजस्याग्रे)
(च) १. वृत्तेर्क्काग्रा for (वृत्तेऽर्काग्रा) ४. हृतार्क्काग्रा for (हृतार्काग्रा)
२. विषुवछा for (विषुवच्छाया) ३. भुजोस्याग्रे for (भुजस्याग्रे)

५. (घ) १. परयो (ग) पराया: (क) पराया: for (पराया)
२. 'न' इस प्रति में नहीं है । (ग) (क) (च)
४. भुजग्रेयो for (भुजाग्रयो)
(ग) ५. शंकु: (ख) शकु: for (शंकु)
(क) ६. कौशि for (कोटि:)
(ख) ७. प्राच्या for (प्राच्य)
८. रन्तरे for (रन्तरं)
(च) ६. तत्प्राच्यां for (तत्प्राच्य) ४. भुजग्रयो for (भुजाग्रयो)

६. (घ) १. भ्रवति (क) for (भ्रमति)
(क) २. दिग्मध्य (ख) दिङ्मध्ये for (दिग्मध्ये)
३. शंकेश् (ख) शंको for (शंको:)
(ख) ४. शांकोर्यंयथादिशं for (शंकोर्यथादिशं)
५. दिङ्मध्ये for (दिग्मध्य)
(च) ३. शको: for (शंको:)
६. विपरितं for (विपरीतं)

शंकुर्लंबछायाक्षज्या तद्वर्गसंयुते मूलम् ।
विषुवत्कर्णछाया कर्णोत्यदा शंकुः ॥ ७ ॥
उन्नतजीवाकोटिः छाया दृग्ज्या भुजो नतज्या वा ।
कर्णछायावृत्तं व्यासार्द्धं द्वयमतोन्यत्र ॥ ८ ॥

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७. (घ) १. क्षय्या (ग) क्षज्य (ख) वज्या for (क्षज्या)
२. मूंलम् (च) for (मूलम्)
३. विषुव तिथिषुव (ग) विषुवति विषुवत्ति for (विषुवत्)
४. कर्णोन्यदा (ग) (क) कर्णोऽन्यदा for (कर्णोत्यदा)

(ग) ५. शंकुर्लम्बः (क) शंकुर्लबश (ख) शंकुलंब for (शंकुर्लंब)
६. कर्णः छाया (क) कर्णश्छाया for (कर्णछाया)

(क) ७. +विषुवति+(च)

(ख) ७. +विषुवति+
४. कर्णोन्यदा for (कर्णोत्यदा)

(च) १. क्षय्या for (क्षज्या) ४. कर्णोन्यदा for (कर्णोत्यदा)

८. (घ) १. कोटिछाया for (कोटिः छाया) (ख) उत्ततजोवकोटि for (उन्नतजीवा-कोटिः)
२. यत्रः for (यत्र)

(ग) ३. द्रिक्ज्या (क) शध्या for (दृग्ज्या)
४. भुजानतज्यावा for (भुजोनतज्यावा) (ख) भुज्या for (भुजो)
५. कर्णः for (कर्ण)

(क) ६. वा (छ) यः for (छाया)
७. तस्या (ज्या) या for (तज्या वा)
८. वृत्तव्यवसार्द्ध for (वृत्तं व्यासार्द्धं)
९. द्वयासनोऽस्यत्रम् for (द्वयमतोन्यत्र)
इसकी श्लोक संख्या ६ है, संभवतः यह मूल है ।

(ख) १०. सार्द्ध for (सार्धं)

(च) १. कोटि for (कोटिः) ३. दृग्द्या for (दृग्ज्या)

शंकु छाया[७] कृत्योस्त्रिज्या कृतितत्समास[५] गुणहृतया[१] ।
मूलं[२] लम्बाक्षज्ये[३]स्तदंशका[६]स्तद्धनुर्भागाः[४] ॥ ९ ॥
विषुवत्कर्णहृते[६] वा शंकु छायागते[३] पृथक् ।
त्रिज्ये[५] त्रिज्येतर जीवा[१] लंबाक्षांसो क्रमज्योना[२] ॥ १० ॥

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९. (घ) १. हृतयो (ग) हृतयोः (ख) हतयोः for (हृतया)

२. मूले (क) (ख) for (मूलं)

३. लंबाक्ष्यज्येतदंश (क) लबाक्षस्थे for (लंबाक्षज्येस्तदशं)

४. तर्द्धनुर्भगाः (क) सद्वक्रभागाः (ख) तद्धनुमागः for (तद्धनुर्भागाः)

(क) ५. नृत्यमासनस्य सूत्रयोः for (तत्समासगुणहृतया)

६. तदसंकाश (ख) तदशकास्व for (तदंशका)

इसकी श्लोक संख्या ८ है

(ख) ७. क्वाया for (छाया)

(च) ३. लम्बाक्ष्यजे for (लम्बाक्षजे) ६. तदंशका for (रतदंशका)

१०. (घ) १. जीवा वालंबाक्षांशो (क) (ख) जीवावलंबाक्षाशो for (जीवालंबाक्षांसो)

२. त्क्रमज्योना (क) कामावना (ख) कमज्योना for (क्रमज्योना)

३. छायाहृते (ग) (क) छायाहते (ख) हृते for (छायागते)

(ग) ४. लंबाक्षांशो for (लंबाक्षांसो)

(क) ५. त्रिद्येतर (ख) तिज्ये for (तिज्येतर) इसकी श्लोक संख्या ११ दी है। परन्तु यह भूल प्रतीत होती है क्योंकि इसकी टीका के अन्त में १० लिखा है ।

(ख) ६. विषुत्वार्यहिते for (विषुवत्कर्णहृते)

(च) ३. छायादृगते for (छायागते)

२. लंबांक्षांशोत्क्रमज्योना ।

[4]नवते ९० [2]ल[1]म्बांशात्प्रोज्य [3]ज्यावेतराक्षलंम्ब[5]ज्ये ।
शंकुछायागुणिते छाया द्वादशहृते वान्ये ॥ ११ ॥
लंबाक्षज्यावर्गं[5] प्रोह्य[1]ज्या कृतेः पदं वान्याः[2] ।
अन्यत्र सर्वदोन्नत[3]जीवांशा नयनमेव[4] ॥ १२ ॥
इष्टदिनार्द्धनतांश[1] क्रान्त्यं[2]शैक्यांतरं[3] क्रियतुलादौ[4] ।
अक्षांशा[5] याम्यायां[6] छायायामंतरमजादौ[7] ॥ १३ ॥

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११. (घ) १. लंबाक्षांशात्प्रात्संज्या (ग) लंबाक्षांशान् (क) लंबाक्षांशान् (त्) for (लंबांशात् प्रोज्यज्या)
(ग) २. यह संख्या लुप्त है (क)
३. प्रोह्य ज्यवितराक्ष (क) प्रोह्यज्या (ख) प्राज्याज्यार्ध for (प्रोज्यज्यावेतराक्ष)
(क) ४. नवतै for (नवते)
(ख) १. लंबक्षाशान् for (लम्बांशात्)
५. लंबज्यो for (लंबज्ये)
(च) १. लंबाक्षांशात् for (लंम्बांशात्)
१२. (घ) १. प्रोक्तज्याकृतेः (ग) प्राज्यत्रिज्योकृतेः (क) प्रोह्य त्रिज्या for (प्रोह्यज्याकृतेः)
२. वान्या (ग) (क) वान्यः for (वान्याः)
३. नतजीवांशा (ग) (क) (ख) नजीवांशा for (न्नतजीवांशा)
४. मेवम् (ग) (च) for (मेव)
(ग) ५. वग्र (ख) वर्ग for (वर्गं)
(ख) १. प्रोज्या त्रिज्या for (प्रोह्यज्या)
४. नयनमवम् for (नयनमेव)
(च) १. प्रोज्य for (प्रोह्य)
२. वान्या for (वान्याः)
१३. (घ) १. दिनार्द्धन्नतांश (ख) दिनार्द्धनातांश for (दिनार्द्धनतांश)
(ग) २. क्रान्ति (क) क्रान्त्यां (ख) क्रान्त्यै for (क्रान्त्यं)
(ख) ३. शैक्यंतर for (शैक्यांतरं)
४. तुल्यादौ for (तुलादौ)
५. अक्षांश for (अक्षांशा)
६. षाम्यायां for (याम्यायां)
७. 'या' लुप्त है
(च) १. दिनार्द्धन्नतांश for (दिनार्द्धनतांश)

मेषवृषमिथुनजा[१] स्वाहोरात्र्यार्द्ध[२] चरदलप्राणान्[३] ।
प्राग्वत्कृत्वा स्वाधो[४] विशोध्य चरखंडकप्राणाः[५] ॥ १४ ॥
मिथुनाहोरात्रार्द्ध[१] क्रियाहोरात्र[३]दल[५]हत[४] गुणितम् ।
तज्ज्याभि[६]राप्तं[२] चापान्तराणि[७] लंकोदयप्राणाः[८] ॥ १५ ॥
ज्यावर्गात्तत्क्रान्तिज्या[५] वर्गोनात्तत्पदाहृता[१] त्रिज्या[२] ।
स्वाहोरात्रार्द्ध हताश्[३]चापांतराण्यथवा[४] ॥ १६ ॥

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१४. (घ) १. जीवा (ग) (क) (ख) जीवा (च) for (जा)
२. रात्रार्द्ध (ग) (क) रात्रर्धं (ख) रात्रार्धं for (रात्र्यार्द्ध)
(ख) ३. चरदप्राण (वा) न् । for (चरदलप्राणान्)
४. स्वाषो for (स्वाधो)
५. च खंडंक प्राणाः for (चरखंडकप्राणाः)
(च) २. रात्रार्द्ध for (रात्र्यार्द्ध)
५. चरषंडक प्राणाः for (चरखंडकप्राणाः)

१५. (घ) १. रात्रार्द्ध क्रिय।द्यहो for (रात्रार्द्धक्रियाहो) (ख) रात्रार्धं for (रात्रार्द्धं)
२. राप्त (क) (ख) राप्त for (राप्तं)
(ग) ३. क्रियाद्य (क) क्रियाद्यहो (ख) क्रियाद्यहो for (क्रियाहो)
(क) ४. हृतं (च) for (हतं)
(ख) ५. रात्रदलं for (रात्रदल)
६. तज्याभि for (तज्ज्याभि)
७. चापंतराणि for (चापान्तराणि)
८. प्राणः for (प्राणाः)
(च) ३. क्रियाद्यहोरात्र for (क्रियाहोरात्र)
६. तद्याभिराप्त for (तज्ज्याभिराप्तं)

१६. (घ) १. वर्गोनात्पदाहृता (ग) वर्गो ना तत्पदाहृता for (वर्गोनात्तत्पदाहृता)
२. त्र्यज्या for (त्रिज्या)
३. हताः (ख) हतास्वार्धाश् for (हृता)
४. ण्यथावाः for (ण्यथवा) (ख) चापांतराप्यथवा for (चापांतराण्यथवा)
(क) मूल श्लोक यहां उपलब्ध नहीं है । केवल टीका अंकित है ।
(ख) १. नात्यादा for (नात्तत्पदा)
(च) ५. ज्यावर्गान्त क्रान्तिज्या for (ज्यावर्गात्तत्क्रांतिज्या)
१. वर्गोनत्पदाहृता
३. हतास्चाधश् for (हताश्)

स्वच[४]रासु[१]भिसूनयुता १६१७[२] क्रमोत्[५] क्रमस्थैः[६] क्रमोक्रम[३]न्यस्ताः ।
उदयप्राणा व्यस्ताश्चार्कं[७] तात्कालिकं कृत्वा[८] ॥ १७ ॥[४]
[६]रविणा भु[३]क्त्याराशेः कला गुणाः[७] स्वोदयासुभिर्भक्ताः[८] ।
[९]राशिकलाभि[५]र्लब्धा [२]प्रश्नासुभ्यो[१०]ऽशवः [१]शोध्याः ॥ १८ ॥

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१७. (घ) १. रूनयुताः (ग) रूनयुताः (क) (ख) नूनयुता for (सूनयुता)
२. +१७९५, १९३५, १९३५, १३९५, १६००+
३. क्रमोत्क्रमन्यस्ताः (ग) (क) क्रमोत्क्रमास्ते (ख) क्रमोक्रमभ ःस्ताः for (क्रमोक्रमन्यस्ताः)

(ग) २. यहाँ कोई संख्या नहीं दी गई ।

(ख) ४. स्ववरासुभिः for (स्वचरासुभि)
५. क्रमाक्रमो for (क्रमोत्क्रमस्थै)
६. : विसर्ग लुप्त हैं
७. श्चार्क for (श्चार्कं)
८. 'कृत्वा' पद लुप्त है ।

(च) १. रूनयुताः for (सूनयुता)
३. क्रमोत्क्रमन्यस्ताः for (क्रमोक्रमन्यस्ताः)
७. चार्क्कं for (चार्कं)

१८. (घ) १. शवशोध्याः for (ऽशवःशोध्याः) (ग) सवः (क) ऽसवः (ख) सवं for (ऽशवः)
२. +१८००(ख) + : +

(ग) ३. भुक्ताराशेः (ख) for (भुक्त्याराशेः)
४. +१६७०, १७९५, १९३५, १९३५, १७९५, १६७०+
५. र्लब्धम् १८०० for (र्लब्धा) (क) लब्धाः for (र्लब्धा)

(क) ६. रविभुक्तहीनराशेः for (रविणा भुक्त्या राशेः)

(ख) ७. गुणा for (गुणाः)
८. सुभिः भक्ताः for (सुभिर्भक्ताः)

(च) ९. ९+१७९५ २+१८००+
१९३५
१९३५
१३९५
१५००+
१०. अवग्रहचिह्नलुप्त

प्रक्षिप्य[६] राशय[२] भुक्तं शेषा सुभ्यः क्रमेण[३] यावंतः[४] ।
शुद्धंत्फदया[१] सूर्ये तावंतो राशयः क्षेप्याः[५] ॥ १६ ।
शेषांत्रिशत्[१] गुणितानस्तन[२] शुद्धोदया सुभिर्विभजेत्[४][५] ।
लब्धंभागादिरवौ[६] प्रक्षिप्य[३] तथा कृते लग्नम् ॥ २०[७] ॥

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१६. (घ) १. शुध्यंत् (ग) शुध्यत्युदयाः (क) शुध्यंत्युदयाः (ख) for (शुद्धत्फदया)

(ख) २. राश for (राश्य)

३. क्रमण for (क्रमेण)

४. यावतः for (यावंत)

५. 'क्षेप्याः' पदलुप्त है ।

(च) ६. +१७६५ } पिछले श्लोक के फुटनोट में संख्याएं दर्शा दीं गई हैं ।
१६३५
१६३५
१३६५
१५०६

१. शुद्धंत्युदयाः for (शुद्धंत्फदया)

२०. (घ) १. शेषांस्तृंशद् (ग) शेषास्त्रिशद् for (शेषांत्रिशत्)
२. गुणिताः श्येनस्तन for (गुणितानस्तन) (ग) नसून for (नस्तन)
(क) दविशुद्धस्योदयाः for (नस्तनशुद्धोदया)

(क) ३. प्रक्षेप्यं for (प्रक्षिप्य)

(ख) १. शेषास्त्रिशद्गुणा for (शेषांत्रिशत् गुणिता)
२. तसून for (नस्तन)
४. शुद्धासुभि for (शुद्धोदयासुभिर्)
५. वित्तजेत् for (विभजेत्)
६. लब्धा for (लब्धं)

(च) १. शेषांत्रिशद्गुणिताः ३० नस्तन for (शेषां त्रिशत् गुणितानस्तन)
७. क्रम संख्या लुप्त

रविराशय[४]भुक्तलिप्तास्तदुदय गुणिता हता[१] ग्रहकलाभिः[२] १८०० ।
लब्धं[५] प्राणा[६]स्थाप्याः प्रक्षिप्यार्के ग्रहाभुक्तम्[३] ॥ २१ ॥
तावत्सूर्ये राशि[१] न[४] क्षिपेत्समो[३] लग्नराशिभिर्यावत्[५] ।
क्षिप्रग्रहाणां[२] प्राणान् प्रक्षिप्य स्थापितेष्वसुषु[७] ॥ २२ ॥
तदधिककालो[१]दयवध[३]राशि[८] कलाभिर्भंजेत्[४] फलं[६] प्राणान् ।
प्रक्षिप्य प्राणेषु[६] प्राणाः[५] सूर्योदया[७]दसकृत् ॥ २३ ॥

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२१. (घ) १. हृतो (क) हृता (ख) कृता for (हतो)
२. गृहकलाभिः (ग) (क) (ख) गृहकालाभिः for (ग्रहकलाभिः)
३. गृहाभुक्तम् (ग) (क) (ख) गृहामुक्तम् for (ग्रहाभुक्तम्)
४. रविराश्यभुक्त (ग) (क) (ख) रविराशिभुक्त for (रविराशयभुक्त)
(ग) ५. लब्धप्राणाः (ख) लब्धां प्राणाः for (लब्धंप्राणा)
(क) ६. प्राणाः (ख) प्राणः for (प्राणा)
(च) ४. रविराश्यभुक्त for (रविराशयभुक्त) १ हृता for (हता) २ गृह for (ग्रह)
६. प्राणाः for (प्राणा) ३. गृहा for (ग्रहा)

२२. (ख) १. राशीन् (क) (ख) राशी for (राशिन)
२. क्षिप्तगृहाणां (ग) क्षिप्तगृणां (क) क्षिप्त गृहाणाँ for (क्षिप्रग्रहाणां)
(क) ३. समं for (समो)
(ख) ४. 'न' लुप्त
५. यावत् for (र्यावत्)
२. क्षिप्तगृहाणां for (क्षिप्रग्रहाणां)
(च) १. राशीन for (राशिन) २. गृहाणां for (ग्रहाणां)
६. स्थापितेष्वसुषुः for (स्थापितेष्वसुषु)

२३. (घ) १. कलोदय (ग) (क) (ख) कलोदय (च) for (कालोदय)
२. प्राणात् for (प्राणान्)
(ग) ३. वधं (क) (ख) for (वध)
४. भजेजेत् for (भंजेत्)
५. प्राणः (ख) for (प्राणाः)
(क) ६. फलप्राणान् (ख) फलप्राणान् for (फलंप्राणान्)
७. (……) ॥ २३ ॥
(ख) ८. राशिभिर्यावत् क्षिप्य गृहाणां प्राणान्प्रभिभजत् for (राशिकलाभिर्भंजेत् फलं प्राणान्)
९. प्राणषु for (प्राणेषु)

प्रागुदयैः प्रश्नासु[2]भिरूनोर्को[4] भुक्त[1]राशिभिर्लग्नम्[5] ।
कृत्वैवमूनमर्कं[3] लग्नसमं प्रागभवेत्कालः[6] ।। २४ ।।
गतशेषाल्पास्याह्नः[1] सौम्योत्तर[2]गोलयोश्चरार्द्धेन[4] ।
ऊनाधिकस्य[5] जीवा स्वाहोरात्र्यार्द्धं[3] संगुणिता ।। २५ ।।
त्रिज्याहृता[2] युतोना क्षितिज्यया सौम्ययाम्ययोश्छेदः[4] ।
छेदोवलम्बकगुणो[3] व्यासार्द्धं[5] विभाजितः शंकुः[1] ।। २६ ।।

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२४. (घ) १. भुक्तः (ग) भुक्ति for (भुक्त)

(ग) २. प्रश्नाशुभि for (प्रश्नासुभि)
३. मूनमर्कं (ख) मूनमर्कलग्नसमं for (मूनमर्कं लग्नसमं)

(ख) ४. रुभोको for (रूनोर्को)
५. लग्नम् for (र्लग्नम्)
६. कलः for (कालः)

(च) ४. रूनोर्क्को for (रुनोर्को)[3] मर्क्कं for (मर्कं)

२५. (घ) १. गत शेषाल्पस्याह्नः (ग) गतशेखाल्पस्याह्नः for (गतशेषाल्पास्याह्नः)
२. सौम्येतर (ग) (क) (ख) सौम्यैतर for (सौम्योत्तर)

(ग) ३. रात्राद्धं (क) (ख) (च) for रात्र्यार्द्धं)

(क) १. गतशेषाल्पस्याह्नः (ख) गतशेषाल्पस्याह्नाः for (गतशेषाल्पास्याह्नः)

(ख) ४. चरार्द्धेनः for (चरार्द्धेनः)
५. ऊनाधिकास्य for (ऊनाधिकस्य)

(च) १. गतशेषाल्पस्याह्नः for (गतशेषाल्पास्याह्नः) २. सौम्येतर for (सौम्योत्तर)

२६. (घ) १. विभाजितशंकुः (च) for (विभाजितःशंकुः)
२. त्रिज्याहृता (च) for (त्रिज्याहृता)
३. छेदावलम्बकगुणो (च) for (छेदोवलम्बकगुणो)

(ग) ४. छेद (क) याम्ययोश्छेदः (ख) for (याम्ययोछेदः)

(ख) ५. व्यासार्धं for (व्यासार्द्धं)

विषुवत्कर्णविभक्तः[१] छेदो वा द्वादशाहृतः[३] शंकुः ।
शकुकृतिर्[२]विहीनाया व्यासार्द्धकृतेः पदं[४] दृग्ज्या ।। २७ ।।
दृग्ज्या द्वादश गुणिता[३] विभाजिता शंकुना[७] फल[१] छाया ।
व्यासार्द्धं[४] छेदहृतं[५] विषुवत्कर्णाहृतं[६] कर्णः[२] ।। २८ ।।
गुणितं वा द्वादशभिर्व्यासार्द्धं[२] शंकुनाहृतं[१] कर्णः ।
जीवा क्षयवृद्धिज्यायुतहीना ज्या[३] क्रियतुलादौ ।। २९ ।।

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२७. (घ) १. विभक्तं (च) for (विभक्तः)

२. शंकुकृतिविहीनाया (ग) (क) (ख) for (शकुकृतिर्विहीनाया)

(क) ३. हृतः (ख) हृतशंकुः for (हृतःशंकुः)

(ख) ४. फलं दृग्जा for (पदंदृग्ज्या)

(च) द्वादशहृतः for (द्वादशाहृतः)

२. शंकुकृतिविहीनाया for (शंकुकृतिर्विहीनाया)

२८. (घ) १. फलं (ग) (क) (ख) फलं for (फल)

२. कर्ण for (कर्ण)

३. +१२+(च)+१२+

(ग) ४. व्यासार्द्धछेदहृतं for (व्यासार्द्धं छेदहृतं)

(क) ५. हृतं (च) for (हृतं)

(ख) ७. शांकुला for (शंकुना)

२९. (घ) १. हृतं for (हृतं) (ग) (क) (ख) हृतकर्ण for (हृतंकर्णः)

(क) २. व्यासार्द्धं (ख) व्यासार्धं for (व्यासार्द्धं)

(ख) ३. जा for (ज्या)

स्वाहोरात्र्यर्द्ध[1] गुणा[7] व्यासार्द्धं[2] विभाजिताऽथवा छेदः ।
शंक्वादि[6] प्राग्वज्ज्या स्वाहोरात्र्यर्द्ध[3] धात[5] कृता[4] ।। ३० ।।
व्यासार्द्धकृति[1] गुणिता[2] विषुवत्करणेन वा भवेत्[3]करणः ।
लम्बगुणो घातः[4] शंकु[6] व्यासार्द्धकृतिभक्तः[5] ।। ३१ ।।

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३०. (घ) १. रात्रार्द्ध (ग) (क) (ख) रात्रार्ध for (रात्र्यर्द्ध)

२. व्यासार्धं (ग) (ख) for (व्यासार्द्धं)

३. रार्द्ध (ग) (क) रात्रार्ध (ख) for (रात्र्यर्द्ध)

४. हृता (ग) (क) हृता (ख) हृता for (कृता)

(ग) ५. घात (क) (ख) for (धात)

६. शंकवादि for (शंक्वादि)

(ख) ७. गुण for (गुणा)

(च) १. रात्रार्द्ध for (रात्र्यर्द्ध) ४. हृता for (कृता)

३१. (घ) १. व्यासार्वकृति १०६६२६०० (ग) व्यासार्द्धकृति १०६६२६०० for (व्यासार्द्धकृति)

२. गुंणिता (ग) (क) (च) for (गुणिता)

३. भवति (ग) (क) (ख) (च) for (भवेत्)

४. व्याघातः (ग) (क) वा घातः (ख) वाघतः for (घातः)

५. कृतिवक्तः (ग) कृतिभुक्तः for (भक्तः)

(ग) ६. शंकुर्व्यासार्द्ध (क) (ख) शंकुव्यासार्ध for (शंकुव्यासार्द्धं)

(ख) १. व्यासार्धकृति १०६६२६०० for (व्यासार्द्धकृति) २. गुंणिता for (गुणिता) ४. व्याघातः for (घातः)

घातोवार्कगुणा १२ स्त्रिज्या विषुवत्कर्णबंधः हृतः शंकुः ।
कर्णकृते संशोध्य द्वादशवर्गं १४४ पदं छाया ।। ३२ ।।
अल्पप्रश्नासूनां यदि बहवश्चरदलासवः क्षितिजा ।
हृतयोना जीवोना क्षयवृद्धिज्योक्तवच्छेषं ।। ३३ ।।
स्वाहोरात्रार्द्धमुदकदक्षिणयोः क्षितिज्यया युतविहीनं ।
द्युदलान्त्यज्याभिज्य क्षयवृद्धिज्या युतोनांत्या ।। ३४ ।।

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३२. (घ) १. कर्णः (च) for (कर्ण)
२. वधः (ग) वध (क) for (बंधः) (ख) 'बंध' पद लुप्त है ।
३. हृतः (ग) (क) (च) for (हृतः)
(ग) ४. गुणास्त्रिज्या (क) (ख) for (कृते)
५. कृतेः (क) (ख) गुणास्त्रिज्या for (गुणा १२ स्त्रिज्या)
६. छायाः for (छाया)
(क) संख्याएँ मूल में अंकित नहीं हैं ।
(ख) ७. संशोध्या for (संशोध्य)
८. वर्णगयछाया for (वर्गं १४४ पदं छाया)
(च) ४. घातोवार्क्कगुणा १२ for (घातोवार्कगुणा १२) २. वधः for (बंधः)
१. कर्णः for (कर्ण)

३३. (घ) १. हृतयोना (ग) (च) for (हृतयोना)
(ग) २. अल्पप्रश्नासूना for (अल्पप्रस्नासूनां)
(क) मूल श्लोक अंकित नहीं है—केवल टीका लिखी हुई है ।
(ख) ३. छाषम् for (छेषम्)

३४. (घ) १. उदग्दक्षिणयोः (ग) स्वाहोरात्रामुदग्दक्षिणयोः (ख) for (स्वाहोरात्रार्द्धमुदकदक्षिणयोः)
(ग) २. द्युदलांतिज्या for (द्युदलान्त्यज्या)
३. त्रिज्या (क) (ख) त्रिज्या (च) for (भिज्या)
४. वृघ्य for (वृद्धिज्या)
५. नांत्याः for (नांत्या)
(क) १. स्वाहोरात्रार्धमुदग्दक्षिणयोः for (स्वाहोरात्रार्द्धमुदकदक्षिणयोः)
६. क्षितिजया (ख) षितिजयया for (क्षितिज्यया)
(च) १. मुदग्दक्षिणयोः for (मुदकदक्षिणयोः)

छेद[1]हता द्युदलांत्या दिनार्द्ध[4]कर्णेन वा [2]कर्णः ।
भक्ता ज्यया ऽथवाऽन्त्या दिनार्द्ध कर्णा [3]हृता कर्णः ॥ ३५ ॥
द्यु दलान्नतो [1]क्रमज्या [2]स्वाहोरात्र्यार्द्ध[4] संगुण विभजेत् ।
व्यासार्द्धेन [5]फलोना द्यु दलान्त्य[3]याथवा छेदः ॥ ३६ ॥
अन्त्यानतो [1]क्रमज्या हीनां ज्या षट् [2]पृथक् [3]छेदः ।
ज्याभ्यां [4]च सह [5]फलानि छाया नयनानि षट् [6]त्रिंशत् ॥ ३७ ॥

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३५. (घ) २. वा गुणा for (वा) (ग) संगुणा for (वा) (क) संगुणा for (वा) (ख) कर्णाः for (वाकर्णः)
१. छेदहृता (ग) (क) (च) for (छेदहृता)
(ग) ३. कर्णहृता (क) कर्णाहिता (ख) कर्णाः हृता for (कर्णाहृता)
(ख) ४. नवागुणाः for (र्द्धकर्णेन)
(च) २. वागुणाकर्णः for (वाकर्णः)

३६. (घ) १. द्युदलान्ततोत्क्रमज्यां (ग) (क) (च) for (द्युदलान्नतो क्रमज्या)
२. स्वाहारात्रार्ध संगुणं विभजेत् । (ग) स्त्राहोरात्रार्द्धसंगुणां विभजेत् for (स्वाहोरात्र्यार्द्धं संगुणा विभजेत्)
३. दलान्त्य ज्याथवा for (द्युदलान्त्ययाथवा)
(ग) ३. दलान्त्यज्या यथा (क) द्युदलान्त्यज्याथवा (ख) for (द्युदलान्त्यययाथवा)
(क) ४. संगुणाम् (ख) संगुणं for संगुणा
(ख) १. द्युदलन्नतोत्कमजां for (द्युदलान्नतो क्रमज्या)
२. स्वाहोरात्राद्धं for (स्वाहोरात्र्याद्धं)
५. फलेना for (फलोना)
(च) २. स्वाहोरात्राद्धं for (स्वाहोरात्र्यार्द्ध)
४. संगुणां for (संगुणा)

३७. (घ) १. अन्त्यानतोत्क्रमज्याहीना (ग) (क) (ख) for (अन्त्यानतो क्रमज्याहीनां)
३. छेदाः (ग) (ख) छेदा for (छेदः)
(च) ४. 'च' अतिरिक्त पाठ
५. फलनि for (फलानि)
६. त्सट्त्रिशत् for (षट्त्रिंशत्)
(च) १. अन्त्यानतोत्क्रमज्याहीन for (अन्त्यानतो क्रमज्याहीनां) ३ छेदाः for (छेदः)

छाया कर्णविभक्ता[4] विषुवत्कर्णेन संगुणा[2] नृज्या[1] ।
लब्धं सौम्येतरयोः[5] क्षितिज्यया[6] हीनसंयुक्तं[3] ॥ ३८ ॥
गुणितं व्यासार्द्धेन स्वाहोरात्रार्द्ध[1]भक्तमाप्तधनुः[2] ।
उत्तर गोले युक्तं याम्ये हीनं चरप्राणैः[3] ॥ ३९ ॥
दिनगतशेष[3]छेद[4]प्राणाः प्रागपरदिनार्द्धयोर्विशोध्याप्तम्[6] ।
व्यासार्द्ध छेषो[1] क्रमजीवा[5] चापं नताः[2] प्राणाः ॥ ४० ॥
स्वाहोरात्रार्द्धेन छायाकर्णाहतेन[2] भक्ताया[1] ।
विषुवत्कर्णे[3] गुणाया[4] व्यासार्द्धकृतेः[5] फलं सौम्ये ॥ ४१ ॥

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३८. (ग) १. त्रिज्या (क) (ख) त्रिज्या for (नृज्या)
(क) २. संगुण for (संगुणा)
३. संयुतम् (ख) for (संयुक्तं)
(ख) ४. विभक्त for (विभक्ता)
५. सौम्येतरयो for (सौम्येतरयोः)
६. ज्याया for (ज्यया)

३९. (ख) १. रात्रार्द्ध for (रात्रार्द्धं)
२. भक्तमप्तधनुः for (भक्तमाप्तधनुः)
३. प्राणै for (प्राणैः)

४०. (घ) १. व्यासार्द्धछिषोत्क्रम (ग) व्यासार्द्धातिशेषोत्क्रम for (व्यासार्द्ध छेषोक्रम)
२. नता (क) नत for (नताः)
(ग) ३. शेषप्राणः (क) शेषप्राणाः for (शेषछेद प्राणाः)
(क) ४. 'छेद' पद लुप्त है । (ख)
५. शेषोत्क्रम (ख) छेसोत्क्रम for (छेषोक्रम)
(ख) ६. विशोध्यप्तम् for (विशोध्याप्तम्)
(च) १. व्यासार्द्धछिषोत्क्रम for (व्यासार्द्ध छेषो क्रम)

४१. (ग) १. भक्तायाः (क) (ख) for (भक्ताया)
(ख) २. कर्णहतेन for (कर्णाहतेन)
(ख) ३. विषुवत्कर्णा for (विषुवत्कर्णे)
४. गुणाय for (गुणाया)
५. कृते for (कृतेः)

क्षयवृद्धिज्याहीनं युक्तं याम्ये[2] धनुश्चर[3]प्राणैः[4] ।
सौम्येयुतं विहीनं याम्ये प्रागपरयोः[5] प्राणाः[1] ॥ ४२ ॥
अह्नोगताऽवशेषाः[3] फलमन्त्याया विशोध्य शेषस्य ।
धनुरुक्रमजीवाभिः[1] पूर्वापरयोर्नताः[2] प्राणाः[4] ॥ ४३ ॥
दिनदलकर्णगुणांत्या[3] छायाकर्णोद्धृता[4] फलोनान्त्या[2] ।
शेषस्योत्क्रमजीवा[5] धनुर्दिनार्द्धनताः[1] प्राणाः ॥ ४४ ॥
चरदल जीवोनाधिक फल क्रमज्यो[1] धनुश्चरार्द्धेन ।
युतहींन पूर्वाह्णे[3] दिवसगतं[4] शेषं[2] अपराह्णे ॥ ४५ ॥

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४२. (क) १. प्राणैः (ख) प्राणः for (प्राणः)
(ख) २. याम्यो for (याम्ये)
३. धनुशर for (धनुश्चर)
४. प्रणै for (प्राणैः)
५. प्रागपरयो for (प्रागपरयोः)

४३. (घ) १. धनुरुत्क्रमजीवाभिः (ग) (क) (ख) (च) for (धनुरुक्रमजीवाभिः)
(ग) १. र्नता (क) नत for (र्नताः)
(क) ३. अह्नोगतावशेषात् (ख) अह्नोगतावशेषा for (अह्नोगताऽवशेषाः)
(ख) ४. प्राणः for (प्राणाः)
(च) ३. अवग्रहचिह्न लुप्त

४४. (घ) १. दिनार्द्धान्नताः for (दिनार्द्धनताः) (ग) (क) दिनार्द्धनत for (दिनार्द्धनताः)
(ग) २. नान्त्या (ख) नान्त्या for (नान्त्या)
(ख) ३, गुणांत्या
४. कर्णाद्धृता for (कर्णोद्धृता)
५. जीव for (जीवा)
१. दिनार्धोन्नतप्राणः for (दिनार्द्धनताः प्राणाः)
(च) १. धनुर्द्दिनार्द्धान्नताः for (धनुर्दिनार्द्धनताः)

४५. (घ) १. क्रमज्या (ग) (क) (ख) क्रमज्या for (क्रमज्यो)
२. शेषमपराह्ले (ग) (ख) शेषमपराह्ने (च) for (शेषं अपराह्णे)
(ग) ३. पूर्वाह्ले (ख) पूर्वाह्न for (पूर्वाह्णे)
(ख) ४. विवसगतं for (दिवसगतं)

उत्क्रमजीवाभ्यधिक क्रमज्यया[4] संयुक्तं[1] (तं) धनुर्धनुषां[6] ।
व्यस्त[5]विशुद्धौ हीनाश्चरांसवः[2] पूर्ववच्छेषं[3] ॥ ४६ ॥
दिनमध्यार्का[1] क्रांत्याक्ष[2]भागयोगांतरं सामान्यदिशोः[4] ।
नतभागा[6] नवते प्राक्[5] ज्योन्नताः[3] शेषाः[7] ॥ ४७ ॥
नतभागज्या द्वादशगुणोन्नतांश[4]ज्यया[5] हृताल्लब्धम्[1] ।
इष्टदिनार्द्धछाया यथोक्तकरणौ[2]दिनार्द्धाद्वा[3] ॥ ४८ ॥

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४६. (घ) १. संयुतम् (ग) (क) (ख) संयुते for (संयुक्तं)
२. चरासवः (ग) (क) (ख) (च) for (चरांसवः)
३. पूर्ववछेषं (ग) पूर्ववत्सेषम् for (पूर्ववच्छेषं)
५. व्यक्त for (व्यस्त)
(ज) १. संयुतं for (संयुक्तं) ६. धनुर्द्धनुषा for (धनुर्धनुषां)
४७. (घ) १. दिनमध्यार्क (ग) (क) (ख) for (दिनमध्यार्का)
२. क्रान्त्यक्ष (ग) (क) (ख) for (क्रांत्याक्ष)
६. नतभागानतभान्नवते ९० (ग) नतभागानतभागान्नवतेः for (नतभागानवते)
३. प्रोन्नताः (ख) प्रोज्योन्नतभागास्तु for (ज्योन्नताः)
(ग) ४. समान्यदिशोः (क) समानदिशोः (ख) समान्यादिशोः for (सामान्यदिशोः)
५. प्रोह्योन्नताः शेषा (क) (ख) देखो ३. for (प्राक्ज्योन्नताः शेषाः)
(क) ६. नतभागा नतभागोन्नवतेः (ख) नतभागान्नवतेः for (नतभागानवते)
(ख) ७. शाय्याः स्युः for (शेषाः)
(च) १. दिनमध्यार्क्का for (दिनमध्यार्का)
२. क्रांत्यक्ष for (क्रांत्याक्ष)
४. समान्यदिशोः for (सामान्यदिशोः)
६. नतभागानतभागान्नवते ९० for (नतभागानवते)
४८. (घ) १. हृता (ग) (क) (ख) हृतालब्धम् for (हृताल्लब्धम्)
२. करणैं (ख) करणे for (करणौ)
३. र्दिनार्धा (ग) दिनार्द्धाद्वा (क) दिनार्धाद्वा for (र्दिनार्द्धाद्वा)
(ग) ४. द्वादगुणोन्नतांश (ख) द्वादशगुणेन्नतांश for (द्वादशगुणोन्नतांश)
(ख) ५. ज्याया for (ज्यया)
३. दिनार्धद्वा for (र्दिनार्द्धाद्वा)
(च) १. हृतालब्धं for (हृताल्लब्धम्)
२. करणौं for (करणौ) ३. र्दिनार्द्धा for (र्दिनार्द्धाद्वा)

उन्नतजीवाभक्तं[४] व्यासार्द्धं[५] द्वादशाहतं[३] कर्णः ।
मध्यछायाकर्णं[१] द्वादशक्रान्त्यतरं[२] पदं वा ॥ ४९ ॥
कुदलां[१]त्याज्या[२] छेदोमध्यछाया यथोक्तकरणैर्वा[३] ।
अन्त्याज्या[४] छेदाद्यं मध्यछाया[५]ऽथवा[६] बहुधा । ५० ॥
विषुवत्कर्णेन[६] गुणा विषुवत्छाया[१] हतोत्तरा[२] क्रान्तिः ।
यद्युनाक्षक्षज्याया[३] शंकु[५]सम[४]मंडलस्थेऽर्के[७] ॥ ५१ ॥

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४९. (घ) १. छायाम् for (छाया)
२. कृत्यंतरपदम् (ग) (क) कृत्यन्तरपदं वा for (क्रान्त्यतरं पदं वा)
३. द्वादशाहतं ११ for (द्वादशाहतं)
(ग) ४. भुक्तं for (भक्तं)
(ख) ५. व्यासार्धं for (व्यासार्द्धं)
१. 'मध्यछायाकर्णं' पद लुप्त हैं ।
२. कृतंतर for (क्रान्त्यतरं) यहां दूसरी पंक्ति 'द्वादश' से आरम्भ है ।
(च) १. छायां for (छाया) २. कृत्यंतरपदं वा for (क्रान्त्यतरं पदं वा)
५०. (घ) १. द्युदलां (ग) (क) (ख) (च) for (कुदलां)
(ग) २. त्यज्या (क) (ख) for (त्याज्या)
३. वरणैर्वा (ख) करणै वाः for (करणैर्वा)
(क) ४. अन्त्यज्या (ख) अत्याज्याः for (अन्त्याज्या)
(ख) ५. मध्यछाया for (मंध्यछाया)
(च) ६. अवग्रह चिह्न लुप्त
५१. (घ) १. विषुवछाया (ग) (ख) विषुवच्छाया for (विषुवत्छाया)
२. हृतोत्तरा for (हतोत्तरा) (क) छायोद्धृतोत्तरा for (छायाहृतोत्तरा)
३. यद्यूनाक्षय्याया (ग) द्यूनाक्षज्यायाः (क) यद्यूनाक्षज्यायाः for (यद्युनाक्षक्षज्याया)
४. समं (च) for (सम)
(ग) ५. शंकुः (क) (ख) 'शंकु' लुप्त पद for (शंकु)
(क) ६. बिषुवत्कर्णेन for (विषुवत्कर्णेन)
३. यद्यूनाक्षज्यायाः for (यद्युनाक्षक्षज्याया)
७. मंडलास्थेर्के for (मंडलस्थे ऽर्के)
(च) १. विषुवछाया for (विषुवत्छाया)
२. हृतोत्तरा for (हतोत्तरा) ३ यद्यूनाक्षज्याया for (यद्युनाक्षक्षज्याया)

सूर्यज्या जिनभागज्यया गुणाक्षज्ययाऽथवा भक्ता ।
अग्रा द्वादशगुणिता विषुवच्छाया विभक्ता वा ॥ ५२ ॥
द्वादश विषुवच्छाया गुणिते पृथगक्षलंबजीवे वा ।
क्रान्तिहृते सममण्डलकर्णौ प्राग्वत् पृथक् छाया ॥ ५३ ॥
अर्क्राग्रा वर्गोनं नृज्या वर्गार्धं ५३४६४५० मर्क १४४ कृतिगुणितं ।
आद्यान्योग्रा द्वादशविषुवच्छाया वधो हृतयोः ॥ ५४ ॥

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५२. (घ) १. ज्ययाथवा (च) for (ज्ययाऽथवा)
२. विषुवछाया (ग) for (विषुवच्छाया)
(ग) ३. दिनभागज्यागुणा for (जिनभागज्यया गुणा) (ख)
(क) ४. अग्रात् (ख) अग्र for (अग्रा)
(ख) ५. गुणाक्षयाथवा for (गुणाक्षज्ययाऽथवा)
६. 'ज्यया' लुप्त पद है ।
७. विभक्त for (विभक्ता)
(च) २. विषुववछाया for (विषुवच्छाया)

५३. (घ) १. विषुवछाया (ग) (च) for (विषुवच्छाया)
२. हृते (ग) (क) (च) for (हृते)
३. छाये for (छाया) (ग) (ख) पृथकार्ये for (पृथक् छाया)
(ख) ४. पृस्थगक्ष for (पृथगक्ष)
५. कर्णौ for (कर्णौ)
(च) ३. छायो for (छाया)

५४. (घ) १. वर्ग्राधी ५३४६४५० for (वर्गार्धं ५३४६४५०) (ग) वर्ग्राधं (ख) वर्गा for (वर्गार्धं)
२. मर्काकृतिगुणितं १४४ (ख) धर्मकृति for (मर्क १४४ कृतिगुणितं)
३. आद्योन्योग्रा (ग) (क) (ख) आद्योन्योग्रा (च) for (आद्यान्योग्रा)
४. विषुवछाया (ग) (च) for (विषुवच्छाया)
५. हृतयोः (ग) (क) (ख) हृतयो for (हृतयोः)
(ग) ६. वर्ग्रोनं for (वर्गोनं)
७. त्रिज्या (क) (ख) for (नृज्या)
वि० श्लोक में दी गई संख्याएं इस प्रति में नहीं है ।
(क) १. वर्गाधिर्मर्क कृति for (वर्गार्धं ५३४६४५० मर्क १४४ कृति)
(च) ८. अर्क्काग्रा for (अर्क्राग्रा) ६ वर्गोनं for (वर्गोनं)
१. वर्ग्राद्धं ५३४६४५० for (वर्गार्धं ५३४६४५०) २ मर्क्क कृतिगुणितं १४४ for (मर्क १४४ कृति गुणितं)
५. हृतयोः for (हृतयोः)

विषुवच्छाया[१] कृत्याद्वा[३] संगयुतया[२] ७२ न्यकृतियुतादाद्यात्[६] ।
पदमन्ययुत[४]विहीनं सौम्येत्तर[५]गोलयोः शंकुः ॥ ५५ ॥
विदिशोः[१] सौम्येत्तरयो[६]रुत्तर[२]गोले पदोनयुक्तो[५] न्यः ।
सममण्डल दक्षिणतो[४]तच्छाया[३] नाडिकाः[७] प्राग्वत् ॥ ५६ ॥
प्राच्यपरा[३] शंकुतलान्तरद्वयव्यस्तकर्णवधविवरं ।
समदिग्विषुवत्छाया[१]न्यदिगैक्यं कर्णविवरहृतम्[२] ॥ ५७ ॥

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५५. (घ) १. विषवछाया, (ग) for (विषुवच्छाया)
२. गसंयुतया ७२ for (संगयुतया ७२)
(ख) ३. कृत्याः व्यागसंयुतया for (कृत्याद्वा संगयुतया ७२)
(ग) ३. कृत्याद्वचग ७२ संयुतया (क) for (कृत्या द्वासंगयुतया)
४. परमन्यतयुत (ख) पदमन्ययुतं for (पदमन्ययुत)
(ख) ६. युतयाद्यात् for (युतादाद्यात्)
(च) १. विषुवछाया for (विषुवच्छाया) २. गसंयुतया ७२ for (संगयुतया ७२)

५६. (घ) १. विदिशो सौम्येतरयो (ग) विदशो सौम्येतरयो (क) for (विदिशोः सौम्येतरयो)
२. रुत्तरागाले (क) रुत्तरागोले for (रुत्तरगोले) (ख) गोपदोन for (गोलेपदोन)
३. तच्छाया (क) नच्छाया (ख) तच्छाया for (तच्छाया)
(ग) ४. दक्षिणागतछाया (क) दक्षिणगे (ख) दक्षिणगो for (दक्षिणतो)
(क) ५. ऽन्यः । (ख) युक्ता यः for (युक्तोन्यः)
(ख) १. वेदि for (विदिशोः)
६. शौम्येतरयो for (शौम्येतरयो)
७. नाहिका for (नाडिकाः)
(च) १. विदिशो for (विदिशोः) ३. तछाया for (तच्छाया)

५७. (घ) १. विषुवछाया (ग) (क) विषुवच्छाया for (विषुवत्छाया)
२. कर्णविवरह्वतम् (ग) कर्णविवरह्वतम् for (कर्णविवरहृतम्)
३. यात्यपरा (ग) प्राच्यापरा for (प्राच्यपरा)
(च) १. विषुवच्छाया for (विषुवत्छाया) २. कर्णविवरहृतम् for (कर्णविवरहृतं)

छायावृत्ताग्रोमा[3] सौम्येन युगान्तरेण[5] याम्येन ।
विषुवच्छाया[1]ज्जादिषु[2] तुलादिषु तथान्तरं[4] हीनं ॥ ५८ ॥
इष्टाछाया[4] वृत्ते तदग्रयो[5] यदुदयास्तमय[6]सूत्रम् ।
अनुपातात्[1] छंको विषुवत्छायांतर[2]मिहऽग्रा[3] ॥ ५९ ॥
शंकुप्राच्यपरांतरविषुवत्छायां[1]ऽगुलांतरं[2] याम्ये ।
उदगैक्यं लम्बगुणं छाया-कर्णोद्धृतं[3] क्रान्तिः[4] ॥ ६० ॥

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५८. (घ) १. विषुवछाया (ग) (च) for (विषुवच्छाया)
२. जादिषु (क) (च) for (ज्जादिषु)

(ग) ३. ग्रोना (क) for (ग्रोमा)
४. तयान्तरं for (तथान्तरं)

(क) ५. युतांऽतरेण for (युतांतरेण)

५९. (घ) १. अनुपातात्तच्छंको (ग) अनुपातात्तच्छंको for (अनुपातातछंको)
२. विषुवछाया for (विषुवत्छाया) (ग) विषुछायांतरमिहाग्रा (क) for (विषुवत्छायांतरमिहऽग्रा)
३. इहाग्रा for (इहऽग्रा)
४. इष्टछाया (ग) (क) for (इष्टछाया)

(ग) ५. तदग्रया for (तदग्रयो)

(क) ६. यंदुदयास्तमयं for (यदुदयास्तमय)

(च) १. अनुपातात्तछंको for (अनुपातातछंको)
२. विषुवछायांतर for (विषुवत्छायांतर)
३. मिहाग्रा for (मिहऽग्रा)

६०. (घ) १. विषुवछायां for (विषुवत्छायां) (ग) (क) विषुवच्छायांतरं for (विषुवत्छायांऽगुलातरं)
२. छायांगुलांतरम् (ग) for (छायांऽगुलांतरं)
४. क्रांति for (क्रान्तिः)

(क) १. विषुवछायां for (विषुवत्छायां) २. गुलांतरं for (ऽगुलांतरं)

क्रान्ति[1]व्यासार्द्धगुणा[7] ३२७० जिनभागज्या १३२६४[5] हता[6]तुरजादौ ।
कर्कादौ[2] चक्रार्द्धात्प्रोक्त[3]तुलादौ स चक्रार्द्धं[4] ॥६१॥
चक्रात्प्रोह्य[1] मृगादौ स्फुटो सकृत्[5] व्यस्तमृणं[6] धनंमध्यम्[4] ।
अर्कास्माद्[2] देशान्तरयुगयाते[7] मध्यमा[3] प्राग्वत्[8] ॥ ६२ ॥

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६१. (घ) १. क्रान्तिर्व्यासार्धं गुणाः (ग) क्रान्तिर्व्यासार्द्धं गुणा (क) for (क्रान्तिव्यासार्द्ध गुणा)

२. कर्क्यादौ (ग) (क) (च) for (कर्कादौ)

३. प्रोत्तुलादौ (ग) प्रोह्य (क) for (प्रोक्ततुलादौ)

४. वक्रार्धम् (क) चक्रार्द्धं (सभार्धेन) for (चक्रार्द्धं)

५. १३२६ for (१३२६४)

६. धनुरजादौ (ग) हृता धनुरजादौ (क) for (हतातुरजादौ)

(च) १. क्रांतिर्व्यासार्द्धं for (क्रान्तिव्यासार्द्धं)

७. गुणाः for (गुणा) ६. हृता १३२६४ नुरजादौ for (१३२६४ हतातुरजादौ)

६२. (घ) १. प्रामृगादौ for (प्रोह्यमृगादौ) (क) ऽऽऽत्प्रास्य for (प्रोह्य)

२. अर्को (ग) (क) मध्यर्कोऽस्य for (अर्कास्माद्)

३. मध्यमाः for (मध्यमा)

४. मध्यः (ग) (च) for (मध्यम्)

(ग) ५. ऽसकृत् (क) ऽशकृद् for (सकृत्)

(क) ६. व्यस्तधनयुषं for (व्यस्तमृणंधनं) (चं) मृणं for (मृणं)

७. हेशातरयगया तेन for (देशान्तरयुगयाते)

(च) १. चक्रात्प्रोज्य for (चक्रात्प्रोह्य)

२. अर्क्कोस्मादेशांतर for (अर्कास्माद्देशांतर)

८. प्रागवत for (प्राग्वत्)

शशिमृगोन्यत्यर्धे[१] रात्रेर्गतशेषनाडिका[२] शंकु[३]।
विपरीतगोलविधिना[५] रात्र्यर्द्धा[४] क्रान्तिराभिर्वा ॥ ६३ ॥
क्षितिजेऽग्रा प्राच्यपराक्रान्तिस्त्रिज्यागुणावलम्बहृता[२][१]।
द्विगुणमुदयास्तसूत्रं[४] तत्त्रिज्या कृतिविशेषपदम्[३] ॥ ६४ ॥
अक्षज्या शंकु[३]वधालम्बक[१]लब्धोदयास्तमयसूत्रात्[२]।
दक्षिणतः शंकुतलं दिवसो रात्रौ तदुत्तरतः ॥ ६५ ॥
दिग्लम्बाक्ष[१]स्वोदयलग्नछायादिषु[२] यदिष्टेषु।
षट् षष्टयार्याणां त्रिप्रश्नाध्याय[३]स्तृतीयोयम्[४] ॥ ६६ ॥

इति ब्रह्मगुप्ते तृतीयोऽध्यायः

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६३. (घ) १. शृंगोन्नत्यर्थं (ग) शृंगोन्यत्यर्थं (क) शृगोन्नत्यर्थं for (शशिमृगोन्यत्यर्धे)
२. नाडिकाम् for (नाडिका)
३. शंकुः (ग) (क) for (शंकु)
४. रात्र्यार्धक्रंतिराभिर्वा (ग) क्रंतिराभिर्वा (क) कोन्तराभिर्वा for (रात्र्यर्द्धा क्रान्तिराभिर्वा)
(ग) ५. विपरीतगेलविधि for (विपरीतगोलविधिना) (च) विपरित for (विपरीत)
(च) १. शृंगोन्यत्यर्थं for (शशिमृगोन्यत्यर्धे)
४. रात्र्यार्धक्रांतिराभिर्वा for (रात्र्यर्द्धाक्रान्तिराभिर्वा)
६४. (क) १. हृता (क) (च) for (हृता)
(ग) २. गुणवलंबहृता for (गुणावलम्बहृता)
(क) ३. वियुक्तपदम् for (विशेषपदम्)
(च) ४. त्सूत्रं for (सूत्रं)
६५. (घ) १. शंकुवधाल्लंबक for (शंकुबधालम्बक) (ग (क)
(ग) २. लब्धोदयस्तसूत्रात् for (लब्धोदयास्तमयसूत्रात्)
(क) ३. शंकुः for (शंकु)
६६. (घ) १. दिल्लंवाक्ष for (दिग्लम्बाक्ष)
(ग) २. छायादिषूपदिष्टेषु (क) (च) for (छायादिषु यदिष्टेषु)
३. त्रिप्रस्नाध्यायः for (त्रिप्रश्नाध्यायस्)
(क) ४. तृतीयोऽयम् for (तृतीयोयम्)
(च) ४. त्रतीयोयं ॥३॥ for (तृतीयोयं ॥६६॥)
वि० श्लोक क्रमांक ६६ के स्थानपर 'तीन' का अंक अध्याय की क्रम संख्या को दर्शाता है।

कालज्ञानं प्रायः पर्वज्ञानार्थमिष्यते सद्भिः।
शशिभास्करग्रहणयोस्तद्भि[1] व्यक्तिः स्फुटाभेदैः[2] ॥ १ ॥
दिग्वर्णवलनवेलायां[1] निमिलनोन्मीलन[3]स्थितिविमर्दाः।
स्पर्श-छाया-मोक्ष-ग्रासेष्ट-ग्रास-परिलेखा[2] ॥ २ ॥
भेदाश्चतुर्दश[4] तयोरिन्द्वर्कग्रहणयोः[5] परिज्ञानात्[1]।
यस्माद्भेदज्ञानं तस्माद् ग्रहणं[2] प्रवक्षामि[3] ॥ ३ ॥
तिथिगतगम्ये भुक्ति[1] भुक्तचंतर[4]हृते[2] फलोनयुतौ।
रविशशिनौ समलिप्तौ यातस्[3]तात्कालिको भवति ॥ ४ ॥

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१. (घ) १. तदभिव्यक्तिः (ग) for (तद्भिव्यक्तिः)

(क) १. स्वदभिव्यक्तिः for (तद्भिव्यक्तिः)

(च) १. तदभिव्यक्तिः for (तद्भिव्यक्तिः)

२. (घ) १. खला निमीलानान्मीलन (ग) वेला निमीलनोन्मीलन for (वेलायां निमिलनोन्मीलन)

(क) मूलश्लोक यहाँ उपलब्ध नहीं, हाँ उसकी टीका दी हुई है।

(च) ३. निमीलनोन्मीलन for (निमिलनोन्मीलन)

३. (घ) १: परिज्ञानातः for (परिज्ञानात्)
२. ग्रहणे (ग) (क) for (ग्रहणं)
३. प्रविक्ष्यामि (ग) (क) प्रवक्ष्यामि for (प्रवक्षामि)

(ग) ४. भेदश्चतुर्दश for (भेदाश्चतुर्दश)
५. ग्रहणयो for (ग्रहणयोः)

(च) २. दृग्रहणो for (दृग्रहणं) ३ प्रविक्ष्यामि for (प्रवक्षामि)

४. (घ) १. गुणेभुक्तचंतर for (भुक्तचंतर)
२. हृते (क) (च) for (हृते)

(क) १. यहाँ 'भुक्ति' के आगे 'गुणे' अधिक पद है
३. पातस् (च) for (यातस्)

(च) ४. +गुणे+

खत्रिघन (घ्न) गुणा व्यासार्द्ध[4] भाजिता[2] ३२७० चन्द्रपातयोगज्या[3] ।
विक्षेपकालाः[5] सौम्याः[6] षट् राश्यूनधिके[1] याम्याः ॥ ५ ॥
रविशशिभुक्ती भवदशगुणे[5] नख[1] स्वरजिनैः[6] हृते[2] नात्ते[3] ।
तत्वाष्ट[7]गुणितभुक्तयोर्विवरं[8] षष्ट्याहृतं[9] तमसः[4] ॥ ६ ॥
छाद्यं[1] छादक मानैक्यार्धं विक्षेप हनिकं[2] हृन्नं[3] $\frac{11}{20}$ $\frac{10}{24}$ ।
सर्वग्रहणं ग्राह्यादधिके खण्ड[4]ग्रहणमूने ॥ ७ ॥

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५. (च) १. षड्राश्यूने धिके (ग) षड्राशूनेधिके (क) षड्राश्यूनेऽधिके for (षट्राश्यूनधिके)

(ग) २. विभाजिता for (भाजिता)

३. ज्याः for (ज्या)

४. +२७०+

५. कलाः (क) for (कालाः)

(च) ६. सौम्या for (सौम्याः)

१. षड्राशूनधिके for (षट् राश्यूनधिके)

६. (घ) १. नखैः (क) (च) for (नखैं)

२. हृते (ग) (क) (च) for (हृते)

३. माने (ग) (क) (च) for (नात्ते)

४. षष्ट्याहृतमंतरं तमसः (ग) षष्ट्याहृतं तसमः for (षष्ट्याहृतं तमसः)

(ग) ५. गुणैः ११।१०। for (गुणे)

६. जिनै २०।२४७ (क) जिनै for (जिनैः)

७. तत्वाष्ट २५।८ (क) तत्त्वाष्ट for (तत्वाष्ट)

(क) ८. भुक्तयो विवरं for (भुक्तयोर्विवरं)

९. षष्ट्याहृतं for (षष्ट्याहृतं)

७. (घ) १. छाद्य-(ग) (क) for (छाद्यं)

२. हीनकं (ग) (क) (च) for (हनिकं)

३. छन्नं । (ग) छिन्नम् (क) छन्नम् (च) for (हृन्नं)

४. षण्ड (क) for (खण्ड)

(च) वि० इस श्लोक के बाईं ओर "$\frac{११}{२०} \big| \frac{१०}{२४} \big|$" संख्यासारणी अंकित है ।

छाद्येन युतोनस्य[४] छादकमानस्य[१] तद्दलकृतिभ्याम् ।
विक्षेपकृत्ति[२] प्रोह्य पदेति व[३] स्थिति विमर्दार्द्धे[५] ॥ ८ ॥
षष्ट्या विभाजिता स्थितिविमर्दार्द्ध[१]नाडिका गुणाः[५] स्वगतिः ।
आदौ रविशशि[६]पाते[२]षूणमसकृ[३]तेषु धनमंते[४] ॥ ९ ॥
स्पर्शान्निमीलनं[१] स्थितिदले विमर्दार्द्धहीनके पश्चात् ।
मोक्षा[३]दर्वागुन्मीलनं विमर्द्द[२]स्तयोरैक्यम्[४] ॥ १० ॥
भुक्त्यन्तरमिष्टोनस्थितिदलघटिका गुण[४]हतं[१] षष्ट्या ।
बाहुः[२] प्राग्वत् तत्फल[५]हीनयुतैः सूर्यशशिः[३] पातैः ॥ ११ ॥

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८. (घ) १. छदक for (छादक)
२. कृति (ग) for (कृत्ति)
३. तिथिवत् (ग) (क) for (तिवस्थिति)
(क) ४. युतोनास्य for (युतोनस्य)
५. विमर्दाधे for (विमर्दार्द्धे)
(च) २. कृति for (कृत्ति) ३ थिवस्थिति for वस्थिति)

९. (घ) १. विमर्ददलनाडिका (ग) (क) for (विमर्दार्द्धनाड़िका)
२. ३. पातेष्वृणमसकृत्तेषु (ग) (क) (च) for (पातेषूणमसकृतेषु)
४. धनमन्तेः for (धनमंते)
(ग) ५. गुणास्वतिः । (क) गुणास्वगतिः for (गुणाः स्वगतिः)
(क) ६. रवींदु for (रविशशि)

१०. (घ) १. निमीलिनं (च) for (न्निमीलनं)
(ग) २. तदर्द्धैक्यम् (क) तदैक्यार्धः for (तयोरैक्यम्)
(च) ३. माक्षा for (मोक्षा)
४. रेक्यम् for (रैक्यम्)

११. (घ) १. हृतं (ग) (क) (च) for (हतं)
२. बहुः for (बाहुः)
३. सूर्यशशिपातैः (ग) (क)
(ग) ४. गुणं for (गुण)
(क) ५. तत्फलं for (तत्फल)
३. सूर्यशशिपातैः for (सूर्यशशिः पातैः)

तात्कालिकविक्षेपः कोटिस्तद्वर्ग[1]युतिपदं कर्णः ।
मानैक्यार्द्धात्कर्णं विशोध्य तात्कालिको ग्रासः ॥ १२ ॥
असकृत्[1] ग्रासकालोनप्रमाणयुतिदलकृते [6]विशोध्य कृतिं[4] ।
तत्कालिक[2]विक्षेपस्य शेषमूल[3]कृतं तिथिवत्[5] ॥ १३ ॥
प्रग्रहण स्थित्यार्द्धात्[4] प्राज्यप्रग्रहणतो भवति कालः ।
मौक्षे विशोध्य मोक्षस्थित्यर्द्धात्प्राग् भवेत्[3] मोक्षम्[2] ॥ १४ ॥
स्फुटतिथ्यंते मध्यं प्रग्रहणं[2] स्थितिदलोनकेभ्यऽधिके[3][1] ।
मोक्षो निमीलनोन्मीलने विमर्दार्ध[4]हीनयुते[6] ॥ १५ ॥

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१२. (घ) १. तद्वर्ग्युति (ग) तद्वर्ग्‌ संयुति for (तद्वर्गयुति)

१३. (घ) १. असकृद्ग्रासकलोन (ग) असकृग्रास कलोन for (असकृत्ग्रासकालोन)
२. तात्कालिक (ग) (च) for (तत्कालिक)
३. शेषमूलं (च) for (शेषमूल)
(ग) ४. कृति for (कृतिं)
५. तितिवत् for (तिथिवत्)
(क) १. असकृद्ग्रासकालोन for (असकृत् ग्रासकालोन)
(च) १. असकृद्ग्रासकलोन for (असकृत्ग्रासकालोन)
६. र्विशोध्य for (विशोध्य)

१४. (घ) १. प्रग्रणतो (ग) प्राज्यप्रग्रहणतो (क) प्रोज्य प्रग्रहणवो for (प्राज्यप्रगणतो)
२. मोक्षात् (ग) (च) for (मोक्षम्)
(ग) ३. भवेन् (क) for (भवेत्)
(क) ४. स्थित्यर्धात् for (स्थित्यर्द्धात्)
५. मोक्षं for (मोक्षे)
(च) १. प्राज्य प्रग्रहणतो for (प्राज्यप्रगणतो)

१.५ (घ) १. दलोनवच (क) दलोनकेऽभ्यधिके for (दलोनकेभ्यऽधिके)
(ग) २. प्रग्ग्रहणं for (प्रग्रहणं)
३. स्थितिददलोनकेभ्यधिके for (स्थितिदलोनकेभ्यऽधिके)
(च) १. अवग्रहचिन्हलुप्त ४. विमर्द्दार्द्ध for (विमर्दार्ध)

प्राग् पश्चान्नतविषुवज्यो वंधा त्रिज्ययाप्तचापांशैः ।
उत्तरयाम्यैः पूर्वा विषुवद् वृतत्रिभे ग्राह्याः ॥ १६ ॥
सममंडलविषुवतो ग्राह्या त्रिगृहाधिकादुदग्याम्यैः ।
क्रान्त्यंशैरपममंडलपूर्वास्याञ्चन्द्रविक्षेपः ॥ १७ ॥
एकान्यदिशायुतिवियुतेर्ज्या प्रगृहणमध्यं मोक्षेषु ।
वलनं निमीलनोन्मीलनेष्टकालेष्टवो ऽन्येदिशां ॥ १८ ॥

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१६. (घ) १. प्राक् (ग) (क) (च) for (प्राग्)
२. विषुवज्ययो (ग) (क) (च) for (विषुवज्यो)
३. वंधात्रिज्यया (ग) (क) (च) for (वंधात्रिज्यया)
४. पूर्वादिषु for (पूर्वाविषुवद्)
५. वृत्त (ग) वृत् for (वृत)
६. ग्राह्या (क) for (ग्राह्याः)

(क) ७. पश्चात् विषुवज्ययो for (पश्चान्नतविषुवज्यो)
८. याम्यै for (याम्यैः)
९. त्रिमे for (त्रिभे)

१७. (घ) १. सममंलाद्विषुवतो (ग) for (सममंडलविषुवतो)
२. त्रिगृहाधिका (ग) for (त्रिग्रहाधिका)
३. पूर्वास्याश्चन्द्र (ग) (क) (च) for (पूर्वास्याञ्चन्द्र)

(क) १. सममंडलाद्विषुवतो for (सममंडलविषुवतो)

१८. (घ) १. न मीलानान् for (निमीलनोन्)
२. कालेष्वतोऽन्यदिशाम् (ग) (च) for (कालेष्टवोऽन्येदिशां)

(ग) ३. एकान्यदिशां (च) for (एकान्यदिशा)
४. विमलं for (वलनं)

(क) अवराम्यदिशाँ ज्यातिहि कुतज्यप्रग्रहणमध्यमोक्षेषु ।
वलनं निमीलनोन्मीनानष्टकालेष्टतोऽम्यदिशांम् ॥ १८ ॥

(च) २. कालेष्वतोन्यदिशां for (कालेष्टवोऽन्येदिशां)

आद्यन्त्ययोः[1] सधूम्रः[8] कृष्णः खण्डग्रहे[2]ऽर्द्धतो[3]ऽभ्यधिके ग्रासः[4] ।
सकृष्न[1] (ष्ण) ताम्रः सर्वग्रहणे शशि[5]कपील[6]वर्णः[7] ।। १९ ।।
मानविमर्दस्थितिदल[1]वलनेष्ट ग्रास समकलाद्येषु ।
चन्द्रग्रहणाध्याय[2] विंशतिरार्या श्चतुर्थीयां[3] ।। २० ।।

इति ब्रह्मगुप्ते चतुर्थोऽध्यायः

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१९. (घ) १. आद्यन्तयोः (ग) (क) for (आद्यन्त्ययोः)

२. ग्रण्डग्रहे (ग) for (खण्डग्रहे)

३. ऽर्कतोभ्यधिके for (ऽर्द्धतोभ्यधिके)

४. ग्रासः (दूसरी पंक्ति का आरम्भ) (ग) (क)

५. शशी (ग) (क) (च) for (शशि)

६. कपिलाँ (ग) कपिलवर्णः (क) कपिलः for (कपिलवर्णः)

७. वर्णः (यह शब्द नहीं है) (क) 'वर्ण' पद लुप्त

(ग) ८. सुधूम्र for (सधूम्रः)

(च) ३. र्द्धतोभ्यधिके for (र्द्धतोभ्यधिके) ६. कपिल for (कपील)

२०. (घ) १. दवलनेष्ट for (दलवलनेष्ट)

२. चन्द्रग्रहणाध्यायो (ग) (क) for (चन्द्रग्रहणाध्याय)

३. चतुर्थीयम् । (ग) (क) for (चतुर्थीयां)

५. 'इति' से 'अध्यायः' तक अंकित नहीं । केवल अध्याय समाप्ति सूचक "छः" अंकित है ;

(च) २. चंद्रग्रहणाध्याया for (चन्द्रग्रहणाध्याय) ३. चतुर्थीयं for (चतुर्थीयां)

५. 'इति' से 'अध्यायः' तक लुप्त हैं । अध्याय समाप्ति सूचक कोई और चिह्न भी विद्यमान नहीं ।

दृग्गणितैक्यं[1] न[2] भवति यस्मात्पंचज्यया रविग्रहणे ।
यस्माद्यथा[3] तदैक्यं तथा प्रवक्ष्यामि तिथ्यन्ते ॥ १ ॥
वित्रिभलग्नसमे[1]ऽर्केन[4] लम्बनं तदधिकोनके भवति ।
तत्संक्रान्ति[3] ज्योदक्[2] यदाक्षजीवा समा न तदा ॥ २ ॥
अवनतिरतोन्यथा भवति संभवेत्तदुदयै[1]र्विलग्नसमं[2] कृत्वा[5] ।
तदुदितघटिकातः छंकुस्[3]तच्चरप्राणैः[4] ॥ ३ ॥
त्रिज्याकृते चतुर्गुण[1]शंकुहृताया[2] फलेन भक्तायाः ।
तात्कालिकार्कराशित्रयोनलग्नान्तरज्याया[4] ॥ ४ ॥

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१. (घ) १. दृग्दणितैक्यं (च) for (दृग्गणितैक्यं)
(ग) ३. तस्माद्यथा for (यस्माद्यथा)
(क) २. 'न' पद लुप्त है ।
३. तस्माद्यथा for (यस्माद्यथा)

२. (घ) १. वित्रिग्नसमे for (वित्रिभलग्नसमे)
२. द्योदक् (ग) ज्योदग (क) ज्यादक् for (ज्योदक्)
(ग) ३. तत्स्वक्रांति (क) तन् खक्रान्ति for (तत्संक्रान्ति)
(च) ४. र्क्केन for (ऽर्केन) ३ तत्सक्रांतिस्योदक् for (तत्संक्रान्तिज्योदक्)

३. (घ) १. स भवे तदुदयै (ग) संभवेतदुयै (क) संभवेतदुदयै for (संभवेत्तदुदगै)
२. विलग्न समं for (विलग्नसमं)
३. घटिकात्तछंकुस् (ग) घटिकास्त छंकु (क) घटिकास्तच्छंकुस् for (घटिकातः छंकुस्)
(क) ५. 'कृत्वा' यह पद पूर्वार्ध का अंतिम न होकर उत्तरार्ध का आरम्भिक है (च)

४. (घ) १. कृतेश्चतुर्गुण (ग) कृतेश्चतुर्गुणं १०६९२९०० for (कृते चतुर्गुणं)
२. हृताया (ग) हृतायाः (च) हृताया for (हृताया)
३. राशित्रं for (राशित्र)
४. लग्नांतरद्यायाः (च) for (लग्नांतरज्यायाः)
(क) १. कृतेः श्चतुर्गुण for (कृते चतुर्गुण)
(च) १. कृतेश्चतुर्गुण for (कृतेचतुर्गुण)

लम्बनघटिकालग्नात् तात्कालिकात्त्रिराश्यूनात् ।
ऋणं (ऋणं) अधिके ऽर्के हीने धनमसकृत्पंच दृश्यन्ते ॥ ५ ॥
करणगुणाद् व्यासार्द्धाद्वसुवेद ४८ विभाजिता फलविभक्ता ।
लम्बननाड्यो भास्करवित्रिभलग्नान्तरं वा ॥ ६ ॥
रविशशिपातगतिकला लम्बनघटिका गुणषष्ट्या ।
यदि लम्बनमृणमूना धनमधिकाः स्वफललिप्ताभिः ॥ ७ ॥
अक्षज्याया वित्रिभलग्नात्स्वक्रान्तिरुत्तरार्कस्य ।
इन्दोर्वा यद्यधिका न नतिः सौम्या ऽन्यथा याम्या ॥ ८ ॥

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५. (घ) १. लब्धं लंबन (ग) लब्धं लंबन् (च) for (लम्बन)
२. ऋणमधिके (ग) रुणमधिकेक्कं हीने (क) ऋणमधिकेऽक्कं हीने for (ऋणं अधिकेऽर्के हीने)
२. ससत्कृत्पंच (क) मसकृत्यं च for (मसकृत्पंच)
४. दश्यंते (क) दश्यन्ते (च) दश्यंते for (दृश्यंते)
(क) १. लब्धं लंबन for (लम्बन)
(च) ५. राश्नात् for (राश्यूनात्) १ ऋणमधिकेर्के for ऋणं अधिकेऽर्के)

६. (घ) १. विभाजितात्पलविभक्ता (ग) विभाजितात्फलविभक्ता (क) (च) for (विभाजिता फलविभक्ता)
२. लंबतन्याड्यो for (लम्बननाड्यो)
३. वित्रिवजग्नांतर (ग) वित्रिलग्नांतर (क) बित्रिभलग्नांतर for वित्रिभलग्नांतरं)
४. घावा (ग) ज्यावा (क) ज्यावा for (वा)
(च) ४. लग्नांतरद्यावा for (लग्नांतरं वां)

७. (घ) १. गुणाद्धृता-गुणा हृता (ग) (क) गुणाहृता षष्ट्या for (गुणषष्ट्या)
(ग) २. शशिपातागति for (शशिपातगति)
३. स्वफललिप्तानि: for (स्वफललिप्ताभिः)
(च) १. गुणा हृताषष्ट्या for (गुणषष्ट्या)

८. (घ) १. अक्षय्याया (ग) अक्षछाया for (अक्षज्याया)
२. अवनतिः (ग) (क) ऽवनतिः for (ननतिः)
(क) ४. स्वाक्रान्ति for (स्वक्रान्ति)
(च) ३. वनतिः for (ननतिः)
५. अवग्रहचिह्न लुप्त

वित्रिभलग्नादुत्तरदक्षिण[1]विक्षेपहीनसंयुक्तम् ।
शंकुधनुरुत्तरायामधिकोनं दाक्षणावनतौ[2] ॥ ९ ॥
तज्ज्येंदु (तज्जेंदु) शंकुराद्यः सवितुः दृक्षेप[1] मंडले युक्ते ।
अपमण्डलेन भानोश्चन्द्रस्य विमण्डलेन युते ॥ १० ॥
त्रिज्या वर्गावुनौं[1] स्वशंकुवर्गेण तत्पदे दृग्ज्ये ।
रविशशिमध्यगतिगुणे तिथिगुणितव्यासदलभक्ते ॥ ११ ॥
४९०[3]५०[4] स्वछायागुणिते वा मध्यगति[1]तिथिगुणस्वकर्णहृते ।
फलयोर्दिक् याम्येतर[2]मवनतिरैक्यं दिगन्यत्वे ॥ १२ ॥
संयोगान्तरमवनतिशशांकविक्षेपयोः सामान्यदिशोः[1] ।
स्फुट[2]विक्षेपः शशिवत्[3] स्थित्यर्द्धं[4] विमर्द[5]दलनाडचः ॥ १३ ॥
प्राग्वल्लम्बनमसकृत्तिथ्यांतात्[1] स्थितिदलेन हीनयुतात् ।
अधिकोनं तन्मध्या ऋणयो[2]रूनाधिकं धनयोः ॥ १४ ॥

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९. (घ) १. दक्षण for (दक्षिण)
२. दक्षिणावनतो (ग) (क) दक्षिणावनतौ for (दाक्षणावनतौ)
(च) १. दक्षण for (दक्षिण) २ दक्षिणावनतो for (दाक्षणावनतो)
१०. (घ) १. दृक् (क) दृक्क्षेप for (दृक्षेप)
(च) १. दृ क्षेप for (दृक्षेप)
११. (घ) १. वर्गान्नुनौ (ग) वर्गानूनौ (क) वर्गाबूनौ for (च) वर्ग्गावुनौ (वर्गावुनौ)
१२. (घ) १. गती (ग) (क) for (गति)
२. साम्येंतर (ग) साम्येतर (क) साम्येऽन्तर for (याम्येतर)
(ग) ३. यह संख्या इस प्रति में अंकित नहीं है।
४. स्वछ्या (क) तच्छाया for (स्वछाया)
१३. (घ) १. समान्यदिशोः (ग) (क) समान्यदिशोः (च) for (सामान्यदिशोः)
२. स्फुटिविक्षेपः for (स्फुट विक्षेपः)
३. शशिन for (शशिवत्)
(ग) ४. स्थित्यर्द्ध (क) for (स्थित्यर्द्धं)
(च) ३. शशिव for (शशिवत्)
५. विमर्द्द for (विमर्द)
१४. (घ) १. असकृत्तिथ्यंतात् (ग) (च) for (असकृत्तिथ्यांतात्)
२. मध्यादृणयो (ग) (क) मध्यादृणयो (च) for (मध्याऋणयो)

यद्यधिकं स्थित्यर्द्धं तदन्तरेणान्यथोनमृणमेकम् ।
अन्यद्धनं तदैक्येनाधिकमेवं[1] विमर्दार्द्धः[2] ।। १५ ।।
स्फुटतिथ्यंता[4]ल्लम्बन[2]मसकृतस्थित्यर्ध[3]हीनयुक्ताद्वा ।
तत्स्फुटविक्षेपकृति[1]स्थित्यर्द्धोनयुततिथ्यन्ते ।। १६ ।।
तत्स्पष्ट[3]तिथिच्छेदांतरे स्फुटे तिथि[1]दले विहीनयुतात् ।
स्वविमर्दार्द्धेनाऽसकृदेवं[5] स्पष्टो[2] विमर्दार्द्धे[4] ।। १७ ।।
शशिवद्वाहुः[4] स्फुटविक्षेपकृतं[1] स्थितिदलेन संगुणिता[3] ।
स्पष्टः[6] स्थित्यर्धहतो[2] भवति भुजः पूर्ववच्छेषम्[4] ।। १८ ।।

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१५. (घ) तदैक्येनाधिकमेवं (ग) (च) for (तदेक्येनाधिकमेवं)
(क) २. विमर्दार्द्धे (च) for (विमर्दार्द्धः)

१६. (घ) १. कृत (ग) कृतः (च) कृत for (कृति)
(ग) २. तालंबन for (ताल्लंबन)
३. मसकृत्स्थित्यर्द्ध for (मसकृतस्थित्यर्ध)
(क) यहाँ पूरा श्लोक अंकित नहीं । लिपिकार की भूल से । केवल अंकित है —
''स्फुटे तस्य ताल्ल तत युत तिथ्यंते'' ।। १६ ।।
(च) ४. तिथांता for (तिथ्यंता)

१७. (घ) १. स्थिति (ग) (क) (च) for (तिथि)
२. स्पष्टे (ग) (क) (च) for (स्पष्टो)
(ग) ३. तत्स्फुट for (तत्स्पष्ट)
४. विमर्दार्द्धं for (विमर्दार्द्धे)
(च) ५. विमर्द्दार्द्धेनासक्तदेवं for (विमर्दार्द्धेनाऽसकृदेवं)

१८. (घ) १. कृतस्थितिर्दलेन for (कृतंस्थितिदलेन) (ग) कृतः (क) कृतः for (कृतं)
२. हृतो (ग) (क) (च) for (हतो)
(ग) ३. संगुणितः (च) for (संगुणिता)
४. पूर्ववछेषम् (क) पूर्ववत् शेषम् ।। १८ ।। for (पूर्ववच्छेषम्)
(क) ५. विसर्गलुप्त
६. विसर्गलुप्त
(च) १. कृतस्थिति for (कृतंस्थिति)
४. पूर्ववछेषम् for (पूर्ववच्छेषम्)

ग्रासात्कालः प्राग्वत्स्पष्टस्थितिदलगुणो सकृद्भुक्तः ।
स्फुटविक्षेपऋतस्थितिदलेन शोध्यः स्थितिदलात्स्वात् ॥ १९ ॥
वलनादिशशिवदन्यत् ग्रहणं तैक्ष्णाद्र्वेरनादेश्यम् ।
द्वादशभागादूनं स्वच्छत्वात्षोडशादिदे ॥ २० ॥
न स्फुटमार्यभटादिष्टर्कग्रहणं यतस्ततः स्पष्टम् ।
शंकुज्यया कृतं लघु लघुतरमेवं रविग्रहणम् ॥ २१ ॥
लग्नात्त्रिराशिहीनादपक्रमक्षांशयुतिविशेषोनात् ।
भतृतया तज्जया भक्ता त्रिज्यार्द्धं कृतिः ३६७३२२५ फलेनहृता ॥२२॥

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१९. (घ) १. विक्षेकृत (ग) विक्षेपकृतः for (विक्षेपऋत)
(ग) २. ग्रासात्कालः (क) ग्रासीत्कालः for (ग्रासात्कालः)
३. शशिवत् (क) स्पर्शवन् for (प्राग्वत्)
(क) ४. ऽसकृद्भुक्तः for (सकृद्भुक्तः)
५. कृत (च) for (ऋत)
६. सोध्यः for (शोध्यः)
७. स्यात् for (स्वात्)

२०. (घ) १. तैक्ष्ण्याद्रवेरनादेश्यम् (ग) (क) (च) for (तैक्ष्णाद्र्वेरनादेश्यम्)
(ग) २. वदन्यग्रहणम् (क) वदन्यद्ग्रहणम् for (वदन्यत् ग्रहणम्)
३. दिदोः (क) for (दिदे)

२१. (घ) १. भटादिष्वर्क (ग) for (भटादिष्टर्क)
(ग) २. तत्स्पष्टम् (क) ततः स्पृष्टम् for (ततः स्पष्टम्)
(क) ३. रवेर्ग्रहणम् for (रविग्रहणम्)
(च) १. भटादिष्वर्क्कग्रहणं for (भटादिष्वर्कग्रहणं)

२२. (घ) १. हीदप for (हीनादप)
२. क्रमाक्षांश (ग) (क) (च) for (क्रमक्षांश)
३. तज्या for (तज्जया) (ग) ज्याछेदस्त्रिज्या (क) ज्ज्याछेदस्त्रिज्या for (भतृतया तज्जया)
४. त्रिज्यार्धकृतिः (ग) र्द्धकृते २६७३२२५ (क) कृतेः for (त्रिज्यार्द्धं कृतिः)
५. हृता (क) for (हृता)
(ग) ६. भत्रितया (क) for (भतृतया)
(च) ६. भत्रीतया for (भतृतया) ३ तज्या for (तज्जया)
४. त्रिज्यार्द्धकृतिः for (त्रिज्यार्द्धकृत्तिः)

त्रित्रिभलग्नार्कांतरजीवा[3] घटिकादिलम्बनं लब्धम् ।
वित्रिभलग्नापक्रमविक्षेपा[4]क्षांशयुतिवियुति[2] (ते) ॥ २३ ॥
जीवा शशांकभास्करमध्यमभुक्तां[1]तरेण संगुणिता[3] ।
पंचदश-भिर्गुणितं[2] या विभाजिता त्रिज्यया वनति[4] ॥ २४ ॥
४६०५० पूर्ववदन्यस्पष्टं[1] ब्रह्मोक्त[3]स्पष्टसूर्यशशिपातैः ।
नार्यभटादिभिरुक्तै[5] र्यातो[2] स्फुटास्ते[4] ततो स्पष्टम्[6] ॥ २५ ॥

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२३. (घ) १. भितृ लग्नार्कांतर (ग) वित्रिभ लग्नार्कांतरे for (त्रित्रिभलग्नार्कांतर)
२. वियुते (ग) (च) for (त्रियुति (ते))

(ग) ३. जीवाद्य for (जीवाघ)
४. विक्षपाक्षांश for (विक्षेपाक्षांश)

(क) यहाँ श्लोक की प्रथम पंक्ति लिपिकार लिखना भूल गया । दूसरी है—
"वित्तिभलग्नापक्रमविक्षे पक्षांशयुतिवियुतेः ॥ २३ ॥"

(च) १. वित्रिभलग्नार्क्कांतर for (त्रित्रिभलग्नार्कांतर)

२४. (घ) १. मध्यमभुक्त्यंतरेण (ग) (क) (च) for (मध्यभुक्तांतरेण)
२. गुणितं (ग) र्गुणितया (क) for (र्गुणितं)

(ग) ३. संगणिता for (संगुणिता)
४. वनतिः (क) for (वनति)

२५. (घ) १. पूर्ववदन्यत्स्पष्टं (क) (च) for (पूर्ववदन्यस्पष्टं)
२. यतो (ग) यतोऽस्फुटा (क) यतोऽस्फुटस्ते for (र्यातो स्फुटास्ते)

(ग) ३. ब्रह्मोक्तं for (ब्रह्मोक्त)
४. स्तैंततोऽस्पष्टाम् (क) स्तेततोऽस्पष्टम् for (स्तेततो स्पष्टम्)

(क) ५. रुक्वेक्तै for (रुक्तै)

(च) २. र्यंतो for (र्यातो)
६. वि०—यहां चिह्न लगाकर ऊपर के रिक्तोपान्त पर निम्नलिखित श्लोक—
किसी अन्य हाथ से लिखा हुआ विद्यमान है—
"अंगुलमात्र विरते रक्तः शशिमंडले भवेत्कर्णः ।
भानोस्तु पुन कृदमो वर्णं सर्वत्र निर्दिष्टः ॥"

इष्टग्रासविमर्दस्थित्यर्द्धा वनति लम्बा[1] नाद्येषु ।
आर्या षड्विंशत्यर्क[2]ग्रहण[3]पंचमोऽध्यायः ॥ २६ ॥
इति [4]ब्रह्मगुप्ते पंचमोऽध्यायः ॥

२६. (घ) २. लंबनाद्येषु (ग) for (लम्बानाद्येषु)

२. षड्विंशत्याऽर्क (ग) (च) for (षड्विंशत्यर्क)

३. ग्रहणं (ग) for (ग्रहण)

(ग) ४. 'इति' से 'अध्यायः' तक इस प्रति में लुप्त । केवल समाप्ति सूचक छः, छः, छः, अंकित है

यह श्लोक इस प्रति में नहीं है ।

(च) १. लंबनाद्यु for (लंबनाद्येषु)

३. 'इति' से 'अध्यायः' तक लुप्त है ।

ग्रहाभास्करांतरैः[1] प्राक् पश्चादर्क[3]ग्रहान्तरैर्यस्मात् ।
स्वांशै[4]र्दृश्या[5] दृश्यास्तस्माद्वक्ष्ये[2] तदानयनम् ॥ १ ॥
प्रागूनभुक्तिरूनो दृश्ये[3] दृश्यो रवि[1]रधिकभुक्तिः ।
पश्चाद्दृश्यो[4]ऽधिकगतिरधिको दृश्यो[5] ग्रहो ऽल्पगतिः[2] ॥ २ ॥
विक्षेपसत्रिराशिक्रान्तिवधो व्यासदलहृतो[3] लिप्ताः ।
शोध्यास्तयोः समदृशो[4]र्यदन्यदिशो[1] ग्रहे[2] क्षेपाः[5] ॥ ३ ॥

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१. (घ) १. ग्रहभास्करान्तरैः (ग) ग्रहभास्करांतरैः for (ग्रहाभास्करांतरैः)

(ग) २. वक्षे for (वक्ष्ये)

(क) यह श्लोक उपलब्ध नहीं है।

(च) १. ग्रहभास्करांतरैः for (ग्रहाभास्करांतरैः) ३ प्राक्पश्चादर्क्क ग्रहांतरै for (प्राक् पश्चादर्कग्रहांतरै)

४. स्वाशै for (स्वांशै) ५. दृश्या for (दृश्या)

२. (घ) १. रवेरधिकभुक्तिः (च) for (रविरधिकभुक्तिः)

२. गति (च) for (गतिः)

(ग) ३. दृश्योश्यो for (दृश्येदृश्यो)

४. पश्चाद्रिश्योरधिक for (पश्चाद्दृश्योऽधिक)

(क) यह श्लोक उपलब्ध नहीं है।

(च) ५. दृंश्यो for (दृश्यो)

३. (घ) १. र्यद्यन्यदिशो (ग) (च) for (र्यदन्यदिशो)

२. ग्रंहे (ग) for (ग्रहे)

(ग) ३. हृतो for (हृतो)

४. सर्मद्दिशो (च) for (समदृशो)

(क) यह श्लोक उपलब्ध नहीं है।

(च) ५. क्षेप्याः for (क्षेपाः)

विषुवच्छाया[1] गुणिताद्विक्षेपा द्वादशो[4]द्धृ[5]ता सोम्यात्[2] ।
फलमृणधनं धनर्णं[6] याम्यादुदयास्तमन्यलग्ने[3] ॥ ४ ॥
प्रागू[3]नमाद्यमधिकं पश्चाल्लग्नाद्ग्रहोदयोस्तमय[4]षड्भयुतम्[5] ।
अन्यदुदयैः[1] घटिकाः कृत्वा[2] नमधिकं समम् ॥ ५ ॥

४. (घ) १. विषुवछाया (ग) (च) for (विषुवच्छाया)
२. सौम्यात् (ग) त्सौम्यात् (क) for (सोम्यात्)
३. उदयास्तमयलग्ने (ग) उदयास्तमलग्ने for (उदयास्तमन्यलग्ने)

(क) ०. विक्षेपात् । तद्वादशो for (विक्षेपा द्वादशो)
५. हृतात् for (द्धृता)
६. धनंर्ण for (धनर्णं)
३. उदयास्तमयलग्नौ for (उदयास्तमन्यलग्ने)

(च) २. सौम्यात् for (सोम्यात्)
३. याम्यादुदयास्तमयलग्ने for (याम्यादुदयास्तमन्यलग्ने)

५. (घ) १. उदयैर्घटिकाः (क) उदयैर्घटिकाः for (उदयैः घटिकाः)
२. कृत्वोनमधिक (ग) (क) कृत्वोनमधिक for (कृत्वानमधिकं समं)

(ग) ३. प्रागूना for (प्रागून)
४. लग्नात्पश्चाद्ग्रहोदयोस्तमयम् for (पश्चाल्लग्नाद्ग्रहोदयोस्तमय)
५. षट्कयुतमन्यदुदयैर्घटिकाः (वि० दूसरी पंक्ति का आरम्भ) for (षड्भयुतम्—द्वि० पं०—अन्यदुदयैर्घटिकाः)

(क) ४. पश्चाल् लग्नात् ग्रहोदयोस्तमयः for (पश्चाल्लग्नाद्ग्रहोदयास्तमय)
५. 'षड्भसंयुतं' for (षड्भयुतम्) दूसरी पंक्ति का आरम्भ

(च) ५ षड्भूयुतं for (षड्भयुतम्)
१. अन्यदुदयैर्घटिकाः for (अन्यदुदयैः घटिकाः)
२. कृत्वोनमधिकसमं for (कृत्वा नमधिकं समं)

द्वादशभिः शितांशुसितजीवज्ञशनिभूमिजा नवभिः ।
द्युत्तर वृद्धयैरंतरघटिका षड्गुणिता कलांशैः ॥ ६ ॥
१२।६।११।१५।१७ दृश्यादृश्यायुतिवद्ग्रहार्क भुक्त्यंतरैक्यलब्धदिनैः ।
ऊनाधिकलिप्ताभ्यः प्राग्वत् तात्कालिकैरसकृत ॥ ७ ॥
प्रतिदिनमुदयास्तमयावसकृत् तात्कालिक गृह विलग्नैः ।
सूर्यास्तमयोदयिकैः शीतांशौ पौर्णिमास्यन्ते ॥ ८ ॥

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६. (घ) १. शीतांशुः (क) (ग) शीतांशुः for (शितांशु)
४. भूमिजातवभिः for (भूमिजानवभिः)
३. द्वयुत्तरवृद्धे (ग) द्वयूत्तरवृद्धि (क) द्वयुत्तरवृद्धै for (द्युत्तरवृद्धयै)
४. कालांशैः (ग) (क) for (कलांशैः)
६. निभूमिजा नवभिः ।६।।११।१३।१५।१७।। for (शनिभूमिजा नवभिः)
(क) ७. षड्गुणित for (षड्गुणिता)
(च) १. शीतांशु for (शितांशु) ३ द्वयुत्तरद्वृद्धैरंतर for (द्युत्तरवृद्धयैरंतर)
४. कालाशैः for (कलांशैः)
७. (घ) १. रसकृतः (ग) रसकृत् (क) रसकृत् for (रसकृत)
(ग) २. यह संख्याएं पूर्वश्लोक के पूर्वार्द्ध के पश्चात् अंकित हैं ।
३. दृश्याग्रहयुति (क) दृश्यादृश्यैर्युति for (दृश्यादृश्यायुति)
(क) ४. ग्राहार्क for (ग्रहार्क)
५. ६. भवति for (लब्धदिनैः)
७. नैकेनाधिक for (ऊनाधिक)
८. लिप्ताभ्यां for (लिप्ताभ्यः)
(च) ४. ग्रहार्क्क for (ग्रहार्क) ७ उनाधिक for (ऊनाधिक)
१. रसकृत् for (रसकृत)
८. (च) १. तालिक for (तात्कालिक)
२. शीतांशो (ग) शीतांशोः (क) for (शीतांशौ)
३. पौर्णिम्यास्यां च (ग) (क) पूर्णिमास्या च (पौर्णिमास्यन्ते)
(ग) ४. वसकृ (क) च सकृत् for (वसकृत्)
५. दयकैः (क) दयकैः for (दयिकैः)
(क) ६. ग्रहाविलग्नैः for (ग्रहविलग्नैः)
४. वसकृत्तात्कालिक for (वसकृत् तात्कालिक)
३. पोर्णिमास्यांत for (पौर्णिमास्यन्ते)

उदयास्तमयावदिदोः[1] कलांशैरर्कसंमिते कार्यम् ।
हीनत्वं त्वधिकत्वंतरे योग काल स्यात् ॥ ९ ॥
उदयास्तविधौ विवद्बुध्य शीघ्रादाप्तफल युतोनज्ञः[1] ।
अस्मद्गुरू विहीन[2] समद्ग्र[3]····भागेन ॥ १० ॥
माना[1]ऽल्पत्वात्पश्चादुदयो[7]स्तमयः[8] सितस्य दशभि[5] प्राक् ।
पश्चान्मानं हत्वा[2] दष्टमयो[3]स्ताभि[4]रुदयः[6] प्राक्[9] ॥ ११ ॥

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९. (क) यह श्लोक मूल पाठ में नहीं है । (ग)

(क) यह श्लोक उपलब्ध नहीं है ।

(च) वि० यहाँ यह श्लोक निम्न उपान्त पर अन्यहस्तलेख में दिया गया है—

१. उदयस्तमयवदिदोः for (उदयास्तमयावदिदोः)

१०. (घ) यह श्लोक मूल पाठ में नहीं है । (ग) (क)
(च) वि० यह श्लोक २५b पृष्ट पर निम्नोपात पर अग्यपस्त से दिया हुआ है !

१. नोज्ञः for (नज्ञः) २ विहिनः for (विहीन)

३. ससम for (समद्ग्र)

११. (घ) इसका संख्याक्रम ९ है (ग)

१. माता for (माना)
२. मानमहत्वा (क) (क) for (मानं हत्वा)
३. दस्तमयो (ग) (क) for (दष्टमयो)
४. ष्टाभि (ग) (क) for (स्ताभि)
(ग) ५. दशभिः (क) (च) for (दशभि)
६. रुदय (क) for (रुदयः प्राक्)
(क) ७. दुदयो for (पश्चादुदयो)
८. स्तमयो for (स्तमयः)

(च) २. मानमहत्त्वादस्तमयो for (मानं हत्वादष्टमयो)
४. ष्टाभिरुदयः for (स्ताभिरुदयः)
९. क्रमसंख्या '९' है !

ज्ञस्यैवं[1] मनुसूर्ये पठितैः[2] कुजजीवपुत्राणाम्[3] ।
उदय[4] प्राग् ऽस्तमयो[5] मानसमत्वाद्भवति पश्चात्[6] ।। १२[7] ।।
आर्यभटः[6] क्षेत्रांशैर्दृश्यान्य[4]दुक्तवा[7]स्तदसत्[1] ।
दृग्गणितैक्यं[5] विसंवाहा दृग्गणितैक्यं[8] स्वकालांशैः[2] ।। १३ ।।

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१२. (घ) इसका संख्याक्रम १० है (ग)

१. ज्ञास्येवं (ग) ज्ञस्यैव (क) ज्ञास्यवं for (ज्ञस्यैवं)
२. पठितै (क) पवितै for (पठितैः)
३. जीवसूर्यपुत्राणाम् (वा) (क) जीवसूर्यपुत्राणां for (जीवपुत्राणाम्)
४. उदयः (ग) (च) for (उदय)
५. प्रागस्तमयो (ग) प्रागस्तमयौ (क) प्रागस्तमयो for (प्राग्ऽस्तमयो)

(ग) ६. माहनमहत्त्वाद्भवति पश्चात् for (मानसमत्त्वाद्भवति पश्चात्)

(क) ७. ।। १० ।। (च) for (।। १२ ।।)

(च) २. पठितै for (पठितैः) ३ + सूर्य +

५. प्रागस्तमयो for (प्राग् ऽस्तमयो)

१३. (घ) इसकी क्रमसंख्या ११ है (ग)

१. दुक्तवांस्तदसत् (ग) (च) for (दुक्तवास्तदसत्)
२. स्वकलांशैः । ११ । (ग) स्वकाल्पांशैः for (स्वकालांशैः)
३. रेखांकित पाठ मूल में नहीं है ।

(ग) ४. दृश्याद्ययुक्त for (दृश्यान्ययुक्त)

५. दृग्गणित विसंवादा (क) दृग्जणितं विसंविवादात् for (दृग्गणितैक्यं विसंवाहा)

(क) ६. आर्यभट्ट for (आर्यभटः)

७. अदुक्तवान् तदसत् for (अदुक्तवास्तदसत्)

८. सूपवित्तकालांशै र्दृग्जणितैक्यं भवति ।। ११ ।। for (विसंवाहा दृग्गणितैक्यं स्वकालांशैः ।। १३ ।।)

(च) २. स्वकालांशैः for (स्वकालांशैः)

८. द्रग्गणितैक्यं for (दृग्गणितैक्यं)

हृग्लग्न[1] हृष्टिभाग ग्रहोदयास्तमयनाडिकाद्येषु[4] ।
मयाध्यायः[2] चतुर्दशभिरार्याभिः[6][3] ॥ १४ ॥
इति[5] ब्रह्मगुप्ते षष्ठोऽध्यायः ।

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१४. (घ) इसकी क्रमसंसंख्या १२ है (ग)

१. हल्लग्न द्दष्टिभाग (ग) हग्लग्नद्रिष्टिभाग for (हृग्गलग्न हृष्टिभाग)
२. उदयास्तमयाध्यायः षष्ठो (ग) (क) उदयास्तमयो for (मयाध्यायः)
३. द्वादशभिरार्याभि । द्वादशभिरार्याभिः । for (चतुर्दशभिरार्याभिः)
५. 'इति' से 'अध्यायः' तक मूल प्रति में नहीं है । केवल समाप्तिसूचक "छः" चिन्ह है ।

(क) ६. ऽध्यायाषष्टो द्वादशाभिरा र्याभिः for (अध्यायः चतुर्दशभि रार्याभिः ॥१४॥)

(च) २. उदयास्तमयाध्यायः षष्ठो for (मयाध्यायः)
३. द्वादशभि for (चतुर्दशभि)
४. 'इति' से 'अध्यायः' तक लुप्त है ।

सितवृद्धि हानिर्वा यदि शापाज्जायते कथम गणितात् ।
उपरि खेरिन्दुश्चेदंर्धांगर्धं सदा शुक्लां ॥ १ ॥
रविद्रष्टं सितमर्द्धं कृष्णमदृष्टं यथा तपस्थस्य ।
कुम्भस्य तथासन्नं खेरर्धस्थस्य चन्द्रस्य ॥ २ ॥

(घ) १. (ग) शापात् ज्ञायते for (शापाज्जायते)

५. कथं (ग) 'अनंकित' है for (कथम)

३. दर्वागर्धं (ग) for (दंर्धांगर्धं)

४. शुक्लम् (ग) for (शुक्लां)

(ग) २. गणितान् for (गणितात्)

(च) ५. कथं for (कथम)

३. चेदर्वागर्द्धं for (चेदंर्धांगर्धं)

(क) १. २. गणितान् for (गणितान्)

३. दर्वागर्द्धं for (दंर्धांगर्धं)

४. शुक्लं for (शुक्लां)

६. वृद्धिर्हानि for (वृद्धिहानि)

२. (घ) १. दृष्टं (ग) द्रिष्टं for (द्रष्टं)

४. रर्धस्थस्य (ग) for (रर्धस्थस्य)

(ग) ३. मकृष्णं for (मदृष्टं)

५. तस्य for (थस्य)

(च) १. दृष्टं for (द्रष्टं)

(क) १. दृष्टं for (द्रष्टं) २. शितमर्द्धं (सितमर्द्धं) ३. दृश्यं for (दृष्टं) ४. रर्धः for (रर्धं)

सिम[1]मुण्णतं यतोर्कं[2] सितासितं शुक्ल[6]कृष्णपक्षांते ।
अर्धागद्धं[3] पश्चाद्गणिता[4] छृंगोन्नतिस्तस्मात्[5] ॥ ३ ॥
रवि[1]चन्द्रपात[4] लग्नैं[2] स्वक्रान्त्युदयास्तलग्नगत[5]शेषाः ।
घटिकाः[6] स्वचरार्द्धस्तौ[3] स्वेष्ट[7]कालिकैः शीतगो[8] कृत्वा ॥ ४ ॥

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३. (घ) १. मुन्नतं (ग) (च) for (मुण्णतं)
२. यतोर्कः (ग) (च) for (यतोर्क)
६. सुक्ल for (शुक्ल)
३. अर्वागद्धं (ग) (च) for (अर्धागद्धं)
४. यस्माद्गणिता (ग) for (पश्चाद्गणिता)
५. छंयोन्नतिस्तस्मात् (ग) for (छृंगोन्नतिस्तस्मात्)

(क) १. मुन्नतं for (मुण्णतं) २. यतोऽर्कः for (यतोर्क) ३. अर्वागद्धं for (अर्धागद्धं)

४. यस्मान् गणितान् for (पश्चाद्गणिता) ५. शृंगोन्नति तस्मान् for (छृं-गोन्नतिस्तस्मात्)

४. (घ) २. लग्नैः (च) for (लग्नैं)
३. स्वचरास्त for (स्वचरार्द्धस्तौ)

(ग) ४. पाता for (पात)
५. गतः for (गत)
६. घटिका स्वचरास्तं for (घटिकाः स्वचरार्द्धस्तौ)
७. श्वेष्ट for (स्वेष्ट)
८. शीतगोः (च) for (शीतगो)

(क) १. रवि चन्द्रपातलग्नैः शृंङ्गोन्नतिकालिकैं स्वक्रान्ति उदयस्तलग्नगतशेषघटिकाः। स्वचरांशून कृत्वा प्रति घटिका शृङ्गोन्नति गणनीयः ॥

for

(रविचन्द्रपातलग्नै स्वक्रान्त्युदयास्तलग्नगतशेषाः ।

घटिकाः स्वचरार्द्धस्तौ स्वेस्टकालिकैः शीतगो कृत्वा ॥४॥)

शशिविक्षेपाक्रमधनुषो योगान्तरं समान्यदिशोः ।
सज्ज्येद्वयक्रमज्या स्वाहोरात्राद्यतो रविवत् ॥ ५ ॥
स्वक्रान्तिज्ये त्रिज्यागुणे हृते लम्बकेन रविशशिनोः ।
अग्रे पृथक् स्वशंकुतल तुल्ययुक्ते विदिक् वियुते ॥ ६ ॥

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५. (घ) ६. धनुखोर्योगांत for (धनुषोयोगांत)

३. तज्येंद्वपक्रमय्या (ग) तज्येंद्वपक्रमज्या for (सज्ज्येद्वयक्रमज्या)

(ग) १. विक्षेपापक्रम for (विक्षेपाक्रम)

७. योगान्तरं for (योगान्तरं)

(च) ६. धनुरवोर्योगांतरं for (धनुषो योगांतरं)

३. तज्येंद्वपक्रमज्या for (सज्ज्येद्वयक्रमज्या)

(क) १. विक्षेपराज्यपक्रम for (शशिविक्षेपाक्रम) २. सभाना for (समान्य)

३. तज्ज्ये for (सज्ज्ये) ४. क्रमज्यात् for (क्रमज्या) ५. यातौ for (यतो)

६. (घ) २. हृते (च) for (हृते)

६. शनिनोः for (शशिनोः) (च)

७. अग्रे for (अग्रे)

(ग) ४. युते for (युक्ते)

५. न्यदिग्वियुते for (विदिक् वियुते)

(क) १. ज्योतिज्ये for (क्रान्तिज्ये) २. वृते for (हृते) ३. लावकेन for (लम्बकेन)

४. युते for (युक्ते) ५. विदिम् for (विदिक्)

पृथगन्तरं[1] संयोगौ[8] भुजो युतोर्का[2]छशी[3] समान्यदिशो[4]।
दिग्ज्या[5] वर्गात्स्वात्[7] स्वपृथक्स्थं[6] वर्गं विशोध्य[9] पदे ॥ ७ ॥
वियुतसहिते[1] रविन्द्वो[6]रेकान्यकपालसंस्कृतयोराद्य[2]।
रविशशिदृक्[3] शंक्वन्तरमन्यो[7]ऽदृक्[4] दृश्यशंक्कैक्यम्[5] ॥ ८ ॥

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७. (घ) १. पृथगंतर (ग) (च) for (पृथगन्तरं)

३. च्छसी (च) for (छशी)

४. समान्यदिशो: (ग) (च) for (समान्यदिशो)

५. दृग्ज्या (ग) दृक्ज्या वर्ग्रात् for (दिग्ज्यावर्गात्)

७. स्वात्स्वं (ग) स्वात्स्वपृथक् स्थवग्र् for (स्वपृथक्स्थंवर्ग)

(ग) ८. भुजौ for (भुजौ)

९. विशोध्यशेषपदे for (विशोध्यपदे)

(च) २. युतोऽर्क्का for (युतोर्का) ५. दृग्ज्या for (दिग्ज्या)
७. स्वात्स्वं for (स्वात्स्व) ६. पृथक् स्वर्गं for (पृथकस्थं वर्गं)

(क) १. पृथगंतरं for (पृथगन्तरं) २. युतोऽर्कात् for (युतोर्का)
३. शशी for (छशी)
४. सामान्य दिशो: for (समान्यदिशो) ५. दृग्ज्यावर्ग्रात् स्वंस्वं for (दिग्ज्या-वर्गात्स्वात् स्व) ६. पृथक् स्ववग्र् for (पृथकस्थंवर्गं)

८. (घ) ६. रवींद्वो (ग) (च) for (रविन्द्वो)

२. संस्थयोराद्य:(ग) (च) for (संस्कृतयोराद्य:)

७. शक्वंवर (ग) शंक्वंतर for (शंक्वन्तर)

४. दृग (ग) दृश्यशंकैक्यम् for (दृश्यशंक्कैक्यम्)

(च) ४. दृग् for (ऽदृक्)

(क) १. सहितैं for (सहिते) २. संस्थयोराद्य: for (संस्कृतयोराद्य:)
३. वृक् for (दृक्)
४. ऽदृक for (ऽदृक्) ५. शङ्कैक्यम् for (शंक्कैक्यम्)

आद्यन्तवर्गयोगान्मूलं पूर्वापरात् भुजात् कोटिः।
भुजकोटिकृतियुतिपदं तिर्यक्कर्णस्य चन्द्राग्र ॥ ९ ॥
एवं तावाद्यावन्यदयोराद्यन्तयो शशिन्यर्कः।
रविरर्द्धचक्रयुक्त कल्पो द्वितृतयोरर्कः ॥ १० ॥
व्यकन्दुदलभुजाशाः शशिमानगुणाः शितं नवतिभक्ताः।
द्विगुणांशो क्रमजीवाद्यावन्नवतिरंशाः ॥ ११ ॥

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९. (घ) १. आद्यान्यवर्ग (ग) आद्यान्यवर्ग्र for (आद्यन्तवर्ग)
२. पूर्वापरा (ग) for (पूर्वापरात्)
३. चन्द्रोग्र (च) for (चन्द्राग्र)
(ग) ४. भुजाः for (भुजात्)
५. तिर्यक्कर्णोस्य (च) for (तिर्यक्कर्णस्य)
(च) १. आद्यांत्य for (आद्यन्त) २. पूर्वापरा for (पूर्वापरात्)
(क) १. आज्याल्प for (आद्यन्त) २. पूर्वोपराभुजाकोटि for (पूर्वापरात् भुजात् कोटिः)

१०. (घ) १. तावाद्यावत्पदयो (ग) तावद्यावत्पदयो for (तावाद्यावन्यदयो)
३. शशीव्यर्क्कः (ग) (च) for (शशिन्यर्कः)
५. द्वितृतीययोरर्कः (ग) for (द्वितृतयोरर्कः)
(च) १. तावाद्यावत्पदयो for (तावाद्यावन्पदयो)
५. द्वित्रीतीययोरर्क्कः for (द्वितृतयोरर्कः)
(क) १. तावद्यावत्यक्षरयो for (तावाद्यावन्यदयो) २. राज्यतयो for (राद्यन्तयो)
३. शशीज्यर्क्क for (शशिन्यर्कः) ४. युक्तः for (युक्त) (ग) युक्तः ६ कलो for (युक्तकल्पो)
५. द्वितृतीयोरर्कः for (द्वितृतयोरर्कः)

११. (घ) १. भुजांशाः (ग) (च) for (भुजाशाः)
३. नवतिभक्ता (च) for (नवतिभक्ताः)
५. द्विगुणांशोत्क्रमजीवा (च) for (द्विगुणांशो क्रमजीवा)
४. तावाद्यावन्नवतिरंशाः (ग) तावद्यावन्नवतिरंशाः for (द्यावन्नवतिरंशाः)
(घ) ६. सितं for (शितं)
(च) ७. व्यक्केंदु for (व्यकेंदु) ३ नवतिभक्ता for (नवतिभक्ताः)
(क) १. भुजांशाः for (भुजाशा) २. शशिमानागुणासितं for (शशिमानगुणाःशितं)
३. भवति for (नवति) ४. जीवातावद् यावन्नवतिरशाः for (जीवाद्यावन्नवतिरंशाः)

नव[1]तेरधिकां[3]शाना क्रमज्यया संयुतो[2] क्रमत्रिज्या ।
चन्द्रप्रमाणगुणिता द्विगुणा[4] व्यासार्द्ध भक्तान्यत् ॥ १२ ॥ ६५[5] । ४०
प्रथमं शुक्लं[1] रात्रौ दिवसेन्य[2]संध्ययोस्तदैक्यार्धम्[6] ।
वर्णो[5]ज्यास[3]वर्दिदावसितस्य सितं श्रवणं[4] गत्या ॥ १३ ॥
शशि[1]मानपादवर्गो[2] नामार्द्ध सितांतरार्द्ध[6] भक्तयुतः[7] ।
परिलेखसूत्रमध्ये[4] शुक्लेर्द्ध[3]ब्दैव परिलेखः[5] ॥ १४ ॥

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१२. (घ) ३. रधिकांशाः नां (ग) रधिकांशानां for (रधिकांशाना)
२. संयुतोत्क्रम (ग) संयुतोत्क्रमे (च) for (संयुतोक्रम)
४. द्विगुण for (द्विगुणा)
(ग) ५. ६५४० for (६५।४०)
(च) ३. रधिकांशाः नां for (रधिकांशानां)
(क) नचते रविकांशानां for (नवतेरधिकांशाना) २. क्तुम for (क्रम)
१३. (घ) २. दिन्य for (दिवसेन्य)
३. वर्णोग्रास for (वर्णोज्यास)
४. श्रवण (च) for (श्रवणं)
(ग) ५. कर्णोन चन्द्रबिंबे शेषस्य ग्रासवद्वर्णः for (वर्णो ज्यासवर्दिदावसितस्य)
(च) ६. तदैक्यार्द्ध for (तदैक्यार्धम्)
(क) १. शुक्तं (शुक्लं) for (शुक्लं) २ दिवसेन्यत् for (दिवसेन्य)
३. वर्णोग्रासवर्दिदावसितेस्य for (वर्णोज्यासवर्दिदासितस्य) ४. श्रवण for (श्रवणं)
१४. (घ) ४. परिलेख द्व शुल्केर्द्धाद्येव (ग) परिलेखसूत्रमद्धे शुल्केर्द्ध ज्यैव for (परिलेख-सूत्रमध्ये शुक्लेर्द्धब्दैव)
३. शुल्केर्द्ध ज्येव for (शुल्केर्द्धब्दैव)
५. परिलेषः (च) for (परिलेखः)
(ग) २. पादवर्ज्योगानार्द्ध for (पादवर्गोनामार्द्ध)
६. वरार्द्ध for (तरार्द्ध)
७. भुक्तयुतः for (भक्तयुतः)
(च) ४. सूत्रमद्धेच for (सूत्रमध्ये)
३. शुक्लेद्ध ष्टैव for (शुक्लेर्द्धब्दैव) ५ परिलेषः for (परिलेखः)
(क) १. शैशमान for (शशिमान) २. पाक्ष्वर्गोमानार्द्ध for (पादवर्गोनामार्द्ध)
३. शुक्लेर्द्धज्येव for (शुक्लेर्द्धब्दैव)

त्रिप्रश्नोक्तचा[५] शंकोः[१] पूर्वापरतो निधाय[४] दिग्मध्ये ।
छायाग्रं छायाग्र[३]च्छंकु[२]ग्रं दीर्घसूत्रवशात् ।। १५ ।।
कृत्वा विंशा[१]द्वितयं दृगुद्धृतं[२] पृथगुच्चरत[३]मन्यत् ।
प्रथमाग्रस्थितदृष्ट्या[५] द्वितीयवंशाग्रगं[४] चन्द्रम्[६] ।। १६ ।।

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१५. (घ) ३. छायाग्रा (ग) छायाग्रात् for (छायाग्र)
२. छंक्वग्र (क) शक्वग्रग for (छंकुग्र)

(ग) १. शंकु for (शंकोः)
४. नधाय for (निधाय)

(च) ५. त्रीप्रश्न्योक्त्चा for (त्रिप्रश्नोक्तचा)
२. छंकुग्र for (छंकुग्र)

(क) १. शंकु for (शंकोः) २. स्थूंक्कग्रगत for (छंकुग्र)

(ग) अवर्केंदुदलभुजांशार्द्ध ज्याकर्णो द्विगुणिता भुजस्य कृति ।
प्रोह्य पदं.........भुजाग्रचंद्रांतरं कोटिः ।। १६ ।।
यह श्लोक 'ग' में अतिरिक्त पाया गया है ।

१६. (घ) ३. प्रथमनुच्चतर for (पृथगमुच्चरत)
४. वंशागं for (वंशाग्रगं)

(ग) १. वंश for (विंशा)
२. दृगुछृतम् for (दृगुद्धृतं)
५. द्रिष्ट्या for (दृष्ट्या)
६. चन्द्रे for (चन्द्रम्)
(वि० इसकी क्रमसंख्या १८ है)

(च) ३. प्रथममुच्चरतमन्यत् for (पृथगमुच्चरतमन्यत्)

(क) १. वंश for (विंशा) (ग) दृगुछितं (ग) for (दृगुद्धृतं) ३. प्रथम-मुच्चतरमन्यत् for (पृथगमुच्चरतमन्यत्)

गृहणं[2] गृहयोगं वा विस्मय[4]करणाय दर्शयेद् गणकः ।
लोकस्य नरपतेर्वा दुष्करमन्यैर्गणितविद्भिः[3] ॥ १७ ॥
इति[3] वाहुकर्णकोटि[1]स्फुटसितपरिलेख[4]सूत्रकरणेषु ।
आर्याष्टादश चन्द्रशृंगोन्नतिरिह सप्तमो ऽध्यायः[5] ॥ १८ ॥
इति[6] श्रीब्रह्मगुप्ते सप्तमोऽध्यायः

(ग) लब्धेवं वानतयोः पूर्वापरयो खेस···चक्रात् ।

अग्रार्क्केंद्वोः शुक्लं पश्चाच्छुक्ले सिते पूर्वात् ॥ १७ ॥

यह श्लोक 'ग' में अतिरिक्त पाया गया है ।

१७. (घ) २. ग्रहयो योगं for (ग्रहयोगं)

३. गणिविद्भिः (ग) गणितषड्भिः for (गणितविद्भिः)

(ग) इसकी क्रमसंख्या १६ है ।

४. विश्मय for (विस्मय)

(क) १. नरपतेदुष्कर for (नरपतेर्वादुष्कर)

१८. (ग) वि०—इसकी क्रमसंख्या २० है ।

३. इतिपादकोटिकर्णः for (इतिवाहुकर्णकोटि)

४. परिलेष for (परिलेख)

२. विंशतिरार्या शृंगोन्नतिरिंदोः सप्तमोध्यायः for (आर्याष्टादशचन्द्रशृंगोन्न-तिरिह सप्तमोऽध्यायः)

(च) ५. अवग्रहचिह्न लुप्त

६. "इति' से "अध्यायः" तक लुप्त है ।

(क) १. कोटिकर्ण for (कोटि) २. आर्योष्टादशभिः for (आर्याष्टादश)

प्राक्चन्द्रलग्नयोर[3]स्तलग्नशशिनो यतो[1]न्तरात्पश्चात् ।
प्रतिदिन[2]मिन्दुच्छाया य[4]तस्तदानयनमभिधास्ये ॥ १ ॥
प्रगृह[2]णकालिकैरिष्टकालिकै[3]र्वार्किलग्नशशिपातैः ।
कृत्वोदयास्तलग्ने स्वचरप्राणान् [1]शंशाकस्य ॥ २ ॥
यद्यधिकमुदयलग्नादू[4]नं [2]षड्गृहयुतास्तमयलग्नात् ।
लग्नं तदा शशांको दृश्यः स[1]वितुर्दर्शने [3]छाया ॥ ३ ॥
लग्नसममुदयलग्[1]नं [3]षड्गृहयुता[2]स्त लग्नं [4]समम् ।
पूर्वापरयोः कृत्वा [5]गतशेषाः स्वोदयै[6]र्घटिका ॥ ४ ॥

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१. (घ) १. यतोंतरात् (ग) यंतोंतरात् (च) for (यतोन्तरात्)
२. प्रतिदिनछाया for (प्रतिदिनमिन्दुच्छाया)
(ग) ३. रभ्र for (रस्त)
४. ततस्तानयनमभिधास्ये for (यतस्तदानयनमभिधास्ये)
(च) १. यंतोंतरात् for (यतोंतरात्)
(क) यतोऽंतरात् for (यतोन्तरात्)

२. (घ) १. शशांकस्य for (शंशाकस्य)
(ग) २. काकालिकै for (कालिकै)
(च) ३. वर्क्कि for (वार्कि)
(क) १. शशांकस्यात् for (शंशाकस्य)

३. (घ) २. षड्गृह् (ग) for (षड्ग्रह)
१. सविदर्शने (ग) सतिदर्शने for (सवितुर्दर्शने)
(ग) ३. छाया: for (छाया)
(च) ४. दुनं for (दूनं) २. षड्गृह for (षड्ग्रह)
१. सवितुदर्शने for (सवितुर्दर्शने)
(क) १. सति for (सवितु)

४. (घ) ३. षड्गृहयुता (ग) (च) for (षड्ग्रहयुता)
४. लग्नसमं (ग) (च) for (लग्नंसमं)
(ग) ५. गशेषा: for (गतशेषा:)
६. घटिका: for (घटिका)
(क) १. लग्न लग्न for (लग्नं) २. युताश्च for (युतास्त)

गतघटिकाः शेषा वा स्वदिनार्द्धं समावंदीदुरद्धार्द्धे ।
गतशेषनाडिकाभिर्नताभिरथवार्कवछंकुः ॥ ५ ॥
शंकुधनुषोऽधिकस्य स्फुटप्रमाणार्द्धं लिप्तिकाभिर्वा ।
रविशशिमध्यगतिकला तिथ्यंशज्योनिताछेदः ॥ ६ ॥
द्वादशभिर्गुणितायां दृज्या लब्धमंगुलाद्यं यत् ।
तत्प्रग्रहे छाया स्फुटा न्यादावान्यथाऽऽसन्ना ॥ ७ ॥

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५. (घ) १. यदींदुमह्लोर्द्धे (ग) यदींदुरह्लोर्द्धे for (वंदीदुरद्धार्द्धे)
२. नवाभि for (र्नताभि)
३. रथवार्कवच्छंकुः (ग) for (रथवार्कवछंकुः)

(च) १. यदींदुरह्लोर्द्धे for (वंदीदुरद्धार्द्धे)
२. रथवार्क्क for (रथवार्क)

(क) १. समायदादुराह्लोऽर्द्धे for (समावंदीदुरद्धार्द्धे) २. रस्त्र for (रथ)
३. वत् शंकुः for (वछंकुः)

६. (घ) १. ज्या (ग) र्ज्या for (र्वा)
३. शद्योनिपाछेदः (ग) श ज्योनिवच्छिदः for (शज्योनिताछेदः)

(क) १. र्या for (र्वा) २. तला for (कला) ३. सज्योतिताछेदः for (शज्योनिता-छेदः)

७. (घ) १. १२. दृग्ज्याया (ग) दृक्ज्यांया for (दृज्या)
३. तत्प्रग्रहणे (ग) सा प्रग्रहणे for (तत्प्रग्रहे)
५. छा for (छाया)
४. स्फुटान्य (च) स्फुटान्य for (स्फुटान्या)
६. यथासन्ना (ग) कन्ययासन्ना for (यथाऽऽसन्ना)

(च) ७+१२+ १. दृग्ज्याया for (दृज्या)
३. तत्प्रग्रहणे for (तत्प्रग्रहे) ८. अवग्रहचिह्न लुप्त

(क) १. दृग्ज्याया for (दृज्या) २. मंगुलाप्तं for (मंगुलाद्यं)
प्रग्रहणे for (प्रग्रहे) ४. न्यदा (ग) for (न्यादा)

ज्येष्टापक्रमभागैर्मध्यछायार्कवच्छशांकस्य ।
शशिवमादातामृक्षाणां तु स्वकांत ध्रुवकात् ।। ८ ।।
इह नोद्दिष्टं यत्तद्रविवद्गतशेषनाडिकाद्येषु ।
आर्याभिर्नवाभिरयं चन्द्रछायाऽष्टमोऽध्यायः ।। ९ ।।

इति श्री ब्रह्मगुप्ते अष्टमोऽध्यायः ।।

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८. (घ) १. स्वेष्टा (ग) for (ज्येष्टा)

२. वछशांकस्य for (वच्छशांकस्य)

३. शशिवद्भौमादीनामृक्षाणां (ग) शशिवद्भौमादीनां नक्षत्राणां च for (शशिवमादातामृक्षाणां)

(ग) ४. स्वकाध्रुवकात् for (स्वकांतध्रुवकात्)

(च) ५. छायार्क्क for (छायार्क) ४. स्वकात् for (स्वकांत)

(क) १. स्वेष्टा for (ज्येष्टा) ३. शशिवत्भौमादीनां नक्षत्राणां स्वकान् ध्रुवकान् for (शशिवमादाता मृक्षाणां तु स्वकांतध्रुवकात्)

९. (घ) २. नवभि for (र्नवाभि)

३. चन्द्रछायां ष्टमोध्यायः for (चन्द्रछायाऽष्टमोऽध्यायः)

(ग) ४. हनोद्दिष्टं for (इहनोद्दिष्टं)

१. यत्तद्रविवत्तच्छेष for (यत्तद्रविवद्गतशेष)

५. आर्यानवभिरयं for (आर्याभिर्नवाभिरयं)

समाप्तिसूचक छः ।। छः ।। छः रेखांकित के स्थान में

(च) २. र्नवभिरयं for (र्नवाभिरयं)

३. अवग्रह चिन्हलुप्त

६. छाः श्री for ("इति······अध्यायः")

(क) १. यद्रविवत् for (यत्तद्रविवद्गत) २. नवभिरियं for (र्नवाभिरयं)

३. चन्द्रच्छाया for (चन्द्रछाया)

शून्येशा[७] यमतिथयः[६] षडगाः षट्भिन्दवः[१] स्वगुण[८] चन्द्राः ।
क्रान्तिर्[२]विक्षेपकालाः[३] कुजबुधगुरुशुक्र[४]रविजानां[५] ॥ १ ॥
११० । १५२ । ७६ । १३६ । १३०
व्यासार्द्धं संयुक्तं त्रिगुणान्त्य फलज्ययान्त्यकर्णोनं[६] ।
त्रिधनगुणं[५] २७ स्वदशांशै[७][२] गुणयांत्य[३] फलज्ययाभक्तं[४] ॥ २ ॥
स्फुटमानकलाभूमिजबुधसुरगुरुशुक्र[१]सूर्यपुत्राणां ।
नाधःस्वयोर्द्र[२]सितयोरासन्नत्वाद्रवेरसितम्[३] ॥ ३ ॥

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१. (घ) ६. मतिथियः (ग) यमातथियः १५२ for (यमतिथयः)
१. षट्त्रींदवः (ग) for (षट्भिन्दवः)
(ग) ७. शून्येंशा ११० for (शून्येशा)
८. १३६ खगुणचन्द्राः for (स्वगुणचन्द्राः)
२. ३. क्रान्तिविक्षेपकला for (क्रान्तिर्विक्षेपकालाः)
(च) ६. तिथियः for (तिथयः) १. षट्त्रींदवः for (षड्भिन्दवः)
(क) १. षट्त्रींदवः for (षट्भिन्दवः) २. क्रान्ते for (क्रान्ति) ३. कला for (कालाः)
४. शुक्रः for (शुक्र) ५. योनाम् for (जानां)

२. (घ) ५. त्रिद्यन (ग) त्रिघनगुणं for (त्रिधनगुणं)
२. स्वद्दशांशै for (स्वदशांशै)
३. गुंणयांत्य for (गुणयांत्य)
(ग) ६. स्वयांत्यकर्णोनम् for (ज्ययान्त्यकर्णोनं)
७. त्यद्दगं दौर्गुणयांत्यफलभक्तम् ॥ २ ॥ for (स्वदशांशैगुणयान्त्यफलज्याभक्तम् ॥२॥)
(च) ५. त्रिद्यन for (त्रिधन) ७. स्वद्दशंशै for (स्वदशांशै)
३. गंुणयांत्य for (गुणयांत्य)
(क) १. कर्णात् for (कर्णोन) २. द्दगंशैः for (दशांशै) ३. गुणितांत्य for (गुणयांत्य)
४. भक्ता for (भक्तं)

३. (घ) २. स्ययो (ग) नाधस्ययोर्ज्ञ for (नाधः स्वयोर्द्र)
(च) २. स्थयोर्द्र for (स्वयोर्द्र)
(क) १. गुरुदैत्येज्य for (सुरगुरुशुक्र) २. स्थयोर्ज्ञ for (स्वयोर्द्र) ३. रशितम् for (रसितम्)

भुक्त्यंतरेण[1] भुक्तं[2] ग्रहान्तरं फलदिनैरधिकं[6] भुक्तौ जीवरविजानां।
प्रागूनगतौ[3] पश्चाद्भु[4]तिरधिके वक्रिणोर्व्यस्ता[5] ॥ ४ ॥
एको[3] वक्रिभुक्त्योर्युत्योनः[1] प्रागथादधिकः[2]।
पश्चात्[4] ग्रहयोरन्तर लिप्तास्तथैवभक्ताः[5] स्वभुक्तिः[6] गुणाः ॥ ५ ॥
स्वफलमृणं प्राक् पश्चाद्युतौ धनं वक्रिणी[3] ग्रहे[1] व्यस्तम्[4]।
समलिप्तौ बुधसितशीघ्रचन्द्रपाते[2] च स्वफलम् ॥ ६ ॥

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४. (घ) ६. दिवैरधिकभुक्तौ (ग) दिनैरधिकभुक्तौ for (दिनैरधिकं भुक्तौ)
४. पश्चाद्युति (ग) पश्चाधृति for (पश्चाद्भृति)
५. व्यस्ता भुक्तिगुणाः (ग) व्यस्ताः for (र्व्यस्ता)
(ग) १, भक्तं for (भुक्तं)
इस श्लोक की प्रथम पंक्ति का अन्तिम शब्द "जीवरविजानां" इस प्रति में उपलब्ध नहीं।
(च) ६. रधिक for (रधिकं) ४ पश्चाद्युति for (पश्चाद्भृति)
५. व्यस्ता for (र्व्यस्ता)
(क) १. भक्तं for (भुक्तं) २. ग्रहंतरं for (ग्रहान्तरं) ३. गतै for (गतौ) ४. पश्चात्द्युति for (पश्चाद्भृति)
५. व्यस्तम् for (व्यस्ता)

५. (घ) ३. वक्री (ग) (च) for (वक्रि)
४. पश्चाञ्च्यात् for (पश्चात्)
(ग) १. युत्योनः for (र्युत्योनः)
२. प्रागवाधिकः पश्चात् for (प्रागथादधिकः। पश्चात्)
५. भक्ता for (भक्ताः)
६. भुक्ति (च) for (भुक्तिः) इस श्लोक की प्रथमपंक्ति का अंतिम पद 'पश्चात्' है। अतः दूसरी पंक्ति 'ग्रहयो' से आरम्भ होती है।
(च) २. प्रागथाऽधिकः for (प्रागथादधिकः)
(क) १. युत्त्येन for (र्युत्योनः) २. प्रागथाधिकः for (प्रागथादधिकः)

६. (घ) ३. वक्रिणि (ग) for (वक्रिणी)
२. पातेषु च (ग) for (पातेच)
४. व्यस्तः for (व्यस्तम्)
(क) १. ग्रहो for (ग्रहे) २. पातेषु च फलम् for (पाते च स्वफलम्)

बुधसित[1]पाते व्यस्तं [2]मन्दफलमुपान्त्यशीघ्रफलम् ।
शेषाणां स्फुटपातात् विक्षेपो[4] मध्यमात्[3] योगात्[5] ॥ ७ ॥
मदंफलस्फुट शशिनो [5]विक्षेपो भौमगु[1]रुशशिनां च ।
मदं[2]फलव्यस्तस्फुटशीघ्रात्[4] बु[3]धशीघ्रयोरथवा ॥ ८ ॥
सम[3]लिप्ता स्फुटमध्यात् स्वपातायु[5]क्तात् ज्ञः[4] शुक्रयोः शीघ्रात् ।
[1]जीवविक्षेपगुणा [2]हतात्कर्णेन विक्षेपः[6] ॥ ९ ॥

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७. (घ) ४. विक्षेपोन्मध्यमात् (च) for (विक्षेपोमध्यमात्)
५. पातात् (ग) for (योगात्)
(च) ४. विक्षेपोन् for (विक्षेपो)
(क) १. सितप्ततै र्व्यस्तम् for (सितपातेव्यस्तं) २. सद for (मन्द) ३. मध्यमात्यात् for (मध्यमात्)

८. (घ) १. शनीनां (च) for (गुरुशशिनां च) (ग) जीवर विजानां for (गुरु-शशिनां च)
४. शीघ्राद्बुध (ग) for (शीघ्रात्बुंध)
३. शुक्रयोरथवा (ग) for (शीघ्रयोरथवा)
(ग) ५. शुक्रयोरथवा (ग) for (शीघ्रयोरथवा)
(च) १. शनीनां for (शशिनाँ)
२. शीघ्राद्बुधशुक्रयो for (शीघ्रात्बुंधशीघ्रयो)
'क' १. जीवरविजानां for (गुरुशशिनां च) २. फला for (फल) ३. शुक्रयो for (शीघ्रयो)

९. (घ) ३. समलिप्त (ग) (च) for (समलिप्ता)
४. ज्ञशुक्रयोः (ग) (च) for (ज्ञः शुक्रयोः)
१. जीवा विक्षेप (ग) (च) for (जीवविक्षेप)
२. गुणाहृतात्फ (ग) गुणाहतीत्य for (गुणाहतात्)
(ग) ५. युक्ता for (युक्तात्)
६. विक्षेपाः for (विक्षेपः)
(चं) २. हृतांत्य for (हृतात्)
(क) २. हतान्य for (हतात्)

अन्तरयोगो तुल्यान्यदिशोर्विक्षेपयोर्ग्रहांतरकं ।
आर्यभटादिष्ट्वेवं समलिप्तिकयोर्युतिर्ग्रहयोः ॥ १० ॥
चित्रास्वातिवदुदयेऽन्यथान्यथास्ते तथायुतौ ग्रहयोः ।
न भवति दृग्गणितैक्यं यथा तदैक्यं तदुक्तिरतः ॥ ११ ॥
ग्रहयोः स्वोदयलग्ने समलिप्तिकयोस्तदस्तलग्ने च ।
उदये स्वोदयलग्ने स्वषड्गृह स्वास्तलग्नसमे ॥ १२ ॥
कृत्वेवं दिनघटिकाः ग्रहयोः स्वोदयविलग्नयोरूनं ।
अनस्यास्तविलग्नादेष्यताधिकं युतिरविता ॥ १३ ॥

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१०. (घ) २. आर्यभटादिष्वेवं (च) for (आर्यभटादिष्ट्वेवं)
(ग) १. अंतरयोगौ for (अन्तरयोगो)
(च) १. योगौ for (योगो)
(क) १. योगौ for (योगो) २. ष्वेवं for (ष्ट्वेवं)

११. (ग) ३. तदुक्तितरः for (तदुक्तिरतः)
(क) १. दयो for (दये) २. युतिः for (युतौ)

१२. (घ) ४. उदयैः (ग) for (उदये)
(ग) ५. सषड्गृहे for (स्वषड्गृह)
६. स्वास्तमयलग्ने for (स्वास्तलग्नसमे)
(च) ७. ग्रहयो for (ग्रहयोः) ४ उदयैः for (उदयै)
(क) १. + स्फुट ग्रह युति संसाधानाय सम + २. समा for (सम)
३. लग्नं for (लग्ने) ४. उदयैः for (उदये) ५. स for (स्व)
६. समो for (समे)

१३. (घ) १. ऊनस्वास्त (ग) ऊनं स्वास्त for (अनस्यास्त)
२. देष्यत्यधिकं (ग) दिष्यत्यधिकं for (देष्यतधिकं)
३. युतिरवीता (ग) युतिरतीता for (युतिरविता)
(ग) ४. कृत्वैवं for (कृत्वेवं)
५. लिलग्नयोरूनम् for (विलग्नयोरूनं)
(च) ऊनस्वास्त for (अनस्यास्त)
३. रवीता for (रविता)
(क) १. ऊनस्वास्त for (अनस्यास्त) २. त्यधिक for (तधिकं)
३. रतीता for (रविता)

ऋणमूनं धनमधिकं स्वोदयलग्नात् समस्त[1]लग्नं चेत्भक्ताः[4] ।
भक्ता स्तन्दरकलाः[2] पृथक् पृथक् स्वदिन[3]नाडीभिः ॥ १४ ॥
ऋणयोर्वा[3] धनयोर्वान्तरेण[1] मुत्या[2]धनर्णयोर्भक्ताः ।
अन्तरलिप्ताः[4] स्वोदय[5]विलग्नयोर्लब्धघटिकाभिः ॥ १५ ॥
उदयास्तविलग्नान्तरकलागुणाः स्वदिननाडिका[2] भक्ताः ।
लब्धकलादिकमूनं[1] स्वास्त विलग्नादुदयलग्नम् ॥ १६ ॥
यद्यधिकमूनमेवं समलिप्तौ स्वोदयाद्युतौ गृहयोः ।
रात्रिविलग्नादूनावधिकौ षड्ग्रहा[1]द्दृश्यौ ॥ १७ ॥

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१४. (घ) १. स्वमस्त for (समस्त)
२. तदंतरकला: for (तन्दरकला:)
(ग) ३. 'स्व' यह पद यहाँ अंकित नहीं ।
(च) ४. 'भक्ता:' द्वितीय पंक्ति का "भक्तास्" रूप में आरंभिक शब्द है ।
२. भक्तास्तदन्तर कला: for (भक्तास्तन्दरकला:)
'क' २. स्वमस्त for (समस्त)
(ग) २. तदंतर काला: for (तन्दरकला:)

१५. (घ) ३. वोधनयो for (र्वाधनयो)
२. युत्या (ग) युत्तचा for (मुत्या)
(ग) ४. अन्तरलिप्ता for (अन्तरलिप्ता:)
५. स्वाद for (स्वोदय)
(च) ३. र्वोधनयो for (र्वाधनयो)
१. र्वातरेण for (र्वान्तरेण)
२. युत्या for (मुत्या)
(क) १. र्वाऽन्तरेण for (र्वान्तरेण) २. युत्तचा for (मुत्या)

१६. (घ) २. नाडिकभक्ता: for (नाडिका भक्ता:)
१. लब्धकलाधिकमूनं (च) for (लब्धकलादिकमूनं)
(क) २. कलाधिकमूनं (कलादिकमूनं)

१७. (घ) १. षड्ग्रहयुताद् (ग) षड्ग्रहायुता for (षड्ग्रहा)
(च) १. षड्ग्रहयुता for (षड्ग्रहा)
(क) १. षड्ग्रहयुता for (षड्ग्रहा)

एवं मानैक्यार्द्धादधिके[1] मध्यांतरे युतिर्ग्[4]हयोः ।
स्थित्यर्द्ध[2]विमर्द[5]दले हीनेतरा[3] गृहेंदुयुतौ ॥ १८ ॥
लम्बनमर्क[5]ग्रहणवद[1]सकृत्[2]स्वावनतिलिप्तिका[4]स्पष्टौ ।
तात्कालिकविक्षेपौ तदन्तरैक्यं[3] समान्यदिशोः ॥ १९ ॥
विक्षेपो मध्यान्तरमुर्ध्व[1]स्वच्छादको ग्रहोऽधस्थः[2] ।
मानैक्यार्द्धादधिके नातिस्पष्टास्फुटोक्तिरतः ॥ २० ॥

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१८. (घ) ३. ताराग्रहेंदुयुतौ (ग) for (तराग्रहेन्दुयुतौ)

(ग) ४. युतिग्रहयोः for (युतिर्ग्र हयोः)

(च) ५. विमर्द्द for (विमर्द)

(क) १. दधि for (दधिके)

२. स्थित्यर्ध for (स्थित्यर्द्ध)

३. तारा for (तरा)

१९. (घ) ३. तदन्तरेक्यम् for (तदन्तरैक्यम्)

(ग) ४. लिप्ता for (लिप्तिका)

(च) ५. मर्क्क for (मर्क)

(क) १. वत् for (वद)

२. दश कृत for (दसकृत्)

३. तदन्तारैक्यम् for (तदन्तरैक्यम्)

२०. (घ) १. मूर्ध स्वछादको ग्रहोधस्थः (ग) मूर्धस्य छादको ग्रहोधस्थः for (मुर्ध्वस्वछादको ग्रहोऽधस्थः)

(च) १. मूर्द्ध for (मुर्ध्व)

२. धस्थ for (ऽधस्थः)

(क) १. मूर्धस्य for (मुर्ध्वस्य)

२. ऽधः स्थः for (ऽधस्थः)

ऊनदिनोदितगुणिता[४]द[3]धिका दिनादूनदिनाहृतालब्धम्[1] ।
अधिकं प्राग्युतिरूनं यद्यधिक दिनो[2]दिनात्पश्चात् ॥२१॥
अन्तरमाद्यो[1] भूयो [2]यदिष्टघटिका फलोनयुतयोश्च[3] ।
प्राक्पश्चा[3]द्वान्तरयोस्तदन्तरे[४]णोद्धृता तदा[५]द्यात् ॥ २२ ॥
[1]युतान्यथेष्ट घटिका गुणितात्फलनाडिकाभिरा[2]द्यवशात् ।
प्राक् सम[3]लिप्तिकलात्पश्चाद्वा ग्रहयुतिर्भवति ॥ २३ ॥
स्वदिनघटिका विभ[3]क्तस्तदुदितपरदिवसनाडिका[1]द्यात् ।
तुल्यः परो[2]दिताभिर्घटिकाभिर्यदियुतिर्ग्रहयोः ॥ २४ ॥

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२१. (घ) ३. अधिक दिनादूनदिनहृताल्लब्धम् (ग) for (अधिकादिनदूनदिनाहृतालब्धम्)
(ग) ४. गणिताद् for (गुणिताद्)
२. दिनोतात्पश्चात् for (दिनोदिनात्पश्चात्)
(च) ३. दधिकदिना for (दधिकादिना)
१. दूनदिनहृताल्लब्धं for (दूनदिनाहृतालब्धं)
(क) १. हृताल्लब्धम् for (हृतालब्धम्) २. सदिनोदिनात्पूर्वे for (दिनोदिनात्पश्चात्)

२२. (घ) १. अन्तमाद्यं for (अन्तरमाद्यो)
(ग) २. न्यदिष्टघटिका for (यदिष्टघटिका)
४. तदन्तरेणोद्धृता for (तदन्तरेणोद्धृता)
५. दाद्यात् for (तदाद्यात्)
(क) १. नाद्यं for (माद्यो) २. ऽन्यदि घटिका for (यदिष्टघटिका)
३. पश्चात् ॥ द्वयन्तरयोः for (पश्चाद्वान्तरयोस्) ४. तदन्तारे for (तदन्तरे)
५. दाधान for (तदाद्यात्)

२३. (घ) १. युत्पान्यथेष्ट (ग) युक्तान्यथेष्ट for (युतान्यथेष्ट)
३. लिप्तिक कालात् (ग) for लिप्तिकलात्)
(च) १. युत्यान्यथेष्ट for (युतान्यथेष्ट)
१. युत्कान्यथेष्ट for (युतान्यथेष्ट) २. ऽराद्यवशात् for (राद्यवशात्)
(क) ३. लिप्तिक कालात् for (लिप्तिकलात्)

२४. (ग) ३. विभक्तात्तदुदित for (विभक्तस्तदुदित)
१. घातः for (घात्)
(क) १. घातः for (घात्) २. परोदिततताभि for (परोदिताभि)

विक्षेपमानसमकलदिनघटिकाः[1] स्वोदयास्तलग्नाद्यैः[3] ।
(पंचविंशति) षड्विंशति[2] आर्याणां नवमो ग्रहमेलकोऽध्यायः[1] ॥ २५ ॥
इति ब्रह्मगुप्ते[4] नवमोऽध्यायः ॥

२५. (घ) २. षड्विंशत्यार्याणां (च) for (पंचविंशति आर्याणां)

(ग) ३. घटिका for (घटिकाः)

दूसरी पंक्ति निम्नांकित है—

'नवमोध्यायोग्रहयुतिरार्याणां पंचविंशत्याः' for (पंचविंशति आर्याणां नवमो-ग्रहमेलकोऽध्यायः)

(च) ४. श्रीः for ("इति...नवमोऽध्यायः")

(क) १. सकल for (समकल)

२. पंचविंशत्यार्यश्च for (पंचविंशति आर्याणां)

अष्टनखैर्मेषगविरदलिप्तोनै गुणैः स्वरै मिथुने ।
कर्कटके गुणषोडशं धृतिभिः सिंहेन व त्रिधनैः ॥ १ ॥
कन्यायां पंचनखैस्तुलिनि अधिधृतिभिरलिनी सेषुकाले ।
द्विचतुर्दशाति धृतिभि धनुषि शंशाक मनुतत्वैः ॥ २ ॥

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१. (घ) ५. मोखग (ग) मोषग for (मेंषग)
१. लिप्तोनैर्गरण (ग) लिप्तोनैर्गुण for (लिप्तोनैगुणैः)
२. स्वस्वरैर्मिथुने (ग) for (स्वरै मिथुने)
६. धृतिर्भि (च) for (धृतिभिः)
७. च (च) for (व)

(ग) ३. कक्र्कटके गुणषोडश for (कर्कटके गुणषोडशं)
४. त्रिघनैः for (त्रिधनैः)

(च) ५. मेंखे for (मेंष)
१. र्गुणस्वरैर्मिथुने for (गुणैः स्वरैर्मिथुने)
८. षोडश for (षोडशं)
४. त्रिद्यनैः for (त्रिधनैः)

(क) १. र्गुण for (गुणैः)
३. कर्कटे for (कर्कटके)
४. त्रिघनैः for (त्रिधनैः)

२. (घ) १. त्र्यतिधृतिभिरलिनि सषुकालेः (ग) त्र्यतिधृतिभिरलिनिसेषुकलैः for (अधिधृतिभिरलिनी । सेषुकाले)
४. धृतिभिर्धनुषि (ग) (च) for (धृतिभिधनुषि)
३. मनुखतत्त्वै (ग) मनुनखतत्त्वैः for (मनुतत्त्वैः)

(ग) २. द्विचतुर्दशानि for (द्विचतुर्दशाति)

(च) १. अतिधृ तिभि रलिनि (अधिधृतिभिरलिनी)
५. क्रमसंख्या लुप्त

(य) १. त्र्यतिधृतिभि रलितेषुकलैः for (अधिधृतिभिरलिनी सेषुकालै)
२. दशा विधृतिः for (द्दशातिधृतिभिः)
३. मनुनखै तत्वैः for (मनुतत्त्वैः)

मकरेष्टनखैः कुम्भे [४]नखषड्विंशै [१]ऋंणे [५]मुनित्रिंशैः ।
पृथगश्विन्यादीनां ध्रु[२]वकांशैर्योगताराश्[३]वः ॥ ३ ॥
ध्रुवका[४]दूनः पश्चा[५]दधिकः प्राग्वत् कृ[२]तेऽन्यथायोगः ।
अन्यत् [१]ग्रहमेलकवत् ध्रु[३]वक्रान्तेर्भवि[६]क्षेपाः ॥ ४ ॥
सौम्यादशा[६]र्कविषया [१]याम्या [२]शर[३]दशभवारसा[५]सौम्याः ।
[४]खसप्त दक्षिणाः खं सौम्याः सूर्य त्रयोदशकाः ॥ ५ ॥

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३. (घ) ४. नखड्विंशै for (नखषड्विंशै)
१. झंषे (ग) झंषे for (ऋंणे)
५. मुनिविंशैः for (मुनित्रिंशैः)
२. ध्रुवकांशै (ग) (च) for (ध्रुवकांशै)
(ग) ३. स्वैः for (श्वैः)
(च) १. झंषे (ऋंषे) for (ऋंणे)
५. मुनित्रिंशैः ॥३०७॥ for (मुनित्रिंशैः)
३. योगताराश्वैः for (र्योगताराश्वैः)
(क) १. झषे for (ऋंणे) २. कांशै for (कांशै) ३. वैष्ट for (श्वैः)

४. (घ) २. प्राग्वत्कृतेन्यथायोगः (ग) प्राग्वत्कृतेऽथायोगः for (प्राग्वत्कृतेऽन्यथायोगः)
३. ध्रुववक्रांन्तेर्भं for (ध्रुवक्रान्तेर्भं)
(ग) ४. दूने for (दूनः)
५. दधिके for (दधिकः)
१. अन्यद्ग्रहमेलकवद्ध्रुववकक्रान्तेर्भंविक्षेपः for (अन्यत् ग्रहमेलकवत् ध्रुवक्रान्तेर्भंविक्षेपाः)
(च) २. अवग्रहचिह्नलुप्त १. अन्यद्ग्रह for (अन्यत्ग्रह)
३. ध्रुववक्रांन्ते for (ध्रुवक्रान्ते) ६. विसर्गलुप्त

५. (घ) ४. षं (ग) खं for (ख)
(ग) १. याम्याः for (याम्या)
२. ३. शरदिग्भवारसाः for (शरदशभवारसा)
५. सौम्यां for (सौम्याः)
(च) ६. दशार्क्कं for (दशार्क) ४. षंसप्त for (खसप्त)
(क) १. याम्याः for (याम्या) २. सर for (शर) ३. दिग् for (दश)
४. खं for (ख)

दक्षिणतोभ[1]यमला[3]: सप्त त्रिंशदुदगंशका याम्याः ।
[6]अध्यर्धत्रिचतुष्कार्द्धं नवमसप्त[2]त्रिंशविषय[5]शरा[4]: ॥ ६ ॥
सौम्याद[1]ब्धिका य[2]ष्टि त्रिंशत्[7] षट्[5]त्रिंशदि[3]तरतो लिप्ताः ।
अष्टादशोत्तरजिनाः षड्[6]विंशत्यंत[4]राण्यंशाः ॥ ७ ॥
प्राजेशयोग[1]न्तरा विक्षेपांशै[3] कलात्रिघनहीनैः[5] ।
आग्नेयस्य[4] कला[2]मेकोन त्रिंशताहीनैः[6] ॥ ८ ॥

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६. (घ) ३. अमला for (यमलाः)
४. शरा (च) for (शराः)
(ग) १. भव for (भ)
२. सत्र्यंश for (सप्तत्रिंश)
५. विखय for (विषय)
(च) ३: विसर्गलुप्त ६. अध्यर्द्ध for (अध्यर्ध)
(क) १. भव for (भ) २. शशंश (शत्र्यंश) for (सप्तत्रिंश)
७. (घ) १. सौम्याद्व्यधिका (ग) (च) for (सौम्यादब्धिका)
३. षष्टि (ग) for (यष्टि)
५. षड्विंश for (षट्त्रिंश)
६. षड्वच ंश त्यंतराण्यंशाः for (षड्विंशत्यंतराण्यशाः)
(ग) ७. स्त्रिंशत् for (त्रिंशत्)
(च) २. षष्टि for (यष्टि) ७. त्रिंश for (त्रिंशत्)
५. षड्त्रिंश for (षट्त्रिंश)
६. षड्वच ंशत्य ंतराण्य ंशाः for (षड्विंशत्य ंतराण्य ंशाः)
(क) १. सौम्यद्व्यधिका for (सौम्यदब्धिका) २. षष्टि for (यष्टि) ३. दिव for (दित)
४. बराण्य ंशाः (ग) for (तराण्य ंशाः)
८. (घ) १. योगतरा (ग) योगतारा for (योगन्तरा)
३. विक्षेपांशैः (ग) for (विक्षेपांशै)
(ग) ४. आग्रे यस्य for (आग्नेयस्य)
(च) १. योगतारा for (योगन्तरा) ३. विक्षेपांशैः for (विक्षेपांशै)
५. +२७+ ६. +३०+
(क) १. योगतारा for (योगन्तरा)
२. कलानामेकोन (ग) for (कलामेकोन)

पंचदशकला हीनैश्चित्रायाः[1] सप्तति[2]र्विशाखायाः[3] ।
षट् सप्तत्या मैत्रस्यैंद्रस्य[4] त्रिंशता हीनैः[5] ॥ ९ ॥
छादय[1] योगतारां मानार्द्धोनाधिकाद्‌ विक्षेपात्[2] ।
स्फुट विक्षेपो यस्याधिकोनको भवति समदिक्सु[3] ॥ १० ॥
विक्षेपोंश[3] द्वितीयादधिको[4] वृषभस्य[1] सप्तदशभागे ।
यस्य गृहस्य याम्यो भिनत्ति शंकट[2] स रोहिण्याः[5] ॥ ११ ॥

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९. (घ) ३. विशाषायाः (च) for (विशाखायाः)
४. मैत्रसौन्द्रस्य (ग) मैत्रस्येन्द्रस्य for (मैत्रस्यैंद्रस्य)
(ग) २. सप्तभि for (सप्तति)
(च) ५. +३०+
(क) १. श्चितायाः for (श्चित्रायाः)
२. सप्तभिः for (सप्तति)

१०. (घ) २. भविक्षेपात् (ग) भवति विक्षेपात् for (विक्षेपात्)
३. समदिक्सुः for (समदिक्सु)
(ग) १. छादयति for (छादय)
(च) २. भविक्षेपात् for (विक्षेपात्)
३. समदिक्सुः for (समदिक्सु)
(क) १. छादयसि for (छादय)
२. भविक्षेपात् for (विक्षेपात्)
३. दिक्स्थः (ग) for (दिक्सु)

११. (घ) ३. विक्षेपौंश for (विक्षेपोंश)
४. द्वितयादधिको (ग) (च) for (द्वितीयादधिको)
(ग) १. वृषस्य for (वृषभस्य)
५. रोहिण्या for (रोहिण्याः)
(च) २. शकटं for (शंकट)
(क) १. मृषभस्य for (वृषभस्य)
२. शकटं (ग) for (शंकट)

विक्षेपें[1]त्ये सौम्ये[4] तृतीयतारां भिनत्ति[5] पित्र्यस्य[7] ।
इन्दुर्भिन्नति[6] पुष्पं[2] पौष्णं वारुण[3]मविक्षिप्तः ॥ १२ ॥
कृत्वापि[6] दृष्टिकर्म[1] श्रीषेणाचार्य[2]भट विष्नु[3]चन्द्रोक्तम् ।
प्रतिदिन[8]मुदयेऽस्ते[5] वा न भवन्ति[4] दृग्गणितयोरैक्यम्[7] ॥ १३ ॥

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१२. (घ) १. विक्षोपंत्ये for (विक्षेपेंत्ये)
४. सौम्ये । २७० । (च) for (सौम्ये)
५. भिनति for (भिनत्ति)
६. इंदुर्भिनत्ति (ग) (च) for (इन्दुर्भिन्नति)

(ग) ७. त्र्यस्य for (पित्र्यस्य)

(क) १. विक्षेपोंऽत्ये for (विक्षेपेंत्ये)
२. पुषां for (पुष्पं)
३. करूण for (वारुण)

१३. (घ) ३. विष्णु (ग) (च) for (विष्नु)
५. मुदयेस्तेवा (ग) for (मुदयेऽस्तेवा)
४. भवति (ग) (च) for (भवन्ति)

(ग) ६. कृत्वा (यहां 'अपि' नहीं है) for (कृत्वापि)
२. श्रीषेणार्यभट for (श्रीषेणाचार्यभट)
७. दृग्गणितरैक्यम् for (दृग्गणितयोरैक्यम्)

(च) ८. प्रतितिदिन for (प्रतिदिन) ५. मुदयेस्ते for (मुदयेऽस्ते)

(क) १. कर्म्म for (कर्म)
२. श्रीषेणार्थ for (श्रीषेणाचार्य)
३. विष्णु for (विष्नु)
४. भवति for (भवन्ति)

भमुनिमृगव्याधानां[७] ततस्तद्दृष्टि[१]कर्म[५] वक्ष्यामि[३]।
दृग्गणित[२] सम[४]देयं शिष्याय[८] चिरोषितायेदम्[६] ॥ १४ ॥

अ	भ	कृ	रो	मृ.	आ.	पु.	पु.	अ.	म.	पू.	उ	ह.	चि	स्वा	वि[७]	अ.[८]	जे[१]	र[३]
००	००	१	१	२	२	३	३	३	४	४	५	५	६	६	७	७	७	८
८	२०	७	१९	३	७	३	१६	१८	९	२७	५	२०	३	१९	२	१४	१९	१
००	००	२८	२८	००	००	००	००	००	००	००	००	००	००	००	००	००	००	००
००	००	००	००	००	००	००	००	००	००	००	०२	००	००	००	००	००	००	००

श[४]	उ.	अ.	अ	घ	श[५]	पू[६]	उ.	रे
८	८	८	९	९	१०	१०	११	१२
१४	२०	२५	८	२०	१०	२६	७	००
००	००	००	००	००	००	००	००	००
००	००	००	००	००	००	००	००	००

१.४ (घ) १. ततो (च) त for (तद) — १. ज्ये ७ १९ ५ ० — ३. मू — ६. पू — ४. पू

३. वक्षामि (ग) कक्षामि for (वक्ष्यामि)

४. समं (च) for (सम)

७. वि	८. अ०	५. श.
७	७	१०
२	१४	२६
५	५	०
०	०	

(ग) ५. दृष्टकर्म for (दृष्टिकर्म)

२. दस्पात्र for (दृग्गणित)

६. विरोषितायेदम् for (चिरोषितायेदम्)

(च) ७. ब्याध्यानां for व्याधानां ३. वक्षामि for वक्ष्यामि

८. सिष्याय for (शिष्याय)

(क) १. ततो for (तद) २. न मागित for (दृग्गणित)

(च)

७. वि.	८. अ.	१. ज्ये०	३. मू for (र)	४. पू for (श)	५. श०
७	७	१	८	८	१०
२	१४	१९	१	१४	२६
५	५	५	०	०	०
०	०	०	०	०	०

(घ) केवलमात्र परिवर्तित रूप — शेष सब ठीक है ।

वि.	ज्ये०	३. मू.	४. श.	५. श.	६. पू
७	७	८	८	१०	,
२	१९	१	१४	२६	,
५	५	०	०	०	,
०	०	०	०	०	,

अतिरिक्त —

विक्षेपाः

अ	भ	कृ	रो	मृ	आ	पु	पु	अ	म	पू	उ	ह	त्रि
१०	१२	५	५	१०	११	६	०	७	०	१२	१३	१३	२
१													
स्वा	वि	अ	ज्ये	मू	पू	उ	उ	श्र	ध	श	पू	उ	रे
२७	१	०	४	५	५	५	१२	३०	३६	०	२४	२६	०
	३०			२०	२०					१८			

(ग) अश्विन्यादिध्रुवकाः

अ	भ	कृ	रो	मृ	आ	पु	पु	अ	म	पू	उ	ह	चि
०	०	१	१	३	२	३	३	३	४	४	५	५	६
८	२०	७	२९	०	७	३	१६	१०	९	२७	५	२०	३
		२८	२८		०	०	०	०	०	०	०	०	०

स्वा	वि	अ	ज्ये[७]	मू[८]	पू[८]	उ[८]	उ[८]	श्र[९]	ध[९]	श	मू	उ[११]	रे[१२]
६	७	७	९	१	२४	२०	२५	८	२०	२०	२०	७	३०
१९	२	१४	५	०	०	०	०	०	०	०	०	०	०
०	५	५	९०	०	०	०	०	०	०	०	०	०	०

क्रांतिज्या[1] तत्क्रान्तिविक्षेप[5]क्रान्तिचापानाम्[2] ।
संयोगान्तर[3]जीवा स्वक्रान्तिज्यै[4]कभिन्नदिशां[6] ॥ १५ ॥
एवं भमुनिध्रुवयो[1] ग्रहतत्क्रान्त्या चन्द्राष्टकं[2] कर्माद्यं ।
कृत्वा ग्रहे भमुनिवत् तस्मात्स्वक्रान्ति जीवा वा[3] ॥ १६ ॥

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१५. (घ) २. चापभागानाम् (ग) for (चापानाम्)

(ग) ५. विक्षेप for (विक्षेप)

६. दिशोः for (दिशां)

(च) २. चापनां for (चापानां)

६. द्यैकभिन्नदिशां for (ज्यैकभिन्नदिशां)

(क) १. क्रांति ज्यतिक्राति for (क्रान्तिज्यातत्क्रान्ति)

२. चापभोगाना for (चापानाम्)

३. सोयोगांचर for (संयोगान्तर)

४. क्रातज्यैः कविभिर्मादिशाम् for (क्रातिज्यैकभिन्नदिशाम्)

१६. (घ) १. ध्रुवयोर्ग्रह for (ध्रुवयोग्रह)

२. च दृष्टि कर्माद्यं (ग) for (चन्द्राष्टकं कर्माद्यं)

(ग) १. एवं भमुनेर्ध्रुवयोर्ग्रहवत्क्रान्त्या for (एवं भमुनिध्रुवयोग्रहतत्क्रान्त्या)

३. च for (वा)

(च) २. च दृष्टि for (चन्द्राष्टकं)

(क) १. भमुनिध्रुवका प्राक् प्रदर्शिता त्विषा ।
सेषामेवकार्यं ग्रहस्य पुनातत् क्रान्ते प्रथमं वृत्कर्णं
कृत्वा पश्चात् तज्ज्ञाति स्वक मुनिध्रुवकवत् ।
for
एवं भमुनिध्रुवयो ग्रहतत्क्रान्त्या चन्द्राष्टकं कर्माद्यं ।
कृत्वा ग्रहे भमुनिवत् तस्मात्स्वक्रान्ति जीवा वा ॥ १६ ॥

त्रिज्याप्तांशु[1]भिरुदयैर्घाता द्विक्षेप[5] सत्रिभक्रान्त्ये[2] ।
ऋण[3]धनमेकान्यदिशोस्तयोर्ग्रहेन[4] भमुनि ध्रुवके ।। १७ ।।
तत्स्वक्रान्तिज्याभ्यां चन्द्रादीनां पृथक् चरप्राणान् ।
कृत्वार्क[3]वत्तदंतरसंयोगो[1] तुल्यभिन्नदिशाम्[2] ।। १८ ।।
तत्प्राणै[1]र्विक्षेपे सौम्ये हीनो[2] ग्रहोऽधिके[3] याम्ये ।
उदयैर्भध्रुवको वागस्त्यध्रुवको[4]ऽथवा लग्नम् ।। १९ ।।

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१७. (घ) ५. द्विक्षेप for (द्विक्षेप)
२. क्रान्त्यो (ग) क्रान्त्योः for (क्रान्त्ये)
(ग) १. त्रिज्यासासुभिरुदयैर्घाता ३२७० for (त्रिज्याप्ताँशुभिरुदयैर्घाता)
३. रुणधन for (ऋणधन)
(च) इस प्रति में यहां 'विक्षेप' शीर्षक से अतिरिक्त निम्न सारणी दी गई है ।

विक्षेपाः

अ	भ	कृ	रो	मृ	आ	पु	पु	अ	म	पु	उ	ह
१८	१२	५	५	१०	११	५	०	७	०	१२	१३	१३
१												

चि०	स्वा.	वि	अ	ज्ये	मू	पू	उ	उ	श्र	ध	श	पू	उ	रे
२	२७	१	०	४	५	५	५	१२	३०	३५	०	२४	२६	०
		३०			२०	२०					१८			

(क) १. सुभिरुदयै for (शुभिरुदयै) २. भक्तम् for (क्रान्त्ये)
३. कर्णामनसे काम्य for (ऋणधनमेकान्य)
४. ग्रहेण for (ग्रहेन)

१८. (घ) १. संयोगौ (ग) संयोगस् for (संयोगो)
(च) ३. कृत्वार्क for (कृत्वार्क)
(क) १. संयोगौ for (संयोगो)
२. दिशम् for (दिशाम्)

१९. (घ) ३. ग्रहोधिको याम्ये (ग) (च) for (ग्रहोऽधिके)
४. ध्रुवकोथवा लम्नम् (ग) (च) for (ध्रुवकोऽथवा लग्नम्)
(क) १. तत्क्रांति ऋणो for (तत्प्राणै)
२. हीने for (हीनो)

उदये गृहभमुनीनामस्तमये षड्गृहाधिकः सौम्ये ।
अधिको याम्ये हीनः षड्राशियुतोस्तमयलग्नम् ॥ २० ॥
उदयविलग्नादधिके षड्राशियुतास्ते लग्नतो हीने ।
रात्रिविलग्ने दश्यादिनेऽपि चन्द्रोन्यथा दृश्यः ॥ २१ ॥
प्रागुदय लग्न मूनं लग्नादधिकं गृहोदयः पश्चात् ।
ऊनमधिकेन तुल्यं कृत्वा घटिकाः स्वराश्युदयैः ॥ २२ ॥
प्रागस्तमयो लग्नाद्गूनं षड्गृहयुतोस्तमयलग्नम् ।
अधिकं पश्चात् घटिकाः कृत्वा सममूनमधिकं चेत् ॥ २३ ॥

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२०. (घ) २. षड्गृहाधिकः (ग) (च) for (षड्ग्रहाधिकः)
(ग) ३. मुनीनां for (मुनीना)
४. ऽस्तमयलग्नम् for (स्तमयलग्नम्)
(क) १. दृक्कर्म कार्यम् for (सौम्ये)

२१. (घ) २. त (ग) (च) for (ते)
१. दृश्यो दिनेपि (ग) दृश्यो दिनेऽपि for (दश्यादिनेऽपि)
(घ) ३. षड्राश for (षड्राशि)
(च) ४. लग्नांतो for (लग्नतो) ।
(क) दश्योदिमेपि for (दश्यादिनेऽपि)

२२. (च) १. राश्युदयो for (राश्युदयैः)

२३. (घ) १. षड्गृह (ग) (च) for (षड्ग्रह)
२. युतास्तमय (ग) for (युतोस्तमय)
४. पश्चाद्घटिकाः (ग) for (पश्चात्घटिकाः)
(ग) ३. अधिकेन for (अधिकं चेत्)
(च) ५. दुनं for (द्रूनं)
४. पश्चाध्यघटिकाः for (पश्चात् घटिकाः)
६. क्रत्वा for (कृत्वा)
(क) १. षड्गृह for (षड्ग्रह)
२. युतास्तमय for (युतोस्तमय)
३. अधिकेन for (अधिकं चेत्)

तात्कालिकोपकरणैः[५] सकृ[१]दागतनाडिकाभिरह्लींदौ[२] ।
रात्रौ[३] वा प्रति घटिकं[६] प्राग्वच्छ्रृंगोन्नतिः धार्या[४] ॥ २४ ॥
मध्यछाया रविवत् स्वक्रान्त्या[४] दर्शनेमनीष्टाच[१] ।
एवं[५] भ[२] मुनीना[६]मन्तर घटिका गुणं[७] भुक्तिः[३] ॥ २५ ॥
षष्ट्या विभजेत्[३] लब्धं प्रागुदयास्तमययोः[७] ग्रहे[४] शोध्यम् ।
पश्चात् क्षेप्यं[१] प्रतिदिनमुदयस्त[५]मयासकृदेवं[६][२] ॥ २६ ॥

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२४. (घ) १. रह्लींदो (ग) रह्लींदोः for (रह्लींदौ)
४. कार्याः (च) for कार्या
(ग) १. सकृतागत for (सकृदागत)
५. तात्कालिकोपकरणै for (तात्कालिकोपकरणैः)
(क) १. शकृद् for (सकृदागत) २. रह्लीदोः for (रह्लींदौ) ३. रात्रो for (रात्रौ)
३. घटिका for (घटिकं)

२५. (घ) ३. कांत्या for (क्रान्त्या)
१. सतीष्टा (ग) सती च for (मनीष्टा)
५. एवं ग्रह (ग) for (एवंभ)
६. मनीना (ग) मुनीना for (मुनीना)
७. गुणां for (गुणं) (ग) गुणाभक्तम् for (गुणं भुक्तिः)
(च) १. सतीष्टा for (मनीष्टा)
५. एवंग्रहभ for (एवंभ)
(क) १. सतीष्टा for (मनीष्टा) २. ग्रह for (भ) ३. भुक्तिम् for (भुक्तिः)

२६. (घ) ३. विभजेल्लब्धं (ग) for (विभजेत्लब्धं)
४. ग्रंह (ग) ग्रंहे (च) for (ग्रहे)
५. उदयास्त (ग) for (उदयस्त)
६. मयावसकृदेवं (ग) for (मयासकृदेवं)
(च) ३. विभजेलब्धं for (विभजेत्लब्धं)
७. विसर्गलुप्त
१. पश्चाक्षेप्यं for (पश्चात्क्षेप्य)
६. मयावसकृदेवं for (मयासकृदेवं)
(क) १. क्षेप्यत्र for (क्षेप्यं)
२. सकृदवम् for (सकृदेवं)

इष्टात्कालात् भानोरुदयास्ताद्वा ग्रहोदयास्तमयैः ।
तात्कालिकै र्विलग्नग्रहोदयास्तमयलग्नाद्यैः ।। २७ ।।
प्रागुदयलग्नमुदयैर्लग्नसमं लग्नमुदयलग्नेन ।
पश्चात् तत् घटिकाभिः कृत्वा तात्कालिकैरसकृत् ।। २८ ।।
उदयं प्रागस्तमयो लग्नेन पश्चानषड्ग्रहास्तमयः ।
लग्नं पश्चाल्लग्नचक्रार्द्धं संयुतास्तमये लग्नेन ।। २९ ।।
उनोल्पभुक्तिरुदितः प्रागथवो देष्यति ग्रहः सूर्यात् ।
पश्चादधिकोधिकगतिरल्पगती वक्रितौ ज्ञसितौ ।। ३० ।।

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२७. (घ) २. कालाद्भानो (ग) (च) for (कालात् भानो)
१. मयै (ग) मयौ for (मयैः)
३. र्विलग्न (ग) (च) for (र्विलग्नं)

(ग) ४. इष्टा for (इष्टात्)
५. ह्रोदयास्तमय......for (ग्रहोदयास्तमय)

(च) १. मयै for (मयैः)

(क) १. मयौ for (मयैः)

२८. (घ) ३. पश्चात्तद्धटिकाभिः for (पश्चात् तत् घटिकाभिः:)
५. पश्चात्त for (पश्चात् तत्)
(च) ५. पश्चाद्धटिकाभिः for (पश्चात्तत् घटिकाभिः) ६ क्रत्वा for (कृत्वा)
(क) १. मदयै for (मुदयै) २. मदय for (मुदय)

२९. (घ) १. सषड्ग्रहास्तमयलग्नम् (ग) (च) for (पश्चानषड्ग्रहास्तमयः । लग्नम्)
३. पश्चाल्लग्नं (ग) for (पश्चाल्लग्न)
(ग) ४. उदयः for (उदयं)
२, मय for (मये)
(क) १. सषट् ग्रहास्तमय लग्नम् for (पश्चानषड्ग्रहास्तमयः लग्नम्)
२. मय for (मये)

३०. (घ) १. ऊनोल्पभुक्तिरुदितः (ग) (च) for (उनोऽल्पभुक्तिरुदितः)
(क) १. दर्ष्यति for (देष्यति)

प्रागू[1]नाधिकभुक्तिः पश्चादधिकोल्पभुक्तिरस्त[2]मितः ।
यास्यत्यथवास्तमयं यतस्ततो दृश्यघटिकोक्तिः ॥ ३१ ॥
घटिकाद्वयेन चन्द्रो दृश्यो[5]र्कात् सि[1]तगुरुज्ञ शनिभौमाः ।
अध्यर्द्ध[4] या घटि[2]काया त्रिभागघटि[3]को ज्ञ (त्त) राधिकाया ॥ ३२ ॥
गृहसूर्यान्तरघटि[4]का स्वभुक्ति लि[1]प्तानि स्व[5]नयुतयो[8]श्च ।
प्राग्वद[2]नंतर हृ[3]ताहीनाधिकनाडिका दिव[6]साः ॥ ३३ ॥

चं	शु	बृ	शु	श	मं
२	३०	१	२	१	२
००	००	५०	००	३०	५०

[7]

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३१. (घ) १. प्रागूनोधिकभुक्तिः for (प्रागूनाधिकभुक्तिः)
(क) २. संमितः for (स्तमितः)
३२. (घ) १. घटिकया (ग) (च) for (घटिकाया)
३. घटिकोत्तराधिकया (ग) (च) for (घटिकोत्तराधिकाया)
(ग) ४. अध्यर्द्धय for (अध्यर्द्ध या)
(च) ५. दृश्योर्क्कात् for (दृश्योर्कात्)
(क) १. शित for (सित) २. घटिकया for (घटिकाया) ३. शशिकोत्तरा for (घटिकोत्तरा)

३३. (घ) ४. घटिकाः (ग) (च) for (घटिका)
५. रूनयुतयोश्च (च) for (स्वनयुतयोश्च)

७

चं.	शु०	बृ०	बु०	श०	मं
३	१	१	२	२	२
	३	५०	१०	३०	५०

२. प्राग्वत्तदंतर (च) for (प्राग्वदनंतर)
३. हृता (ग) कृता for (हृता)
६. दिवसा (च) for (दिवसाः)
(ग) ८. युततयोश्च for (युतयोश्च)
(च) ३. हृता for (हृता)
(क) १. लिप्ताभिरून for (लिप्तानिस्वन)
(ग) २. तदंतर for (दनंतर)
३. हवा for (हृता)

७

चं	शु०	बृ०	बु०	श०	मं०
३	१	१	२	२	२
	३	५०	१०	३०	५०

विपरित[६]धनमृणं[१] सौम्यशुक्रयोर्वक्रिणोः[७] स्वभुक्तिकलाः[२] ।
एवमुदयास्तमययो[३] विपरितं[८] वक्रिणः[४] स्वफलम्[५] ॥ ३४ ॥
विक्षेपो[१] दक्षिणतस्तक्रांते[२]र्भागि सप्तसप्तत्या[४] ।
मिथुनस्य सप्तविंशे भागेनस्त्योन्नतैर्भागैः[३] ॥ ३५ ॥

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३४. (घ) ६. विपरीत (ग) for (विपरित)
७. विक्रणोः for (वैक्रिणो)
३. एवनुदयास्तमययो (ग) एवमुदयास्तमययो for (एवमुदयास्तमययो)
८. विपरीतं (ग) for (विपरितं)

(ग) १. रुणधनं for (धनमृणं)

(च) ७. ि क्रिर्णे for (वक्रिणोः)
८. विपरितं for (विपरितं)

(क) १. ऋृणधनं for (धनमृणं)
२. कालः for (कलाः)
३. उदक for (उदया)
४. वक्रिणि (ग) for (वक्रिणः)
५. फलाम् for (फलम्)

३५. (घ) १. विक्षिप्तो (ग) for (विक्षेपो)
२. वक्रांते (ग) तत्क्रान्ते for (तक्रान्ते)
३. नस्त्योन्नतै भागैः (ग) गस्त्योनतैर्भगैः for (नस्त्योन्नतैर्भगैः)

(ग) ४. 'सप्त' यह पद यहां अंकित नहीं ।

(च) १. विक्षेप्रो for (विक्षेपो)
२. तत्क्रांते for (तक्रान्ते)
३. नस्त्योन्नतैभागैः for (नस्त्योन्नतैर्भगैः)

(क) १. विक्षिप्तो for (विक्षेपो)
२. स्व for (स्त)
३. भागेरगेस्त्योर्नतैः for (भागेनस्त्योन्नतै)

नवते[1]स्तनैर्दृश्यो [3]घटिकाद्वितयेन [2]तदुदयविलग्नम्
[6]उदयैरधिकं [7]कृत्वा [4]तदुदयसूर्योस्तमयलग्नम् ॥ ३६ ॥
[5]षड्भयुतमूनमुदयैः [1]षड्राशियुतं [2]तदस्तमयसूर्यः ।
[3]घटिकाद्वितयेनैवं [4]षड्भागयुतेन मृगे[6]हंतु ॥ ३७ ॥
एवं [4]नक्षत्राणां घटिका[5]द्वितयेन [1]सत्रिभागेन ।
[2]उदयार्कोस्तमयार्का [3]व्यस्तोनस्तत्सदादृश्यम् ॥ ३८ ॥

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३६. (घ) १. रूनैदृश्यो (ग) रूनैर्दृश्यो for (स्तनैर्दृश्यौ)
३. ६० घटिका for (घटिका)
(ग) ४. तद्रूदय for (तदुदय)
(घ) ५. रूनैदृश्यो ६० for (स्तनैर्दृश्यो)
६. रुदयै for (उदयै) ७. क्रत्वा for (कृत्वा)
(क) १. रूनै for (स्तनै) २. विलग्नम) for (तदुदयविलग्नम्)

३७. (घ) २. तदस्तमसूर्यः for (तदस्तमयसूर्यः)
३. घटिद्वितयेनैवं for (घटिद्वितयेनैवं)
४. षड्भागायुतेन (च) for (षड्भागयुतेन)
(ग) ५. भार्द्धयुत for (षड्भयुत)
६. हंतुः for (हंतु)
(च) ७. मृगहंतु for (मृगेहन्तु)
(क) १. रासि for (राशि)

३८. (घ) १. सतृभागेन (च) for (सत्रिभागेन)
३. व्यस्योनस्तत्सदा (च) for (व्यस्तोनस्तत्सदा)
(ग) ४. नक्षत्राणामेवं for (एवं नक्षत्राणां)
५. द्वितेन for (द्वितयेन)
२. उदयार्को मस्तयकाद्यस्योनस्तदादृश्यम् for (उदयार्कोस्तमयार्का व्यस्तोनस्तत्सदादृश्यम्)
(च) २. उदयार्क्कोस्तमयार्क्का for (उदयार्कोस्तमयार्का)
(क) १. त्रिभागेन for (सत्रिभागेन २. उदय (लक्षय) लग्नमधिकं कृत्वा पूर्ववदुदयास्स्तार्या भवति for (उदयार्कोस्तमयार्काव्यस्तौनस्तदादृश्यम)

उदयास्तसूर्योरन्तरे[१] रवौ दृश्यते[४]ऽन्यथास्तमितः[२] ।
उनाधिकार[३]विकला रविभुक्त्या भाजिता दिवसाः ॥ ३९ ॥
षड्विंशो[१] मिथुनांशेः[६] शकचत्वारिंशता ४० मृग व्याधः[२] ।
तक्रांते[५]र्दक्षणतो[३] विक्षिप्ता[४]गस्त्यवच्छेषम् ॥ ४० ॥
गुणिता व्यासार्द्धेन स्वक्रान्तिज्यावलंबकहताग्रा[१] ।
प्रतिदिनमुदयास्तमया वर्गाग्रे[२] भग्रहमुनीनो[३] ॥ ४१ ॥

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३९. (घ) १. उदयास्तसूर्यायारंतरे (ग) उदयास्तासूर्ययो for (उदयास्तसूर्योरंतरे)
२. स्तमित for (स्तमित) (ग) न्यथास्तमितिः for (ऽन्यथास्तमितः)
३. ऊनाधिकार (ग) for (उनाधिकार)
(ग) ४. दृश्यतेः for (दृश्यते)
(च) १. उदयास्तसूर्यायोरन्तरे for (उदयास्तसूर्योरन्तरे)
२. न्यथास्तमित for (ऽन्यथास्तमित)
(क) ६. सूययोरन्तर for (सूर्योरन्तरे)

४०. (घ) १. षड्विंशे (ग) (ग) for (षड्विंशो)
५. तत्क्रांतेर्दक्षिणतो (ग) तत्क्रांतोर्दक्षिणतो for (तक्रान्तेर्दक्षणतो)
४. विक्षिप्तोगस्त्यवच्छ्ष (ग) विक्षिप्तोगस्त्यवछेषम् for (विक्षिप्तागस्त्य-वच्छेषम्)
(ग) ६. मिथुनांशेऽशक for (मिथुनांशेः शक)
(च) ५. तत्क्रांते for (तक्रांते)
३. र्दक्षिणतो for (र्दक्षणतो)
(क) १. विंशे for (विंशो) २. व्याधेः for (व्याधः) ३. दक्षिणे for (र्दक्षणतो)
४. विक्षेपोऽगस्त्य for (विक्षिप्तागस्त्य)

४१. (घ) १. ज्यावलंबलकहृताग्रा (ग) ज्यावलंबकोद्धृता स्वाग्रा for (ज्यावलंबकहृताग्रा)
२. वग्राग्रे (ग) for (वर्गाग्रे)
३. मुनीनाम् (ग) भग्रहमुनीनाम् (च) for (भग्नहमुनीनो)
(च) १. हृताग्रा for (हृताग्रा)
(क) १. प्रतिदिनमुदयास्तमयावयात्रे वग्रहमुनीरमां
गुणिता व्यासार्द्धेन स्वक्रान्तिज्या साद्धेनानेन
for (गुणिता व्यासार्द्धेन स्वक्रान्तिज्या वलंबकहताग्रा । प्रतिदिनमुदयास्त-मया वर्गाग्रे भग्नहमुनीनो ॥)

अग्राशंकुतलैक्यं[1] तुल्यदिशोरन्तरं तथान्यदिशो[4] ।
प्राच्यपरायाः[5] शंकोः[6] तलं[3] दग्रे ग्रहो नं[2] च ॥ ४२ ॥
शंकुतल प्राच्यपरांतरं भुजो दक्षिणोत्तरं कर्णः[2] ।
दग्ज्या[1] तद्वर्गांतरमूलं दिग्मध्यतः[3] कोटिः ॥ ४३ ॥
उनाधिक[3]शंकुगुणाः स्वशंकुभक्ताः पृथक् स्वदग्याग्रे[1] ।
कृत्वो[6]नाधिकशंकु[4]दृष्टिं[5] कृत्वोनशंक्वग्रे[2] ॥ ४४ ॥

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४२. (घ) ३. शंकोस्वलं तदग्रे for (शंकोः तलं दग्रे)
२. भं वा (ग) for (नं च)

(ग) ४. तथान्य दिशोः for (तथान्यदिशो)
५. परयोः for (परायाः)

(ब) ६. शंको for (शंकोः)
३. तलं तदग्रे for (तलंदग्रे)

(क) १. तलेकां for (तलैक्यं) २. भ वा for (नं च)

४३. (घ) २. दक्षिणोत्तरः (ग) (च) for (दक्षिणोत्तरं)
१. दृग्ज्यातद्वर्गांतर मूलं (ग) (च) for (दग्ज्यावर्गान्तरमूलं)
३. दिग्मध्यत (च) for (दिग्मध्यतः)

(क) १. दुप उप स्वर्गांतर मूलं for (दग्ज्यातद्वर्गांतरमूलं)

४४. (घ) ३. ऊनाधिक (ग) (च) for (उनाधिक)
१. दृग्याग्रे (ग) सुदृग्ज्याग्रे for (स्वदग्याग्रे)
४. शंक for (शंकु)
२. शंक्वाग्रं (शंक्वग्रे) (ग) शक्वग्रे for (शंक्वग्रे)

(ग) ५. दृश्यं for (दृष्टिं)

(च) १. स्वदृग्याग्रे for (स्वदग्याग्रे)
६. क्रत्वो for (कृत्वो)
२. शंक्वग्रें for (शंक्वग्रे)

(क) १. दृस्या for (स्वदग्याग्रे) २. शंकुः for (शंक्वग्रे)

प्रति[1]घटिकमधिकशंकोग्र[5]हमध्ये दर्शयेत्[6] भुवा ।
त्रि[2]प्रश्नोत्तया रवि[3]वच्छंकु भ्रमणादि[4]क्रमशेषम् ।। ४५ ।।
शंकु प्राच्यपरां[2]त्तरं विषुवच्छायैक्य मु[4]त्तरे नृ[3]तले ।
या[1]म्योतरं गुण[5]हृतं स्वक्रान्तिर्लम्ब कर्णाभ्याम् ।। ४६ ।।
तच्चा[4]पांशा स[1]दशैः मं[2]धुवकापक्रमांशकै[5]रूना ।
विक्षे[3]पांशे व्य[6]स्ता व्यस्तविशुद्धा व्य[7]सदृश्यांशैः ।।४७।।

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४५. (घ) ५. मग्रे (ग) ग्रहमग्रे
६. दर्शयेनि (ग) दर्शयेन्मुनि भंवा for (दर्शयेत् भुवा)
३. रविवत्शंकु (च) for (रविवच्छंकु)
४. कमशेषम् (ग) (च) for (क्रमशेषम्)
(ग) २. त्रिप्रस्नोक्तं for (त्रिप्रश्नोत्तया)
(च) २. मग्रे for (मध्ये) ६. दर्शयेनि for (दर्शयेत्)
(क) १ अधिघटिकादिसमधिशंका ग्रहणं मप्रे दर्शयन् मुनिनंद for (प्रतिघटिकमधिकशंकोग्र हमध्ये दर्शयेत् भुवा)
२. तृः for (त्रि) ३. विवन् for (रविव) ४. कमा for (क्रम)

४६. (घ) २. परांतर (ग) (च) for (परांत्तरं)
३. नृतरे for (नृतले)
१. याम्येंतरं (ग) याम्यैरंतर for (याम्योतरं)
(च) ४. मुत्तर for (मुत्तरे)
५. गुणहृतं for (गुणाहृतं) १. याम्योत्तरं for (याम्योतरं)
(क) १. याम्येंतरे for (याम्योत्तरं)

४७. (ट) ४. चापांशाः (ग) (च) for (चापांशा)
१. सदृशैः (ग) (च) for (सदशैः)
५. रूनाः (ग) for (रूना)
३. विक्षेपांशा (ग) विक्षेपांशाद्व्यस्ता for (विक्षेपांशे व्यस्ता)
६. व्यस्तविशुद्धाव्यसदृश्यांशैः (ग) विस्तविशुद्धा for (व्यस्तविशुद्धाव्यसदृश्यांशैः)
(ग) २. भंध्रुवका (च) for (मंधुवका)
७. वसद्रिशांशैः for (व्यसदृश्यांशैः)
(क) १. सदृशै for (सदशैः) २. ध्रुवकः for (मंधुवकः) ३. पांशा for (पांशे)

सहिता विक्षेपांश[४]स्तन्नापांशकवशादुदग्याम्या[१] ।
एवं विक्षेपांशाः[२] तक्रांत्यंशै[५]र्ध्रुवो[३] रविवत् ॥ ४८ ॥
उनैमानैक्यार्द्धात्[२] ग्रहयोमध्यांतरे[३] युतिर्ग्रहयोः[४] ।
समलिप्तिकयो ग्रहणादधिके[१] स्फुट मानयोगार्द्धात्[५] ॥ ४९ ॥
समलिप्तिकालिकार्कात्[४] कृत्वा लग्नं स्वदेश[३]राश्युदयैः[२] ।
ग्रहयोः समलिप्तिकयोः[६] स्वदिनोदिननाडिका[१] प्राग्वत्[५] ॥ ५० ॥
अधिकदिनोदितघटिकाभिरूनदिननाडिका गुणा[३] भक्ताः ।
अधिकदिननाडिकाभिः[१] फलनाड्यो[२] यदि भवन्त्यूनाः[४] ॥ ५१ ॥

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४८. (घ) ४. विक्षेपांशा (ग) for (विक्षेपांश)
१. याम्याः (ग) (च) for (याम्या)
५. तत्क्रांत्यंशै (च) for (तक्रांत्यंशै)
(ग) २. विक्षेपांशैस्तत्क्रान्त्यशा for (विक्षेपांशाः त क्रांत्यंशै)
(क) १. यामाः for (याम्या) २. विक्षेपाश for (विक्षेपांशाः)
३. जातैविक्षेपानयनम् for (ध्रुवोरविवत्)

४९. (घ) २. ऊनेमानैक्यार्द्धा (ग) (च) for (उनैमानैक्यार्द्धात्)
३. ग्रहयोर्म्मध्यांतरे (ग) (च) for (ग्रहयोमध्यांतरे)
४. ग्रहयैः for (ग्रंहयोः)
(ग) १. ग्रंहणवदधिके for (ग्रहणादधिके)
५. योगार्द्धा for (योगार्द्धात्)
(च) ४. ग्रहयौः for (ग्रंहयोः)
(क) १. वदधिके for (दधिके)

५०. (घ) २. राश्युदयै (ग) for (राश्युदयैः)
१. नाडिकाः (ग) स्वदिनोदितनाडिका for (स्वदिनोदिननाडिका
(ग) ३. स्वदेदेश for (स्वदेश)
(च) ४. कालिकार्क्कात् for (कालिकार्कात्)
१. स्वदिनोदिननाडिकाः for (स्वदिनोदिननाडिका)
५. प्रग्वत् for (प्राग्वत्)
(क) ६. स्वदितनाडिका for (स्वदिनोदिननाडिका) ४. कति for (र्कात्)

५१. (घ) २. नाड्यं for (नाड्यो)
(ग) ३. भक्ता for (भक्ताः) ४. भवत्यूनम् for (भवन्त्यूनाः)
(क) १. गुण for (दिन)

उनदिवसो[2] दिताभ्यो घटिकाभ्यः प्रागथाधिकाः[3] पश्चात् ।
योगस्तत्[5] घटिकांतरमाद्यं[1] कृत्वेषु[4] घटिकाभिः ।। ५२ ।।
गुणिता[2] स्वभुक्तलिप्ता[3] षष्टिहृताः[4] प्रागणं[1] धनं पश्चात् ।
आद्यवदन्तरमन्यत्प्राक्[6] पश्चार्द्धान्तिर[5] द्वितयम् ।। ५३ ।।
आद्यघटिकान्तरं[3] वशात्प्राक्[4] पश्चाद् वा युतिः प्रथमकलात्[1] ।
कृत्वा पृथकदिनोदित[5] घटिकास्तत्कालिक[2] ग्रहयोः ।। ५४ ।।

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५२. (घ) २. ऊन (ग) ऊनादिवसो (च) for (उनदिवसो)
(ग) ३. प्रागधिकाः for (प्रागथाधिकाः)
४. कृत्वेष्ट for (कृत्वेषु)
(च) ५. योगस्तद्धटिकांतरमाद्यं for (योगस्तत् घटिकांतरमद्यं)
(क) १. घटिकांदिफलं ग्राह्यं for (घटिकांतमाद्यं)
२. यदिभरमाद्यं कृत्वेष्ट for (घटिकांतरमाद्यं कृत्वेषु)

५३. (घ) २. गुणिताः for (गुणिता)
३. लिप्ता (ग) (च) for (लिप्ता)
१. प्रागृणं (ग) (च) for (प्रागणं)
(ग) ४. षष्टिहृताः (च) for षष्टिहृताः)
५. पश्चाद्वान्तर for (पश्चार्द्धांतर-द्वांतर-)
(क) १. प्रागृण for (प्रागणं) २. गुणिताः for (गुणिता) ३. लिप्ताः for (लिप्ता) ५. पश्चाद्वांतर for (पश्चार्द्धान्तर-द्वांतर)
६. मन्यत्प्रा for (मन्यत्प्राक्)

५४. (घ) ३. अद्य (च) for (आद्य)
४. घटिकान्तरवशात् (ग) आद्यवटिकांतरवशा for (घटिकांतरं वशात्)
५. पृथगुदितोदित (ग) पृथग्दिनोदित for (पृथकदिनोदित)
(ग) २. तात्कालिकग्रहयोः for (तत्कालिकग्रहयोः), इसकी श्लोक संख्या ५५ है ।
(च) ४. घटिकांतरवशात् for (घटिकांतरवशात्)
५. पृथगुदिनोदित for (पृथक्दिनोदित)
(क) १. कालात् for (कलात्) (ग) २. कोलिक for (कालिक) इसकी श्लोक संख्या ५५ है ।
(ग) यद्याद्यान्यांतरयोरन्तर हृत मन्यथा तदैक्येन ।
गाद्यन्तरष्टिभिर्घटिका निर्गुणित माप्ताभिः ।। ५४ ।।
इसमें यह अतिरिक्त श्लोक पाया गया है ।
(क) १. आद्यंतर for (प्राद्यंतर)

उदितघटिका यदिहृता गुणिताश्चाद्यान्यदिवसघटिकाभिः ।
यद्याद्यानान्तरयोरंतर हृतमन्यथा तदैक्येन ॥ ५५ ॥

५५. (क) १. हृता for (हृता) २. स्वान्य for (द्यान्य)

३. अन्योदितटिकाभिस्तुल्यो योगोभवेदसकृत् for (यद्याद्यानांतरयोरंतरहृतमन्यथा तदैक्येन) इसकी श्लोक संख्या ५६ है।

(क) यद्याद्यान्यान्तरयोरन्तर हृतमन्यथा तदक्येन ।
आद्यंतरमिष्टाभिर्घटिकाभि गुणितमाप्ताभिः ॥ ५५ ॥

for

उदितघटिका यदि हृता गुणिताश्चाद्यान्यदिवसघटिकाभिः ।
यद्याद्यानाँतरयोरंतर हृतमन्यथा तदैक्येन ॥ ५५ ॥

(घ) १. हृता (ग) (च) for (हृता)

२. गुणिताश्चश्चा (ग) गुणिताश्चस्वान्य for (गुणिताश्चाद्यान्य)

३. यद्याद्यान्यांतर for (यद्याद्यानांतरयोरंतर)

वि०—इस श्लोक में एक और पंक्ति है और उसके पश्चात् क्रमसंख्या ५४ लिखी है। पंक्ति है —

"आद्यंतरमिश्चादाँतरै द्वितयं । ष्टाभिर्घटिकाभिर्गुणितमास्ताभिः ॥ ५४ ॥
for (यद्याद्यानाँतरयोरन्तरहृतमन्यथा तदैक्येन)

(ग) ५. उदकैत for (उदित)
वि० इसका उत्तरार्ध निम्नांकित है—श्लोक संख्या ५६ है।
'अन्योदितघटिकाभिस्तुल्यायोगो न चेदसकृत' for (यद्याद्यानांतरयोरंतर हृतमन्यथा तदैक्येन)

(च) २. गुणिताश्चश्चान्यदिवसघटिकाभि for (गुणिताश्चाद्यान्यदिवसघटिकाभिः)

३. यद्याद्यान्यांतरं for (यद्याद्यानांतरयोरंतर)

६. हृतमन्यथा for (हृतमन्यथा)

आद्यंतरमिष्टाभिर्घटिकाभिर्गुणितमाप्ताभिः।
अन्योदित घटिकाभिस्तुल्यो योगो भवेदसकृत् ।। ५६ ।।
अन्येष्टनाडिकाभिः कृत्वा तुल्या यदा तदा योगः।
कार्यो अंगोन्नतिवत् ग्रहमध्यान्तरे योगे ।। ५७ ।।

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५६. (क) उदितघटिका यदि हृता गुणिताश्च स्वान्यदिवस घटिकाभिः।
अन्योदित घटिकाभिस्तुल्यो योगो भवेदसकृत् ।। ५६ ।।
for
आद्यंतरमिष्टाभिर्घटिकाभिर्गुणितमाप्ताभिः।
अन्योदित घटिकाभिस्तुल्यो योगो भवेदसकृत् ।। ५६ ।।

(वि) इस श्लोक का पूर्वार्ध —अतिरिक्त ५४ का उत्तरार्ध भी है।

(घ) वि० इस श्लोक की पहली पंक्ति पिछले श्लोक की अंतिम पंक्ति दर्शाई गई है। क्रम संख्या ५४ लिखी है।
१. 'भिश्चाद्यंतरे द्वितयं, ष्टाभिर्घटिकाभिर्गुणितमास्ताभिः ।। ५४ ।।' इस पंक्ति के पश्चात् ५५ संख्या कहीं नहीं है। हां "अन्योदित ········असकृत" लिखकर ।। ५६ ।। संख्या लिखदी है।

(ग) यह श्लोक इस प्रति में नहीं है।
इसकी पहली पंक्ति—ग के ५४ संख्यावाले श्लोक की दूसरी पंक्ति है। तथा ग के ५६ संख्या वाले श्लोक की दूसरी पंक्ति, इसकी दूसरी पंक्ति है। देखो पिछला श्लोक।

(च) २. यहां पर भी क्रमसंख्या ५६ दी हुई है।

५७. (घ) २. शृंगोन्नतिवद्ग्रहमध्यांतरे (ग) शृंगोन्नतिवद्ग्रहयो for (अंगोन्नतिवत् ग्रहमध्यान्तरे)
१. कार्यो for (कार्यो)
३. मंध्यान्तरे for (मध्यांतरे)
इसकी श्लोक संख्या मिलती जुलती है।

(च) ४. क्त्वा for (कृत्वा) शृंगोन्नतिवद्ग्रहमध्यांतरे योगे for (अंगोन्नतिवत् ग्रहमध्यांतरे योगे)

(क) १. कायो for (कार्यो) २. शृङ्गान्नति for (अंगोन्नति)
३. ग्रहयोम् for (ग्रहमध्यांतरे) ४. योगः for (योगे)

बाहु[५] संयोगांतरमन्ना[१]शंक्वग्रयोः समान्य[२]दिशोः ।
कर्णोद[२]ग्ज्येकोटि[३] स्वकर्णभुजकृतिविशे[४]षपदे ॥ ५८ ॥
कोटि[१]भुजकर्णशंकु[६] षष्टि[२] गुणाध्[३]वाहृता मध्यात् ।
कोटि[४] प्रथक्व्य[८]सार्ये प्राच्यां प्रा[७]गपरयोः पश्[५]चात् ॥ ५९ ॥

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५८. (घ) १. माग्रो शंकुग्राह्या: (ग) मग्राशंक्वग्रयो for (मन्नाशंक्वग्रयोः)
२. सामान्यदिशोः for (सम्मान्यदिशोः)
३. दृज्ज्येकोटि (ग) कर्णौ दृग्येज्येकोटी for (कर्णोदग्ज्येकोटि)
४. वेशेषयदे for विशेषपदे)

(ग) ५. वाहुः for (बाहु)

(च) १. माग्राशंकुग्रह्योः for (मन्नाशंक्वग्रयोः)
२. सामान्यदिशोः for समान्यदिशोः)
३. दृज्येकोटी for (कोटि) ४. वशेषपदे for (विशेषपदे)

(क) १. मग्रासंक्क for (मन्नाशंक्वग्रयोः) २. दृश्यौ for (दिशोः) ३. कौटी for (कोटि)

५९. (घ) ३. गुणाव्याहृता हृतान्मध्यात् (ग) गुणान् व्यासदलहृतान् for (गुणाध्वाहृता मध्यात्)
३. कोटी पृथक् पृसार्ये (ग) कोटीपृथक् प्रसार्ये for (कोटि प्रथक्व्यसार्ये)

(ग) ६. शंकून् for (शंकु)
७. प्रागपरया; for (प्रागपरयोः)

(च) ३. गुणा व्याहृतान्मध्यात् for (गुणाध्वाहृतामध्यात्)
४. कोटी for (कोटि)
८. पृथक्पृसार्ये for (प्रथक्व्यसार्ये)

(क) १. काटिभुजर्ण for (कोटि भुजकर्ण) २. यष्टि (ग) for (षष्टि)
३. गुणात् व्यासिक्तात्म for (गुणाध्वाहृता मध्यात्)
४. क्वाऽग्रपृथक् प्रसयो for (कोटिप्रथक्व्यसार्ये) ५. मध्यात् for (पश्चात्)

कोटचग्राभ्यां बाहुकर्णे दिग्मध्यतो भुजाग्रांतौ ।
बाहुग्राह्यो स्वशंकुषष्टि मध्यान्तराग्रांते ॥ ६० ॥
दिग्मध्ये स्थित द्रष्टृचा पृथग् ग्रहौ दर्शयेत् स्वशंक्वग्रे ।
योगे शंक्वग्न्तरमंतरमथवान्यदाग्रहयोः ॥ ६१ ॥
नावार्यो ज्ञातेरपि तन्त्रैरार्यभटविष्णुचन्द्राद्यैः ।
यो ब्रह्मधूलिकर्म विदाचार्यत्वं भवति तस्य ॥ ६२ ॥

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६०. (घ) ४. ग्राद्या for (ग्राह्यो) (ग) बाहुग्रयोः for (बाहुग्राह्यो)
५. शंकूयष्टी (ग) for (शंकुषष्टि)
(ग) १. कर्णो for (कर्णे)
६. मध्यात्तदाग्रांते for (मध्यांतराग्रांते)
(च) ७. कोद्यग्राम्यां for (कोटचग्राभ्यां) बाहुकर्णौ for (बाहुकर्णे)
३. भुजाग्रांतो for भुजाग्रांतौ
४. बाह्वग्राह्यो for (बाहुग्राह्यो) ५. स्वशंकूयष्टी for (शंकुषष्टि)
६: मध्यांतराश्रांते for (मध्यांतराग्रांते)
(क) १. कणात् for (कर्णे) २. दृग् for (दिग्) ३. भुजाग्रातौ for (भुजाग्रांतौ)
४. बाह्वग्रयोः for (बाहुग्राह्यो) ५. यष्टि for (षष्टि)
६. मध्यत्तदग्रते for (मध्यांतराग्रांते)

६१. (घ) १. दृष्टृचा (ग) (च) for (द्रष्टृया)
३. शकूवयांतर (ग) शंक्वग्रांतर for (शंक्वग्रंतर)
(ग) ४. दिग्मध्यस्थित for (दिग्मध्येस्थित)
(च) ३. शंकूवग्रांतर for (शंक्वग्रन्तर)
(क) १. दृष्टृचा for (द्रष्टृया) २. ग्रहोदशयन्न for (ग्रहौ दर्शयेत्)
३. स्वस्वाप्रतिर्मततो सलभ्य for (शंक्वग्रन्तरमन्तर)

६२. (घ) १. न वार्यो (ग) नाचार्यो for (नावार्यो)
२. ज्ञातैरपि (ग) (च) for (ज्ञातेरपि)
३. ब्राह्मधूलि (च) ब्राह्मधूलिकर्म्म for ब्रह्मधूलिकर्म)
(ग) ४. राचार्यभट for (रार्यभट)
(क) १. नाचार्यौ for (नावार्यो) २. जातै for (ज्ञातेरपि) ३. ब्राह्म for (ब्रह्म)

रविशशितमस्त्रिवरितं[1] ब्रह्मोक्तं पुण्यमङ्कुतं ज्ञात्वा[4]।
रविचन्द्रराहु लोकात्[2] प्राप्नोति पुमानीह[3] यशश्च ॥ ६३ ॥
अन्यैरप्यूक्तमिदं[4] योयं सम्यक्[5] ग्रहं[1] विजानाति ।
याति सद्दरलोकं[2] ग्रहाष्टकज्ञं[3] परं ब्रह्म[4] ॥ ६४ ॥
मध्यमगतिः[4] स्फुटगति[5] स्त्रिप्रश्नश्चन्द्र[6]भास्कर[1] ग्रहणे ।
उदयास्तमय[2]प्रतिघटिकामिदोः[3] शृङ्गोन्नतिछाये ॥ ६५ ॥

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६३. (घ) १. तृवरितं (ग) तमस्त्रिचरितं for (तमस्त्रिवरितं)
३. पुमानिह (च) for (पुमानीह)
(ग) ४. श्रुत्वा for (ज्ञात्वा)
२. लोकान् for (लोकात्)
(च) १. तमसृचरितं for (तमस्त्रिचरितं)
(क) १. चरितं for (वरितं) २. लोकान् (ग) for (लोकात्)
३. पुमानिह (ग) for (पुमानीह)
६४. (घ) ४. अन्यैरप्युक्तमिदं (ग) (च) for (अन्यैरप्यूक्तमिदं)
५. सम्य (ग) सम्यग्ग्रहं for (सम्यक्ग्रहं)
२. सतद्ग्रहलोकं (ग) (च) for (सद्दरलोकं)
३. ग्रहाष्टज्ञः (ग) ग्रहाष्टकज्ञः for (ग्रहाष्टकज्ञं)
(ग) ४. ब्रह्मः for (ब्रह्म)
(च) ५. सम्यग्रहं for (सम्यक्ग्रहं)
३. ग्रहाष्टकज्ञः for (ग्रहाष्टकज्ञं)
(क) २. सतग्रह for (सद्दरलोकं)
३. ग्रहाष्टज्ञः for (ग्रहाष्टकज्ञं)
६५. (घ) १. भास्करं (च) for (भास्कर)
२. उदयास्तमयः (ग) उदयास्तमयौ for (उदयास्तमय)
३. प्रतिघटिर्कानदो (ग) प्रतिघटिकमिदु for (प्रतिघटिकामिदोः)
(ग) ४. मध्यगतिः for (मध्यमगतिः)
५. स्पष्टगति for (स्फुटगति) ६. त्रिप्रस्नचन्द्र for (त्रिप्रश्नश्चन्द्र)
(च) २. उदयास्तमयः for (उदयास्तमय) ३. प्रतिघटिर्कामदो for (प्रतिघटिकामिदोः)
(क) १. मध्यमगतिस्त्रिप्रश्नश्चंद्र भास्कर ग्रहणे । उदयास्तमयः । चंद्रग्रहणं चतुर्थः सूर्यग्रहणं पचमः । उदयास्तमय षष्टाप्रति घटिका मिंदोः शृंगोन्नति छाये । for (मध्यमगतिः स्फुटगतिस्त्रिप्रश्नश्चन्द्रभास्करग्रहणे । उदयास्तमय प्रतिघटिकामिदोः शृङ्गोन्नतिछाये ।)

ग्रहयोगोत्र[1] ग्रहयुतिरार्यात्रिशति[3] युताष्ट सप्तत्या ३७८
अध्यायैर्दशभिर्धू[5]लिकर्म[6] वोच्चैर्[4]विना ब्रह्मं[2] ॥ ६६ ॥
गुरुणा नधूलिकर्म[5] प्रतिकंचुककारिणे[1] प्रदातव्यम् ।
दत्त सुकृतप्रणाशं[4] कुरुते प्रतिकंचुकं[2] यस्य[3] ॥ ६७ ॥
ग्रहमेलके[4] यदुक्तं तत्स्थूलं[5] स्पष्टमिह[3] यदुक्तं तत् ।
ग्रहभमुनींदु[1] छाया शृङ्गोन्नतिभोदयाद्येषु[2] ॥ ६८ ॥
सूर्यास्तमयादिष्टाद्रातिगताच्छेष्ट[1] भोदयास्तमयौ[2] ।
जानाति न कश्चिदपि ब्राह्मनं मुच्चान्यतन्भज्ञः[3] ॥६९॥

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६६. (घ) १. भ (ग) (च) for (त्र)
(ग) ३. त्रिशती for (त्रिशति)
४. चाद्यै for (वोच्चै)
(च) ५. ईशभि for (दशभि) ६. धूलिकर्म्म for (धूलिकर्म)
(क) १. भ for (त्र) २. ब्राह्मी (ग) ब्राह्म्ये for (ब्रह्मं)

६७. (घ) ३. योस्य (ग) (च) for (यस्य)
(ग) १. प्रतिकंचककारिणे for (प्रतिकंचुककारिणे)
४. सुकृतः प्रणाशः for (सुकृतप्रणाशः)
(च) ५. कर्म्म for (कर्म)
(क) १. प्रातस्थर्क् क कारिणो for (प्रतिकंचुककारिणे)
२. सुर्क योस्या for (चुकंयस्य)

६८. (घ) १. ग्रेहभमुनींदु (ग) for (ग्रहभमुनींदु)
(ग) ३. स्पष्टमिदं for (स्पष्टमिह)
(च) ५. तस्थूलं for (तत्स्थूलं)
(क) १. ग्रहण मनींदुछायो for (ग्रहभमुनींदुछाया) २. लोदयाद्येषु for (भोदयाद्येषु)
४. ग्रहामलके for (ग्रहमेलके) ३. स्पष्ट इह for (स्पष्टमिह)
यह यहीं समाप्त है ।

६९. (घ) १. दिष्टयाद्ग्रारिगता for (दिष्टाद्रातिगता) (ग) सूर्यास्तमयाद्वारात्रिगता for (सूर्यास्तमयादिष्टाद्रातिगता)
२. द्वेष्ट (ग) स्वेष्टभोदयास्तमयोः for (छेष्टभोदयास्तमयौ)
३. ब्राह्मं मुत्चान्यतंत्रज्ञः (ग)ब्राह्मं मुक्तान्यतंत्रज्ञः for (ब्राह्मनं मुचान्यतन्भज्ञः)
(क) यह श्लोक उपलब्ध नहीं,
(च) १. दिष्टयाद्ग्रारिगता for (दिष्टाद्रातिगता) २. द्वेष्ट for (छेष्ट)
३. ब्राह्मं मुचान्यतंत्रज्ञः for (ब्राह्मनंमुचान्यतंत्रज्ञः)

भमुनी[1]ध्र्‌व विक्षेप गृहोदयास्त मयनाडिकाद्येषु[3] ।
अध्यायोभगृह[4] युतिरार्याणां सप्तति दंश[2] ॥ ७० ॥
इत्ति ब्रह्मगुप्ते दशमोऽध्यायः ॥

इति श्री ब्राह्मस्फुटसिद्धान्ते ग्रहताराविक्षेपाधिकारोदशमः ॥ १० ॥
सम्पूर्णा पूर्वादशाध्यायी

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७०. (घ) १. भमुनि (ग) (च) for (भमु)

२. दंशमा for (दंश)

(ग) ३. कालिकाद्येषु for (नाडिकाद्येषु)
आर्याणां सप्तत्या दशमोभग्रहयुतिरध्यायः ॥ ७० ॥
इति श्री ब्रह्मगुप्ताचार्य विरचिता दशाध्यायी समाप्ता ॥
for (अध्यायोभग्रहयुतिरार्याणां सप्ततिर्दश ॥७०॥ इति ब्रह्मगुप्ते दशमोऽध्यायः)

(क) यह श्लोक उपलब्ध नहीं है।

(च) २. ईंश for (दंश)
४. 'इति' से 'अध्यायः' तक लुप्त

(ग) वि०-अतिरिक्त पाठ—
इति श्री ब्रह्मगुप्ताचार्य विरचिता दशाध्यायी समाप्ता । अथ स्वस्ति श्री संवत् १६७७ वर्षे शाके १५४३ प्रवर्तमाने ॥ ज्येष्ठबदि १० सोमे । रेवती घटी १८ पल १७ नक्षत्रे । अत्र ग्रन्थ लिषित समये श्री राजनगर मध्यवास्तव्यं ।श्री······ज्ञातीय । ज्योति श्री ···कस्य इयं पुस्तिकालिंषितमस्ति । उक्तं च । याद्रिशं पुस्के द्रिष्ट्वा ताद्रिशं लिखितं मया । यदिशुद्धम-शुद्धं वा मम दोषो न दीयते ॥ पुनः ॥ भग्नदृष्टि कटिग्रीवाबद्धमुष्टिरधोमुखम् । कष्टेन लिखितं शास्त्रं यत्नेन परिपालयेत् । लेषकपाटकयोः शुभं भवतु । स्वयं पठनार्थं तथापुत्रपौत्रादिपठनार्थं । परोपकारार्थं । श्री कृष्णार्पणमस्तुः ॥ श्रीरस्तु मंगल मस्तु । शुभंभवतु । जयोस्तु । छः छः छः छः छः छः । उक्तं च । ब्रह्मा प्राह त नारदाय हिमगुर्य शौनकायालं मांडव्याय वसिष्ठसंज्ञकमुनिः सूर्यामियायं हिं यत् । सत्पक्षागमशास्त्र युक्तममिदं शास्त्रं विहायान्यथा । ये कुर्वंति नरान् निर्वहति तो विज्ञानशून्याश्चिरम् ॥

अथ तन्त्र परीक्षा नामैकादशोध्यायः

ये[१] ज्ञान पटलरु[२]द्धदशोन्यब्रह्मा[३]द्वदन्ति सिद्धान्तम्[४] ।
तेषां युगादिभे[५]देद्ये दोषास्तान्प्र[६]वक्षामि ॥ १ ॥
युगमाहुः प[१]ञ्चाब्दं रविशशिनोः संहितांग का[३]रये ।
अधिमासा वमरात्र स्फु[४]टतिथ्यज्ञान तदस[२]त् ॥ २ ॥

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१. (घ) १. येऽज्ञान for (ये ज्ञान)
२. रुद्धद्दशो (ग) रुद्धदशो for (रूद्धदशो)
३. न्यद्बाह्याद्वदन्ति (ग) ऽन्यद्ब्राह्याद्वदन्ति for (न्यब्रह्माद्वदंति)
४. सिद्धांतात् (ग) (च) for (सिद्धान्तम्)
५. भेदाद्ये (ग) (च) for (भेदेद्ये)
६. प्रवक्ष्यामि (ग) प्रविक्ष्यामि for (प्रवक्षामि)

(च) २. रुद्धद्दशो for (रूद्धदशो)
३. द्ब्राह्याद्वदन्ति for (ब्रह्माद्वदन्ति) ४. सिद्धान्तात् for (सिद्धान्तम्)
६. प्रवक्ष्यामि for (प्रवक्षामि)

(ग) वि०-अतिरिक्त पाठ—
अथ ब्रह्मगुप्तसिद्धांते एकादशमोऽध्यायः प्रारम्यते ॥ खखखार्क १२००० द्वृताब्देभ्यो गतगम्याल्पा-त्खशून्य यमल । २०० हृतात् । लब्धं त्रि ३ सायक हतं कलाभिरूनौ सदार्केंदू ॥ १ ॥ विधु वज्जीवेद्वि २ हतं चन्द्रोच्चें तिथि १५ गुणं च सितशीघ्रे ॥ द्वीषु ५२ हतं च स्वांर द्वि २ कु १ वेद ४ हतं च पात कुजशनिषु ॥ २ ॥ ग्रहबीजानि ब्रह्मसिद्धांते ॥

२. (घ) १. पंचाक्षरं for (पञ्चाब्दं)
२. ज्ञानतस्तदसत् (ग) तस्तदसत् for (ज्ञानतदसत्)

(ग) ३. —-रयैं for (कारये)
४. स्फुतिथ्य for (स्फुटतिथ्य)
५. ज्ञान् for (ज्ञान)

(च) ३. काराय for (कारये)

भानि [1]ध्रुवपंचाशत् द्वा[4]वर्कादयो जिनोक्तं यत् ।
ध्रुवम[2] सस्यावर्णो भवति [3]यतोह्ला ततो सतत् ॥ ३ ॥
[1]आर्यभटो युगपादांस्त्रीन् [4]पातानाह कलियुगादौ यत् ।
३२४०००० तस्य कृतां त[2]र्यस्मात् स्वयुगाद्यंतौ न [3]तस्मात् ॥ ४ ॥
र[4]वियुगभगणां र[5]व्युधृति [1]४३२०००० यत्प्रोक्तं [2]तत्र[6]योर्युगं [3]स्पष्टम् ।
त्रिशतीरव्युदयानां तदन्तरं हेतुना केन ॥ ५ ॥[7]

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३. (घ) १. पंचांशत् for (पंचाशत्) (ग) चतुः पंचाशत् द्वौ for (ध्रुवपंचाशत् द्वा)
२. ध्रुवमत्सस्या (ग) ध्रुवमत्सस्यावर्त्तो for (ध्रुवमसस्यावर्णो)
३. यतोह्ला ततोसत्तत् (ग) for (यतोह्लाततो सतत्)

(च) ४. द्वावक्कादियौ for (द्वावर्कादयो)
२. ध्रुवमत्सस्यावर्णौ for (ध्रुवमसस्यावर्णो)
३. यतोह्ला ततो सत्तत् for (यतोह्ला ततो स तत्)

४. (घ) १. अर्यभटो for (आर्यभटो) (ग) आर्यभटोसुत for (आर्यभटोयुग)
२. यस्मात्तं for (र्यस्मात् स्व)
३. तत्तस्मात् (ग) for (न तस्मात्)

(ग) ४. यतोनाह for (पातानाह)

(च) १. अर्यभटो for (आर्यभटो)
३. न तत्तस्मात् for (न तस्मात्)

५. (घ) १. ४३२००० (च) for (४३२००००)
२. तंत्रयो for (तत्रयो)
३. स्पष्टान्यत् for (स्पष्टम्)
वि०—इस श्लोक की दूसरी पंक्ति यहां लिपिकार लिखना भूल गया प्रतीत होता है। यही नहीं छठे श्लोक की पहली पंक्ति भी यहां लुप्त है।

(ग) ४. युगरविभगणाः for (रवियुगभगणां)
५. रव्युद्रिति for (रव्युधृति)
६. युगं for (र्युगं)
७. +३०० ॥०॥+

(च) १. ४३२०० यत्पोक्तं for (४३२००००

युगवर्षा[3]दिनवदच्चैत्र सितादेः समं[4] प्रवृत्तान्यत् ।
तदसत्[1] यतः स्फुटयुगं[5] तस्थैर्यान्[2]मंदपातानाम् ॥ ६ ॥
ग्रहभुक्ते[1]रूनाया मंदोच्चं[4] भवति शीघ्रमधिकायाम् ।
[5]उच्चगतौ मंदोच्चं न विना भुक्तेंदु[2] वर्जमेतः[3] ॥ ७ ॥
आर्याष्टशते[1] पाता भ्रमंति दशगीतके[2] स्थिराः पठिताः ।
मुक्तेंदु[3]पातमंडपमण्डले[5] भ्रमति[4] स्थिरानातः ॥ ८ ॥
आर्यभटो जानाति ग्रहाष्टाति[1] यदुक्तवांस्तदसत् ।
राहुकृतं न ग्रहणं तत्पातो[2] नाष्टमो राहुः ॥ ९ ॥

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६. (घ) यहां श्लोक का पूर्वार्घ लुप्त है।
१. तदराज् (ग) तदसद्युतः for (तदसत्—तदसत् यतः)
२. तत्स्थैर्यान् (ग) स्थैर्यान् for (तस्थैर्यान्)
(ग) ३. युगवर्षादी for (युगवर्षादि)
४. सप्रवृत्तानयत् for (समं प्रवृत्तान्यत्)
५. युतं गं न for (युगं)

७. (घ) १. रूनायां for (रूनाया)
२. भुत्तयेन्दु for (भुक्तेंदु)
३. वर्जमतः for (वर्जमेतः)
(ग) ४. परिधि फले व्यावहारिके त्रिगुणे for (मंदोच्चं भवति शीघ्रमधिकायाम्)
५. दूसरी पंक्ति बिल्कुल भिन्न है—
'तद्वर्गाभ्यां दशभिः संगुणिताभ्यां सूक्ष्मे'

वि०—तीसरी पंक्ति यह है—
उच्चं भवति शीघ्रमधिकायां । उच्चगतौ मंदोच्चं न विना भुक्त्येंदुवर्ज्मनः ॥७॥
अर्थात् रेखांकित दो पंक्तियां अधिक हैं।

८. (घ) १. आर्याऽष्टशते (च) for (आर्याष्टशते)
२. दशगीतेके (ग) दशगीतिके for (दशगीतके)
३. मुक्त्वेन्दु (ग) for (मुक्तेंदु)
४. भ्रमंति (ग) for (भ्रमति)
(ग) ५. मपमंडले for (मंडपमण्डले) (च)
(च) २. दश२गीतके for (दशगीतके)

९. (घ) १. ग्रहाष्टकगति (ग) for (ग्रहाष्टाति)
२. तस्पातो (ग) तस्यातो for (तत्पातो)

न समा[3]युगमनुकल्पाः कल्पादिगत[1] कृतादियातं च ।
स्मृत्युक्तैरार्य[2]भटो ना तो जानाति मध्यगतिं ॥ १० ॥
उँ[1]कारो दि[3]नवारो गु[2]रुरदयिकोस्य भवति कल्पादौ ।
न भ[4]वत्यर्कों यस्मादोंकारे विस्वरस्तस्मात् ॥ ११ ॥
सूर्योदयाच्चतु[1]र्थात् दिन[2]पात् यदुवाच त[3]दसदार्यभटः ।
लं[4]कोदयो यतो[5]र्कं स्यास्तमयं प्राह सिद्ध पुरे ॥ १२ ॥
आधि[1]कैः शतैश्चतु[2]र्भिवर्ष सहस्त्रै[3]श्चतुर्दशाभिरेकः १४४०० ।
यु[5]गपातै[6]र्दिनवारोत्तरयो[4]दयिकर्द्ध रात्रिकयोः ॥ १३ ॥

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१०. (घ) १. कल्पादिगतं (ग) (च) for (कल्पादिगत)
२. स्मृत्युक्तैर्यभटो for (स्मृत्युक्तैरार्यभटो)
(ग) ३. समायुतं गमनुकल्पाः for (समायुगमनुकल्पाः)

११. (घ) १. ओंकारो for (उँकारो)
२. रौदयिको (ग) रोदयिक्येस्य for (रदयिकोस्य)
(ग) ३. दिनचरै for (दिनवारो)
(च) २. गुरुरौदयिको for (गुरुरदयिको)
४. न भवत्यक्र्को for (न भवत्यर्कों)

१२. (ग) १. चतुर्थान् for (चतुर्थात्)
२. दिनपान for (दिनपात्)
३. तव for (तद)
४. लंकोदये for (लंकोदयो)
५. यतोर्क्कस्या for (यतोर्कस्या)

१३. (घ) १. अधिकैः (ग) (च) for (आधिकैः)
२. चतुर्भिर्वर्ष (ग) (च) for (चतुर्भिवर्ष)
३. चतुर्दशभिरेकः (ग) (च) for (चतुर्दशाभिरेकः)
४. मौदयिकार्द्ध (ग) for (योदयिकर्द्ध)
(ग) ५. युगजातै for (युगपातै)
६. र्दिनवारोंत्तर for (र्दिनवारोत्तर)
(च) ४. मोदयिकर्द्ध for (योदयिकर्द्ध)

उदयिकाद्दिन[१] भुत्तचार्द्ध[२] रात्रिको मध्यमोभवेत्[३] पूतः ।
कतरं[४] स्फुटं न निश्चितमनयोः[५] स्फुटमेक्रमपि[६] नातः ॥ १४ ॥
षोडशगियिवि[१] योजन परिधि षडम्दव्यासं[२] पुनर्लाविदता[३] ।
आत्मज्ञानं[४] ख्यापितमनिश्चयः स्वमतिकृतकत्वात् ॥ १५ ॥[४]
भुव्यासस्य[१] ज्ञाना[२] ध्व्यर्थं देशांतरं[३] दज्ञानात् ।
स्फुटतिथ्यंताज्ञान[४] तिथिनाशाद्[५] गृहणयोनाशः ॥ १६ ॥

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१४. (घ) १. औदयिकाद्दिन (ग) औदयिकादिन for (उदयिकाद्दिन)
२. भत्तचार्द्ध for (भुत्तचार्द्ध)
३. भवत्पूनः (ग) (च) for (भवेत्पूतः)
४. कतरत् (ग) कतर for (कतरं)
५. निश्चत for (निश्चित) (च)

(ग) ६. मतिनातः for (मपिनातः)

(च) १. औदयिकाद्दिन for (उदयिकाद्दिन) ४. कतरत् for (कतरं)

१५. (घ) १. षोडशगियियोजनपरिधि (ग) षोडासगियियोजनपरिधि for (षोडशगियिवियोजन परिधि)
२. षडि भूव्यासं (ग) निभूव्यासं for (षडम्दव्यासं)
३. पुनर्जिलावदता (ग) पुना लावदता for (पुनर्लाविदता)
४. आत्माज्ञानं (ग) (च) for (आत्मज्ञानं)

(च) २. षड्भिभूव्यासं for (षडम्दव्यासं)
३. पुनर्किलावदता for (पुनर्लाविदता)
४. यहाँ क्रमसंख्या लुप्त है ।

१६. (घ) १. भूव्यासस्या (ग) (च) for (भुव्यासस्य)
२. ज्ञानाद्व्यर्थं (ग) (च) for (ज्ञानाध्व्यर्थं)
३. तदज्ञानात् (ग) for (दज्ञानात्)
४. ज्ञानम् (ग) for (ज्ञान)
५. नाशाद्ग्रणयोर्नाशः (ग) for (नाशाद्ग्रहणयो नाशः)

(च) ५. नाशाद्ग्रणयोर्नाशः for (नाशाद्ग्रहणयो नाशः)

प्राणेनैतिकलाभूर्यदि तत्ककुतो व्रजेत्किमध्यानम् ।
आर्वतनमुर्व्याश्चेत्त पतंति समुच्छ्रयः कस्मात् ॥ १७ ॥
उदयिके यः परिधिर्विषमोन्योन्य समेन्यभुजस्य गुणः ।
तदसद्विषमांतफलं यतोन्ययुग्मादि फल तुल्यम् ॥ १८ ॥
विषमोन्योन्ये युग्मे परिधिर्गुणकः क्रमोक्रमाद्यानाम् ।
चक्रार्द्धे फलनाशो न भवति यस्मादसत्तदपि ॥ १९ ॥
व्यासार्द्धहतो बाहुः परिधिविशेषाहतः फलोनयुतः ।
प्रथमोधिकोनकोय तदसत्पदयोः परिधिपाठात् ॥ २० ॥

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१७. (घ) १. कलां (ग) (च) for (कला)
२. तत्कत्कुतो (ग) तत्क्व कुतो (तत्ककुतो)
३. चेन्न for (चेत्त)
४. समुछ्रयः (ग) समुच्छ्रयाः for (समुच्छ्रयः)
(ग) ५. भूयदि for (भूर्यदि)
६. आवर्तनमुर्व्याश्चेन्न (च) for (आर्वतनमुर्व्याश्चेत्त)
(च) ४. समुच्छ्रयः for (समुच्छ्रयः) २. तत्क्वकुतो for (तत्ककुतो)

१८. (घ) १. औदयिके (ग) (च) for (उदयिके)
२. द्विषमेन्योन्य (ग) विषमेन्योन्यः for (विषमोन्योन्य)
३. समे भुजस्य गुणः (ग) समे भुजस्य गुणाः for (स मेन्यभुजस्य गुणः)
४. यग्मादि for (युग्मादि)
(ग) ५. यतोन for (यतोन्य)
(च) २. र्वविषमे for (विषमो) ३. समे भुजस्य for (समेन्यभुजस्य)

१९. (घ) १. विषमे (ग) (च) for (विषमो) २. न्यो (ग) for (न्योन्ये)
३. क्रमोत्क्रमज्यानाम् (ग) for (क्रमोक्रमाद्यानाम्)
(च) १. विषमेन्योन्योयुग्मे for (विषमोन्यान्ये युग्मे)
३. क्रमोत्क्रमाद्यानां for (क्रमोक्रमाद्यानां)

२०. (घ) १. कोयत्तदसत् for (कोयतदसत्) (ग) २. हृतौ for (हतो)
(च) २. हृतो for (हतो) १. यत्तदसत्पदयोः for (यतदसत्पदयोः)

विषमसमयोर्यदि द्वौ परिधि[1] किं सूर्य चन्द्रयोर्नोक्तौ[2] ।
घटते न कथंचिदियं स्फुटक्रियोदयिकतन्त्रोक्ता ॥ २१ ॥
उत्तरगोले[2] ग्रायां विषुवद्यातो[3] यदुक्तमुनायाम्[1] ।
सममंडलगस्तदसत् क्रान्तिज्यायां यतो भवति ॥ २२ ॥
व्यासार्द्धे[3]न भविभक्ता दग्गति[2]जीवा चतुर्गुणा[4] लब्धम् ।
लंबननाड्यः[1] पंचदशगुणितया त्रिज्यया भक्ताः[5] ॥ २३ ॥
दृक्षेपज्या भुक्ति[2]तराहता[1] लब्धमवनतिर्भवति ।
स्फुटयोजनकर्णाभ्यां भूव्यासार्द्धे[3]न च विना स्पष्टे ॥ २४ ॥
आर्यभटेनास्मि[1] मतिलघुनि[4] किमर्थं महत्कृतं कर्म[2] ।
गणिताज्ञानाजाड्यं[5][3] विजानयता[6] यदि ततः सुतराम् ॥ २५ ॥

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२१. (घ) १. परिधी (ग) (च) for (परिधि)
२. योर्नोक्तौ (ग) योनोक्तौ for (योर्नोक्तौ)
२२. (घ) १. मूनायाम् (ग) (च) for (मुनायाम्)
(ग) २. गोगे for (गोले)
३. ज्यातो for (द्यातो)
२३. (घ) १. ताड्यः for (नाड्यः) २. दृग्गति (ग) दगाति for (दग्गति)
(ग) ३. 'भ' लुप्त है ।
४. चतुगुणा for (चतुर्गुणा)
५. भक्ता for (भक्ताः)
(च) २. दृग्गति for (दग्गति)
२४. (घ) १. तराद्धिता for (तराहता)
(ग) २. भुक्त्यंतरा for (भुक्तितरा)
३. भूव्यासे for (भूव्यासार्द्धेन)
(च) १. हृता for (हता)
२५. (घ) १. आर्यभटेनास्मिं सति (ग) आर्यभटेनास्मि न सति for (आर्यभटेनास्मिमति)
२. कर्मः for (कर्म)
३. ज्जाड्यं for (जाड्यं)
(ग) ४. लघुति for (लघुनि)
५. ज्ञातानाज्जाड्यं for (ज्ञानाजाड्यं)
६. विजानता for (विजानयता)
(च) २. कर्म्म for (कर्म)

लंबनमृणधनमुक्तं पूर्वापरयोस्तिथौ दिनार्द्धस्य ।
युक्तो भावो यद्भवति तद्दृणधनयोस्थिोकधरम् ॥ २६ ॥
दृग्क्षेपज्या बाहु दृग्ज्याकर्णोनयोः क्तितिशेषात् ।
मूलंदृग्गतिजीवा संस्थानमयुक्तमेतदपि ॥ २७ ॥
लंबनघटिका लिप्ता दृशज्ययार्कंदुदृग्गतिकलानाम् ।
यस्मान्न समस्तस्मात् दृशज्यया लंबनं स्थूलम् ॥ २८ ॥
वित्रिभलग्ने दृक्षेपमंडलयुतो ज्या मध्या ।
मध्यादृक्षेपज्यानार्यभटोक्तनया तुल्या ॥ २९ ॥

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२६. (घ) १. स्थितौ (ग) for (स्तिथौ)
२. कतरत् (ग) for (कधरम्)
(ग) ३. पूर्वापरास्थितौ for (पूर्वापरयोस्तिथौ)
(च) १. स्तिथोकतरत् for (स्थिोकधरम्)

२७. (घ) १. दृक्षेपज्या (ग) क्षेपज्या for (दृग्क्षेपज्या)
२. कृतिविशेषात् for (क्तितिशेषात्)
(ग) ३. दृंगत्या for (दृग्ज्या)
२. कृतिविशेषात् (च) for (क्तितिशेषात्)
(च) १. दृक्षेपज्या for (दृग्क्षेपज्या) ५. दृंग्ज्या for (दृग्ज्या)

२८. (घ) १. दश (ग) द्रश for (दृश)
२. समा (च) for (सम)
(ग) ३. यस्मा समास्तस्मा for (यस्मान्न)
(च) १. दशज्ययार्कंदु for (दृशज्ययार्कंदु)
४. द्रग्गति for (दृग्गति) ५. दशज्यया for (दृशज्यया)

२९. (घ) १. मंडलं तदप (ग) मंडलं तप तदप for (मंडल युतो)
२. युतौ (ग) for (युतो)
३. (लुप्त)
४. भटोक्तातया (ग) for (भटोक्तनया)
(च) ३. "मध्या" लुप्त ५. दृक्येपज्या for (दृक्षेपज्या)
४. भटोक्ता तया for (भटोक्तनया)

दृक्षेपज्यातो सत्तन्नाशादवनते भवति[४] ।
नाशः[१] [५]अवनतिनाशाभ्रामस्यो[२] नाधिकवार[३] विगृहणे ॥ ३० ॥
पंचज्यया यतोर्क[३]गृहणं श्रीषेणविष्णु[१]चन्द्रकृतम् ।
आर्यभटोक्तान्यनयोरर्क[४] गृह दुषणानि[२] ततः ॥ ३१ ॥
एवं विचार्यमाणं पंचज्यालम्बनं महास्थुलम्[१] ।
स्थुलावनतिश्च[२] तथा दृशज्यया[४] लंबनावनति[३] ॥ ३२ ॥
नाडीचुतुष्टु[१]विधिना सर्वत्रसमो यतस्तत स्थुलः[२] ।
मानार्थ[३]कर्ममहत्कृत्[४] मार्यभटेन लघुनि सति ॥ ३३ ॥

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३०. (घ) १. पहली पंक्ति का अंतिम शब्द 'नाशः' ।
२. नाशादग्रासस्यो for (नाशाभ्रामस्यो)
३. नाधिकता रवि for (नाधिकवारवि)
(ग) ४. भवति नाशः for (भवति)
५. दूसरी पंक्ति का आरम्भ 'अवनतिनाशादग्रासस्यो ना'
(च) २. नाशादग्रासस्यो for (नाशाभ्रामस्यो)

३१. (घ) १. विष्णु चं कृतं for (विष्णुचन्द्रकृतम्)
२. दूषणानि (ग) for (दुषणानि)
(च) ३. यतोर्क्क for (यतोर्क) १. चन्द्रकृतं for (चन्द्रकृतम्)
४. रर्क्क for (रर्क)

३२. (घ) १. स्थूलं (ग) माहास्थूलं for (महास्थुलम्)
२. स्थूलाऽवनतिश्च (ग) for (स्थुलावनतिश्च)
३. वनती (ग) चनती for (वनति)
(च) १. महास्थूलं for (महास्थुलम्)
२. स्थूलावनतिश्च for (स्थुलावनतिश्च)
४. दशज्यया for (दृशज्यया)
३. लंबनावनती for (लंबनावनति)

३३. (घ) १. चतुष्क (ग) (च) for (चुतुष्टु)
२. स्थूलः (ग) (च) for (स्थुलः)
३. मानार्थं (ग) (च) for (मानार्थ)
४. महत्कृत (ग) (च) for (महत्कृत्)

विक्षेपगुणा[1]क्षज्या[4] लंबकभक्ता ग्रहे[2] मृणधनं यत् ।
उत्क्रमुदयास्तसमयो[3]न्नं[5] प्रतिघटिकं ततस्तदसत् ॥ ३४ ॥
त्रिज्या कृत्या[6] भक्ता विक्षेपापक्रमगुणो[4] क्र[7]मज्येंदोः ।
अयनांतेमृ[1]णधनं न तदयनादौ[5] ततौ[2] सा[3] तत् ॥ ३५ ॥
दक्कर्ण[1] विज्ञानात्[2] कालाविज्ञानमकथितत्वाच्च ।
कालज्ञानाच्छंकोरज्ञानं कोटिनाशोतः ॥ ३६ ॥
शशिशंकोः शच्य[1]पराकोटि[2]भुजवर्ग[4]युतिमूलम् ।
तिर्यक्कर्णो न भवति यतो[3] चन्द्रांतरं कर्णः ॥ ३७ ॥

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३४. (घ) १. गुण for (गुणा)
२. गृहे (ग) ग्रहेष्वृण for (ग्रहे)
३. मययो (ग) for (समयो)
(ग) ४. थ्या for (ज्या)
५. नंम्रतिघटिकं for (न्नंप्रतिघटिकं)
(च) १. गुणाक्ष्यज्या for (गुणाक्षज्या) २. गृहे for (ग्रहे)

३५. (घ) १. यद्दण (ग) (च) for (मृण)
२. ततो (ग) for (ततौ)
३. सत्तत् (च) for (सातत्)
(ग) ४. विक्षेपायनगुणोत् for (विक्षेपापक्रमगुणो)
५. तत्तस्यादौ for (नतदयनादौ)
(च) ६. क्रत्या for (कृत्या) ७. गुणोत्क्रम for (गुणोक्रम)

३६. (घ) १. दक्कर्मा (ग) (च) for (दक्कर्ण)
२. विज्ञातात् for (विज्ञानात्)

३७. (घ) १. प्राच्य (ग) (च) for (शच्य)
२. कोटिकोठि (ग) कोटिः कोटि for (कोटि)
३. यंतोर्कचंद्रांतरं (ग) for (यतोचंद्रांतरं)
(ग) ४. वर्ग्र for (वर्ग)
(च) ३. यंतो for (यतो)

कोटिश्रवण[3]ज्ञानात्[1] शशिना श्रृङ्गोन्नतिर्विसंवदति[4] ।
उदयास्तमयो दिनकृतः[5] प्रतिघटिकं माती[2] च वाज्ञानात् ॥ ३८ ॥
अर्केद्वतरघटिका[1] व्यस्तज्या चन्द्रमानगुणिता[3] यत् ।
व्यास विभक्ता शुद्धं[4] यतो न द्रक्[2] सममसत्तस्मात् ॥ ३९ ॥
प्राक् गुदितोभ्यधिकः[1] पश्चादुदिनकोयरेव्यस्तः[2] ।
कालो यः[3] छायार्थं तदसत्स्फुटभुक्तिमान्[4] प्राक् ॥ ४० ॥
उदितामुदिता[1]स्तमितावशेषकालान्न[2] वेत्ति यः स कथम् ।
आर्यभटज्ञः शशिनः[3] छाया श्रृङ्गोन्नति[4] वेंति[5] ॥ ४१ ॥

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३८. (घ) १. ज्ञाना छशिन for (ज्ञानात् शशिना) (ग) छशिनः for (शशिना)
२. प्रतिघटिकमतीव वा ज्ञानात् (ग) प्रतिघटिकमतीव चाज्ञानात् for (प्रतिघटिकं माती च वा ज्ञानात्)
(ग) ३. श्रवणा for (श्रवण)
४. विसंवदतिः for (विसंवदति)
५. दिनकृतः for (दिनकृतः)
(च) १. ज्ञाना छशिना for (ज्ञानात् शशिना)
२. प्रतिघटिकमती च for (प्रतिघटिकं माती च)

३९. (घ) १. अर्क्केद्वंतर (ग) (च) for (अर्केद्वतर)
२. द्दक्सम (ग) (च) for (द्रक्सम)
(ग) ३. गुणिना for (गुणिता)
४. शुक्लं (च) for (शुद्धं)

४०. (घ) १. प्राक्च्गुदितोऽभ्यधिकः (ग) प्राक् प्रागुदितोभ्यधिकः for (प्राक् गुदितोभ्यधिकः)
२. दुदितो न कोपरे व्यस्तः (ग) (च) for (दुदिनकोयरे व्यस्तः)
३. कालो छायार्थं (ग) कालौ य स्थार्यर्थं for (कालो यः छायार्थं)
४. भुक्तिमानात् प्राक् (ग) भुक्तिगमना प्राक् for (भुक्तिमान् प्राक्)
(च) १. प्राक्चगुदितोऽभ्यधिकः for (प्राक् गुदितोभ्यधिकः)

४१. (घ) १. नुदिता (ग) (च) for (मुदिता)
२. कालान for (कालान्न)
३. शशिन (ग) शशिनस्छाया for (शशिनः छाया)
४. श्रृंगोन्नती (ग) (च) for (श्रृङ्गोन्नति)
५. वेत्ति (ग) (च) for (वेंति)
(ग) ३. शशिन for (शशिनः)

स्वयमेव नामय कृतमार्यभटेन[1] स्फुटं स्वगणितस्य ।
सिद्धांतदस्फुटत्वं[2] ग्रहणार्दानां[3] विसंवदति[4] ।। ४२ ।।
जानात्येकमपि[1] यतो नार्यभटो[4]गणितकाल[5]गोलानाम् ।
न मया प्रोक्तोनि[2] ततः पृथक् पृथक् दुषणात्येषाम्[3] ।। ४३ ।।
आर्यभटदुषणानां[1] संख्या वक्तुं न शक्यते यस्मात् ।
तस्मा दयमुद्देश्यो[2] बुद्धिमतान्यानि योज्यानि ।। ४४ ।।
कालांतरेण[3] दोषा येन्यैः प्रोक्ता न ते मयाभिहिताः ।
किं ते दूष्येष्वथ[1] दूषकेषु[4] कोशोऽत्र पेयः स्थात्[2] ।। ४५ ।।
श्रीषेणविष्णुचन्द्रप्रद्युम्नार्यभटलाटसिंहानाम् ।
ग्रहणादिविसंवादात् प्रतिदिवसं सिद्धमकृत्वम्[1] ।। ४६ ।।

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४२. (घ) १. यत्कृत (ग) (च) for (यकृत)
२. सिद्धं (ग) (च) for (सिद्धांत)
३. ग्रहणादीनां (च) for (ग्रहणार्दानां)
४. विसंवादात् (च) for (विसंवदति)

४३. (घ) १. जातात्येकमपि (च) for (जानात्येकमपि)
२. प्रोक्तानि (ग) for (प्रोक्तोनि)
३. पृथग्दूषणान्येषाम् (ग) पृथग्दूषणान्येषाम् for (पृथक्दुषणात्येषाम्)
(ग) ४. तार्य for (नार्य)
५. काकाल for (काल)
(च) ३. पृथग्दूषणान्येषां for (पृथक्दुषणात्येषाम्)

४४. (घ) १. दूषणानां (ग) पूषणानां for (दुषणानां)
२. मुद्देशो (ग) (च) for (मुद्देश्यो)
(च) १. दूषणानां for (दुषणानां)

४५. (घ) १. दूष्येद्यथ (ग) दूष्येप्यथ for (दूष्येष्वथ)
२. स्यात् (च) for (स्थात्)
(ग) ३. कालानांतरेण for (कालांतरेण)
४. दूबकेषु for (दूषकेषु)
(च) १. दूष्येष्वथ for (दृष्येष्वथ)

४६. (ग) १. सिद्धमत्कृत्वम् for (सिद्धमकृत्वम्)
(च) १. मकृत्वं for (मकृत्वम्)

युक्तयार्यभटोक्तानि प्रत्येकं दुषणानि[1] योज्यानि ।
श्रीषेण प्रभृतीनां कानिचिदन्यानि[2] वक्ष्यामि ॥ ४७ ॥
लाटात्[3]सूर्यशशांकौ मध्याविंदुच्च[1] चंद्रपातौ च ।
कुजबुधशीघ्रबृहस्पतिसितशीघ्रशनैश्चरान्मध्या[2] ॥ ४८ ॥
युगयात[1]वर्षभगणान् वाशिष्ठान्[4] विजयनंदिकृत[2]पादान्[5] ।
मंदोच्चपरिधिपात[3]स्पष्टीकरणाद्यमार्यभटात् ॥ ४९ ॥
श्रीषेण[1] ग्रहित्वा चन्द्र[4]रत्नोच्चयरोमकः कृतः[5] ।
कथा[2] एतान्येव गृहीत्वा[5] वसिष्ठो[3] विष्णुचन्द्रेण ॥ ५० ॥
अनयोर्न कदाचिदपि ग्रहणादिषु भवति दृष्टिगणितैक्यम् ।
यद् भवति तद्यु[1]गुणाक्षरमतो स्फुटाभ्यां किमेताभ्याम् ॥ ५१ ॥

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४७. (घ) १. दूषणानि (ग) (च) for (दुषणानि)
२. कानिचदन्यानि for (कानिचिदन्यानि)

४८. (घ) १. बिंदूच्च (ग) (च) for (विन्दुच्च)
२. मघ्यात् (ग) for (मध्या)
(च) ३. लाटा for (लाटात्)

४९. (घ) १. यान for (यात) २. कृत (ग) कृतम् for (कृत)
३. मंदोच्चपरिपात (ग) मंदोच्चपरिधिपातः for (मंदोच्चपरिधिपात)
(ग) ४. वाशिष्टाद्विजयनंदि for (वाशिष्टान् विजयनंदि)
५. पादम् for (पादान्)
(च) १. युगपात for (युगयात)

५०. (घ) १. श्रीषोणन गृहीत्वा (ग) श्रीषेणगृहीत्वा for (श्रीषेण ग्रहित्वा)
२. कंथा (पहली पंक्ति के अन्त में) for (कथा)
३. वासिष्टो (ग) (च) for (वसिष्टो)
(ग) ४. 'चन्द्र' यहां अंकित नहीं ५. ग्रहीत्वा for (गृहीत्वा)
(च) १. श्रीषेणेन गृहीत्वा for (श्रीषेण ग्रहित्वा)
५. क्रतः for (कृतः)
५१. (घ) १. तद्घुणाक्षर (ग) तत् ध्रुगणाक्षर for (तद्युगुणाक्षर)
(च) १. तद्युगणाक्षर for (तद्युगुणाक्षर)

नाचोच्चवृत्तमध्यस्य गोलबाहुचेन नामकृतमुच्चम् ।
तस्थो न भवत्युच्चो यतस्ततो वेत्ति नोच्चमपि ॥ ५२ ॥
अन्या विक्षेपकला मंदान्यत्वात्फलाधिकाः स्पष्टाः ।
यस्मान्माहायुगादौ न राहुमंदाः स्फुटात्तस्मात् ॥ ५३ ॥
परमालाब्दमिथुनांते द्युरात्रि नाड्योर्कगतिवशाहृतवः ।
नायनयुगमयनवशात् स्थिरमयी तद्वितयमपि तस्मात् ॥ ५४ ॥
तद्युगवधो महायुगमुक्तं श्रीषेणविष्णुचन्द्राद्यैः ।
तत्स्थुलं दृग्लिप्ता माहायुगादौ ग्रहेषु यतः ॥ ५५ ॥
कदिनादौ स्मृतियुक्तं ग्रहभोत्पतिर्दिनक्षये प्रलयः ।
तान्यपि बहुनि यस्मान्महायुगेऽतो प्रसिद्धमिदम् ॥ ५६ ॥

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५२. (घ) १. नीचोच्च (ग) नीचोच्चावृत्त for (नाचोच्चवृत्त)
२. तास्था for (तस्थो)
(च) १. नीचोच्च for (नाचोच्च)

५३. (घ) १. फलाधिका (च) for (फलाधिकाः)
२. महा (ग) (च) for (माहा)
३. स्फुटाः तस्मात् (ग) स्फुटास्तस्मात् for (स्फुटात्तस्मात्)
(च) ३. स्फुटाः तस्मात् for (स्फुटात्तस्मात्)

५४. (घ) १. परमाल्पा (ग) परिमाल्पा for (परमालाब्द)
२. स्थिरमय (ग) for (स्थिरमयी)
(ग) ३. न द्वितयमपि for (तद्वितयमपि)
(च) १. परमाल्पाब्द for (परमालाब्द) २. स्थिरमपि for (स्थिरमयी)

५५. (घ) १. स्थूलं (ग) for (स्थुलं) २. महा for (माहा)
(ग) ३. मयाहायुग for (महायुग)
(च) ३. तत्स्थूलं for (तत्स्थुलं) २. महायुगादौ for (माहायुगादौ)

५६. (घ) १. स्मृतिषुक्तं (ग) स्मृतिषूक्तं for (स्मृतियुक्तं)
२. बहूनि (ग) for (बहुनि)
(ग) ३. पत्तिर्दिनेक्षये for (पतिर्दिनक्षये) ४. युगेतो for (युगेऽतो)
(च) १. स्मृतिषुक्तं for (स्मृतियुक्तं)
३. ग्रहभोत्पत्तिर्दिनक्षये for (ग्रहभोत्पतिर्दिनक्षये)

प्रतिदिवस विसंवादात्[1] गृहतिथिकरणर्क्ष दिवसमानानाम् ।
ग्रहणग्रहयोगादिषु पादं पादेन कः स्पृशति ॥ ५७ ॥
अंगचितिविजयनंदिप्रद्युम्नादीनि पादकरणानि ।
यस्मात्तस्मात्तेषां दूषणान्यत्र लिखितानि ॥ ५८ ॥
इत्ति बहुधा विवदंति गृर्हथिनः[1] सद्गृहा[2] इव प्रसभम् ।
ब्राह्मे स्फुटसिद्धान्ते रवींदु भूयोगमज्ञात्वा[3] ॥ ५९ ॥
तंत्रभ्रंशं प्रतिदिनमेवं विज्ञाय[1] धिमता[2] यत्नः[3] ।
कार्यस्तस्मै[4] दृग्गणितैक्यं[5] सदा भवति ॥ ६० ॥
चन्द्ररविगृहणेंदु छायादिषु सर्वदा यतो ब्राह्मे ।
दृग्गणितैक्यंभवति स्फुटसिद्धान्तस्ततो ब्राह्मः ॥ ६१ ॥
योयज्जनात्तेषां[1] स वेत्ति तद्दुषणानि[2] कथितानि ।
आर्यभटाद्युक्तानां तन्त्राणां दुषणाध्याये[3] ॥ ६२ ॥

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५७. (घ) १. विसंवादाद्ग्रह for (विसंवादात्ग्रह) (च) विसंवादाद्ग्रह for (विसंवादात्ग्रह)

५८. (घ) १. अंकचिति (ग) अंकयिति for (अंगचिति)
(ग) २. 'न' यहां अतिरिक्त है ।
(च) १. अंकचिति for (अंगचिति) २. +न+

५९. (घ) १. ग्रहार्चिनः (ग) ग्रहार्थिनः for (ग्रर्हथिनः)
(ग) २. सग्रहा for (सद्ग्रहा) ३. मत्कृत्वा for (मज्ञात्वा)

६०. (घ) १. विज्ञाया (च) for (विज्ञाय) २. धीमता (ग) (च) for (धिमता)
३. यत्ना (ग) यत्तः for (यत्नः) ४. तस्मि (ग) तस्मिन्यस्मिन् for (तस्मै)
५. दृग्गणितै किं for (दृग्गणितैक्यं)
(च) ४. कार्यस्तस्मि for (कार्यस्तस्मै)

६२. (घ) १. यं जानात्तेषां (ग) यं जानात्येषां for (यज्जनात्तेषां)
२. दूषणानि (ग) for (दुषणानि)
३. दूषणाध्याये ग) (च) for (दुषणाध्याये)
(च) १. यो यजनात्तेषां for (यो यज्जनातेषां)
२. तद्दूषणानि for (तद्दुषणानि)

इत्ति[४] कथिततन्त्राणाका[१]न्पठ[२]तिरपि दूषणैः करोत्यज्ञानात्[५] ।
तन्त्र परीक्षार्यणां[३] त्रिषष्टिरेकादशोध्यायः ॥ ६३ ॥
इति श्री[६] ब्रह्मगुप्तसिद्धान्ते एकादशोऽध्यायः ।

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६३. (घ) १, २. तन्त्रगणकान्यदितै (ग) तन्त्रगणकान् पठितैरपि for (तन्त्राणाका-न्पठतिरपि)

३. परीक्षार्याणाम् (ग) for (परीक्षार्यणां)

(ग) ४. इति for (इत्ति) ५. करोत्यज्ञान् for (करोत्यज्ञानात्)
समाप्तिसूचक चिह्न छः छः छः

(च) १. तन्त्रगणकान्यदितैरपि for (तन्त्राणाकान्यठतिरपि)
५. करोत्यज्ञान् for (करोत्यज्ञानात्)
२. परिक्षार्याणां for (परीक्षार्यणां) ६. 'इति' से 'अध्यायः' तक सब लुप्त ।

अथ गणिताध्यायः

द्वादशः

परिकर्म[6] विंशति[1] यः संक(व)लिताद्यं[2] पृथक्[3] विजानाति ।
अष्टौ च व्यवहारान्[4] छायातान्[5] भवति गणकः सः ।। १ ।।
विपरीत छेदगुणाः[2] राश्योः[3] छेदांशकाः समछेदाः ।
संकलितेशा[1] योज्या व्यवकलितेंशांतरं कार्यम् ।। २ ।।
रूपाणि छेदगुणान्यंशयुतानि द्वयोर्बहुनां[1] वा ।
प्रत्युत्पन्नो[3] भवति छेदवधेनोधृतांशवधः[2] ।। ३ ।।
प्रत्युत्पन्नः परिवर्त्य[5] भागहारछेदांशौ[7] छेदसंगुणछेदः[1] ।
अंशांशगुणो भाज्यस्य[2] भागहारः[6] सवर्णितयोः[3] मागहारः[4] ।। ४ ।।

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१. (घ) १. विंशंति (ग) for (विंशति) २. संकलिताद्यां (ग) (च) for (संकलिताद्यं)
३. पृथग्विजानाति (ग) (च) for (पृथक् विजानाति)
४. व्यवहां (ग) व्यवहारांस् for (व्यवहारान्)
५. छायांतान् (ग) (च) for (छायातान्)
(ग) ६. परिकर्म्म for (परिकर्म)

२. (घ) १. संकलितेंऽशा (ग) (च) संकलितेंशा for (संकलितेशा)
(ग) २. गुणा for (गुणाः) ३. राश्योश्छेदांशकाः for (राश्योः छेदांशकाः)

३. (घ) १. बहूनां (ग) for (बंहुनां)
२. वधेनोद्धृतांशवधः (ग) बधेनोद्धृतोंशवधः for (वधेनोधृतांशवधः)
(च) १. बंहूनां for (बंहुनां) ३. प्रत्युत्पत्पन्नो for (प्रत्युत्पन्नो)
२. वधेनोद्धृतांशवधः for (वधेनोधृतांशवधः)

४. (घ) १. शंगुण for (संगुण) २. भाद्यस्य (च) for (भाज्यस्य)
३. सवर्णवयोः (ग) सवर्णितयोः for (सवर्णितयोः)
वि० यहाँ श्लोक समाप्त ।
४. भागहारः (च) for (मागहारः)
(ग) ५. परिवृत्य (इसी पद से श्लोकारंभ होता है)
६. भाहारः for (भागहारः)
वि०-इस श्लोक में "प्रत्युत्पन्नः"...... और "भागहारः" पद अंकित नहीं है ।
(च) ७. छेदंशौ for (छेदांशौ)

सवर्णितांशवर्गच्छेदकृति विभाजितो भवति वर्गः[2] ।
सवर्णितांशमूलं छेदपदेनोधृते[1] मूलम् ।। ५ ।।
वर्ग[1]मूलो स्थाप्यों[2]त्पद्यनोन्य[3]कृतिस्त्रिगुणोत्तरसंगुणा[8] च यत्प्रथमा[4] ।
नोत्तरकृतिं[5] रंत्यगुणा[6] त्रिगुणा[6] चोत्तर घनश्च घनः ।। ६ ।। घनः समाप्तः[7]
छेदो[4]घना द्वितीयात्[1] घनमूलकृतिस्त्रिसंगुणा[2] सकृतिः ।
शोध्या त्रिपूर्वगुणिता प्रथमात् घनतो[5] घनो मूलं ।। ७ ।। घनमूलं समाप्तः[3]
घनमूलं[6] समाप्तः

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५. (घ) १. पदेनोद्धृतं (ग) (च) for (पदेनोधृते)
(ग) २. वर्ग्रः for (वर्गः)

६. (घ) १. वर्ग्र ('वर्ग्रमूलो' यह शब्द पांचवें श्लोक का अंतिम पद है)
२. स्थाप्योंत्यघनो (ग) स्थाप्योंत्यघनोत्यकृति for (स्थाप्योंत्पद्यनो)
३. न्यत्कृति for (न्यकृति) ४. तत् (ग) तत्प्रथमान् for (यत्प्रथमा)
५. उत्तरकृति (ग) उत्तरकृतिरंत्यगुणा for (उत्तरकृतिं)
६. त्रिणा (ग) त्रिगुणाच्चोत्तर for (त्रिगुणा)
७. समाप्तः for (घनः समाप्तः)
(ग) १. यह पद यहाँ लुप्त है । ८. संगुणो for (संगुणा)
(च) २. स्थाप्योंत्यघनोन्यकृति for (स्थाप्योंत्पद्यनोन्यकृति)
५. उत्तरकृतिं for (नोत्तरकृतिं) ६. रत्यगुणा for (रंत्यगुणा)
७. समाप्तः for (घनः समाप्तः)

७. (घ) १. द्वितीयाद्धनमूल (ग) द्द्वितीयाद्धनमूल for (द्वितीयात् घनमूल)
२. संगुणाप्तकृतिः (ग) for (संगुणासकृतिः)
३. समाप्तम् for (समाप्तः)
(ग) ४. छेदाघना for (छेदोघना)
५. प्रथमाद्धनोमूलं for (प्रथमात् घनतो घनमूलं)
वि०-'घनमूलं······समाप्तः" शब्द अंकित नहीं है ।
(च) १. द्वितियाद्वघनमूलकृति for (द्वितीयात् घनमूलकृति)
२. संगुणाप्तकृतिः for (संगुणा सकृतिः)
५. प्रथमाद्धनतो for (प्रथमात् घनतो)
३. घनमूलं समाप्तं for (घनमूलं समाप्तः)
६. 'घन' से 'समाप्तः' तक लुप्त

सदृश[2]छेदांशयुति[3]छेदविभक्ताफलं प्रथमजातौ ।
अंशै[1]रेशागुणिता छेदै[4] छेदा द्वितीयाभ्याम् ।।८।। प्रथमद्वितीयजाति समाप्त:[5]
ऊर्द्धांशा[3] छेदगुणास्तृतीयजातौ द्वयोः पृथक् परयोः ।
छेदै[4] छेदा गुणिताः स्वांशयु[5]तोनै[1]रूपरिमांशाः ।। ९ ।।
तृतीय चतुर्थीजाति स[2]० ।

त्रैराशिके प्रमाणफलमिच्छाद्य तयोः सदृशराशि[1]ः ।
इच्छाफलेन गुणिता प्रमाण[2]भक्ताफलंभवति ।। १० ।। त्रैराशिकं स[3]०
व्यस्तत्रैराशिकफला[1]मिच्छाभक्तः प्रमाणफलघातः । व्यस्तत्रैराशिकं स[3]०
त्रैराशिकादिषु फलं विषमेष्वेकादशां[2]तेष ।। ११ ।।

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८. (घ) १. रंशा (ग) for (रेशा)
(ग) २. सद्रिश for (सदृश) ३. युतिश्छेद for (युतिछेद)
४. छेदैश्छेदा for (छेदैछेदा)
५. "प्रथम······समाप्तः" शब्द अंकित नहीं है ।
(च) १. अंशैरंशा for (अंशैरेशा)

९. (घ) १. रुपरिमांशाः (च) for (रूपरिमांशाः) २. समाप्तेः for (स०)
(ग) ३. ऊर्ध्वांशाश्छेद for (उर्द्धांशाछेद) ४. छेदैश्छेदा for (छेदैछेदा)
५. युरेता for (युतो)
वि० "तृतीय···से जाति स०" तक अंकित नहीं है ।
(च) २. जाती समाप्ते for (जाति स०)

१०. (घ) १. राशी (ग) (च) for (राशिः) २. प्रमाणक्ता for (प्रमाणभक्ता)
३. समाप्तम् for (स०)
(ग) "त्रैराशिकं समाप्तं" शब्द अंकित नहीं है ।
(च) समाप्तं for (स०)

११. (घ) १. फलमिच्छा (ग) for (फलामिच्छाभक्तः)
२. दश्यंतेषु for (दशांतेषु) ३. समाप्तम् for (स०)
(ग) ३. 'व्यस्त' से 'स०' तक यहां अंकित नहीं है ।
(च) २. दृश्यंतेषु for (दशांतेषु)

फलं[1] संक्रमणमुभयतो[2] बहुराशिवधे तुलवधहृतो[3] ज्ञेयः ।
सकलेष्वेवं भिन्नेषु[4] भयतच्छेदसंक्रमणं ॥ १२ ॥
पंचसप्तनवैकादशराशि[5] समातानि ।
प्राग् मूल्यव्यत्यासो भांडप्रतिभांडिके[1]त्यदुक्तः[2] ।
सम[3]परिकर्मान्यष्टानां[4] व्यवहाराणामभिहितानि ॥ १३ ॥
कालगुणितं प्रमाणं फलभक्तं व्येकगुणहृतं[1] कालः ।
स्वफलयुतरूपभक्तं मूलफलैक्यं भवति मूलम् ॥ १४ ॥
कालप्रमाणघातः परकालहृतो द्विधाद्यमिश्रवधात् ।
अन्यार्द्धकृति[2]युतात्पदमन्यार्द्धोन[3] प्रमाणफलम् ॥ १५ ॥

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१२. (घ) १. फल for (फलं) २. मुयतो for (मुभयतो)
३. वधेऽल्पवध (ग) वधाऽल्पवधहृतो (कृतो) for (वधेतुलवधहृतो)
४. भन्नेषू (ग) भिग्नेषूभयतश्छेद for (भिन्नेषुभयतच्छेद)
५. राशिकानि for (राशि) (च)

(ग) ५. 'पंच' से 'समाप्तानि' तक पद यहां अंकित नहीं है ।

(च) १. फल संक्रमण for (फलं संक्रमण)
३. तुल्यवधहृतो for (तुलवधहृतो)

१३. (घ) १. भ्यंडप्रतिभ्यंडिके for (भांडप्रतिभांडिके)
२. इत्युदुक्त (अ) न्यदुक्तसमम् for (त्यदुक्तः)
३. सम्रं (अ) for (सम)
४. अरिकर्माण्यष्टानां (ग) परिकर्माण्यष्टनां for (परिकर्मान्यष्टानां)

(ग) ४. परिकर्माण्यष्टानां for (परिकर्मान्यष्टानां)

१४. (अ) १. हृतं (च) for (हतं)

१५. (ग) १. मन्यार्द्धोनम् for (मन्यार्द्धोन)

(च) २. कृति for (कृति) ३. पदमन्याः र्द्धोन for (पदमन्यार्द्धोन)

प्रश्नेपयोगहृतया[1] लब्धा[2] प्रश्नेपका[3] गुणा लाभाः ।
ऊनाधिकोत्तरार्द्ध[4]स्तद्युतोनया स्वफलमूनं[5] युतम् ॥ १६ ॥
मिश्रक व्यवहार[6] समाप्तः

पदमेकहीनमुत्तरगुणितं संयुक्तमादिनांत्यधनम् ।
आदि युतान्त्यधनार्द्धमध्यधनं पदगणं[1] गुणितम्[2] ॥ १७ ॥
उत्तरहीना[1]द्विगुणादिशेशवर्गं[2] धनोत्तराष्टवधे ।
प्रश्निप्य[3] पदं शेषोनं द्विगुणोत्तर[5] हूतं[4] गछः ॥ १८ ॥
एकोत्तरमेकाद्यं[4] यदीष्ट[1]गच्छस्य[2] भवति संकलितम् ।
तद् वियुत्[5] गच्छ गुणितं तृ हूतं[3] संकलितम्[6] ॥ १९ ॥

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१६. (घ) १. प्रक्षेपयोगहृतया (ग) (च) for (प्रश्नेपयोगहृतया)
२. लब्ध्वा for (लब्धा) ३. प्रक्षेपका (ग) प्रक्षेपक for (प्रश्नेपका)
४. त्तरास्तद्युतो (ग) (च) for (त्तरार्द्धस्तद्युतो)
५. मूनयुतम् (ग) (च) for (मूनंयुतम्)
(ग) 'मिश्रक' से 'समाप्तः' तक अंकित नहीं है ।
(च) ३. प्रक्षेपका for (प्रश्नेपका)
६. व्यवहारः for (व्यवहार)

१७. (ग) १. पदगुणं for (पदगणं) २. गणितम् for (गुणितम्)

१८. (घ) १. उत्तरहीन (ग) (च) for (उत्तरहीना)
२. शेषवर्गं (ग) (च) शेषवर्गं for (शेशवर्गं)
३. प्रक्षिप्य (ग) (च) for (प्रश्निप्य)
४. हृतं (ग) यह पद अंकित नहीं है । for (हूतं)
(ग) ५. द्विगुणोत्तरं for (द्विगुणोत्तर)
(च) ४. हृतं for (हूतं)

१९. (घ) १. यदिष्ट (ग) (च) for (यदीष्ट) २. गछस्य (ग) (च) for (गच्छस्य)
३. हृतं (ग) त्रिहृतं for (तृहूतं)
(ग) ४. एकोत्तमेकाद्यं for (एकोत्तरमेकाद्यं)
५. गछ for (गच्छ) ६. संकलितं सकलितम् for (संकलितम्)
(च) ५. वियुतगछ for (वियुत्गच्छ) ३. त्रिहृतं for (तृहूतं)

द्विगुणपदसैकगुणितं तत्रृहतं भवति वर्गसंकलितम् ।
घूनसंकलितं तत्क्रतिरेषां समगोलकैश्चितयः ॥ २० ॥
श्रेष्टीव्यवहार समाप्तः ॥

स्थूलफलं त्रिचतुर्भुजबाहुप्रतिबाहुयोगदलघातः ।
भुजयोगार्द्धचतुष्टयभुजो न घातात्पदं सुक्ष्मम् ॥ २१ ॥
भुजकृत्यंतरर्भूहृं तहीनयुताभूर्द्विभाजिता बाधे ।
स्वाबाधावर्गोनाद्भुजवर्गान्फलमवलंब ॥ २२ ॥
अविषमचतुस्त्रभुजगतिभुजवधयोर्युते पदं कर्णः ।
कर्णाकृतिर्भूमुखयुतिदल व(प)र्गो नापदं लंब ॥ २३ ॥

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२०. (घ) १. तत्रिहृतं (ग) तत् त्रिहृतं for (तत्रृहतं)
२. घन (ग) घनसंकलित for (घूनसंकलितं)
३. तत्कृति (ग) for (तक्रति) ४. श्रेढी व्यवहारः for (श्रेष्टी व्यवहार)
(ग) ५. संलितम् for (संकलितम्)
४. वि० 'श्रेष्टी' से 'समाप्तः' तक यहाँ अंकित नहीं है ।
(च) १. तत्रृहतं for (तत्रृहतं) २. घनसंकलितं for (घूनसंकलितं)
३. तत्क्रति for (तक्रति) ४. श्रेढी for (श्रेष्टी)

२१. (घ) १. सूक्ष्मम् (ग) for (सुक्ष्मम्)
(च) १. शूक्ष्मं for (सुक्ष्मम्)

२२. (घ) १. भूहृंत (ग) भूहृत्हीन for (भूहृंत)
२. मूलमवलंबः (ग) मूलमवलंब for (फलमवलंब)
(ग) ३. भूर्द्विभाजिता बाधे for (भूर्द्विभाजिताबाधे)
(च) १. भूहृंत for (भूंहृत) २. मूलमवलंबः for (फलमवलंब)

२३. (घ) १. भुजगतिभुजगति (ग) भुजप्रतिभुजवधयो for (भुजगतिभुजवधयो)
२. भुजवधयोर्युतेः (ग) र्युतेः for (भुजवधयोर्युते)
३. लंबः (ग) (च) for (लंब)
(ग) ४. चतुरस्त्र for (चतुस्त्र)
(च) २. र्युतेः for (र्युते)

कर्णकृतेः कोटिकृतं[1] विशोध्य[3] मूलं भुजो भुजस्य कृतिं ।
प्रोह्य[4] यंदं[2] कोटिबाहु कृतियुतिपदं कर्णः ॥ २४ ॥
कर्णयुतादुर्द्धाधरखण्डे[4] कर्णावलंबयोगे[1] ।
वास्वाबाधे[2] स्वयुतिहृते[3] द्विधा प्रथक्कर्णलंबगुणे ॥ २५ ॥
अविषमपार्श्वभुजगुणकर्णौ[1] द्विगुणोवलंबकविभक्तः[3] ।
हृदयं विषमस्यभुजः[4] प्रतिकृतिभुजकृतियोगमूलार्द्धं[2] ॥ २६ ॥
त्रिभुजस्य बधोभुजयोर्द्विगुणितलंबोद्धृतो[4][5] हृदयरजः ।
नृचतुर्भुजहृदय[6][1] द्विगुणं[7] वहिवृत[2] विष्कुंभः[3] ॥ २७ ॥

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२४. (घ) १. क्रिति (ग) कृतिं for (कृतं)
२. प्रोह्य पदं कोटिः (ग) for (प्रोह्ययंदं कोटि)
(ग) ३. विशोध्यं for (विशोध्य)
(च) १. कृतिं for (कृतं)

२५. (घ) १. वा (इस पंक्ति का अंतिम शब्द 'वा' है) (ग)
२. (दूसरी पंक्ति 'स्वा—' से आरम्भ होती है) (ग)
३. ह्रिते (ग) हृते द्विधा पृथक् for (हृतेद्विघा प्रथक्)
(ग) ४. मूर्ध्वा for (दुर्द्धा)
(च) ४. दूर्द्धाधर for (दुर्द्धाधर) ३. हृते for (हृते)

२६. (घ) १. गुणः (ग) (च) for (गुण)
२. (यहां 'कृति' शब्द मूल पाठ में नहीं है) (ग)
(ग) ३. द्विगुणावलंबक for (द्विगुणोवलंबक)
४. विषमभुजः for (विषमस्यभुजः)
(च) २. 'कृति' लुप्त

२७. (घ) १. हृदयं (ग) (च) for (हृदय)
२. वृिर्त्त (ग) वृ्त्त for (वृत)
३. विष्कंभः for (विष्कुंभः)
(ग) ४. त्रुजयो for (भुजयो) ५. लंबोहृतो for (लंबोद्धृतो)
६. त्रि for (नृ) ७. द्विगुणितं for (द्विगुणं)
(च) २. वृर्त्त for (वृत्त)

कर्णा[१]स्त्रितभुजघा[२]तैकामुभयथान्योन्यभाजितं गुणयेत् ।
योगेन [३]भुजप्रतिभुजवधयोः क[४]र्णोपदे विषमे ।। २८ ।।
विषम[२]चतु[१]रस्त्रमध्ये विषमत्रिभुजद्वयं प्रकल्प पृथक् ।
कर्णद्वयेन पूर्ववदाबाधे लंबकौ च पृथक् ।। २९ ।।
विषमभुजांतस्त्रि[२]भुजे प्रकल्प्य कर्णौ[३] भुजो तदाव[१]धे ।
पृथ[४]गूर्द्धा धरखण्डे कर्णयुतौ कर्णयोरधरे ।। ३० ।।
त्रिभुजभु[४]जौभूर्भु[१]मिस्तलल्लंबो[२] उर्द्ध मवलंब खण्डम् ।
[३]लंबकयोगार्द्धं मधरोनम् ।। ३१ ।।

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२८. (घ) १. कर्णासृत (ग) कर्णाश्रित for (कर्णास्त्रित)
२. घातैक्य (ग) घातैः क्य for (घातैका)
(ग) ३. 'ज' अंकित नहीं है ४. कर्णो for (कर्णो)
(च) १. कर्णासृत for (कर्णास्त्रित) २. घातैक्यमुभयथा for (घातैकामुभयथा)

२९. (घ) १. चतुरस्त्रमध्ये (च) for (चतुरस्त्रमध्ये)
(ग) २. विखम for (विषम)

३०. (घ) १. वाधे (ग) तदा माबाधे for (तदावधे)
(ग) २. ये for (जे)
३. कर्णो भुजौ । (यहां पहली पंक्ति समाप्त—दूसरी पंक्ति 'तदा' से आरम्भ)
४. चरषंडे for (धरखण्डे)
(च) २. स्त्रिभुजे for (स्त्रिभुजे)
३. कर्णौभुजौ for (कर्णौभुजो) ४. पृथगूर्धाधरखण्डे for (पृथगूर्द्धाधरखण्डे)

३१. (घ) वि०—यहां इस श्लोक का उत्तरार्ध लिखना लिपि कार भूल गया प्रतीत होता है, '३१' का संख्याक्रम भी नहीं मिलता ।
१. भूमि for (भुमि) २. लंबयोरधरे (ग) लंबकाधरं for (उर्द्धमवलंब)
(ग) १. भूमि for (भुमि) ३. दूसरी पंक्ति – ऊर्ध्वमवलंबखंडं लंबकयोगार्द्धमधरोनम्
(च) १. भूंमिस् for (भुंमिस्)
वि०—यह श्लोक यहां ३१ व ३२ मिला जुला इस प्रकार है—
त्रिभुलभुजौ भूर्भूमिस्तल्लंबोऊर्द्ध मवलम्बखंडं लंबकयोगार्द्धमधरोनं ।। ३१ ।।
वि० रेखांकित पद से आगे का समस्तभाग ऊपर अन्यहस्त से लिखा हुआ है ।
(ङ) ४. त्रिभुजे for (त्रिभुज) १. तुभूमि for (भूर्भूमि)
२. लम्बकाधरं for (उर्द्धमवलंब) ३. +ऊर्ध्वमवलम्बखण्डम्+

कर्णावलकयुतौ[2] खंडे कर्णावलंबयोरधरे ।
[3]अनुपातेन [4]तुद्गूने [5]उद्ध [1]शून्यांस [6]पाटायाम् ॥ ३२[7] ॥
कृतियु[1]रसदृशराश्योर्बाहुधातो[5] द्विसंगुणो लंबः ।
कृत्यन्तर[2]म[3]सद्वशयोर्द्विगुणं[6] द्विसमत्रिभुजम्दमि[4]ः ॥ ३३ ॥
इष्टद्वयेन[1] भक्तो द्विधेष्टवर्ग[2]फलेष्टयोगार्द्धे ।
विषम[3]त्रिभुजस्य भुजा विष्टोनफलार्द्धयोगा[4] भूः ॥ ३४ ॥
इष्टस्य भुजस्य कृति[1]र्भक्तो नेष्टेन तद्वलं[2] कोटिः ।
[3]आयनचतुरस्त्रस्य[4] क्षेत्रस्येष्टाधिका कर्णः ॥ ३५ ॥

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३२. (घ) (वि०—पहली पंक्ति लिपिकार लिखना भूल गया प्रतीत होता है)
१. सून्यांस (ग) तव्यांस for (शून्यांस)
(ग) २. कर्णावलंबकयुतौ (च) for (कर्णावलकयुतौ)
३. अमुपातेन for (अनुपातेन) ४. तद्गूने (ङ) for (तुद्गूने)
५. ऊर्द्ध्वेस् for (उर्द्ध) ६. पारायाम् for (पाटायाम्)
(च) ७. यहां क्रमसंख्या ३१ ही अंकित है ।
(ङ) २. कर्णावलंबकयुतौ for (कर्णावलकयुतौ)
५. ऊर्ध्वे for (उर्द्ध) १. सूच्यांस for (शून्यांस)

३३. (घ) १. कृतियुतिर (ग) (च) for (कृतियुर)
२. कृत्यंतर (ग) (ङ) for (कृत्यंतर)
३. मसदृशयो (ग) (च) (ङ) for (मसद्वशयो)
४. त्रिभुज भूमिः for (त्रिभुजम्दमि)
(ग) ५. घातो (च) (ङ) for (धातो)
६. द्विद्विसमत्रिभुजभूमिः for (द्विसमत्रिभुजम्दमिः)
(च) ४. त्रिभुजभूमिः (ङ) for (त्रिभुजम्दमिः)
(ङ) १. कृतियुतिर for (कृतियुर)

३४. (घ) १. ष्टद्वयेन for (इष्टद्वयेन)
(ग) २. वर्ग्रः for (वर्ग) ३. विषत्रिभुजस्य for (विषमत्रिभुजस्य)
(ङ) २. वर्गः foı (वर्ग) ४. योगोभूः for (योगाभूः)

३५. (घ) १. कृति (ग) (च) (ङ) for (क्रति)
२. तद्दलं (ग) (ङ) for (तद्वलं) ३. आयत (च) (ङ) for (आयन)
४. चतुरस्रस्य (ग) (च) (ङ) for (चतुरस्त्रस्य)

आयतकर्णौ[५] बाहु[१] भुजकृति[६]रिष्टेन भाजितेष्टोना ।
द्विहृता[२] कोट्यधिका[७]भूर्मूखमूलाना[३]द्विसमचतुरस्त्रे[४] ॥ ३६ ॥
कर्णकृति[१]स्त्रिसमभूजास्त्रयश्चतुर्थो विशोध्य कोटिकृति[३] ।
बाहुकृते[४]स्त्रिगुणार्या[५] यद्यधिकोभूर्मुखं हीनः ॥ ३७ ॥
जात्यद्वयकोटिभुजाः परकर्णगुणाः[१] भुजाश्चतुर्विषमे ।
अधिकोभूर्मुखमूनो बाहु द्वितयं भुजा त्वन्यौ[२] ॥ ३८ ॥
इष्टगुणकारगुणितो गिर्युच्छ्रायः पुरांतरमनष्टम् ।
द्वियतं[१] गुणाकर[२]भाजितमुत्पातोन्यस्य समगत्योः[३] ॥ ३९ ॥
व्यासव्यासार्द्धकृति[१]परिधिफले व्यासहारिके[२] त्रिगुणे ।
तद्वर्गाभ्यां[३] दशभिः संगुणिताभ्यां पदे सुक्ष्मे[४] ॥ ४० ॥

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३६. (घ) १. बाहू (ङ) for (बाहु) २. हृता (ङ) for (हृता)
३. मुंखभूना (ग) for (मूंखमूलाना)
४. चतुर (यहां 'चतुर' के पश्चात् 'स्त्रे' और संख्या क्रम लिखना लिपिकार भूल गया है) ।
(ग) ५. आयनकर्णौ for (आयतकर्णौ)
(च) ६. क्रति for (कृति) ३. भूमुंखमूलाना for (भूमूंखमूलाना)
(ङ) ७. कोटचधिका for (कोद्यधिका) ३. भूमुंखमूना for (भूमूंखमूलाना)
३७. (घ) १. कृतिम् (ग) कृति for (क्रति) २. भुजा (ग) (ङ) for (भूजा)
३. कृतिम् (ग) (ङ) (क्रति) ४. कृते (ङ) for (क्रते)
५. गुणायायद्यधिको (ग) (ङ) for (गुणार्यायद्यधिको)
(च) ३. कृति for (क्रति)
(ङ) १. कृतिस् for (क्रतिस्)
३८. (घ) १. कर्णगुणा (ग) हता for (कर्णगुणाः) २. वन्यो for (वन्यौ)
(च) १. गुणा for (गुणाः)
(ङ) १. कर्णगुणा for (कर्णगुणाः)
३९. (घ) १. द्वियुत (ग) (ङ) for (द्वियुतं)
(ग) २. गुणकार (च) (ङ) for (गुणाकर) ३. समगत्यौ for (समगत्योः)
४०. (घ) १. कृती (ग) कृती (ङ) for (कृति)
२. व्यावहारिके (ग) (च) (ङ) for (व्यासहारिके)
३. तद्वर्गाभ्यां (ग) तद्वर्ग्राभ्यां (च) तद्वर्गाभ्यां for (तद्वगाभ्यां)
४. सूक्ष्मे (ग) (च) (ङ) for (सुक्ष्मे)

वृत्ते शरो[1]नगुणि[5]तात् व्यासा[2]च्चतुराहतात्पदं जीवा ।
ज्यावर्ग[3]श्चतुराहत[4]शरभक्तः शरयुतो व्यासः ॥ ४१ ॥
ज्याव्यासकृतिविशेषा[3]न्मूलव्यासांतरार्द्धमिषुरल्पः ।
व्यासो[1] ग्रासोनगुणौ ग्रासो नैक्यो[2]द्धतौ बाणौ ॥ ४२ ॥
इष्टशरस्य[1] भक्ते ज्यार्द्धं कृ[2]न्तिशरफ[6]ले युतौ[3] व्यासौ[7] ।
शरयोः फ[8]लयोरैक्यं ग्रासौ[9] ग्रासद्य[4]दुनं तत् ॥ ४३ ॥[5]

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४१. (घ) १. शरोत for (शरोन)
२. व्यासाच्चाँतु (ग) द्वचासा for (व्यासाच्चतु)
३. ज्यावर्गस्य for (ज्यावर्गश्च) ४. तुराहह for (तुराहत)

(ग) ५. गुणिता for (गुणितात्)

(च) ५. गुणिताद्वचासाच्च (ङ) for (गुणितात् व्यासाच्च)

४२. (घ) १. व्यासौ (ग) (ङ) for (व्यासो)
२. ग्रासोनैक्याधृतौ (ग) ग्रासोतैक्योद्ध तौ for (ग्रासोनैक्योद्धतौ)

(ग) ३. विशेषा मूलं for (विशेषान्मूल)

(च) २. ग्रासोनैक्योधृतौ for (ग्रासोनैक्योद्धतौ)

४३. (घ) १. शरद्वयभक्ते (ग) (च) (ङ) for (शरस्यभक्ते)
२. कृतीशर (ग) (ङ) for (कृंतिशर) ३. युते (ग) (च) for (युतौ)
४. ग्रासाद्यदूनं (ग) ह्यदनंतत् for (ग्रासद्यदुनं)
५. +क्षेत्र व्यवहारः समाप्तः+

(ग) ६. पले for (फले) ७. व्यासो for (व्यासौ)
८. पलयो for (फलयो) ९. ग्रासो (ङ) for (ग्रासौ)

(च) २. कृती for (कृंति) ४. ग्रामाद्यदूनं for (ग्रासद्यदुनं)

(ङ) ६. युते for (फले) ३. फले for (युतौ)
४. ग्रासोनमैक्यं for (ग्रासद्यदुनं)

क्षेत्र[२]व्यवक्षेत्रफलं वेधगुणं समखातफल[८]हतं[३] त्रिभिः शून्या।[४]
मुख[५]तुल्यतुल्यभुजैक्याने[६]काग्रहृतानि समरस्त्रः[७] ॥ ४४ ॥
मुखतुल[१]युतिः दलगुणितं[२] वेधगुणं व्यासहारिकं[३] गणितम्।
मुखतलगुणैक्यार्द्धं[४] वेधेन[६] गणितमौच्चम्[५] ॥ ४५ ॥
उद्र[२]गणिताद्विशोध्य व्यवहारफलं[३]त्रिभिर्भजेच्छेशम्[१]।
लब्धं व्यवहारफले प्रक्षिप्य फलं[४] भवति सूक्ष्मं ॥ ४६ ॥

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४४. (घ) १. +अथ खातः+ २. ('क्षेत्र व्यव'—यहाँ लुप्त है)२. (ग)+क्षेत्रव्यवहारः+
३. हृतं (ग) for (हतं) ४. शून्याः (ग) सूध्याः for (शून्या)
५. मुषतुल (ग) मुखतुल (च) for (मुखतुल्य)
६. न्येका (ग) न्यैकाग्र for (नेकाग्र)
७. समरज्जुः (ग) (ङ) for (समरस्त्रः)
(ग) ८. फलं (च) (ङ) for (फल)
(च) २. क्षेत्रे व्यवहारः समाप्तः, अथ खातः for (क्षेत्रव्यव)
४. शून्याः for (शून्या) ६. न्येकाग्रहृतानि for (नेकाग्रहृतानि)
७. समरस्रः for (समरस्त्रः)
(ङ) २. 'क्षेत्रव्यव' लुप्त ४. सूच्याः for (शून्या)
५. मुखतलतुल्य for (मुखतुल्यतुल्य)
४५. (घ) १. तल (ग) मुखतलयुति (च) for (मुखतुलयुतिः)
२. गणितं (ङ) for (गुणितं)
३. व्यावहारिकं (ग) (च) (ङः) for (व्यासहारिकं)
४. गणितैक्यार्द्धं (ग) मुखवगतैक्यार्द्धं for (गुणैक्यार्द्धं)
५. मौद्रम् (ङ्म्) (ग) मौत्र for (मौच्चम्)
(ग) ६. गुणम् for (गणित)
(च) १. मुखतलयुति for (मुखतुलयुतिः)
४. गणितैक्यार्द्धं (ङ) for (गुणैक्यार्द्धं) ५. मौध्रम् for (मौच्चम्)
(ङ) १. मुखतलयुति for (मुखतुलयुतिः)
६. +स्याद्+५ मौत्रम् for (मौच्चम्)
४६. (घ) १. छेषम् (ग) च्छेषम् for (छेशम्)
(ग) २. औद्र for (उद्र)
(च) २. तुद्र for (उद्र) १. छेषं for (छेशम्)
(ङ) २. औत्र for (उद्र) ३. भजेत् त्रिभिः शेषम् for (त्रिभिर्भजेच्छेशम्)
४. भवति फलं सूक्ष्मम् for (फलंभवतिसूक्ष्मम्)

खात[1] व्यवहारश्चतुर्थः
आकृतिफलमौव्याहृतमग्रतलैक्यार्द्धमौच्यदैर्ध्यगुणम् ।
घनगुणितमिष्टकाघनफलेन हृतमिष्टकागणितम् ॥ ४७ ॥
चितिव्यवहारः समाप्तः ॥
विस्तारायामांगुलघातो मार्गाहृतो द्विवेदहृतः ।
किष्कं गुलग्निलब्धं तत्पणवतिर्भवति कर्मः ॥ ४८ ॥

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४७. (घ) १. स्याव्यवहार (ग) श्री खातव्यवहारश्चतुर्थः for (खातव्यवहारश्चतुर्थः)
२. मरैन्य (ग) मौव्य for (मौच्य)
३. दैघ्य for (दैर्ध्य) ४. गुणाः (च) for (गुणम्)
५. गणित (ग) (च) (ङ) for (गुणित) ६. हृत (ग) (च) (ङ) for (हृत)

(ग) ७. चितव्यवहारः for (चितिव्यवहारः)

(च) १. स्याव्यवहारश्चतुर्थः for (खातव्यवहारश्चतुर्थः)

(ङ) १. "खात—चतुर्थः" लुप्त ७. मौच्च्याहृत for (मौव्याहृत)
२. मौच्च्य for (मौच्य) ७. इति चितिव्यवहारः for (चितिव्यवहारः समाप्तः)

४८. (घ) १. विस्तराया for (विस्तारायां)
२. मागहितो (ग) माग्रहितो for (मार्गाहृतो)
३. द्विवेहृतः (ग) द्विवेदहृतः (च) (ङ) for (द्विवेदहृतः)
४. किष्कं (ग) (च) for (किष्कं)
५. गुलानि (ग) (च) (ङ) for (गुलग्नि) ६. कर्म्मः (ग) for (कर्मः)

(ग) ७. विस्तारायामंगुल for (विस्तारायांमांगुल)

(च) ७. विस्ताराया for (विस्तारायां) ६. कर्म्म (ङ) for (कर्मः)

(ङ) ७. विस्तारायामाङ्गुल for (विस्तारायांमांगुल)
८. षण्णवति for (पणवति)

शाकादिषु[1] शाल्मल्यां शतद्वयं जीवके[4] शतं विशं शाल[5]ः ।
सरलादिषु[2] सर्वविहग्रूसु[3] चतुः षष्टिः ।। ४६ ।।
क्रवच[6] व्ययहार समाप्तः ।

नवम[1] सूकिषु दशमस्थूलेष्वेकादशो[2] भवत्यणुषु ।
परिधेर्वेधपरिधिः[4] षडंशवर्गो[5] हतो[3] गणितम् ।। ५० ।।
द्विचतुः सत्र्यंशगुणोमित्यंतर[1] बाह्यकोणगः ।
परिधिः[2] प्राग्वत्कृत्वा गणितं तद् गणितं स्वगुणकारहूतं[3] ।। ५१ ।।
राशिव्यवहारः[4] समाप्तः ।

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४६. (घ) १. शालाल्पांश for (शाल्मल्यांश)
२. सरलादिषुशतं सर्व (ग) for (सरलादिषुसर्व)
३. विदारूपु (ग) विवहारुषु for (विहग्रूसु)
(ग) ४. बीजकेन for (जीवके)
५. यहां 'विंशं' पर श्लोकार्ध समाप्त करके 'शाल' से दूसरी पंक्ति आरम्भ है।
(ङ) ६. क्रकचव्यवहारः (च) for (क्रवचव्यवहार)
(च) ५. वीशंशालः for (विशंशालः) २. +शतं+
३. विदारुषु for (विहग्रुसु)
(ङ) ५. विंशं for (विशंशालः) २. ३. शतमथाविदारुषु for (सर्वविहग्रुषु)
६. लुप्त ।

५०. (घ) १. नवमं शूकिषु (ग) नदमः सूकिषु for (नवमसूकिषु)
२. दशमः (ग) (ङ) for (दशम) ३. वर्गाहतो (ग) वर्ग्राहतो for (वर्गोहतो)
(ग) ४. परिधेर्वेधः (च) (ङ) for (परिधेर्वेधः)
(च) १. नवमंशूकिषु for (नवमसूकिषु) ३. वर्गाहतो (ङ) for (वर्गोहतो)
(ङ) १. नवमः शूकिषु for (नवमसूकिषु) ५. परिधेः for (परिधिः)

५१. (घ) १. भित्त्यंतर (ग) (च) for (मित्यंतर)
२. परिधिः (यह शब्द पहली पंक्ति का अन्तिम शब्द है) (ङ)
३. हृतम् (ग) (च) (ङ) for (हूतं)
(ङ) १. मित्त्यन्तर् for (मित्यंतर)
४. इति राशिव्यवहारः for (राशिव्यवहारः समाप्तः)

छायांतरसैकहूतं द्युदलं प्रागपरयो द्युगतशेषम् ।
दिनगतं शेषांशहूतं द्युदलं छायांतरव्येकम् ॥ ५२ ॥
दीपतलशंकुतलयोरंतरमिष्टप्रमाणशंकुगुणम् ।
दीपशिखोच्या शंकुं विशोध्य शेषोद्धृतं छाया ॥ ५३ ॥
छायाग्रांतरगुणिता छाया छायांतरेण भक्ता भूः ।
भूः शंकुगुणा छाया विभाजिता दीप शिखौच्यम् ॥ ५४ ॥

छाया व्यवहार समाप्तः

गुणकार खण्डतुल्यो गुण्यौ गोमूत्रिकाकृतो गुणितः ।
सहितः प्रत्युत्पन्नो गुणकारकभेदतुल्यो वा ॥ ५५ ॥

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५२. (घ) १. +अथछाया+ (आरंभिक प्रकरण का नाम)
२. छायानरसैकहृतं (ग) (ङ) for (छायांतरसैकहूतं)
३. र्द्युगतशेषम् (ङ) (ग) र्द्युगशेषम् for (द्युगतशेषम्)
४. दिनगत (ग) (च) (ङ) for (दिनगतं)
५. हृतं (ग) (च) (ङ) for (हूतं)
६. छायानरव्येकम् (ग) छायामराव्येकम् for (छायांतरव्येकम्)
(च) १. +अथछाया+ ७. हृतं for (हूतं)
३. र्द्युगतशेषं for (द्युगतशेषम्)
(ङ) १. छायानरव्येकम् for (छायांतरव्येकम्)
५३. (घ) १. छंकु (ग) च्यं छं कुं for शंकुं २. दोषोद्धृतं for (शेषोद्धृतं)
(ग) ३. दीपशिखौ (च) for (दीपशिखो)
(च) १. व्याछंकुं for (च्याशंकुं)
(ङ) ३. शिखौच्च्याच्छंकुं for (शिखोच्याशंकुं)
५४. (घ) १. दीपक (च) for (दीप)
(ग) २. भक्ता (अतिरिक्त अंकित) ३. छायाव्यवहारः for (छायाव्यवहार)
(ङ) १. दीपशिखयौच्च्यम् for (दीपशिखौच्यम्)
५५ (घ) १. स्वंज for (खण्ड) २. ण्गुण्यो (ग) गणो for (गुण्यौ)
३. कृतो (ग) (ङ) for (कृतो)
४. प्रत्युत्पन्नौ (ग) प्रत्युत्पन्नो for (प्रत्युत्पन्नो)
(ग) ५. गणितः for (गुणितः)
(ङ) २. गुण्यो for (गुण्यौ)

गुण्यो राशिर्गुणकारराशिनेष्टधिकोनकेन गुणः ।
गुण्येष्टवधो न यतो गुणकेभ्यधिकोनके कार्यः ।। ५६ ।।
छेदेनेष्ट युतोनेना संभाज्यादनष्टमिष्टगुणम् ।
प्रकृतिस्थछेदहृतं लब्धायुतहीनकमनष्टम् ।। ५७ ।।
गुणछेदफलवधो गुणकहतो गुण्यभाजितो गुणकः ।
छेदो धृतः फलं गुण्यगुणवधः फलहृतः छेदः ।। ५८ ।।
गुण्यगुणकारयोः छेदलब्धयो द्वयो द्वयोर्नाशः ।
तेषां दश्यो व्यस्तौ कृत्वा तस्थानयो रिष्टौ ।। ५९ ।।

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५६. (घ) १. राशिनेष्टा (ग) (च) (ङ) for (राशिनेष्ट)
२. युतो (ग) (च) (ङ) for (यतो)
(ग) ३. गुण्यष्ट for (गुण्येष्ट) ४. गुणिकेभ्य for (गुणकेभ्य)
(च) ३. गुणेष्ट for (गुण्येष्ट)
(ङ) ४. गुणकेऽभ्यधिको for (गुणकेभ्यधिको)

५७. (घ) १. छेदो नष्टयुतो for (छेदेनेष्टयुतो)
२. नेनाप्तं (ग) (च) (ङ) for (नेनाप्तं)
३. हृतं (ग) (च) (ङ) for (हृतं)
(ग) ४. दिनष्ट for (दनष्ट) ५. लब्ध्वायुतकम् for (लब्ध्वायुतं)
(ङ) ५. लब्ध्या for (लब्ध्वा)

५८. (घ) १. गुण्य (ग) (ङ) for (गुण)
२. फलहृतः (ग) फलहृत (च) for (फलहृतः)
(ग) ३. हृतो for (हतो)
(ङ) ३. गुणकहृतो for (गुणकहतो) ४. द्धतः for (धृतः)
२. फलहृतश्छेदः for (फलहृतः छेदः)

५९ (घ) १. गुणागुण for (गुण्यगुण)
१. द्वियोर्द्वयोर्नाशः (ग) वा द्वयोर्द्वयोर्नाशः for (द्वयोर्द्वयोर्नाशः)
(ग) ३. दृश्यो (च) for (दश्यो) ४. व्यस्तो for (व्यस्तौ)
(च) १. विसर्ग लुप्त २. द्वयोर्द्वयोर्नाशः for (द्वयोर्द्वयोर्नाशः)
५. तस्थानयो for (तस्थानयौ)
(ङ) ६. कारयोश्छेद for (कारयोः छेद) ७. लब्धयोर्यदि द्वयो for (लब्धयोर्द्वयो)
२. द्वयोर्द्वयो for (द्वयो द्वयो) ३. दृश्यौ for (दश्यो)
८. श्चेष्टौ for (रिष्टौ)

गुण्यं गुणकारं वा गुणये[3] छेदेन भागहरस्य[1] ।
गुण्यगुणकारराश्यो[4] छेदगुणो भागहरश्च[2] ॥ ६० ॥
छेदस्य[1] छेदरूपं कृत्वा न्यदूक्तवत्सर्वम्[5] ।
अपवर्त्यौ[2] तुल्यो[3] न छदगुणौ[4] छेदगुण्यौ[6] वा ॥ ६१ ॥
स्वविकलषष्ट्यंशगुणं[4][6] सकलस्त्र्यंशोद्धतो[1] विकलवर्गः[5] ।
प्रश्नेप्यः[2] सकलकृतौ वर्गघातौ[3] द्वित्रितुल्यवधौ ॥ ६२ ॥
राशेखनं[1] द्विगुणं बहुतरगुणमूनकृति[3]युतं[4] वर्गः ।
राशेरिष्टयुतोनाद्वधः कृतिवेष्ट[2]कृतियुक्तः[5] ॥ ६३ ॥

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६०. (घ) १. भागहारस्य (ग) (च) (ङ) for (भागहरस्य)
२. भागहारश्च (ङ) for (भागहरश्च)
(ग) ३. गुणयो for (गुणये)
(च) २. भागहारश्च for (भागहरश्च)
(ङ) ३. गुणयेच्छेदेन for (गुणयेछेदेन) ४. राश्योश्छेद for (राश्योछेद)

६१. (घ) १. अछेदस्य छेदं (ग) for (छेदस्य छेदरूपं)
२. अपवर्त्यौ for (अपवर्त्यौ) ३. तुल्येन (ग) for (तुल्योन)
४. छेदगुणौ (ग) for (छदगुणौ)
(ग) ५. दुक्तवत्सर्वम् (ङ) for (दूक्तवत्सर्वम्) ६. छेदगुण्यो वा for (छेदगुण्यौ वा)
(च) ५. न्यदुक्तवत् for (न्यदूक्तवत्) २. अपवर्त्त्यौ for (अपवर्त्यौ)
४. छेदगुणौ for (छदगुणौ)
(ङ) १. अच्छेदस्य for (छेदस्य)
३, ४, ६. छेदगुणौ तुल्येनेष्टेन for (तुल्यो न छदगुणौ छेद)

६२. (घ) १. सकलस्त्रिंशोद्धृतो (ग) सकलस्त्रिशोहृतो for (सकलस्त्र्यंशोद्धतो)
२. प्रक्षेप्यः (ग) (च) (ङ) for (प्रश्नेप्यः)
३. वर्गघनौ (ग) वर्ग्रघनौ for (वर्गघातौ)
(ग) ४. वश्यंशगुणः for (षष्टयंशगुणं) ५. वर्ग्रः for (वर्गः)
(च) १. सकलस्त्रिशो हृतो for (सकलस्त्र्यंशोद्धतो)
(ङ) ६. गुणः for (गुणं) १. सकलास्त्रिशोद्धतो for (सकलस्त्र्यंशोद्धतो)
३. वर्गघनौ for (वर्गघातौ)

६३. (घ) १. रूनं (ग) (च) (ङ) for (खनं) २. वेष्ट (ग) (च) for (वेष्ट)
(ग) ३. कृवि for (कृति) ४. बुतं वर्ग्रः for (युतं वर्गः)
५. र्युक्तः for (युक्तः)
(च) ३. क्रति for (कृति) (ङ) २. कृतिर्वेष्ट for (कृतिवेष्ट)

इष्टाल्पराशिवर्गौ युक्तोना वितरत्रिकलवर्गाभ्याम् ।
द्विगुणोत्तरराशिभ्याम्[1] भक्तौ[3] तेनाधिकाभ्याम्[2] ॥ ६४ ॥
स्थानांतरेषु लब्धं येन समं[2] फलयुतोनकछेदः[3] ।
दलित[1]कृतियोगान्तरपदमितरो वा फलयुतो नः ॥ ६५ ॥
दिग्मात्रमेतदन्या[4] ज्योत्पत्तौ कुट्टके च कथयिष्ये ।
संकलितादिष्टार्याः[1] षट्षष्टिर्द्वादशोऽध्यायः[2] ॥ ६६ ॥
इति[3] ब्रह्मगुप्ते द्वादशोऽध्यायः ।
इति श्री ब्राह्मस्फुट सिद्धान्ते द्वादशोध्यायः ।

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६४. (घ) १. द्विगुणोतर (ङ) for (द्विगुणोत्तर)
२. तेनाधिकोनाभ्याम् (ग) (च) (ङ) for (तेनाधिकाभ्याम्)
(ग) ३. भक्तो for (भक्तौ)
(च) १. द्विगुणोतर for (द्विगुणोत्तर)

६५. (घ) १. दलितः (ग) (च) (ङ) for (दलित)
(ग) २. 'समं' यहां अंकित नहीं है ।
(ङ) ३. युतोनकच्छेदः for (युतोनकछेदः)

६६. (घ) १. संकलितादिष्वार्याः (ग) for (संकलितादिष्टार्याः)
२. +६६+
३. यह पंक्ति इस प्रति में लुप्त है । (ग)
(ग) ४. दिग्मात्रामेतदत्य for (दिग्मात्रमेतदन्या)
(च) ३. 'इति' से 'अध्याय' तक समाप्तिसूचक वाक्य लुप्त ।
(ङ) ४. दिङ्मात्रमेतदन्यज् for (दिग्मात्रमेतदन्या)
१. दिष्वार्या for (दिष्टार्याः)

अथ प्रश्नाध्यायः

त्रयोदशः

तत्र तावन्मध्यगत्युत्तराध्यायः

प्रश्नध्यायान्[1] प्रवक्षामि[3] सोत्तरान् गणकबुद्धिवृद्धि[4]करान् ।
यैर्ज्ञातैस्तन्त्रविदामाचार्यो भवति बुद्धिमताम्[2] ॥ १ ॥
अधिमासकैः[2] सविकलैर्दृष्टै र्युगयातमवमररात्रैर्वा[3] ।
द्युगणेन वायुगगतयो[1] वेत्ति स कालतंत्रज्ञः[4] ॥ २ ॥
अवमाति[3] यः[4] सविकलैरधिमासैरधिकमासकानवमैः ।
ग्रहमिष्टं ताभ्यां वायो वेति[1] स कलतंत्रज्ञ[2] ॥ ३ ॥
द्युगुणं[1] विनाधिमासावमैर्विनादिन गणेन चन्द्राक्कौं ।
ताभ्यां विना[2]स्फुटतिथिं यो वेत्ति स काल[3]तंत्रज्ञः ॥ ४ ॥
इष्टान्मध्यादन्यांस्तिथि[3]मिष्टान्मध्यमाछशिग्रहणम् ।
इष्टाद्रविंदु[1]पातै र्यो[2] वेत्ति बिना[4] स तंत्रज्ञः ॥ ५ ॥

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१. (घ) १. प्रश्नाध्यायान् (ग) प्रस्नाध्यायान for (प्रश्नध्यायान्)
२. बुद्धिमत्यम् (ग)बुधिमताम् for (बुद्धिमताम्)
(ग) ३. वक्ष्यामि for (प्रवक्षामि) ४. 'वृद्धि' पद अंकित नहीं है ।
(च) १. प्रश्नाध्यायान् for (प्रश्नध्यायान्)

२. (घ) १. वायुगगं (ग) वायुगगतं for (वायुगगत)
(ग) २. अधिमासिकैः for (अधिमासकैः) ३. मवमरात्रैर्वा for (मवमररात्रैर्वा)
४. तत्रज्ञः for (तंत्रज्ञः)
(च) ३. मवमरात्रैर्वा for (मवमररात्रैर्वा)

३. (घ) १. वेत्ति (च) for (वेति)
२. कालतंत्रज्ञः (ग) सकलतंत्रज्ञः for (सकलतंत्रज्ञ)
(ग) ३. अवमानि for (अवमाति) ४. 'यः' पद यहाँ अंकित नहीं है ।
(च) २. सकालतंत्रज्ञः for (सकलतंत्रज्ञ)

४. (घ) १. द्युगणं (ग) (च) for (द्युगुणं)
(ग) २. 'विना' अंकित नहीं ३. 'सकाल' अंकित नहीं

५. (घ) १. रवींदु (ग) for (रविंदु) २. यो for (र्यो)
(ग) ३. दन्यास्तिथि for (दन्यांस्तिथि)
४. 'बिनास' पद अंकित नहीं । इसके स्थान में यहाँ 'सकल' अंकित है ।
सकल for ('बिनास)

त्रिगुणः शनिरिन्दुनोन्य[1]भगणलब्धैर्ग्रहादिभिः[2] सहितः ।
भौमोऽर्को[3]गुरुरिंदुच्चं[5] वान्यभगणाः[4] के ॥ ६ ॥
द्वित्रिगुणयो रविर्द्वोर्युति[1] कुजोनान्यभगणलब्धेन ।
राश्यादिनाधिक[2]गुरूरूना शशि[3]रन्यभगणाः के ॥ ७ ॥
द्रष्टो[1]दयिकानश्विन्यौ[3] दयिकात्वा[4]करो तिथौ[2] मध्यात् ।
मध्यार्कं[5] गुणार्कं[6] गुणमिष्टं मध्यं स तंत्रज्ञः ॥ ८ ॥
पातोनतुल्यो[1]मगतीन् प्रतिलोमगतीन् ।
ग्रहान् दिवसं[2] वारं विपरीतैः शन्याद्यैर्यो वेत्ति[3] स कालतंत्रज्ञः ॥ ९ ॥

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६. (घ) १. रिन्दुनोऽन्य (ग) रिन्दूनोन्य for (रिन्दुनोन्य)
२. ग्रंहादिभिः (ग) for (ग्रंहादिभिः)
३. भौमो हीनोर्का (ग) भौमो हीनोर्को for (भौमोऽर्को)
४. वाऽन्यभगणाः for (वान्यभगणाः)
(ग) ५. रिंदूच्चं for (रिंदुच्चं)
(च) ३. भौमोर्क्को for (भौमोऽर्को)

७. (घ) १. रवींद्वोर्युतिः (ग) रवींद्वोर्युतिः (च) for (रविर्द्वोर्युति)
२. नाधिका (ग) for (नाधिक) ३. शनि (ग) for (शशि)
(च) ३. शनि for (शशि)

८. (घ) १. इष्टौ (ग) for (द्रष्टो)
२. यो (ग) (च) for (ौ)
(ग) ३. दयिकोनश्विन्यौ for (दयिकानश्विन्यौ)
४. दयिको न वा for (दयिकात्वा)
(च) १. इष्टोदयिका for (द्रष्टोदयिका) ५. मध्यार्क्कं for (मध्यार्कं)
६. गुंणमिप्टं for (गुणमिष्टं)

९. (घ) १. पातानतु लोमगतीन् (ग) पातानतु लोमगतीन् for (पातोनतुल्योमगतीन्)
२. दिवस (ग) for (दिवसं)
(च) १. पातोनतुलो for (पातोनतुल्यो)
३. वत्ति for (वेत्ति)

व्यतिपातवैधृतबृहस्पतिवर्षस्वोच्चनीचपरिवर्तनात् ।
द्विग्रहयोगाश्च युगे यो वेत्ति स कालतंत्रज्ञः ॥ १० ॥
सावनमासाब्दाधिप होरेशानिष्टमध्यसंयोगात् ।
इष्टगुणितैर्युतोना दिष्टान्यो वेत्ति गणकः सः ॥ ११ ॥
युगरविदिवसैर्गुणिता गताधिमासाः स्वशेषसंयुक्ता ।
भक्ता युगाधिमासैः फलं युगादेर्गता दिवसाः ॥ १२ ॥
गुणितानि चन्द्रदिवसैर्गतावमानि स्वशेषसहितानि ।
विभजेद्युगावमैः फलमनष्टमधिमासकैर्गणितम् ॥ १३ ॥
हूर्तामिदुदिनैर्लब्धाधिमासदिवसैर्विहिनकमनष्टम् ।
युगयातदिनान्यधिमासदिनगणेष्टग्रहाद्यमत ॥ १४ ॥
द्यु गुणेंदुदिवसघातात् कुदिनाप्तमधोयुगादिमासगणम् ।
युगशशिदिनभक्तं फलमासदिनोनं युगगतदिनानि ॥ १५ ॥

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१०. (घ) १. परिवत्तात् (ग) परिवर्तान् for (परिवर्तनात्)
२. योगांश्च (च) for (योगाश्च)
(ग) ३. व्यतीपात for (व्यतिपात) ४. सकलतंत्रज्ञः for (सकालतंत्रज्ञः)
(च) १. परिवर्त्तान् for (परिवर्तनात्)
११. (ग) १. गुणिति for (गुणितै)
१२. (घ) १. र्गुणिताधिमासाः for (र्गुणितागताधिमासाः)
२. संयुक्ताः (ग) (च) for (संयुक्ता)
(च) १. गुणिता for (र्गुणिता)
१३. (घ) १. मानिः for (मानि)
२. र्गुणिता (ग) गुणितम् for (र्गणितम्)
(च) २. र्गुणितं for (र्गणितम्)
१४. (घ) १. हृत (ग) (च) for (हूत) २. लब्धा for (र्लब्धा)
३. विहीन (च) for (विहिन) ४. दिनाऽन्यधि for (दिनान्यधि)
(ग) ५. मिंदू for (मिंदु) ६. ग्रहाद्यमतः for (ग्रहाद्यमत)
१५. (घ) १. गणेंदु (ग) (च) for (गुणेन्दु)
(ग) २. कुदिनाप्तं for (कुदिनाप्त) ३. मधोर्यु for (मधोयु)
४. गुणम् for (गणम्)
(च) ४. युगाधिमासगणं for (युगादिमासगणम्)

गुणमधिमासकशेषं युगकुदिनै खमशेषमधिमासैः ।
तद्यु तिरिंदुदिनहृताधिमासशेषं स्फुटं भवति ॥ १६ ॥
कुदिनगताधिकमासकघातः स्पष्टाधिमासशेषयुतः
भक्तो युगाधिमासैरहाणिः पूर्ववन्मध्याः ॥ १७ ॥
भूदिनगता इवमवधः शेषयुक्तो युगावमविभक्तः ।
लब्धं भवति द्युगुणो युगयातो मध्यमाः प्राग्वत् ॥ १८ ॥
युगगतराशिमासवधाद्रविमासाप्तं दिनाकृतिं सदिनम् ।
भूदिनगुणशशिदिनहृतपाप्तमहर्गणः मैकम् ॥ १९ ॥

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१६. (घ) १. दित for (दिन) २. हृताधि (च) for (हृताधिमास)
(ग) ३. शेषस्फुटं for (शेषं स्फुटं)

१७. (ग) १. 'क' अंकित नहीं
२. मासरहर्ग्रणः for (मासैरहाणिः)
३. पूर्ववत् मध्या for (पूर्ववन्मध्या)
(च) २. युगाधिमासैरहर्गणः for (युगाधिमासै रहाणिः)

१८. (ग) १. वधः स्वशेष for (वधः शेष)
२. द्युगणो (ग) (च) for (द्युगुणो)
(ग) ३. मध्यमा for (मध्यमाः)
(च) १. +स्व+

१९. (घ) १. युगगराराशि (ग) युगतराशि for (युगगतराशि)
२. दिनीकृतं (ग) (च) for (दिनाकृतं)
३. गुणं for (गुण)
४. शशिदिनैहृता (ग) शशिदिनहृत for (शशिदिनहृत)
५. मासमहर्गणः (ग) मासमहर्ग्रणः for (पाप्तमहर्गणः)
६. सैकम् (ग) (च) for (मैकम्)
(ग) ७. मासास्त for (मासाप्तं)
(च) ५. मासमहर्गणाः for (पासमहर्गणः)
४. दिनहृत for (दिनहृत)

गतदिवसा[5] पृथक्[1] विमासक गुणिता रविदिनाप्तमासदिनैः[7] सहिता[2] ।
पृथग्वमगुणा[3] शशिदिवसाप्तोन[6]काकपणः[4] ॥ २० ॥

गुणिताद्युगाधिमासैर्युगभू[2] दिवसैर्हृ[3]तादवमशेषात् ।
फलयुक्तमधिकमासकशेषं मध्यावतोऽर्केंदू[1] ॥ २१ ॥
अधिमासोवम[3]शेष[1]युगशशिभूहृते[2] पृथग्लब्धे
मासदिनाद्यैस्त्याज्ये गतमासदिनानि चैत्राद्यैः[4] ॥ २२ ॥
अवमावशेषलब्धा[2] सहितानि[3] पृथक् त्रयोदश[4]गुणानि[5] ।
अधिमास शेषलब्धा हीनानि[1] पृथग् रविशशांकौ[6] ॥ २३ ॥

२०. (घ) १. पृथगविमासकगुणिता (ग) पृथगधिमासकगुणिता for (पृथक् विमासक-गुणिता)
२. सहिताः (ग) for (सहिता)
वि० यह दूसरी पंक्ति का आरंभिक शब्द है
३. पृथगवमगुणाः (ग) for (पृथग्वमगुणा)
४. द्युपणः for (कपणः)
(ग) ५. गतदिवसाः for (गतदिवसा)
६. दिनसाप्तोन······॥ २० ॥ for (दिवसाप्तोन)
(च) १. पृथगविमासक for (पृथक् विमासक)
७. मासदिनैसहिताः for (मासदिनैः सहिता)
३. पृथग् वमगुणाः for (पृथग्वमगुणा)   ४. काद्युषणः for (काकपणः)
२१. (घ) १. ऽर्केन्दुः for (ऽर्केंदू)
(ग) २. (भू) अंकित नहीं   २. हृंता for (हृंता)
४. फलयुक्तं मधिमासशेषं for (फलयुक्तमधिकमासकशेषं)
(च) ३. हृता for (हृंता)   १. मध्यावतोऽक्कंदू for (मध्यावतोऽर्केंदू)
२२. (घ) १. शेषे (ग) for (शेष)
२. भूदिनहृते (ग) भूदिनहृता for (भूहृते)
(ग) ३. मधिमासावम for (अधिमासोवम)
४. चैत्रदै for (चैत्राद्यैः)
(च) २. +दि+
२३. (घ) १. हीनातिपृथग् for (हीनानि पृथग्)
(ग) २. लब्धाः for (लब्धा)   ३. सहिता for (सहितानि)
४. तयोर्दश for (त्रयोदश)   ५. गुणाणेनि for (गुणानि)
६. शशिकौ for (शशांकौ)

गतमासदिनावशेष[2]लब्धियोगाः[3] त्र्योदश[4]गुणाच्च ।
अधिमासशेषलब्धारविचन्द्रोच्चै[1] युते शोध्ये ।। २४ ।।
केन्द्रे[3] पृथक्[4] फले द्वादशोद्धृते न्यस्तमृण[5]धनं सौरम् ।
अनुलोममैदवं[1] मासदिनावमशेषलब्धियुतौ[2] ।। २५ ।।
तिथिविकलषष्टि[1]घाताद्रविह्रत[2]भुक्त्यंतराप्त[3]घटिकासु[4] ।
देशांतरमनुलोमं[5] भुजांतरं[6] चार्कं[7] फलमसवः ।। २६ ।।
अवमविकलं न सावनमेभिः परिकल्पितं यतश्चांद्रम्[2] ।
नार्यभटाद्यैः प्रश्नो[3] मध्यान्यत्वा कृतो[1] ज्ञातः ।। २७ ।।
ज्ञातभुगणादि[1]भुक्तं सविकलमिष्ट युगभगण संगुणितम्[3] ।
ज्ञातयुगभगणभक्तं मध्योभगणादिफलमिष्टः[2] ।। २८ ।।

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२४. (घ) १. चन्द्रोच्चे for (चन्द्रोच्चै)
(ग) २. दिनावमशेष for (दिनावशेष)
३. योगा for (योगाः) ४. त्रयोदश for (त्र्योदश)
(च) ४. त्रयोदश for (त्र्योदश)

२५. (घ) १. मैंदवं (ग) मैवं for (मैंदवं)
२. लब्धयुतौ for (लब्धियुतौ)
(ग) ३. केन्द्रं for (केन्द्रे) ४. प्रथक् for (पृथक्)
५. बस्तमृण for (न्यस्तमृण)

२६. (ग) १. 'ष्टि' for (षष्टि)
२. द्रविहित for (द्रविह्रत) ३. भुक्तांतराप्त for (भुत्तय्ंतराप्त)
४. घटीकासु for (घटिकासु) ५. मनुलोमौ for (मनुलोमं)
६. भुजांतर for (भुजांतरं) ७. वाऽर्क for (चार्कं)
(च) २. द्रविह्नत for (द्रविह्रत)
७. चार्क्कं for (चार्कं)

२७. (घ) १. त्कृतोऽज्ञातः for (कृतोज्ञातः)
(ग) २. यतश्चान्द्र for (यतश्चान्द्रम्) ३. प्रस्नो for (प्रश्नो)

२८. (घ) १. भगणादि (ग) (च) for (भुगणादि) २. मिष्टम् for (मिष्ट)
(वि०)—इस श्लोक की दोनों पंक्तियों के मध्य में निम्नांकित तीसरी पंक्ति भी दी गई है—
"ज्ञात युगभगणादिभुक्तं सविकलमिष्ट युग भगण संगुणितम्"
(ग) ३. संयुणितम् for (संगुणितम्)

इष्टाहृतभक्तानां [१]ध्व्यादिनां संयुतेर्द्वयोरथवा ।
इष्टगुणकारगुणयोर्विभक्तयोर्[२]वांतरादथवा ॥ २९ ॥
[१]ज्ञानैक[४]भगणभुक्तिस्तद्भग[२]माप्तं [५]यदिष्टभगणेभ्यः ।
[६]भगण[३]दिवसविकलं सविकलेष्टभगणादि गुण[७]मिष्ट ॥ ३० ॥
शशिदिनगुणं सविकलं [२]वद्भुक्तं मंडलादितद्भगणैः ।
[१]विभेजफलं सविकला[३]स्थितयः प्राग्वत् स्फुटीकरणम् ॥ ३१ ॥
पातेंदुयोगलब्धौ [२]कृत्वा देशांतराद्यमनुलोमम् ।
विक्षेपो [१]स्यात्सूर्यादिभिर्विनेंदुग्रहणमेवम् ॥ ३२ ॥
कुदिन[१]हृत[३]मवशेषं द्वादशभिर्[४]गुणितं [२]मास[५]मशाद्यम् ।
द्वादशगुणतिथ्यंशैर्युतं धनं भास्करे चंद्रः ॥ ३३ ॥

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२९. (घ) १. नांद्यादीनां (ग) नां द्व्यादीनां for (ध्व्यादिनां)
(ग) २. वांतरदथवा for (वांतरादथवा)
(च) १. द्व्यादीनां for (ध्व्यादिनां)

३०. (घ) १. ज्ञातैक (च) for (ज्ञानैक)
२. भाप्तं (च) for (माप्त)
३. भगणादिसविकलं for (भगणदिवसविकलं)
(ग) ४. भगणस्तद्भगणात for (भगणभुक्ति) ५. यं for (य)
६. भगणादि दिसविकलं for (भगणदिवसविकलं)
७. गुणमिष्टम् for (गुणमिष्ट)
(च) ६. भगणा for (भगण)

३१. (घ) १. विभजेत्फलं (च) for (विभेजफलं)
(ग) २. यद्भुक्तं for (वद्भुक्तं)
३. स्तिथयः (च) for (स्थितयः)

३२. (घ) १. विक्षेपोस्मात् (ग)(च) for (विक्षेपोस्यात्)
(च) २. क्रत्वा for (कृत्वा)

३३. (घ) १. हृत for (हृत) २. माप्त (ग) (च) for (मास)
(ग) ३. मवमशेषं for (मवशेषं) ४. गुंणित for (गुंणितं)
५. मंशाद्यम् for (मशाद्यम्) (च)
(च) १. हूत for (हृत)

द्यु[1]गुण युगाधिमासैर्गुणितं युगभू[5]दिनैर्भजे[2]ल्लब्धम् ।
भगणादिमध्यमार्क[3]स्त्र्योदश गुणाधिक[4]श्चन्द्रः ॥ ३४ ॥
इष्टगु[1]णकारगुणितं ग्रहभगणैक्यांत[3]र यथा नि[4]हितम् ।
कृ[6]त्वा कुदिनैर्वि[5]भजे छेषो न[2] युतानि कुदिनानि ॥ ३५ ॥
[1]अघनभगणलब्धं घन[2]र्णमिष्टग्रहस्य युगभगणैः ।
अन्यफलमृणधनं चेद्धूनयुतान्यन्ययुगभगणाः ॥ ३६ ॥
भदिनानि ग्रहभगणैरूनानि भवंति साव[2]नदिनानि ।
इष्टा[1]श्विन्योदयिकाः स्वसावनैः पूर्ववन्मध्याः ॥ ३७ ॥
रविभगणाप्तं[1] दिसविकलं ज्ञेयमंडलेभ्यो यत् ।
मध्या[3]र्कसविकलकलासंगुणितं ज्ञेयमध्यम[2]कलाः ॥ ३८ ॥

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३४. (घ) १. द्युगणं (ग) द्युगुणं for (द्युगुण)   २. भीजल्लब्धम् for (भंजेल्लब्धम्)
३. मध्यमार्कत्रयोदश (ग) for (मध्यमार्कस्त्र्योदश)
४. गुणाधि चेंदुः (ग) गुणाधिकं चन्द्रः for (गुणाधिकश्चन्द्रः)
(ग) ५. भूदि नै (च) for (भूदिनै)
(च) १. द्युगणं for (द्युगुण)   ३. मध्यमार्क्कत्रयोदश for (मध्यमार्कस्त्र्योदश)
४. गुणाधिकश्चेंदुः for (गुणाधिकश्चन्द्रः)

३५. (घ) १. गुणित for (गुणितं)
२. छेषोऽनयुतानि for (छेषो न युतानि)
(ग) ३. क्यांतरं for (क्यांतर)
४. भिहितम् for (निहितम्)
५. विभजेत् शेषो for (विभजे छेषो)
(च) ६. कृत्वा for (कृत्वा)

३६. (घ) १. यद्यन्य (ग) for (अघन)   २. धनर्णं (ग) for (धनर्णं)
(च) १. अद्य for (अघ)   २. धनर्ण्यं for (धनर्णं)

३७. (घ) १. इष्टाश्विन्यौदयिकाः (ग) for (इष्टाश्विन्योदयिकाः)
(ग) २. सवनदिनानि for (सावनदिनानि)

३८. (घ) १. रविभगणाप्तलिप्तादि for (रविभगणाप्तम्)
(ग) २. मध्यकलाः for (मध्यमकलाः)
(च) ३. मध्यार्क्क for (मध्यार्क)

इष्टभगोन[1] भूदिनशेषैर्भगणैः क्रतो मध्यः[2] ।
अनुलोगमगो विलोमो भवति विलो[3]मोनुलोमगतिः ।। ३९ ।।
द्युगुणेन[2] कुदिनशेषै[3]रनुलोमगो विलोमगतिः ।
भवति विलोमो मध्यो[2]रनुलोमगो वाक्तः प्राग्वत्[4] ।। ४० ।।
कल्पदिनसप्तकवधात् कल्पगताहर्ग[2]णोनकच्छेषात् ।
सप्तहृ[1]ता दिनवारः शेषं[3] शन्यादिको भवति ।। ४१ ।।
व्यतिपा[3]त वैधृतान्यर्क[5] चंद्रभगण[4]युताद्विसंगुणिता[1] ।
गुरूवर्षाण्याश्वा युजा द्वादशगु[2]णिताः गुरोर्भगणाः ।। ४२ ।।
स्वोच्चग्रहयुगभगणा विशेषि[2]तास्वोच्चनीचपरिवर्ताः ।
भगणांतरं वि[1]योगा कार्यस्त्रैराशिकेन गताः ।। ४३ ।।

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३९. (घ) १. इष्टभगणोन (ग) (च) for (इष्टभगोन)
२. क्रतोग्रहो मध्यः for (क्रतोमध्यः)
३. लोमोऽनुलोमगतिः (ग) तिलोमोनुलोमगतिः for (विलोमोनुलोमगतिः)
(च) २. क्रतो ग्रहोमध्या for (क्रतोमध्यः)

४०. (घ) १. द्युगणेन (ग) (च) for (द्युगुणेन)
२. मध्योऽनुलोमगो (ग) मध्योनुलोमगो for (मध्योरनुलोमगो)
(ग) ३. शेषैर्भगणै for (शेषैरनुलोमगो) ४. प्रग्वत् for (प्राग्वत्)
(च) २. मध्योऽनुलोमगो for (मध्योरनुलोमगो)

४१. (घ) १. सप्तहृताद्दिनवारः (ग) सप्तहृतादिनवारः for (सप्तहृतादिनवारः)
(ग) २. हर्ग्रणो for (हर्गणो) ३. शेषः for (शेषं)
(च) १. सप्तहृताद्दिनवारः for (सप्तहृतादिनवारः)

४१. (घ) १. संगुणिताः (ग) (च) for (संगुणिता)
२. गुणिता गुरोर्भगणाः (ग) for (गुणिताः)
(ग) ३. व्यतीपात for (ब्यतिपात) ४. भगणा for (भगण)
(च) ५. वैधृतान्यर्क्क for (वैधृतान्यर्क) २. गुणिता for (गुणिताः)

४३. (घ) १. द्वियोगाः (ग) (च) द्वियोगा for (वियोगा)
(ग) २. विशेषिताः for (विशेषिता)

द्युगुणास्त्रिंशद्[1] भक्ताद्यलब्धं[2] द्विगुणितं सरूपं[4] तत् ।
सप्तविभक्तं शेषः सावनमासाधिपोर्कादि[3] ॥ ४४ ॥
षष्टिशतत्रयभक्तात् कल्पगताहर्गणात्[2]फलं त्रिगुणम् ।
सैकं[3] सप्तविभक्तं सायनवर्षाधिपोर्कादि ॥ ४५ ॥
अर्कोन[5]लग्नहोरा[2] पंच गुणाः सविकलाः[3] यदि सरूपाः ।
सप्तविभक्ता[1] शेषो दिनाधिपात्[4] कालहोरेशः ॥ ४६ ॥
त्रिचतुरनंतर षष्टयः[1] सावनमासाब्ददिनस[2]होरेशाः ।
दिनगतघटिका द्विगुणा[3] पंच हृता[4]श्चान्यमतमेतत् ॥ ४७ ॥
गछधनमिष्ट गुणितै[1]धनैर्युतोनं पृथक् पृथक् सहितम् ।
गुणक युतोन पदहृत[2] सर्वधनमतोवशेषाणि[3] ॥ ४८ ॥

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४४. (घ) १. द्युगणास्त्रिंशद् (ग) (च) for (द्युगुणास्त्रिंशद्)
२. यल्लब्धं (ग) भक्तात् यल्लब्धं for (भक्ताद्यलब्धं)
३. ऽर्कादिः for (र्कादि)
(ग) ४. सरूप for (सरूपं)
(च) २. भक्ताद्यल्लब्धं for (भक्ताद्यलब्धं) ३. र्क्कादिः for (र्कादि)

४५ (घ) १. र्कादिः for (र्कादि)
(ग) २. हर्ग्रणा for (हर्गणा) ३. सैक for (सैकं)
(च) १. र्क्कादिः for (र्कादि)

४६. (घ) १. सप्तविभक्ताः (ग) (च) for (सप्तविभक्ता)
(ग) २. होराः (च) for (होरा) ३. सविकला for (सविकलाः)
४. दिनपाद्यः काल for (दिनाधिपात् काल)
(च) ५. अर्क्कोन for (अर्कोन)

४७ (घ) १. षष्टाः (ग) (च) for (षष्टयः) २. दिवस(ग) for (दिनस)
३. द्विगुणाः (ग) (च) for (द्विगुणा)
(च) २. मासाब्द्दिवसहोरे रेशाः for (मासाब्ददिनसहोरेशाः)

४८ (ग) १. गुणतै for (गुणितै) २. हृतं for (हृत)
(च) ३. शाषेणि for (शेषाणि)

मध्योत्तरमेकोनार्याः पंचाशस्त्रयोदशोध्यायः[1] ।
ज्ञात्वैनं तंत्रविदामाचार्यो भवति मध्यगतौ ।। ४६ ।।

इतित्र्योदशोऽध्यायः[1]

इति ब्राह्मस्फुटसिद्धान्ते मध्यगतिप्रश्नोत्तराध्यायः
त्रयोदशः ।

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४६ (घ) १. पंचाशत्त्रयोदशोध्यायः (ग) पंचशत्त्रयोदशोव्यायः for (पंचाशस्त्रयोदशोध्यः)

(ग) २. नार्या for (नार्याः)

३. 'इति' से 'अध्यायः' तक अंकित नहीं, केवल समाप्तिसूचक ।। छः ।। ।।छः ।। ।। छः ।। अंकित है ।

(च) १. पंचाशत्त्रयोदशोध्यायः for (पंचाशस्त्रयोदशोध्यायः)

३. 'इति' से 'अध्यायः' तक लुप्त.

अथ स्फुटगत्युत्तराध्यायः

चतुर्दशः

भुजभागैः कोटिज्यां कोद्यंशैर्यः करोति बाहुज्याम् ।
कोटिं भुजेन बाहुं क्योस्त्रावा स्फुटगतिज्ञः सः ॥ १ ॥
परमफलकेंद्रविकः करोति कोटिछ्या स्फुटं कर्णम् ।
कर्णांतिकोटिकोद्या बाहुं वा स्फुटगतिज्ञः सः ॥ २ ॥
केंद्रभुजकोटिजीवा परमफलज्ञः करोति यः कर्णम् ।
स्वोच्चं स्वफलस्पष्टं करोति यः स्फुटगतिज्ञः सः ॥ ३ ॥
द्युगुणस्फुटग्रहयो भुजकोटिज्ये फले विना ज्याभिः ।
ज्याभिर्विना फलधनुः करोति वा स्फुटगतिज्ञः ॥ ४ ॥
इष्टश्विन्योदयिकान् करोति यो मध्यमान् ग्रहान् स्पष्टान् ।
स्वोच्चस्फुटैर्ग्रहं यः करोति वा स्फुटगतिज्ञः सः ॥ ५ ॥

१. (घ) १. कोटयंशै (ग) (च) for (कोद्यंशै) २. कोद्यावा (ग) (च) for (क्योस्त्रावा)
(ग) ३. कोटिभुजेन for (कोटिंभुजेन) ४. बाहु for (बाहुं)
(ङ) २. कोटया वा for (क्योस्त्रा वा) ५. स्फुटगतिज्ञः for (स्फुगतिज्ञः)
२. (घ) १. विद्युः (ग) वित् यः for (केन्द्रविकः) २. ज्यया (ग) (ङ) for (छया)
(ग) ३. कोटिम् for (कोटि)
(च) १. विद्युः for (विकः) ४. कर्ण्यं for (कर्णम्)
३. कर्ण्यातिकोटिकोद्या for (कर्णातिकोटिकोद्या) ५. ज्ञतिज्ञः for (गतिज्ञः)
(ङ) १. विद्यः for (विकः) ३. कोटिकोटया for (कोटिकोद्या)
३. (च) १. कर्ण्यं for (कर्णं)
(ङ) २. सफलं for (स्वफलं)
४. (घ) १. द्युगणा (ग) सुगुणात् for (द्युगुण) २. ग्रहं (ग) (च) (ङ) for (ग्रह)
(ग) ३. स्फुटं (ङ) for (स्फुट) ४. +सः+ (च) (ङ)
(च) १. द्युगणा for (द्युगुण)
(ङ) १. द्युगणात् for (द्युगुण)
५. (घ) १. इष्टाश्विन्यौदयिकान् (ग) इष्टाश्विन्योदयिकान् for (इष्टश्विन्योदयिकान्)
२. मध्यमान् स्पष्टान् for (मध्यमान् ग्रहान् स्पष्टान्)
(घ) ३. स्पुगतिज्ञः for (स्फुटगतिज्ञः)
(च) १. इष्टाश्विन्यो for (इष्टश्विन्यो)
(ङ) ४. मध्यान् for (मध्यमान्)

संक्रान्तेराद्यंतौ ग्रहस्य यो राशिभतिथिकरणांतान् ।
व्यतिपाताद्यंतौ वा यो वेत्ति स्फुटगतिज्ञः सः ॥ ६ ॥
व्यासदलमितरजीवाभुजकोट्यंशो क्रमज्ज्यया हीनम् ।
कोटिभुजज्या व्यासार्द्धकृतिविशेषात्पदं चान्या ॥ ७ ॥
कोटिज्ज्यया द्विगुणया गुणांत्यफलज्यता युतोनायाः ।
मृगकर्क्यादौ त्रिज्यां तत्फलकृतियुते पदं कर्णः ॥ ८ ॥
त्रिज्यांत्यफलत्ववितियुतेः कर्णकृतेश्चांतरेवशेषं यत् ।
द्विगुणांत्यफलहृतं तत्कोटीज्या बाहुजीवातः ॥ ९ ॥

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६. (घ) १. करणान्तात् (ग) (च) for (करणांतान्)
(ग) १. राद्यंतो for (राद्यंतौ) ३. तिथिक for (तिथि)

७. (घ) १. ज्येयाहीनाम् (च) for (ज्यया हीनम्) २. वान्या for (चान्या)
(ग) ३. कोटच्यंशोत्क्रम (च) for (कोट्यंशोक्रम)
(ङ) ३. कोटच्यंशोत्क्रम for (कोट्यंशोक्रम)

८. (घ) १. गुणयांत्यफल (ग) (च) for (गुणांत्यफल)
२. ज्यया (ग) (च) for (ज्यता)
३. त्रिज्यांत्यफल (ग) for (त्रिज्यां तत्फल) ४. युते: (ग) (च) for (युतेपदं)
(च) ६. मृगकर्क्यादौ for (मृगकर्क्यादौ) ३. त्रिज्यांत्यफल for (त्रिज्यांतत्फल)
५. कर्ण्यः for (कर्णः)
(ङ) १. ऽन्त्यफलज्या गुणितया for (गुणांत्यफलज्यता)
३. त्रिज्यान्त्यफलज्या for (त्रिज्यांतत्फल) ४. युते: for (युते)

९. (घ) १. त्रिज्यांत्यफत्वति for (त्रिज्यांत्यफलत्वति)
२. तत्कोटिज्या (च) (ङ) for (तत्कोटीज्या)
(ग) ३. कृति for (त्वति) ४. हृतं for (हृतं)
(च) १. त्रिद्यांत्य for (त्रिज्यांत्य) ३. फत्वतियुतेः for (फलत्वतियुतेः)
(ङ) ३. कृतियुतेः for (त्वतियुतेः) ५. तरेऽवशेषं for (नरेवशेषं)
६. जीवाऽतः for (जीवातः)

[१]कथ्नामंडल[६]तुल्यं प्रतिमंडल[२]मध्यमवनिमध्यात्स्वेत्[३] ।
[४]त्स्वोच्चनीचवृत्तव्यासार्द्धे भिमुखमुच्चास्य[५] ॥ १० ॥
प्रतिमंडलस्य परिधौ मध्यमभुक्त्या [२]स्फुटग्रहो भ्रमति ।
मंदोच्चादनुलोमं शीघ्रात्प्रतिलोमम[१]वनिस्थाः ॥ ११ ॥
स्पष्टं पश्यति [३]यस्मात् [१]मध्याद्धनाधिकं स्वकक्षायाम् ।
तस्मात्तदन्तरफलमृणं धनं [२]धने वा ग्रहे मध्ये ॥ १२ ॥
अंत्यफल[१]ज्ययात्स्वा[३]न्यदयोराद्यंतयोरूपरिकोटिः ।
[२]द्वितीययोर्यंतोधस्तदंतरैक्यं ततः [४]कोटिः ॥ १३ ॥

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१०. (घ) १. कक्षा (ग) (च) (ङ) for (कथ्ना) २. मंलमध्य for (मण्डलमध्य)
३. खे (ग) (ङ) for (स्वेत्) ४. तत्स्वोच्चनीच (ग) (ङ) for (त्स्वोच्चनीच)
५. मुच्चस्य (ग) (च) for (मुच्चास्य)
(ग) ६. तुल्य (ङ) for (तुल्यं)
(च) ३. त्स्वेत for (त्स्वेत्)
(ङ) ५. ऽभिमुखमुच्चस्य for (भिमुखमुच्चास्य)

११. (घ) १. अवनिस्थः (ग) for (अवनिस्थाः)
(ग) २. स्पुटग्रहो for (स्फुटग्रहो)
(च) १. मवनिस्थः (ङ) for (मवनिस्थाः)

१२. (घ) १. मध्यादूनाधिकं (ग) (च) (ङ) for (मध्याद्धनादिकं)
(ग) २. 'धने' लुप्त है, (ङ) ।
(च) ३. यस्मान् for (यस्मात्) ।

१३. (घ) १. ज्याग्रात्स्यात् (ग) for (ज्ययात्स्वान्)
२. द्वितृतीययोः (ग) for (द्वितीययो)
(ग) ३. पदयो for (यदयो) ४. कोटि for (कोटिः)
(च) १. अंतफ (त्यु) फलज्याया for (अंत्यफलज्यया)
३. त्स्वात्यदयो for (त्स्वान्यदयो)
(ङ) १. ज्याग्रात् for (ज्ययात्) ३. स्यात्पदयो for (स्वान्यदयो)
२. द्वितृतीययो for (द्वितीययो) ३. रधस्तात् for (यंतोधस्)

कोट्यांत्यफलाद्यैक्यं मकरादावंतरं कुलिरादौ ।
तद्बाहुज्याकृत्योः संयोगपदं भवति कर्णः ॥१४ ॥
प्रतिमंडलपदमाद्यं ग्रहत्रयं सांत्यधनुरतोन्यच्च ।
चक्र.द्धांतमतोन्यद्याद्यभचक्रांतं मंत्यमतः ॥ १५ ॥
त्रिमनेवांत्यफलधनुर्युतमाद्यं नवममं तृतीयपदमून ।
द्विचतुर्थेषु द्वादशभाग्निप्रतिमंडलपदानि ॥१६॥

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१४. (घ) १. कोटयंत्य (ग) for (कोट्यांत्य)
२. फलद्यैक्यं (ग) फलज्यैक्यं for (फलाद्यैक्यं)
३. कुलीरादौ (ग) (च) (ङ) for (कुलिरादौ)

(च) १. कोटयांत्य फलाद्यैकं for (कोट्यांत्यफलाद्यैकं) ४. कर्ण्यः for (कर्णः)

(ङ) १. कोटयन्त्य for (कोट्यांत्य) २. फलज्यैक्यं for (फलाद्यैक्यं)

१५. (घ) १. ग्रहत्रयं (ग) गृहत्रयं for (ग्रहत्रयं)
२. रतोऽन्यच्च (ग) रतोन्यश्च for (रतोन्यच्च)
३. मतोन्यद्व्याद्यभ (ग) for (मतोन्यद्याद्यभ)
४. चक्रांतमंत्यमतः (ग) for (चक्रांतमंत्यमतः)

(ग) ५. चक्रार्धंत for (चक्राद्धांत)
(च) १. गृहत्रयं (ङ) for (ग्रहत्रयं)
(ङ) ५. चक्र र्धमनेनोनं द्वितृतीयं चतुर्थमाद्यसमम् for (चक्राद्धांतमतोन्यद्याद्यभच-
क्रांतं मंत्यमतः)

१६. (घ) १. त्रिभमेवांत्य for (त्रिमनेवांत्य) २. नवमभम् for (नवममं)
३. मूनम् (ङ) for (मून) ४. भानि for (भाग्नि)

(ग) यह श्लोक इस प्रति में नहीं है ।

(च) १. त्रिभमेवांत्य for (त्रिमनेवांत्य) ४. द्वदशभानि for (द्वदशभाग्नि)
(ङ) १. त्रिभमन्त्य for (त्रिमनेवांत्य) २. नवमं for (नवममं)
४. षड्द्वादशभानि for (षुद्वादशभाग्नि)

कर्णाहृते[1] व्यासार्द्धं भुजज्यया गुणितमाप्तधनुराद्यैः[2]।
प्रोह्यदला[3]द्वितये[4] षड्राशियुतं[5] तृतीयपदे ॥ १७ ॥
चक्रत्प्रोह्य[1] चतुर्थे स्फुटोच्चयो[4]रंतरं स्वमंदोच्चे[2] क्षेप्यम्[5] ।
शीघ्रे शोध्यं तत्स्पष्टं[6] पूर्ववच्छेषम्[3] ॥ १८ ॥
मध्यस्फुटांतरकला बाहुफलं भवति तीक्ष्णकिरणस्य ।
स्फुटभुक्तयार्कादीनां[1] भुजान्तरं क्षयधनं रविवत् ॥ १९ ॥

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१७. (घ) १. कर्णाहृतं (ग) (ङ) for (कर्णाहृते) २. राद्यैः (ग) राद्ये for (राद्यैः)
३. भदला (ग) (ङ) for (दला)

(ग) (वि० यहां यह श्लोक १६ की संख्या पर अंकित है ।)

४. द्वितीये (ङ) for (द्वितये) ५. षड्राशयुतं for (षड्राशियुतं)

(च) १. हृतं for (हृते) ३. प्राकरभदला for (प्रोह्यदला)

(ङ) २. राद्ये for (राद्यैः)

१८. (घ) १. चक्रात्प्रोह्य (ग) (ङ) for (चक्रत्प्रोह्य)
२. मंदोच्चोत्क्षेप्यम् (ग) for (मंदोच्चे)
(वि० 'मंदोच्चे' पर श्लोकार्ध समाप्त ।)
३. छेषम् for (वच्छेषम्)

(ग) ४. स्पुटोच्च for (स्फुटोच्चयो)
५. 'क्षय्यं' for (क्षेप्यं)
(वि० इससे द्वितीय पंक्ति का आरम्भ)
६. स्पष्टः (ङ) for (स्पष्टं)
(वि० इसकी श्लोक संख्या १७ है ।)

(च) १. चक्रात्प्रोक्ष्य for (चक्रत्प्रोह्य) ६. तत्स्पष्ट for (तत्स्पष्टं)

(ङ) ३. पूर्ववत्शेषम् for (पूर्ववच्छेषम्)

(वि० श्लोक की दूसरी पंक्ति "क्षेपम्" शब्द से आरम्भ होती है ।)

१९. (ग) (वि० इसकी श्लोक संख्या १८ है)

(च) १. भुक्तयार्क्कादीनां for (भुक्तयार्कादीनां)

(ङ) १. भुक्तयार्क्कादीनां for (भुक्तयार्कादीनां)

मंडलशेषात्[3] स्वोच्चं विशोध्य शेषं[4] चतुर्गुणालब्धम्[2] ।
केंद्र[5] यदा निजिनगुणा[1] जीवा गतयेयगतयो यैः ।। २० ।।
छेदचतुर्थे[1] बाहुर्येयागतगतैस्तथा[2] कोटिः ।
प्राग्वदिनेन्दुभुजफलं[4] तथाफलं[5] भूसुतादिनाम्[3] ।। २१ ।।
फलचापकला गुणिते छेदे मंडलकलाह्लत लब्धम्[1] ।
मंडलशेषे पूर्ववद्रणधनमस्माद्[2] ग्रहः स्पष्टः ।। २२[3] ।।

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२०. (घ) १. गुणात् (ङ) for (गुणा) २. गतयेयैः (ग) गयेयैः for (गतयोयैः)
(ग) ३. शेखात् for (शेषात्) ४. शेखाश्च for (शेषं च)
५ पदानि for (यदानि) (च) (ङ)
(वि० इसकी श्लोक संख्या १६ है ।)
(च) १. यै for (यैः)
(ङ) ४. सद्दशं for (शेषं) ६. चतुर्गुणाल्लब्धम् for (चतुर्गुणालब्धम्)
२. गतयेयैः for (गतयोयैः)

२१. (घ) १. चतुर्थेबाहुर्ये (ग) चतुर्थेबाहु for (चतुर्थे बाहुर्ये)
२. यगतागतगवे (गे) यगतागतगतै for (यागतगतै)
३. सुतादीनाम् (ग) (ङ) for (सुतादिनाम्)
(ग) ४. 'भु' लुप्त है । (वि० इसकी श्लोकसंख्या २० है ।)
(च) १. चतुर्थेबाहुर्ये for (चतुर्थे बाहुर्ये) २. यगतागतगतैस्तथा (यागतगतैस्तथा)
३. सुतादीनां for (सुतादिनाम्)
(ङ) १. चतुर्थेबाहो for (चतुर्थेबाहु) २. येंयगता for (येंया)
५. मन्दफलं for (तथाफलं)

२२. (ग) १. कलाहृते ल्लब्धम् (ग) for (कलाह्लत लब्धम्)
२. पूर्ववद्दणधन (ग) (ङ) for (पूर्ववद्रण)
(वि०—यहाँ संख्याक्रम २२ के स्थान में २३ लिखा हुआ है)
(ग) यहाँ श्लोक संख्या २१ है । २२ वाँ श्लोक इसके स्थान पर निम्नांकित है—
भुजकोटयंशो न गुणाभाद्धांशातश्चतुर्थ भागोनैः ।
पंच द्वींदुखचंद्रैर्विभाजिता व्यासदलगुणिताः ।। २२ ।।
(च) १. हृतेल्लब्धं for (हृतलब्धम्) २. पूर्ववद्दणधन for (पूर्ववद्रणधन)
३. (वि० क्रमसंख्या २३ अंकित है ।)
(ङ) १. कलाहृते for (कलाह्लत)

तज्ये[3] परमफलज्या संगुणितात्[1] फ फले विनाद्याभिः[2] ।
इष्टोच्चनीचवृत्तव्यासार्द्धं[4] परमफलजीवा ॥ २३ ॥

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२३. (घ) वि० अतिरिक्त श्लोक —

तज्ये परमफलज्या संगुणितात्फले विभुजकोटय्ंशो न गुणा भाद्धींशास्तच्चतुर्थे भागो नेः । पंचद्वींदुखचंद्रै विभाजिता व्यासदलगुणिताः ॥ २३ ॥

(वि० यह श्लोक यहाँ २३ संख्याक्रम पर पाया गया)

२३. (घ) (वि० इसकी क्रम संख्या २४ है ।)

१. तत्पले (ग) संगुणितास्तत्फले for (संगुणितात्फफले)

२. ज्याभिः (ग) (ङ) for (द्याभिः)

(ग) वि० अतिरिक्त श्लोक —

सतज्ये परमफलज्या संगुणितास्तत्फले विना ज्याभिः ।
इष्टोच्चनीचवृत्तः व्यासार्द्धं परमफलजीवा ॥ २३ ॥

३. तत् ज्ये for (तज्ये)

(वि० इसकी क्रम संख्या २३ है ।)

(च) यहाँ पर यह पंक्तियाँ लुप्त हैं—इनके स्थान में निम्नांकित शब्द किसी अन्यलेख में-निम्नोपांत में अंकित हैं ।

"भुजकोटय्ंशो गुणा भाद्धींशास्तच्चतुर्थ भांतैः ।
पंचाद्धीं दुखचन्द्रै विभाजिता व्यासदलगुणिता ॥"

३. तद्ये for (तज्ये) १. संगुणितात्फले for (संगुणितात् फ फले)

(वि० क्रमसंख्या २४ अंकित है ।)

(ङ) २३ वाँ श्लोक निम्नांकित है—

:भुजकोटय्ंशोनगुणा भाद्धींशास्तच्चतुर्थभागोनैः ।
पञ्चद्वींदुखचन्द्रैर्विभाजिता व्यासदलगुणिता ॥ २३ ॥"

'तज्ये······जीवा' की क्रमसंख्या २४ है ।

३. तज्ज्ये for (तज्ये) १. तत्फले for (त् फले)

इष्टज्या संगुणिता[1] पंचकयमलैक शून्यचन्द्रमसा[2]।
इष्टज्या[3]पादयुतव्यासार्द्धविभाजितालब्धम्[4] ॥ २४ ॥
नवतिकृतेः प्रोह्यपदं नवतेः संशोध्य शेषकला[1]।
एवं धनुरिष्टाया[2] भवति ज्यया[3] विना ज्याभिः[4] ॥ २५[5] ॥
इष्टोदयिकभुजांतरमित[1] व[4] स्फुट[2] मध्यमांतरकलाभिः।
वाश्विन्यौदयिकेषु[3] स्वचर[5]प्राणैः स्वफलमेवम्[6] ॥ २६ ॥

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२४. (घ) (वि० इसकी क्रमसंख्या २५ दी गई है ।)
१. संगुणिताः (ग) (च) (ङ) for (संगुणिता)
२. चन्द्रमसः (ग) शून्यचन्द्रसमः for (चन्द्रमसा)
(च) २. चन्द्रमसः for (चन्द्रमसा) ३. इष्टद्या for (इष्टज्या)
४. (वि०क्रमसंख्या २५ अंकित है ।)
(ङ) (वि० इस श्लोक की क्रमसंख्या २५ है)
२. चन्द्रमसः for (चन्द्रमसा)

२५. (घ) १. कलाः for (कला) (ग) शेषभागकलाः or (शेषकला)
२. धनुरिष्टयो for (धनुरिष्टाया) ३. ज्याया (ग) (च) (ङ) for (ज्यया)
(वि० —इसकी संख्या २६ अंकित है)
(ग) ४. विज्याभिः for (विनाज्याभिः)
(च) १. शेषभागकलाः for (शेषकला) २. रिष्टया for (रिष्टाया)
५. (वि० क्रमसंख्या २६ अंकित है)
(ङ) १. शेषभागकलाः for (शेषकला) ४. विनाज्याभि for (विनाज्याभिः)
(वि० इसकी क्रमसंख्या २६ है)

२६. (घ) १. इष्टौदयिक (ङ) for (इष्टोदयिक)
२. मिनवत (ग) मिनवत् for (मितव)
३. नाश्विन्योदयिकेषु (ग) नाश्विन्योदधिकेषु for (वाश्विन्यौदयिकेषु)
(ग) ४. भुजातर for (भुजांतर) ५. स्वरप्राणैः for (स्वचरप्राणैः)
(च) ६. (वि० यहां क्रमसंख्या २७ अंकित है) (ङ)
(ङ) २. वि० मिनवत् for (मितव) ७. मिनवत् for (मेवम्)
३. नाश्विन्यौदयिकेषु for (वाश्विन्यौदयिकेषु)

स्वोच्चं[1] विशोध्य कृ[4]त्वा प्राग्वत्फलमृणधनं विपर्यस्वम्[2] ।
कार्यमि[3]नष्टेस्पष्टे पु[5]नः पुनर्निश्चलो[6] मध्यः ॥२७ ॥
मानार्द्धात्[7] षष्टि[5]गुणाद्भुक्ति हृ[3]तान्नाडिकादिलब्धेन ।
राश्यंतान् प्राणादि[1] पश्चा[2]देतोर्कसं[4]क्रांतेः[6] ॥ २८ ॥
संक्रांति पु[1]ण्यकालो यल्लब्धं नाडिकादि तद्द्वि[4]गुणम् ।
स्नानजपहोमा[2]दिकोत्र धर्मो विशिष्टफल[3] ॥ २९ ॥[4]

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२७. (घ) १. विविशोध्य (ग) स्वोच्चविशोध्य for (स्वोच्चं विशोध्य)

(वि० इसकी क्रमसंख्या २८ अंकित है)

(ग) २. विपर्यस्तम् (ङ) for (विपर्यस्वम्) ३. कार्यमनष्टे for (कार्यमिनष्टे)

(च) ४. क्रत्वा for (कृत्वा) ५. षुनः for (पुनः)

६. (वि० यहां क्रमसंख्या २८ अंकित है) (ङ)

(ङ) १. स्वोच्चाद् for (स्वोच्चं) ३. कार्यमनष्टस्पष्टे for (कार्यमिनष्टेस्पष्टे)

२८. (घ) १. प्रागादिः (ग) for (प्राणादि) २. पश्चादंतोर्क (ग) for (पश्चादेतोर्क)

(वि० इसकी क्रमसख्या २९ अंकित है)

(ग) ३. हृता (ङ) for (हृता) ४. संक्रान्ते for (संक्रान्तेः)

(च) ५. षष्टी for (षष्टिः) १. प्रागादिः (ङ) for (प्राणादि)

२. पश्चादंतोर्क्संक्रांतेः for (पश्चादेतोर्कसंक्रांतेः)

६. (वि० यहां क्रमसंख्या २९ अंकित है) (ङ)

(ङ) २. पश्चादंतोऽर्क for (पश्चादेतोर्क) ७. मानार्धात् for (मानार्द्धात्)

२९. (च) १. पुण्यकालो (ग) (च) for (पुष्यकालो)

(वि० इसकी क्रमसंख्या ३० अंकित है)

(ग) २. होमदानादि (ङ) for (होमादि) ३. फलम् for (फल)

(च) ४. (वि० यहां क्रमसंख्या ३० अंकित है) (ङ) ।

(ङ) १. पुण्यकालो for (पुष्यकालो) ४. तद्द्विगुणम् for (तद्विगुणम्)

२. होमदानादिकोऽत्र for (होमादिकोत्र)

३. विशिष्टफलः for (विशिष्टफल)

एवं नक्षत्रांतातिथिकरणतो छशिप्रमाणार्द्धात् ।
षष्टिगुणात् रविशशिनोभुक्तचंतर लब्धघटिकाभिः ॥ ३० ॥
संक्रांतिस्थो यावत्करोति मिश्रं फलं ग्रहस्तावत् ।
यस्मात्तस्मादिष्टो राद्यंतौ परिदरति लोकः ॥ ३१ ॥
चक्रार्द्धेऽर्कशशियुतौ भिन्नायनयोरपक्रमच्चे ।
रविशशिनोः सममधुधृतयोगादिषु वच्च्यतिपातः ॥ ३२ ॥

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३०. (घ) १. त्तिथि (ग) (च) for (तिथि) २. छसि (ग) शिशि for (छशि)
(वि० इसकी क्रमसंख्या ३१ है)
(ग) ३. करणी for (करणतो) ४. (च) (ङ) द्रवि for (त्रवि)
५. भुत्तचतर for (भुत्तचंतर)
(च) ३. करणांताछसि for (करणतोछशि) ६. क्रमसंख्यालुप्त
(ङ) ७. नक्षत्रान्तात् for (नक्षत्रान्ता) ३. करणान्ता for (करणतो)
२. च्छशि for (छशि) ५. भुंत्तचन्तर for (भुत्तचंतर)
(वि० इसकी क्रमसंख्या ३१ है) ।

३१. (घ) (वि० इसकी क्रमसंख्या ३२ है) १. विमिश्रं for (मिश्रं)
२. तस्माद्विष्टे (ग) तस्मादिष्टे for (तस्मादिष्टो)
३. परिहरति (च) (ङ) for (परिदरति)
(ग) ४. त्वाद्यंतौ for (राद्यंतौ) ५. (वि० क्रमसंख्या ३२ अंकित है) । (ङ)
(ङ) २. तस्माद्विष्टे for (तस्मादिष्टो)

३२. (घ) (वि० इसकी संख्या ३३ अंकित है) ।
१. कक्रार्द्धे (ग) चक्रार्धेर्के for (चक्रार्द्धेऽर्कं)
२. रपक्रमसमच्चे (ग) रूपक्रमसमत्वे for (रपक्रमच्चे)
३. योगद्विषवद्वातीपातः (ग) तद्वषवद्वयतीपातः for (योगादिषुवच्च्यतिपातः)
(च) २. रपक्रममच्चे for (रपक्रमच्चे)
३. योगाद्दिषुवद्वयतीपातः for (योगादिषुवच्च्यतिपातः)
४. (वि० क्रमसंख्या ३३ अंकित है) (ङ)
(घ) २. रपक्रमसमत्वे for (रपक्रमच्चे) ३. योगाद्विषदो for (योगादिषु)
४. व्यतीपातः for (वच्च्यतिपातः)

चक्रे वैधृतमेकायतस्थयोः[1] क्रांतिजीवयोः[5] साम्ये[6] ।
धन[2]रविगणि[3]योगादग्नि वदूनाधिक[7] कलभ्यः[4] ।। ३३ ।।[8]
भुक्त्यैक्य[1]लब्धदिवसैः रवींदुपातायुतोनकाः स्वफलैः ।
अर्कक्रान्तिज्याधनुरिंदो विक्षेप[2]युक्तोनम्[4] ।। ३४ ।।
त्रिनवग्रहेंदु[1] क्रान्तिर्मेव[2] तुलादौ दिवाकरक्रांतः[3] ।
उना[4]यावदभावस्तावद्भावो[5] न्यथा[6]र्केन्द्वोः[7] ।। ३५ ।।

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३३. (घ) १. मेकायस्थयोः (ग) मेकायनस्थयोः for (मेकायतस्थयोः)
२. इंधन (ङ) (ग) (च) for (धन)
३. मणि (ग) (च) (ङ) for (गणि)
४. कलाभ्यः (ग) (च) (ङ) for (कलभ्यः)
(वि० इसकी क्रमसंख्या ३४ अंकित है) (ङ)
(ग) ५. जीवाया: for (जीवयोः) (प्रथम पंक्ति समाप्त)
६. दूसरी पंक्ति का अंतिम पद ।
७. वरूनाधिक for (वदूनाधिक)
(च) ८. क्रमसंख्या ३४ अंकित है (ङ) ।
(ङ) १. मेकायनस्थयोः for (मेकायतस्थयोः)

३४. (घ) १. भुतर्यैक्य (ग) (च) (ङ) for (भुक्त्यैक्य)
२. विक्षेप (ग) (च) (ङ) for (विक्षेप)
(वि०-इसकी क्रम संख्या ३५ अंकित है)
(च) ३. अर्क्क for (अर्क)
४. (वि०—यहां क्रमसंख्या ३५ अंकित है) (ङ)
(ङ) ५. दिवसै for (दिवसैः)

३५. (घ) १. त्रिनवगृहेंदु (ग) (च) (ङ) for (त्रिनवग्रहेंदु)
२. मेंष (ग) (च) (ङ) for (मेंव)
४. ऊना (ग) (च) (ङ) for (उना) ५. ऽन्यथा (ङ) for (न्यथा)
(वि०—इसकी क्रमसंख्या ३६ अंकित है ।)
(च) ६. र्क्केंद्वोः for (र्केन्द्वोः)
७. (वि०—यहां क्रमसंख्या ३६ अंकित है) (ङ)
(ङ) ३. दिवाकरक्रान्तेः for (दिवाकरक्रान्तः)

व्यतिपातयोपक्रमयोर्दिवसाम्ये वैधृतं दिगन्यत्वे ।
अधिको द्यूनः कल्पो दिग्मेदेपक्रमः शशिनः ।। ३६ ।।
मेषतुलादाविन्दोरपक्रमेल्यपक्रमाद्दुने ।
एष्यत्यधिके तीतो विपरीतः कार्कमकरादौ ।। ३७ ।।
क्रान्त्योर्युतिरन्यदिशोरेकदिशोरन्तरं व्यतिपाते ।
एकादशो युतिरंतरमन्यदिशो वैधृते प्रथमः ।। ३८ ।।

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३६. (घ) (वि०—इसकी क्रमसंख्या ३७ अंकित है)
१. व्यतिपातोपक्रमयो (ग) व्यतीपातोपक्रमयो for (व्यतिपातयोपक्रमयो)
२. दिक्साम्ये (ग) दिक्साम्ये (च) for (दिवसाम्ये)
३. दिग्भेदे (ग) (च) for (दिग्मेदे)
(ग) ४. अधिकाप्यूनः for (अधिकोद्यूनः)
(च) १. व्यतिपातोपक्रमयो for (व्यतिपातयोपक्रमयो)
५. वैद्धृतं for (वैधृतं) ६. (क्रमसंख्या ३७ अंकित है) (ङ)
(ङ) १. व्यतिपातोऽपक्रमयो for (व्यतिपातयोपक्रमयो)
२. दिक्साम्ये for (दिवसाम्ये) ५. वैधृतो for (वैधृतं)
४. न्यूनः for (द्यूनः) ७. कल्प्यो for (कल्पो)
३. ऽपक्रमः for (पक्रमः)
३७. (घ) (वि०—इसकी क्रमसंख्या ३८ है)
१. दूने (ग) द्यूने for (दुने) २. ऽतीतो for (तीतो)
३. कर्क्वि (ग) कर्क्कि for (कार्कि)
४. मेतुला for (मेषतुला)
(च) १. दूने for (दुने) ३. कर्क्किमकरादौ for (कार्किमकरादौ)
५. (वि०—यहां क्रमसंख्या ३८ अंकित है) (ङ)
(ङ) १. दूने for (दुने) २. त्यधिकोऽतीतो for (त्यधिकेतीतो)
३. कर्क for (कार्कि)
३८. (घ) (वि०—इसकी क्रमसंख्या ३९ अंकित है)
१. एकदिशो (ग) एदिशोर्युति for (एकादशोयुति)
(ग) २. व्यतीपाते (ङ) for (व्यतिपाते)
(घ) १. एकदिशोर्युति (ङ) for (एकादशोयुति)
३. (वि०—यहां क्रमसंख्या ३९ अंकित है) (ङ)
(ङ) ४. वैंधृते for (वैधृते)

एवं द्वितीयराशियुतिहीनै[४] रिष्टनाडिका[२]स्वफलैः ।
एष्यदतीत वा यदिराशिद्वयमपि तदंतरकम् ॥ ३६[३] ॥
छेदोन्यथा तदैक्यं घात[२]स्येष्टघटिका प्रथमराश्योः ।
फलघटिकाभिर्मध्यं द्वयो[३]रपि प्रथ[१]मराशिवशात् ॥ ४०[४] ॥
तात्कालिकैर्ग्रहैर[३]सकृदिष्टघटिकाफलोन[१]युक्तैस्तैः ।
प्राग्वत्प्रथमे[२] छेदः प्रमाणयोगार्द्धलिप्तानाम् ॥ ४१[४] ॥
इष्टघटिकागुणा[५]नामसकृत[१] फलनाडिकाभिराद्यंतैः[२] ।
व्यतिपाप[३]वैधृतानयनमन्यतंत्रेषु न ग्राह्[४]यात् ॥ ४२[६] ॥

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३६. (घ) (वि०—इसकी क्रमसंख्या ४० अंकित है)
१. एष्यदतीनं for (एष्यदतीतं)
(च) २. नाडिकाः for (नाडिका) १. ऐष्यदतीतं for (एष्यदतीतं)
३. (वि०—यहां क्रमसख्या ४० अंकित है) (ङ)
(ङ) ४. युतहीनै for (युतिहीनै)
४०. (घ) (वि०—इसका संख्याक्रम ४१ है)
१. प्रमराशिवशात् for (प्रथमराशिवशात्)
(ग) २. घतस्येष्ठ for (घातस्येष्ट) ३. द्वरपि for (द्वयोरपि)
(च) ४. (वि०—यहां क्रमसंख्या ४१ अंकित है) (ङ)
४१. (घ) (वि०—इसकी क्रमसंख्या ४२ है)
१. फलोनक्तैस्तैः for (फलोनयुक्तैस्तैः)
२. प्रथमछेदः (ग) प्रमछेदः for (प्रथमेछेदः)
(च) ३. रसक्रदिष्ट for (रसकृदिष्ट) ४. (वि०—यहां क्रमसंख्या ४२ अंकित है) (ङ)
(ङ) २. प्रथमश्छेदः for (प्रथमेछेदः)
४२. (घ) (वि०—इसकी क्रमसंख्या ४३ है)
१. असक्रत्फल (ग) for (असकृतफल) २. राद्यंतो (ग) for (राद्यंतैः)
३. व्यतिपात (ग) व्यतीपात (ग) व्यतीपात for (व्यतिपाप)
४. ग्राह्मात् (ग) ब्रह्मात् for (ग्राह्यात्)
(ग) ५. गुणनाम् for (गुणानाम्)
(च) १. मसक्रत्फल for (मसकृतफल) ४. ग्राह्मात् for (ग्राह्यात्)
६. (वि०—क्रमसंख्या ४३ अंकित है) । (ङ)
(ङ) १. असकृत् for (असकृत) २. राद्यन्तौ for (राद्यंतैः)
३. व्यतिपात for (व्यतिपाप) ४. ग्राह्मात् for (ग्राह्यात्)

रविर्बिंबमेकमार्गाच्छिशिबिंबापक्रमे भवति यावत् ।
तावत्फलं तदुक्तं तद्भावो तत्फलाभावः ॥ ४३ ॥
ग्रहकक्ष्यायनतुल्याः कक्षास्तन्मंदशीघ्रपातानाम् ।
यस्मात्तस्मान्न पृथकक्षाः कल्प्याश्चलोच्चाद्याः ॥ ४४ ॥
पौलिशरोमकवाशिष्ट सौरपैतामहेषु यत्प्रोक्तम् ।
तन्नक्षानयनं नार्यभटोक्तं तदुक्तिरतः ॥ ४५ ॥

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४३. (घ) (वि०—इसकी क्रमसंख्या ४४ है)
१. मार्ग्रा (ग) मार्ग्रात शशि for (मार्गाच्छिशि)
२. तदभावे (ग) तद्भावे for (तद्भावो)

(ग) ३. बिंबापक्रमो for (बिंबापक्रमे) ४ तावत्पलं for (तावत्फलं)
५. तत्फलोभाव: for (तत्फलाभाव:)

(च) २. तदभावे for (तद्भावो) ६. (वि०—क्रमसंख्या ४४ अंकित है) (ङ)

(ङ) १. मार्गाच्छिशि for (मार्गाच्छिशि) २. तदभावे for (तद्भावो)

४४. (घ) (वि०—इसकी क्रमसंख्या ४५ है)
१. पृथक्कक्षा: (ग) पृथक् कक्ष्या for (पृथकक्षा:)
२. कल्प्याश्चलोच्चाद्या: (ग) कल्पाचलोच्चाद्यात् for (कल्प्याश्चलोच्चाद्या:)

(ग) ३. ग्रहकक्षायन तुल्या for (ग्रहकक्ष्यायनतुल्या:) ४. तस्मात्तते for (तस्मान्न)

(च) १. पृथक्कक्षा: for (पृथकक्षा:) ५. (वि० क्रमसंख्या ४५ अंकित है) (ङ)

(ङ) ३. कक्षयैव for (कक्ष्यायन) १. पृथक् कक्षा for (पृथकक्षा:)
७. तुल्या कक्षा for (तुल्या:कक्षा) २. कल्प्या for (कल्प्याश्)
७. स्तनमंद शीघ्र for (तन्मन्द) ८. चलोचाद्या for (चलोच्चाद्या:)

४५. (घ) (वि०—इसकी क्रमसंख्या ४६ है)
१. तन्नक्षत्रानयनम् (ग) for (तन्नक्षानयनं)

(ग) २. पौलश for (पौलिश) ३. सौर्य for (सौर)

(च) १. तन्नक्षत्रानयनं for (तन्नक्षानयनं) ४. (यहां क्रमसंख्या '४६' अंकित है ।)

(ङ) ५. वासिष्ठ for (वाशिष्ठ)

अध्वर्द्धार्द्ध[1] क्षेत्रान्यूडुनि[2] षट्[4] षट्[3] भवन्ति पञ्चदशाः[5] ।
ऋक्षाणि समक्षेत्राण्यभिजिद्भोगो भवत्येकः ।। ४६[6] ।।
केशादित्यविशाखा[5] प्रोष्ट[6] पदार्यम्ल[4] वैश्वदेवाग्नि[1] ।
षट् षट् ज्येष्टाभरणी स्वात्यर्द्धा[2] त्रारूणाश्लेषा[3] ।। ४७[7] ।।
पंचदशात्रानुक्ता न्येको भिजदुक्त[1]रक्ष[5]भोगोन्यः[2] ।
तन्मानं[3] नाक्षत्रं दुरधिगमं मंदबुद्धिनाम्[4] ।। ४८[6] ।।

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४६. (घ) (वि० इसकी क्रमसंख्या ४७ है)

१. अध्यर्द्धार्द्ध (ग) (च) for (अध्वर्द्धार्द्ध)

२. क्षेत्राण्युड्डूनि (ग) for (क्षेत्रान्यूडुनि) ३. पट् (ग) षड् for (षट्)

(ग) ४. 'षट्' पद लुप्त है ५. दशः for (दशाः)

(च) २. क्षेत्राण्युड्डूनि for (क्षेत्रान्यूडुनि) ३. पट् for (षट्)

६. (यहां क्रमसंख्या ४७ अंकित है।) (ङ)।

(ङ) अध्यर्धानि भवन्ति षड् नक्षत्राण्युड्डूनि षडर्धानि ।

पञ्चदश समक्षेत्राण्यभिजिद्भोगो भवत्येकः ।।४७।।

for

"अध्वर्द्धार्द्ध क्षेत्रान्यूडुनि षट् षट् भवन्ति पञ्चदशाः ।

ऋक्षाणि समक्षेत्राण्यभिजिद्भोगो भवत्येकः ।। ४६।।

४७. (घ) (वि० इसकी क्रमसंख्या ४८ है)

१. वैश्वदेवानि (ग) (च) (ङ) for (वैश्वदेवाग्नि)

२. स्वात्यार्द्रा (ग) for (स्वात्यर्द्धा) ३. श्लेषाः (ङ) for (श्लेषा)

(ग) ४. मदार्यम्ल for (पदार्यम्ल)

(च) ५. विशाषा for (विशाखा) ६. प्रौष्ट for (प्रोष्ट)

२. स्वात्यार्द्धा for (स्वात्यर्द्धा) ३. श्लेषाः (ङ) for (श्लेषा)

७. (वि० —यहां क्रम संख्या अंकित नहीं है)

५. पदार्यम्ण for (पदार्यम्ल) २. स्वात्यार्द्रा for (स्वात्यर्द्धा)

४८. (घ) (वि०—इसकी क्रमसंख्या ४९ है)

१. ऽभिजिदुक्त (ङ) for (भिजिदुक्त)

२. भोगोऽन्यः (ग) भोगान्यः for (भोगोन्यः) ३. तात्मानं for (तन्मानं)

४. मंदबुधीनाम् (ग) (च) मंदबुद्धीनां for (मंदबुद्धिनाम्)

(ग) ५. ऋक्ष (ङ) for (रक्ष) (च) ३. तत्मानं for (तन्मानं)

६. (वि०—यहाँ क्रमसंख्या ४९ अंकित है) (ङ)

(ङ) ३. यस्मात् तन्नक्षत्रं for (तन्मानं नाक्षत्रं) ४. मन्दबुद्धीनाम् for (मंदबुद्धिनाम्)

अध्यर्द्धा[2] समक्षेत्राणां मध्यगते[3] लिप्तिकाः शशिनः ।
अध्यर्द्धार्द्धैक[4]गुणा भभोगलिप्तास्तदैक्योना[1] ॥ ४९[5] ॥
मंडललिप्ताः शेषो भोगोभिजित्[1] शशांक[2] भगणा[3] वा ।
त्रिघनगुणाः संशोध्याः कल्पदिनेभ्यो यदवशेषम् ॥ ५०[4] ॥
तद्भगणैर्दिनभोगो[1] भिजितो भभोगलिप्तोनाः[3] ।
भानि ग्रहभुक्त[4]कला गतगम्या गतिहृता[2] दिवसाः[5] ॥ ५१[6] ॥
भफलं प्रोक्तमभिजितो मंगलपात्रासु[3] संहिताकारैः ।
यैस्तद्भोगोनोक्तास्ते[1] गणकाः संहिता[2]बाह्याः ॥ ५२[4] ॥

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४९. (घ) (वि०—इसकी श्लोक संख्या ५० अंकित है)
१. तदैक्योनाः (च) (ङ) for (तदैक्योना)
(ग) २. अध्यद्धार्द्ध for (अध्यर्द्धा) ३. मध्यगति (ङ) for (मध्यगते)
(च) ४. अध्यर्घ्यार्द्धैक for (अध्यर्द्धार्द्धैक)
५. (वि०—यहां क्रमसंख्या ५० अंकित है) (ङ)
(ङ) २. अध्यर्घार्घ for (अध्यर्द्धा) ४. अध्यर्घार्घैक for (अध्यर्द्धार्द्धैक)

५०. (घ) (वि०—इसकी क्रमसंख्या ५१ है)
१. भोगोऽभिजित् (ग) भोगोभिजितः for (भोगोभिजित्)
(ग) २. शशी for (शशांक) ३. भगणैर्वा for (भगणावा)
(च) ४. (वि०—यहां क्रमसंख्या ५१ है) (ङ)
(ङ) १. ऽभिजितोभोगः for (भोगोभिजित्)

५१. (घ) (वि०—इसकी क्रमसंख्या ५२ है)
१. भुक्तिर्भोगाभिजितो (ग) दिनभुक्तिर्भोगो for (दिनभोगो)
२. हृता (ग) (च) for (हृता)
(ग) ३. लिप्तोनाम् for (लिप्तोनाः) ४. भुक्ति for (भुक्त)
५. दिवसा for (दिवसाः)
(च) ६. (वि०— यहां क्रमसंख्या ५२ है) (ङ)
(ङ) १. ऽभिजितो for (भिजतो) ७ + भोगो +

५२. (घ) (वि० इसकी क्रमसंख्या ५३ है) १. नोक्तस्ते (ग) (ङ) for (नोक्तास्ते)
(ग) २. सहिता for (संहिता)
(च) ३. यात्रासु for (पात्रासु) ४. (वि०—यहां क्रमसंख्या ५३ अंकित है) (ङ)
(ङ) ३. यात्रासु for (पात्रासु)

अर्घ्यार्द्ध[1]क्षेत्राणि[2] संहिता स्वभिहितानि गर्गाद्यैः ।
यस्मादुड्डुनि[3]तस्मान्नार्यभटोक्तं तदानयनम् ॥ ५३[4] ॥
आर्याणां पञ्चांश[1]च्चतुर्भिरधिका चतुर्दशो[2]ऽध्यायः ।
चतुर्दशो[3]ध्यायः समाप्तः

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५३. (घ) (वि०—इसकी क्रमसंख्या ५४ है)
१. अध्यर्द्धा (ग) अध्यर्द्धादि for (अर्घ्यार्द्ध) २. क्षत्राणि for (क्षेत्राणि)

(ग) ३. यस्मादुड्डति (च) for (यस्मादुड्डनि)

(च) १. अध्यर्द्धार्द्धक्षेत्राणि for (अर्घ्यार्द्धक्षेत्राणि)
४. (वि०—यहां क्रमसंख्या ५४ अंकित है) ।

(ङ) १. अध्यर्धादि for (अर्घ्यार्द्ध) ३. यस्मादुडूनि for (यस्मादुडूनि)

५४. (घ) १. चतुर्भि (ग) च्चतुर्भि for (चतुभि) २. चतुर्द्दशो (ग) for (चतुर्दशो)

(ग) 'चतुर्दशो' से 'समाप्तः' तक अंकित नहीं है । इसकी दूसरी पंक्ति निम्नांकित है
'स्फुटगतिरुत्तरमन्या दिशा व्यूह्यत्प्रस्नात् ॥५४॥

(च) १. पञ्चाशच्चतुर्भिरधिका for (पञ्चांशच्चतुभिरधिका)
२. चतुर्द्शोध्यायः for (चतुर्दशोऽध्यायः)
३. 'छ' for (चतुर्दशोध्यायः समाप्तः)

(ङ) १. च्चतुर्भि for (च्चतुभि)
४. + स्फुटगत्युत्तरमन्यान् दिशाऽनयया ऽभ्युपगमेत् प्रश्नान् ॥५५॥
३. इति स्फुटगत्युत्तराध्यायश्चतुर्दशः for (चतुर्दशोऽध्यायः समाप्तः)

अथ त्रिप्रश्नोत्तराध्यायः

पञ्चदशः

स्फुटगत्युत्तरमन्या दिशानयाप्पूहयेत्प्रश्नम्।

योह्लपूर्वापरयोस्तुल्यछायांगुलाग्रयो बिन्दु।

विक्ष्याक्रांन्त्याक्षांशै विना दिशो वेत्ति गणकः सः ॥ १ ॥

त्रिछायाग्रज्ञो यः क्रान्त्यक्षार्के विना दिशो भ्रमणम्।

छायाग्रस्य दिनार्द्धे छायां वा वेत्ति गणकः सः ॥ २ ॥

यः छायाग्रं दृष्ट्वा क्रांत्यक्षज्ञो दिशो विजानाति।

शंकुछायाभ्रमणे दिक्ज्ञो वा वेत्ति गणकः सः ॥ ३ ॥

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१. (घ) १. प्रश्नात् (च) for (प्रश्नम्) २. (वि०—यहाँ पर समाप्तिसूचक चिह्न है)
३. योऽह्न (ग) येह्नः for (योह्न) ४. बिंदू (ग) बिंदुः for (बिंदु)
५. वीक्ष्य (ग) for (विक्ष्य) ६. विना (ग) for (विना)
(ग) ७. स्फुटगतिरुत्तर for (स्फुटगत्युत्तर)
८. व्यूयत्प्रस्नात् ॥ ५४ ॥ for (प्पूहयेत् प्रश्नम्)
(च) ३. योऽह्न for (योह्न) ५. विक्ष्य for (विक्ष्या)
४. बिंदू for (बिंदु) ६. विना for (विना)
(ङ) ३. योऽह्न for (योह्न) ४. विन्दु for (बिंदु)
५. बीक्ष्य for (विक्ष्या) ७. क्रान्त्यक्षांशै for (क्रान्त्याक्षांशैं)
६. विना for (विना)

२. (घ) १. ग्रछाया for (त्रिछाया) २. दि अर्द्धे छायां (ग) दिनार्द्ध for (दिनार्द्धे)
(ग) ३. क्रांति क्षार्के विना for (क्रान्त्यक्षार्के विना)
(च) ३. क्रान्त्यक्षार्क्के for (क्रान्त्यक्षार्के)
(ङ) १. त्रिच्छाया for (त्रिछाया) ३. क्रान्त्यक्षार्के विना for (क्रान्त्यक्षार्के विना)
२. दिनार्धच्छायां for (दिनार्द्धे छायां)

३. (ग) १. दिज्ञो for (दिशो) २. "सः" यहाँ यह पद लुप्त है
३. यश्छायाग्रं for (यः छायाग्रं)
(वि० इसकी श्लोक संख्या ४ है। तीन की संख्या का श्लोक लुप्त है।)
(च) ४. क्रत्यक्षज्ञो for (क्रांत्यक्षज्ञो)
(ङ) ३. यश्छायाग्रं for (यः छायाग्रं) १. दिग्ज्ञो for (दिक्ज्ञो)
५. शंकुच्छाया for (शङ्कुछाया)

दृष्ट्वा विषुवछायां[4] लम्बश्नेज्ये[1] करोति यो बहुधा ।
मध्यछायार्कज्ञो[3] श्नांशान्यो[2] वेत्ति गणकः सः ॥ ४ ॥
यश्चरखंडकलं[1]कोदयाद्विजानाति[5] लग्नमुदयैः स्वैः ।
लग्ना[2] घटिका छा[3]यांगत शेषनताच्च[4] गणकः सः ॥ ५ ॥
गतशेषनता घटिका छायातो[3] भिष्टदिनदलछायां[1][4] ।
बहुधार्कक्रान्त्यश्नान[2] दृष्ट्वा यो वेत्ति गणकः सः ॥ ६ ॥

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४. (घ) १. लंबक्षोज्य (ग) for (लंबश्नेज्ये)
२. ऽक्षांशान् (ग) क्षांशान् for (श्नांशान्)

(ग) (वि० इसकी श्लोक संख्या ५ है)

(च) १. लंवक्षेज्ये for (लंबश्नेज्ये) ३. मध्यछायाऽक्र्कज्ञो for (मध्यछायार्कज्ञो)
२. क्षांशान् for (श्नांशान्)

(ङ) ४. विषुवच्छायां for (विषुवछायां) १. लंबाक्षज्ये for (लंबश्नेज्ये)
३. मध्यच्छाया for (मध्यछाया) २. ऽक्षांशान् for (श्नांशान्)

५. (घ) १. खंड (ग) for (खंडकलं) २. लग्नाद्घटिका (ग) for (लग्नाघटिका)

(ग) (वि० इसकी श्लोक संख्या ६ है)
३. श्छाया for (छायांगत) ४. नताश्च (च) for (नताच्च)

(च) २. लग्नाद्धटिका for (लग्नाघटिका) ४. नत्ताच्च for (नताच्च)

(ङ) १. खण्डक for (खंडक) ५. लङ्कोदयान् for (लङ्कोदयाद्)
२. लग्नाद् for (लग्ना) ३. घटिकाश्छायां for (घटिकाछायां)

६. (घ) १. ऽभीष्ट (ग) भीष्ट for (भिष्ट) २. क्रान्त्यक्षान् (ग) for (क्रांत्यश्नान)

(ग) ३. श्छायातो (ङ) for (छायातो) ४. छायाः for (छायां)
(वि० इसकी श्लोक संख्या ७ है)

(च) १. ऽभीष्ट (ङ) for (भिष्ट)
२. बहुधार्क्कक्रान्त्यक्षान् for (बहुधार्कक्रान्त्यश्नान)

(ङ) ४. दलच्छायाम् for (दलछालां)
२. बहुधा क्रान्त्यर्काक्षान् for (बहुधार्क क्रान्त्यश्नान)

[1]क्रांतिज्ञः सममंडल शं[2]कु[3]कर्णं [4]वयोश्नलंबज्ञः ।
[5]जानाति कोणशं[6]कुच्छाया घटिकाः स तंत्रज्ञः ॥ ७ ॥
शंकुतलप्राच्यपरांतरद्वयं [1]विक्षयो विजानाति ।
वि[4]षुवच्छायामेकं [2]द्रष्ट्वादित्यं [3]च गणकः सः ॥ ८ ॥
[5]पातलशंकु[1]मुदयेंदुस्ते वा दृग्ज्यां खे [3]विजानाति ।
[2]द्रक् पाताल [6]द्रक्शंकोः पृथक् तले वा स [4]तंत्रज्ञः ॥ ९ ॥

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७. (घ) १. कांतिज्ञः for (क्रांतिज्ञः) २. शंकुं (च) (ङ) for (शंकु)
३. कर्णः (च) for (कर्णं)
४. वयोक्षलंबज्ञः (ग) च योक्षलंबज्ञः for (वयोश्नलंबज्ञः)
५. जानाति जानाति for (जानाति) ६. शंकुं for (शंकु)
(ग)(वि०— इसकी श्लोक संख्या ८ है)
(च) ४ वयोक्षलंबज्ञः for (वयोश्नलंबज्ञः)
(ङ) ३. कर्णं च for (कर्णं व) ४. योश्नलंबज्ञः for (योश्नलम्बज्ञः)
६. शंकुच्छाया for (शंकुछाया)

८. (घ) वीक्ष (ग) वीक्ष्य for (विक्षयो)
२. दृष्ट्वादित्यं (ग) (च) for (द्रष्ट्वादित्यं)
(ग) (वि०—इसकी श्लोकसंख्या ९ है)
(च) १. वीक्ष for (विक्ष) ३. व for (च)
(ङ) १. वीक्ष्य for (विक्ष) ४. विषुवच्छाया for (विषुवछाया)
२. दृष्ट्वाऽऽदित्यं for (द्रष्ट्वादित्यं)

९. (घ) १. मुदयेऽस्ते (ग) मुदयेस्ते for (मुदयेंदुस्ते)
२. दृग्पावालगशंक्वोः (ग) दृग्पातालगशंकुकोः for (द्रक्पाताल द्रक्शंकोः)
(ग) ३. विजानाति for (विजानाति)
४. तत्रज्ञः for (तंत्रज्ञः) ५. पाताल for (पातल)
(वि०—इसकी भी श्लोकसंख्या ९ है)
(च) ५. पाताल for (पातल) २. दृग्पाताल for (द्रक्पाताल)
६. द्रग्शंक्वोः for (द्रक्शंकोः)
(ङ) ५. पाताल for (पातल) २. दृक्पाताल for (द्रक्पाताल)
१. मुदयेऽस्तो for (मुदयेन्दुस्ते) ३. खेविजानाति for (खे विजानाति)
६. गशङ्क्वोः for (द्रक्शंकोः)

दिनगत[२]शेषप्राणैरिष्टार्को[१] दिनदलान्नतै[४]रथवा ।
भवति सम[५]मंडले यैर्यस्तान् कथयति स तंत्र[६]ज्ञः ॥ १० ॥
सममंडलगः[३] प्राणै[१]र्दिनगत शेषै नतै[२] र्दिनार्द्धाद्वा ।
यै[४]र्भवति ज्ञात्वा[५] तान्योऽर्कं[६] कथयति स तंत्रज्ञः ॥ ११ ॥
यः सम[५]मंडलशंकु[१]कर्णं व[२] वीक्ष[३] सूर्यमानयति[२] ।
रविसममंडलशंकुज्ञो[६] क्षं कथयति[४] स तंत्रज्ञः ॥ १२ ॥
रविलग्नांतर घटिका[१] विनोदयैर्लग्न[२]मिष्टघटिकाभिः ।
वेत्ति चरार्द्धादक्षं योर्कज्ञो[३] वा स तंत्रज्ञः ॥ १३ ॥
अक्षचरार्द्धाज्ज्ञार्कं[३] छायातो यश्चरार्द्ध[१]मिष्टायाः ।
इष्टचरार्द्धा[४]दथवा छायां कथयति[२] स तंत्रज्ञः ॥ १४ ॥

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१०. (घ) १. रिष्टाऽर्कां (ग) रिष्टाऽर्को for (रिष्टार्को)
(ग) २. दिनगते for (दिनगत) ४. दिनदलान्नतेरथवा for (दिनदलान्नतैरथवा)
५. समंडले for (सममंडले) ६. तत्रज्ञः for (तंत्रज्ञः)
(च) १. ऽर्क्को for (र्को)
११. (घ) १. र्नतै (ग) (च) (ङ) for (नतै) २. र्दिनार्द्धाद्वा (च) for (दिनार्द्धाद्वा)
(ग) ३. सममंडलगं for (सममंडलगः) ४. यैर्भवति (च) for (यैर्भवति)
५. नूयोर्कं for (न्योऽर्कं)
(च) ५. तान्योऽर्क्कं for (तान्योऽर्कं)
(ङ) १. र्दिनार्धाद्वा for (दिनार्द्धाद्वा) ६. योऽर्कं for (योऽर्कं)
१२. (घ) १. शंकु (ग) (ङ) for (शंकु) २. वा (च) (ङ) for (व)
३. वीक्ष्य (च) (ङ) for (वीक्ष) ४. कथति (च) for कथयति)
(ग) ५. समंडल for (सममंडल)
(ङ) ६. ऽक्षं for (क्षं)
१३. (ग) १. घटिको for (घटिका) २. लग्न for (लंग्न)
(च) ३. योऽर्क्कज्ञो for (योर्कज्ञो)
(ङ) ३. योऽर्कज्ञो for (योर्कज्ञो)
१४. (घ) १. यस्यरार्द्ध (ग) यश्चचरार्ध for (यश्चरार्द्ध)
२. कथति for (कथयति)
(ग) ३. चरार्द्धज्ञो for (चरार्द्धाज्ञार्कं) ४. चरार्द्धदथवा for (चरार्द्धादथवा)
(च) ३. ज्ञार्क्कं for (ज्ञार्कं)
(ङ) ३. चरार्धज्ञोऽर्कं for (चरार्द्धाज्ञार्कं) ४. चरार्धादथवा for (चरार्द्धादथवा)

[५]मध्यछायातो [१]क्षविदानयति [६]रवि[२]वाक् रज्ञोश्नं ।
[३]योग्रार्कज्ञो [४]लंबाक्षज्ये कथयति स तंत्रज्ञः ॥ १५ ॥
[६]उदयेस्तमये [१]चाग्रां वेत्ति दिनार्द्धे नतोन्नत[२]ज्ययः ।
ताभि[४]र्विषुवछाया [३]श्नज्या[५]लंबान् स तंत्रज्ञः ॥ १६ ॥
[४]दिनरात्र्यर्धे यश्चर[५]दलाद् विना [६]स्वेकरोति वाताभ्यां ।
अक्षावलंबकौ वा [१]नस्तमयार्का[३]त्स तंत्रज्ञः ॥ १७ ॥

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१५. (घ) १. छायातोक्षविदानयति (ग) तोऽक्षविदानब्दि for (च्छायोतोक्षविदानयति)
२. रविवाकरज्ञोक्षम् (ग) रविदिवाकरज्ञोऽक्षम् for (रविदिवाकरज्ञोऽक्षम्)
३. लोबाक्षज्ये for (लम्बाक्षज्ये)

(च) २. रविवाक्रज्ञोक्षं for (रविवाक्रज्ञोश्नं) ३. योग्रार्क्कज्ञो for (योग्रार्कज्ञो)
४. लंबाक्ष्यज्ये for (लंबाक्षज्ये)

(ङ) ५. मध्यच्छायातो for (मध्यछायातो)
१. ऽक्ष for (क्ष) ३ योऽग्रार्कज्ञो for (योग्रार्कज्ञो)
६. र्रवि for (रवि) २. दिवाकरज्ञोऽक्षम् for (वाक्रज्ञोश्नं)
४. लम्बाक्षांशान् for (लम्बाक्षज्ये)

१६. (घ) १. वाग्रां (ग) (ङ) for (चाग्रां) २. ज्ये (ग) ज्येयः for (ज्ययः)
३. क्षज्या (ग) क्षप्या for (श्नज्या)

(ग) ४. विषुवा for (विषुवछाया) ५. लंबात् for (लंबान्)

(च) ३. क्षज्या for (श्नज्या)

(ङ) ६. उदयेऽस्तमये for (उदयेस्तमये) २. ज्ये यः for (ज्ययः)
४. विषुवच्छाया for (विषुवछाया) ३. क्षज्या for (श्नज्या)

१७. (ग) १. नस्तमयार्के for (नस्तमयार्कात्) २. नस्तमयार्को for (नस्तमयार्कात्)
३. न स for (त्स)

(च) ४. दिनरात्र्यार्धे for (दिनरात्र्येर्धे) १. नस्तमयार्क्कात्स for (नस्तमयार्कात्स)

(ङ) ४. 'लुप्त' for (दिनरात्र्येर्धे) ५. दलंविना for (दलादविना)
६. +दिनरात्र्यर्धे+१. ऽनस्तमयार्कान् for (नस्तमयार्कात्)

आय निवक्योनां प्रश्नानामुत्तरं चतुःषष्टि ।
आयास्त्रिप्रश्नोक्ताशेषप्रश्नोत्तरोक्तिरतः ।। १८ ।।
विषुवच्छाया गुणिता स्वाहोरात्र्यार्द्धं भाजिता त्रिज्या ।
क्रान्तिद्वादशगुणिता फलचापकला श्रुभिः सहितैः ।। १९ ।।
स्वचरप्राणैर्दिनगतशेषैः सममंडले रविर्भवति ।
फल चापाशून्यभिस्तिथि घटिकाभि नताभिर्वा ।। २० ।।
उदयसममंडलान्तरं घटिकाज्यालंबकाहतं गुणयेत् ।
अक्षज्यया हृतां तत त्क्रांन्त्या व्यासार्द्धसंगुणया ।। २१ ।।

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१८. (घ) १. आर्यानिवकोक्तानां (ग) (ङ) for (आयनिवक्त्योनां)
२. आर्यास्त्रि (ग) (च) for (आयास्त्रि)
(ग) ३. प्रस्नाना for (प्रश्नाना) ४. प्रस्नोक्ताः for (प्रश्नोक्ता)
(च) १. आर्यानिवक्यानां for (आयनिवक्योनां)
(ङ) ५. षष्टया foi (षष्टिः) २. आर्याणां for (आयास्त्रि)
४. प्रश्नोक्त्या for (प्रश्नोक्ता)

१९. (घ) १. गुणित (ग) गुणित (ङ) for (गुणिता)
२. रात्रार्ध (ग) (ङ)for(रात्र्यार्द्ध)
(ग) ४. त्रिज्याः for (त्रिज्या)
(च) १. गुणित for (गुणिता) २. रात्रार्द्ध for (रात्र्यार्द्ध)
३. कलासुभिः for (कलाश्रुभिः)
(ङ) ५. विषुवच्छाया for (विषुवच्छाया)

२०. (घ) १. चापाशूनाभि (ग) चापास्तनुभि for (चापाशून्यभि)
२. न्नंतानिर्वाः (ग) नंताभिर्वा for (नताभि)
(च) ३. द्दिन for (दिन) १. शून्याभि for (शून्यभिः)
२. न्नताभिर्वाः for (नताभिर्वा)
(ङ) १. चापन्यूनाभि for (चापाशून्यभि) २. नंताभि for (नताभि)

२१. (घ) १. ज्यां (ङ) for (ज्या) २. लंबकाहृता (ङ) (ग) लंबकाहृलांfor (लंबकाहतं)
३. अज्यया (ग) अक्षया for (अक्षज्यया)
४. हृत्यांतक्रान्त्या (ग) हृतांत्यक्रान्त्या for (हृतां ततत्क्रान्त्या)
(ग) ५. मडलांतरघटिकाज्यां for (मंडलान्तरं घटिकाज्या)
(च) २. हृतां for (हृतं) ४. हृत्यांतक्रांत्या for (हृतांततत्क्रान्त्या)
(ङ) ४. हृताऽन्त्यक्रान्त्या for (हृतां ततत्क्रांन्त्या)

लब्धधनुरविरजाक्ष कर्कटकादौ विशोद्ध चक्राद्धात् ।
तज्या तदुदय सममंडलांतरा क्षुज्ययाभक्ता ॥ २२ ॥
प्रश्न सममण्डला सुक्रमज्यया संगुणा सकृत्सूर्यः ।
प्रश्न घटिकाभिरेवं गतघटिकाभिर्भवत्यहः ॥ २३ ॥
त्रिज्यादिनार्द्धसममंडलांतरा सुज्यायाः कृतिविशेषः ।
स्वविषयविषुवच्छाया वर्गेण गुणो द्विधा प्रथमाः ॥ २४ ॥
व्यासार्द्धवर्गभक्तौ लब्धं ध्वादशकवर्ग संयुक्तम् ।
छेदो द्वितीयराशे लब्धं पदं क्रान्तिरर्कातः ॥ २५ ॥

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२२. (घ) १. रजादौ (ग) (च) for (रजाक्ष) २. विशोध्य (ग) (च) for (विशोद्ध)
(च) ३. कक्कट for (कर्कट) ४. सुज्यया for (क्षुज्यया)
(ङ) ५. रिनो for (रवि) १. ऽजादौ for (रजाक्ष)
३. कर्क्याकौ यदि for (कर्कटकादौ) २. विशोध्य for (विशोद्ध)
६. तज्ज्या for (तज्या)

२३. (घ) १. गत शेषोभिर्भवत्यह्नः (ग) गतशेषाभिर्भवत्यह्नः for (गतघटिकाभिर्भवत्यहः)
(ग) २. प्रस्न for (प्रश्न) ३. प्रस्न for (प्रश्न)
(च) ४. सकृसूर्यः for (सकृत्सूर्य) ४. गतशेषाभि (ङ) for (गतघटिकाभि)
५. र्भवत्यह्नः (ङ) for (र्भवत्यहः)
(ङ) ४. ऽसकृत् सूर्यः for (सकृत्सूर्यः)

२४. (घ) १. सुज्ययोः (गं) (ग) (ङ) for (सुज्यायाः)
२. विषुच्छाया (ग) (च) for (विषुवच्छाया)
३. प्रथमः (ग) (च) (ङ) for (प्रथमाः)
(ग) ४. दिनासम for (दिनार्द्धसम) ५. स्वविष for (स्वविषय)
(च) २: विषुवच्छायावर्गेण for (विषुवछायावर्गेण)

२५. (घ) १. वग्र for (वर्ग) (ग) वग्रभक्तो for (वर्गभक्तौ)
२. द्वादश (ग) for (ध्वादश) ३. संयुक्ताम् for (संयुक्तम्)
४. लब्धपदं (ग) (च) (ङ) for (लब्धंपदं)
(च) ५. रक्कातः for (रर्कातः)
(ङ) १. व्यासार्ध वर्गभक्तो for (व्यासार्द्धवर्ग भक्तौ)
२. द्वादशज for (ध्वादशक) ४. रर्कोऽतः for (रर्कातः)

सममण्डल शंकुगुणाक्षज्या[3] जीनभाग[1]जीवया भक्ता[2] ।
फलधनुरर्को[4] जादौ कर्क्यादौ प्रोह्य चक्रार्द्धात् ॥ २६ ॥
द्वादशगुणिताक्षज्या[2] विषुवच्छायो[3] गुणावलंबज्या ।
सममंडल कर्कादौ[1] क्रान्तिज्ये भास्करः प्राग्वत् ॥ २७ ॥
परमापक्रमजीवा तत्कालिक[1]सूर्यबाहुसंगुणिता ।
सममंडलशंकुहृता[2]क्षज्या[3] तच्चापमक्षांशाः ॥ २८ ॥
लंकोदयचरदलवद्रवि[4]लग्नाभ्यां पृथक् पृथक् प्राणाः[1] ।
कृत्वा तदंतरैक्यं मृगकर्क्यादिषु[2] पृथक् लिप्ताः[3] ॥ २९ ॥

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२६. (घ) १. दिन (ग) जिन for (जीन)   २. भक्ताः (ग) for (भक्ता)
(ग) ३. क्षय्या for (क्षज्या)
(च) ३. जिनभाग for (जीनभाग)   ४. धनुरर्क्को for (धनुरर्को)
(ङ) ३. ऽक्षज्या for (क्षज्या)   १. जिन for (जीन)
४. रर्कोऽजादौ for (रर्कोजादौ)

२७. (घ) १. कर्णाकृते (ग) कर्णाहृते (ङ) for (कर्कादौ)
(ग) २. क्षय्या for (क्षज्या)
३. विषुवच्छाया for (विषुवच्छायो (च) for (विषुवच्छायो)
(च) १. कर्णाहृते for (कर्कादौ)
(ङ) २. ऽक्षज्या for (क्षज्या)   ३. विषुवच्च्छाया for (विषुवच्छायो)

२८. (घ) १. तात्कालिक for (तत्कालिक)
(ग) २. हृता for (हृता)   ३. क्षय्या for (क्षज्या)
(ङ) ३. ऽक्षज्या for (क्षज्या)

२९. (घ) १. प्राणान् (ग) (च) for (प्राणाः)
२. मृगकर्क्यादिषु (ग) मृगकर्कादिषु for (मृगकर्क्यादिषु)
३. पृथग्लिप्ताः (ग) (च) (ङ) for (पृथक्लिप्ताः)
(ग) ४. लंकोदचरदलद्रवि for (लंकोदयचरदलवद्रवि)
(च) २. मृगकर्क्क्यादिषु for (मृगकर्क्यादिषु)
(ङ) १. प्राणाव् for (प्राणाः)

मेषादिषु कर्कादिषु विशोध्य भार्द्धा तुलादिषु सभार्द्धा ।
मकरादिषु संशोध्याश्चक्ररवि भुक्ता लिप्ता वा ॥ ३० ॥
लग्नकालाद्यू ना सचकालिप्ता विना स्वराश्यूदयैः ।
एवं स्फुटाभवंत्यर्क लग्नयोरंतरप्राणाः ॥ ३१ ॥
अष्टयमाश्रुत्य गुणा दिगिषु कालोना रदाः सतिथिलिप्ताः ।
स्वचरार्द्धांशैरूना विपरीता संयुता व्यस्तै ॥ ३२ ॥

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३०. (घ) १. कक्यादिषु (ग) कक्र्यादिषु (ङ) for (कर्कादिषु)
२. भार्द्धात् (ग) for (भार्द्धा) ३. सभार्द्धाः (ग) for (सभार्द्धा)
४. चक्राद्रवि (ग) (च) (ङ) for (चक्ररवि)
५. भुक्तलिप्तोनाः (ङ) (ग) भुक्तलिप्तोना for (भुक्तालिप्तावा)

(च) १. कक्वर्यादिषु for (कर्कादिषु) ६. तुलादीषु for (तुलादिषु)
३. "सभार्द्धा" लुप्त ५. भुक्तलिप्तोनाः for (भुक्तालिप्तावा)

(ङ) ६. शोध्या for (विशोध्य)

३१. (घ) १. लग्नकला (ग) (च) (ङ)for (लग्नकाला)
२. यद्यूनाः (ग) (च) (ङ)for (यद्यूना)
३. सचक्रलिप्ता (ग) (ङ) for (सचकालिप्ता)
४. राश्युदयैः (ग) रास्युदयैः for (स्वराश्यूदयैः)

(ग) ५. दिना for (विना)

(च) ३. सचक्रलिप्ताः for (सचकालिप्ता) ४. स्वराश्युदयैः for (स्वराश्यूदयैः)
६. भवंत्यर्क्क for (भवंत्यर्क)

(ङ) ४. स्वराश्युदयैः for (त्वराश्यूदयैः) ७. रंतते for (रंतर)

३२. (घ) १. यमाः (ग) (च) (ङ) for (यमा)
२. शून्य (ग) (च) (ङ) for (श्रुत्यगुणा)
३. कलोना (ग) (च) (ङ) for (कालोना) ४. रूनाः (च) for (रूना)
५. व्यस्तैः (ग) (च) (ङ) for (व्यस्तै)

(ग) ६. विपरीताः (ङ) for (विपरीता)
(च) ६. विपरिताः for (विपरीता)

व्यस्ता[१] चा जादीनां[२] कलांशलग्नमिष्टघटिकांशैः ।
लग्ना[३] घटिकाः कालांशै[४] विनैवं[५] स्वराश्यूदयैः[६] ॥ ३३ ॥
इष्टार्कं[४] चरार्द्धं[२] ज्या क्षय[१]वृद्धिज्याद्यु[५]रात्रिदलगुणिता[३] ।
व्यासार्द्धेन विभक्ता क्षितिजा द्वादशगुणा भक्ता ॥ ३४ ॥
क्रांत्याविषुवछाया क्षितिजेष्टु क्रान्तिवर्ण[१]योगं पदम् ।
अग्रे[२] क्षितिजापक्रमजीवे[३] त्रिज्या गुणोभक्ता[४] ॥ ३५ ॥
अर्काग्रयाक्ष[६]कलंबक[४]जीवे दिनकृत[१]चरासुविज्ञाने ।
अर्कज्ञाने[२] ज्ञाने[५] विषुवछाया चराभूनाम्[३] ॥ ३६ ॥

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३३. (घ) १. व्यस्तश्चाजादीनां (ग) (च) (ङ) for (व्यस्ताचाजादीनां)
२. कालाँशा (ग) कालांशौ for (कलाँश)
३. लग्नाद्धटिकाः (ग) (च) (ङ) for (लग्नाघटिकाः)
४. कालांशकै (ग) (च) (ङ) for (कालांशै)
५. विनैवं (ग) (च) (ङ) for (विनैवं)
६. स्वराश्युदयैः (ग) (च) (ङ) for (स्वराश्यूदयैः)
(च) २. कालांश for (कलांश) (ङ) २. काजांशैर्लग्न for (कलांशलग्न)
३४. (घ) १. क्षयं for (क्षय)
(ग) २. चरार्द्धंज्या (ङ) for चरार्द्धंज्या) ३. गुणिताः for (गुणिता)
(च) ४. इष्टार्क्क for (इष्टार्कं) २. द्याक्षय for (ज्याक्षय)
(ङ) ५. द्यु रात्रदल for (द्यु रात्रिदल)
३५. (घ) १. वर्गयोगपदम् (ग) (च) for (वर्णयोगंपदम्)
२. अग्ना (ग) अग्रा for (अग्रे) ३. जीव (ग) जीवा for (जीवे)
४. गुणेभक्ते (ग) (च) (ङ) for (गुणोभक्ता)
(च) २. अग्रक्षिति for (अग्रे क्षिति) ३. जीवत्रीज्या for (जीवेत्रिज्या)
(ङ) १. वर्गयोगपदम् for (वर्णयौगंपदम्) २. अग्रा for (अग्रे)
३६. (घ) १. कृच्चरा for (कृतचरा) (ग) दिनकृच्चरासुविज्ञाते for (दिनकृतचरासुविज्ञाते)
२. अर्का (ग) for (अर्कं) ३. चरासूनाम् (ग) (ङ) for (चराभूनाम्)
४. 'क' यहां 'क' लुप्त है (च) (ङ) ५. ज्ञाते ज्ञाते for (ज्ञाने ज्ञाने)
(च) ६. अर्क्काग्र for (अर्काग्र) ४. लंबक for (कलंबक)
१. दीनकृच्चरा for (दिनकृतचरा) २. अर्क्कांज्ञाने for (अर्कज्ञाने)
३. चरासूनां for (चराभूनाम्)
(ङ) ६. अर्काग्रयाऽक्ष for (अर्काग्रयाक्ष) १. कृच्चरासु for (कृतचरासु)
२. अर्काज्ञाने for (अर्कज्ञाने) ७. विषुवच्छाया for (विषुवछाया)

अष्टचरार्द्धयस्य[१] ज्या क्षयवृद्धि ज्यातदर्कवधकृत्या[२] ।
त्रिज्याविषवच्छाया[५] वधवर्गो[३] युतवधच्छेदः[४] ॥ ३७ ॥
व्यासार्द्धक्रते[१] मूलं क्रांतिज्यावासदलगुणा[२] भक्ता ।
जीनभागजीवया[३] लब्धचापमर्कपादैः[६][४][५] प्राग्वत् ॥ ३८ ॥
विषुवच्छाया[२] भक्ता स्वचरार्द्धज्येष्टयात्यया[१] भक्ता गुणिता ।
लब्धस्य चापमिष्ट[३] छायायाश्चरदलप्राणाः ॥ ३९ ॥
स्वचरार्द्धज्या[१]भक्ता विषुवच्छायेष्ट[४] चरदल[२] श्नुनाम् ।
गुणिताज्येष्ट[३] चरदल विषुवच्छाया[४] फलं भवति ॥ ४० ॥

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३७. (घ) १. चरार्धस्य (ग) इष्टचरार्द्धस्य for (अष्टचरार्द्धयस्य)
२. कृत्याः (ग) क्रत्या for (कृत्या) ३. ववर्गो for (वधवर्गो)
४. हृताछदः (घ) हृतछेदः for (युतवधछेदः)
(ग) १. अष्टचरार्द्धस्य ज्या for (अष्टचरार्द्धयस्य ज्या) २. क्रत्या for (कृत्या)
४. हृतछेदः for (वधछेदः)
(ङ) १. इष्टचरार्धस्य for (अष्टचरार्द्धयस्य) ५. विषुवच्छाया for (विषूवछाया)
४. युतहृतश्छेदः for (युतवधछेदः)
३८. (घ) १. कृतेर्मूलं (ग्र) भुक्तेर्मूलं for (क्रतेमूलं) २. व्यास (ग) (ङ) for (वास)
३. जिन (ग) (च) (ङ) for (जीन) ४. मर्कः for (मर्क)
५. पदैः (ग) (ङ) for (पादैः)
(ग) ६. लब्धं for (लब्ध)
(च) १. कृते for (क्रते) ४. मर्क्कः for (मर्क)
(ङ) १. कृतेर्मूलं for (क्रतेमूलं)
३९. (घ) १. व्यया गुणिता (ग) न्यया गुणिता for (त्यया भक्ता गुणिता)
(च) १. ज्येष्टयान्यया गुणिता for (ज्येष्टयात्ययाभक्ता गुणिता)
(ङ) २. विषुवच्छाया for (विषुवछाया) १. ऽन्यया for (त्यया)
३. मिष्टच्छायाया for (मिष्टछायाया)
४०. (घ) १. चरार्द्धज्या (ग) व्यचरार्द्धज्या for (चरार्द्धज्या)
२. चरदलासूनाँम् (ग) (ङ) for (चरदलश्नुनाम्)
(ग) ३. ज्ययैष्ट for ज्ययेष्ट)
(च) २. चरदलामूनां for (चरदलश्नुनाम्) ३. चेष्ट for (ज्येष्ट)
(ङ) १. चरार्धज्या for (चरार्द्धज्या) ३. ज्ययेष्ट for (ज्येष्ट)
४. विषुवच्छायेष्ट for (विषुवछायेष्ट)
५. विषुवच्छाया for (विषुवछाया)

मध्यम[1]छायाग्रमुदक् शंकु[2]तलादक्ष[3]नत[4]भागः ।
दक्षिणतो[6] यदि सौम्याः स्वाक्षांशा[5] सर्वदा याम्याः[7] ॥ ४१ ॥
द्यु दलनतो[1]क्षांशानामेक दिशानामंतरं[6] युति[5]र्भेदे[2] ।
क्रांत्यंशाः प्रागदिनः[3] क्रांत्यंशोरेव[4] मक्षांशाः ॥ ४२ ॥
उदये[1] ज्येष्ठापक्रम[4] जीवा कृत्यंतरात्पदं क्षितिजा[2] ।
व्यासार्द्ध[5] गुणा क्षितिजा भक्तोदयजिवया[3] कक्षः[4] ॥ ४३ ॥

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४१. (घ) १. मध्यछाया (ग) for (मध्यमछाया)
२. तलाद्दक्षिणे (ग) तलाद्दक्षिणोनतभागा: for (तलाद्दक्षिणा नता भागाः)
३. नता (ङ) for (नता) ४. भागाः (ङ) (भागः)
५. स्वाक्षांशाः (च) (ङ) for (स्वाक्षांशा)
(ग) ६. दक्षणतो for (दक्षिणतो) ७. याम्या for (याम्याः)
(च) १. मध्यछायाग्रमुदक् for (मध्यमछायाग्रमुदक्)
६. द्दक्षिणतो for (दक्षिणतो)
(ङ) १. मध्यच्छाया for (मध्यमछाया) २. द्दक्षिणा for (दक्ष)

४२. (घ) १. नतांक्षा शानामेक (ग) नतः क्षांशानामेक for (नतोक्षांशानामेक)
२. भेदो (ग) भेदै for (र्भेदे)
३. प्राग्वदिनः (ग) प्राग्वदितः for (प्रागदिनः)
४. क्रांत्यंशैरेव (ग) (च) (ङ) for (क्रान्त्यंशोरेव)
(ग) ५. 'युति' लुप्त है
"क्रांत्यंशाः प्राग्वदितः" दो बार लिखा गया है।
(च) १. द्यु दलनताक्षांशानामेक for (द्यु दलनतोक्षांशानामेक)
३. प्राग्वदिनः for (प्रागदिनः)
(ङ) १. नताक्षांशानामेक for (नतोक्षांशानामेक)
६. दिशामन्तरं for (दिशानामंतरं) ३. प्राग्वदनः for (प्रागदिनः)

४३. (घ) १. उदय (ङ) for (उदये) २. क्षितिजाल्पा for (क्षितिजा)
३. जीवयाक्षज्या (च) for (जिवयाकक्षः)
(ग) 'म' लुप्त
४. पक्षज्यात् शेषाः ॥४३॥ for (कक्षः)
(च) ३. जीवयाक्षज्या for (जिवयाकक्षः)
(ङ) ५. व्यासार्धं for (व्यासार्द्ध) ३. जीवयाऽक्षज्या for (जिवयाकक्षः)

उदय ज्यया[2] विभक्ता क्रांतिज्या व्यास[3]गुणालंबः[4] ।
द्वादश[1]गुणिता क्षितिजा विषुवच्छाया[5] हृता[1] क्रान्तिः ॥ ४४ ॥
यष्टिव्यासार्द्धाग्रा[1]प्राच्यपरा भास्करांतरां[2]शज्या ।
द्विगुणमुदया[3] सूत्रं तत्त्रिज्या कृति[4]विशेषपदम् ॥ ४५ ॥
द्यु[3]दले शंकु[4] न तज्ये[7] प्राच्यपराया यदि स्थितः शंकुः ।
उदगूना[5] दक्षिणतः[1] स्तदंतरे[2]णाधिकार्काग्रा[6] ॥ ४६ ॥
उत्तरगोले[1] नं[4] तदं[6] याम्य[5] गोलगे सूर्ये ।
शंकुतल[2] शंकु हृतं[3] विषुवच्छाया द्विषट्क गुणम् ॥ ४७ ॥

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४४. (घ) १. हृता (ग) (च) for (हृता)
(ग) २. ज्याया for (ज्यया) ३. +दल+ (ङ) (च)
४. लब्धाम् for (लम्बः)
(ङ) ५. विषुवच्छाया for (विषुवछाया)

४५. (घ) १. ऽग्रा (च) for (ग्रा)
(ग) २. 'तरां' पद लुप्त है
३. मुदयास्तसूत्रं (ङ) for (मुदयासूत्रम्)
४. क्रांति foi (कृति)
(च) २. ज्याः for (ज्या)
(ङ) १. व्यासार्धेऽग्रा for (व्यासार्द्धेग्रा)

४६. (घ) १. दक्षिणत (ग) for (दक्षिणतः)
२. ऽधिका for (धिका)
(ग) ३. द्यूदले for (द्युदले) ४. शंकुतज्ये for (शंकुनतज्ये)
५. उदगुना for (उदगूना) ६. काकाग्रा for (कार्काग्रा)
(च) ७. तच्छे for (तज्ये) १. दक्षिणांत for (दक्षिणतः)
६. ऽधिकार्क्काग्रा for (धिकार्काग्रा)
(ङ) १. दक्षिणत for (दक्षिणतः)

४७. (घ) १. गोलेर्ग्रो (ग) उत्तगोलेग्रो for (उत्तर गोले)
२. तलं (ग) (ङ) for (तल)
३. हृतं (ग) (ङ) (च) for (हृतं)
(ग) ४. मंतदंतरं for (नं तदंतरं) ५. गोले for (गोलगे)
(च) १. गोलर्ग्रोनं for (गोलेनं) ३. तदंतरं for (तदं)
७. विषुवच्छाया for (विषुवछाया)

शंकुतलशंकुगरिणते त्रिज्ये तद्वर्ग[१]युतिपदविभक्ते ।
अक्षावलंबज्ये[२] द्युदलस्थे[३]ऽर्कान्यदा द्युदलात्[४] ॥ ४८ ॥
छायावृते[१]ऽर्काग्रा कर्णगुणा व्यासदल हृता[२]र्काग्रा ।
प्राच्यपरा शंक्वंतर[३]मुत्तरयाम्यं तदून[४] युता[५] ॥ ४९ ॥
उत्तर गोले याम्ये विषुवच्छाया[३]ग्रयांतरं[४] हीनम् ।
एवं विषुवच्छाया युक्ति[१]विहीनांतरेणाग्रा[२] ॥ ५० ॥
बाहु[५]क्रांतिः कोटिः क्षितिजा[२]तद्वर्गयुतिपदं कर्णः ।
अग्रोदयास्त[३] सूत्राद्दक्षिणतो[४] द्रश्य[१] शंकु तलम् ॥ ५१ ॥

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४८. (घ) १. तर्द्वर्ग for (तद्वर्ग)
२. अक्षावलंबकज्ये (ग) अक्षावलंबकज्ये (ङ) for (अक्षावलंबज्ये)
३. ऽर्केऽन्यदा (ग) स्छेऽर्केन्यद for (ऽर्कान्यदा)
(ग) ४. द्यूदलात् for (द्युदलात्)
(च) १. तर्द्वर्ग for (तद्वर्ग) २. अक्षावलंबकद्ये for (अक्षावलंबज्ये)
३. ऽस्वर्केऽन्यदा for (ऽर्कदान्यदा)
(ङ) ३. ऽस्वर्केऽन्यदा for (ऽर्कान्यदा)
४९. (घ) १. वृत्तऽर्काग्रा (ग) (ङ) for (वृतेऽर्काग्रा)
२. हृता for (हृता)
(ग) ३. शंकुतर for (शंक्वन्तर) ४. तदूनं for (तदून)
५. युतम् for (युता)
(च) १. छयावृत्तेऽक्काग्राकर्णा for (छायावृत्तेऽर्काग्राकर्णा)
२. हृताक्काग्रा for (हृताकाग्रा) ४. तदूना for (तदून)
(ङ) २. हृताऽर्काग्रा for (हृतार्काग्रा)
५०. (घ) १. युक्त (ग) (च) (ङ) for (युक्ति)
(ग) २. विहिनां वा रणाग्रा (विहीनांतरेणाग्रा)
(ङ) ३. विषुवच्छाया for (विषुवछाया) ४. ऽग्रयान्तरं for (ग्रयांतरं)
५. विषुवच्छाया for (विषुवछाया)
२. विहीनाऽन्तरेणा for (विहीनांतरेणाग्रा)
५१. (घ) १. द्दश्य (ग) for (द्रश्य)
(ग) २. क्षितिजां for (क्षितिजा) ३. अग्रोदयास्त्र for (अग्रोदयास्त)
४. दक्षणतो for (दक्षिणतो)
१. द्दश्य (ङ) for (द्रश्य)
(ङ) ५. बाहुः for (बाहु)

त्रिज्याक्षयवृद्धिद्यैक्यांतर[1] मुदगितरयोर्दिनार्द्धांत्या[2] ।
व्यासार्द्धचरार्द्धं[3] ज्यांतर[4] संयोगोर्द्धं[5]रात्रांत्या ॥ ५२ ॥
उक्रम[1]जीवा[2] चापं क्रमजीवाचापसहितमधिकं[3] यत्[5] ।
दिनरात्र्यर्द्धं प्राणाः पृथग्दिना[4] चरदलप्राणैः ॥ ५३ ॥
दिवसार्द्धोत्क्रम[3]जीवाधिकक्रमज्याधिका[4]दिनार्द्धंत्या[1] ।
व्यासार्द्धं दिनार्द्धंत्यांतर[2] चरज्याक्षयजीवातः[5] ॥ ५४ ॥

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५२. (घ) १. द्यैक्यांतर (ग) ज्यैक्यांतर for (द्यैकांतर)
(ग) २. दिनार्द्धाद्वा for (दिनार्द्धांत्या) ३. दिनार्द्ध for (चरार्द्ध)
४. ज्यांतरं for (ज्यांतर) ५. संयोगेद्धं for (संयोगोर्द्ध)
(च) २. द्दिनार्द्धांत्या for (दिनार्द्धांत्या)
(ङ) १. ज्यैक्यान्तर for (द्यैकान्तर) २. दिनार्धान्त्या for (दिनार्द्धांत्या)
३. व्यासार्ध चरार्ध for (व्यासार्द्ध चरार्द्ध)
५. संयोगेऽर्धरात्र्यन्त्या for (संयोगोर्द्धरात्रांत्या)

५३ (घ) १. उत्क्रम (ग) (च) for (उक्रम)
(ग) २. तीवा for (जीवा) ३. मधीकं चेत् for (मधिकं यत्)
४. विमा for (दिना)
(ङ) १. उत्क्रम for (उक्रम) ५. चेत् for (यत्)
४. पृथग् विना for (पृथग्दिना)

५४. (घ) १. नार्द्धांत्या (ग) (च) for (नार्द्धंत्या)
२. त्यांतरं (ग) (च) for (त्यातर)
(ग) ३. दिवासार्कोत्क्रम for (दिवसार्द्धोत्क्रम) ४. ज्यया for (ज्या)
५. 'य' लुप्त है (ङ)
(च) ५. चरद्याक्षजीवातः for (चरज्याक्षयजीवातः)
(ङ) ३. दिवसार्धोत्क्रम for (दिवसार्द्धोत्क्रम) ४. ज्याऽधिका for (ज्याधिका)
१. दिनार्धान्त्या for (दिनार्द्धंत्या)
२. व्यासार्ध दिनार्धार्द्धन्त्यान्तरं for (व्यासार्द्ध दिनार्द्धांत्यातर)
५. ऽक्षजीवाऽतः for (क्षयजीवातः)

स्वाहोरात्रार्द्धसम[1] यत्राक्षज्याबलंबकः[2] ।
क्रान्त्या[3] ह्येषा[4] दिगम्यता वद्यावत्[5] कर्क्यादिगस्य[6] खेः ।। ५५ ।।
नास्तमयस्तत्र[3] तुला मकरादिस्थस्य[4] नोदयोर्कस्य[2][1] ।
तन्मध्यांतरलिप्ता मध्यमभुक्त्या हृता[2] दिवसाः ।। ५६ ।।
कोणछाया[8] क्रतिदल[7] यद[1]विषुवछायाया[5] रुदानृतबलं[2] प्राच्य परयोः[3] ।
यद्यैक्यंतरं[4] याम्यदिक्स्थं[6] चेत् ।। ५७ ।।

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५५. (घ) १. समा (ग) for (सम)
२. ज्यावलंबकः क्रान्त्या for (ज्याबलंबकः क्रान्त्या)
३. यह पद 'पहली पंक्ति के अन्त में है ।
४. मेषादिगस्य (ग) for (ह्येषा दिगम्यता)
५. तावद्यावत् for (वद्यावत्) ६. कर्कादिगस्य for (कर्क्यादिगस्य)
(च) १. समा यात्रा for (सम यत्रा) ४. मेषादिगस्य for (ह्येषादिगम्य)
६. कर्क्यादिगस्य for (कर्क्यादिगस्य)
(ङ) १. रात्रार्धसमा for (रात्रार्द्धसम)
३. 'क्रान्या' यह शब्द पहली पंक्ति का अन्तिम है ।
४. ५. मेषादिगस्य तावद्यावत् for (ह्येषा दिगम्यता वद्यावत्)

५६. (च) १. नोदयोऽर्कस्य (ग) नोदयेऽर्कस्य for (नोदयोर्कस्य)
२. हृता (ग) (ङ) for (हृता)
(ग) ३. सूत्रतुला for (स्तत्र तुला) ४. छस्य for (स्थस्य)
(च) १. नोदयोऽर्क्कस्य for (नोदयोर्कस्य) २. हृता for (हृता)
(ङ) १. नोदयोऽर्कस्य for (नोदयोर्कस्य)

५७. (घ) १. पद (ग) (च) (ङ)for (यद) २. रुदग्नृतलं (ग) (ङ) for (रुदानृतल)
वि० श्लोक की पहली पंक्ति समाप्त ।
३. 'प्राच्य परयोः' दूसरी पक्ति के आरंभिक पद हैं (ग)
४. यद्यैक्यमंतरं (ग) (च) (ङ) for (यद्यैक्यंतरं)
(ग) ५. छाययो for (छायाया) ३. प्राच्य पराया (ङ) for (प्राच्यपरयोः)
वि० दूसरी पंक्ति का आरम्भ ।
६. स्छ for (स्थं)
(च) ७. कृतिदल (ङ) for (क्रतिदल) २. रुदग्नृतबलं for (रुदानृतबलं)
(ङ) ८. कोणच्छाया for (कोणछाया) ५. विषुवच्छाययो for (विषुवछायाया)

कोण[२]छायाकर्णेन भक्तमवलंबकेन संगुणितम् ।
इष्टापक्रमजीवा त्रिप्रश्नोक्त्या स्फुटोर्को[१]तः ।। ५८ ।।
मध्य[३]मगति स्फुट[४]गति त्रिप्रश्नात्[६] सोत्तरान् विजानाति य[१]ः ।
स भवत्याचार्यो [५]ब्रह्मोक्ता ज्ञानतंत्र[२]ज्ञाः ।। ५९ ।।
अध्यायः पंचदशस्[५]त्रिप्रश्नस्योत्तरं [१]यदीह नोक्तम् ।
[६]आर्याषष्ट्योक्तं तद्[२]गोलादुत्प्रेक्ष्य बुद्धि[३]मता ।। ६० ।।

[४]इतिब्रह्म गुप्ते त्रिप्रश्नाध्यायः
पंचदश अध्यायः समाप्तः

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५८. (ङ) २. कोणच्छाया for (कोणछाया) १. ऽर्कोऽतः for (र्कोतः)

५९ (घ) १. 'यः' दूसरी पंक्ति का पहला पद है ।
२. तंत्रज्ञः (च) for (तंत्रज्ञाः)

(ग) ३. मध्यगतिः for (मध्यमगति)
४. स्पष्टगतिः for (स्फुटगति) १. 'यः' लुप्त है
५. वै ब्रह्मोक्तानान्य तंत्रज्ञा for (ब्रह्मोक्ताज्ञानतंत्रज्ञाः)

(ङ) ३. मध्यगति for (मध्यमगति) ४. स्पष्टगति for स्फुटगति)
६. त्रिप्रश्नान् for (त्रिप्रश्नात्) १. 'यः' लुप्त ।
५. ब्रह्मोक्तान् for (ब्रह्मोक्ता) २. योऽन्यतंत्रज्ञः for (ज्ञानतंत्रज्ञाः)

६०. (घ) १. यदिह (ग) (ङ) for (यदीह) २. दुप्रेक्ष्य for (दुत्प्रेक्ष्य)
३. बुद्धिमताः for (बुद्धिमता)
वि०—४. 'इति' से आरंभ कर 'समाप्त' तक मूल में लुप्त है ।

(ग) ५. त्रि for (स्त्रि) ६. तच्चार्याषष्ट्यो यं for (आर्याषष्ट्योक्तं)
४. इति ब्रह्मसिद्धांते त्रिप्रश्नोत्तर पंचदशोध्यायः for (इत्ति ब्रह्मगुप्ते त्रिप्रश्नाध्यायः)

(च) १. यदिह for (यदीह)
४. 'इति' से 'समाप्तः' तक समस्त लुप्त

(ङ) १. तच्चार्याषष्ट्याऽयं for (आर्याषष्ट्योक्तं)
२. गोलादुत्प्रेक्ष्य for (तद्गोलादुत्प्रेक्ष्य)

अथ ग्रहणोत्तराध्यायः

षोडशः

ग्रहणग्रहसंयोगग्रहः[1] क्षीयोगेषु[3] सर्वतन्त्र[4]विदाम् ।
आचार्य[5]छेद्यक[6] विद्यतस्ततः[7] छेदकं[2] वक्षे[8] ।। १ ।।
दुर्जनकृतघ्नशत्रु प्रतिकंचुक करि[1]पतितमुर्खेभ्यः[2] ।
छेदक[3]मदेय[4]भ्योददतः[6] सुकृतायुषोर्नाशिः[5] ।। २ ।।
उषिताय दीर्घकाल[1]शिष्याय गुणान्विताय[4] भक्ताय ।
आत्रे[5] वास्तुह[2] देवा सुताय वा छेदकं[3] देयम् ।। ३ ।।

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१. (घ) १. ग्रह (ङ) (ग) for (ग्रहः) २. छेद्यकं (च) (ङ) for (छेदकं)

(ग) ३. क्षतंत्रेषु for (क्षीयोगेषु) ४. 'तंत्र' लुप्त है, (ङ)
५. आचार्यः for (आचार्य) ६. छेदक for (छेद्यक)
७. तत् for (ततः) ८. वक्ष्ये (ङ) for (वक्षे)

(ङ) ३. क्षतंत्रेषु for (क्षीयोगेषु) ५. आचार्यश् for (आचार्य)
७. ततश् for (ततः)

२. (घ) १. कारि (ग) (ङ) for (करि) २. मूर्षेभ्यः (ग) for (मुर्खेभ्यः)
३. छेद्यक (ग) (ग) (ङ) for (छेदक) ४. यमेभ्यो (ग) (ङ) for (यभ्यो)
५. नशि (ग) नाशः for (र्नाशिः)

(ग) ६. दहतः for (ददतः)

(च) १. कारिपतित for (करिपतित) २. मूर्षेभ्यः for (मुर्खेभ्यः)
४. मदेयमेभ्यो for (मदेयभ्यो)

(ङ) २. मूर्खेभ्यः for (मुर्खेभ्यः)

३. (घ) १. दीर्घकालं (ग) (च) (ङ) for (दीर्घकाल)
२. सुहृदेवा (ग) for (स्तुहदे) ३. छेद्यकम् (च) (ङ) for (छेदकं)

(ग) ४. गुणाधिकाय (ङ) for (गुणान्विताय)

(च) २. वासुहृदेवा for (वास्तुहदेवा)

(ङ) ५. पात्रे for (आत्रे) २. सुहृदे वा for (स्तुहदे वा)

विषु[1]वदयमंडलदिशो वलनज्याभि ग्रहा[2]स्त्रिग्रहवृत्ते ।
संपर्क्क[5] ग्राह्य[3]वायो वेत्ति छेदक[4]ज्ञः सः ॥ ४ ॥
संपर्क[4]मण्डले यः प्रग्रहमोक्षो[2]पृथक्[3] स्वविक्षेपात् ।
मध्यान्मध्यग्रासं परिलिखित[1] छेदक[5]ज्ञः सः ॥ ५ ॥
परिलितीष्ट[1]ग्रासं तत्कालिक[5] बाहुकोटिकर्णो[2] यः ।
अथवा निमिलनोन्मीलन[3]द्वयं छेदक[4]ज्ञः सः ॥ ६ ॥

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४. (घ) १. वदपमंडल (च) (ङ) for (वदयमंडल)
२. ग्र॑हात्त्रि (ग) ग्रत्रिगृहवृत्ते for (ग्रहास्त्रिग्रहवृत्ते)

(ग) ३. ग्रास्यै for (ग्राह्य)

(च) २. ग्र॑हात्त्रिगृहवृत्ते for (ग्रहास्त्रिग्रहवृत्ते) ४. छेद्यकज्ञः (ङ) for (छेदकज्ञः)

(ङ) २. भिस्त्रिगृहवृत्ते for (भिग्रहास्त्रिग्रहवृत्ते) ५. संपर्के for (संपक्कें)
३. ग्रासं for (ग्राह्य)

५. (घ) १. परिलिषिति (ग) पिरिलिषति for (परिलिखित)

(ग) २. मोक्षे for (मोक्षो) ३. प्रथक् for (पृथक्)

(च) ४. संपक्कं for (सम्पर्क) १. परिलिषिति for (परिलिखिन)

(ङ) २. मोक्षौ for (मोक्षो) १. परिलिखति for (परिलिखित)
५. च्छेदकज्ञः for (छेदकज्ञः)

६. (घ) १. परिलिषतीष्ट (ग) परिलिषतीष्ट (च) for (परिलितीष्ट)
२. कर्णेर्यः (च) (ङ) for (कर्णोयः)
३. निमीलनोन्मीलन (ग) (च) for (निमिलनोन्मीलन)
४. छेद्यकज्ञः (च) (ङ) for (छेदकज्ञः)

(ग) ५. तात्कालिबाहुकोटि (ङ) for (तात्कालिकबहुकोटि)

(च) ५. तत्कालि for (तत्कालिक)

(ङ) १. परिलिखतीष्ट for (परिलितीष्ट)

ग्राह्यं परिलिखितैक्यं परिलिखति ग्रहादिकं तत्र ।
भूमौ यफलके वा पर्वंतं छद्म(द्य)कज्ञः सः ।। ७ ।।
देशांतरं यथा द्रक् प्रग्रहणांतराद्विजानाति ।
यो रेखातोध्वानं पर्वेष्टदिनात् स तत्रज्ञः ।। ८ ।।
योवेति राहुमार्गं तेनेष्टकालमिष्टकालाद्वा ।
ग्रासं ग्रासात्कालं जानाति छेद्यकज्ञः सः ।। ९ ।।
व्यासप्रमाणयोगग्राह्यग्रहाकदलानि वलनाद्या ।
विक्षेपाश्चापरतः पभृतिखे पूर्वतः शशिनः ।। १० ।।

७. (घ) १. परिलिख्यैकं (ग) परिलेख्यैक्य (ङ) for (परिलिखितैक्यं)
२. लिषति (ग) for (लिखति) ३. प्रग्रहादिकं for (ग्रहादिकं)
४. पर्वर्त्तव (ग) परिवर्त्य (ङ) for (पर्वंतं)
५. छेद्यकज्ञः (ग) छेदकज्ञः for (छद्यकज्ञः)
(ग) ६. यः (ङ) for (य)
(च) १. परिलिख्यैकं for (परिलिखितैक्यं) ४. पर्वर्त्त for (पर्वंतं)
५. वछेद्यकज्ञः for (छद्यकज्ञः)
(ङ) ३. ग्रहग्रहादिकं for (ग्रहादिकं) ५. च्छेद्यकज्ञः for (छद्म(द्य)कज्ञ)
८. (घ) १. यथागत (ग) ययागत for (यथा)
२. द्दक्यग्रहणां (ग) for (द्रक्प्रग्रहणांतरा)
३. ऽध्वानं (ग) (च) (ङ) for (ध्वानं) ४. पर्केष्ट (च) for (पर्वेष्ट)
५. तंत्रज्ञः (ग) (ङ) for (तत्रज्ञः)
(ग) ६. योरखातो for (योरेखातो)
(च) १. यथागत for (यथा) २. द्दक्यग्रहणांतरा for (द्रक्पग्रहणांतरा)
(ङ) १. यथागत for (यथा) . २. द्दक् for (द्रक्)
९. (घ) १. वेत्ति (च) (ङ) for (वेति) २. वा: for (वा)
(ग) ३. ग्रास (ङ) for (काल) ४. छेदकज्ञ: for (छद्य(द्म)कज्ञः)
(च) ३. ग्रास for (काल) २. मिष्टकलाद्वाः for मिष्टकालाद्वा)
(ङ) ४. च्छेद्यकज्ञः for (छद्य(द्म)कज्ञः)
१०. (घ) १.ग्राहक (ग) (ग) (ङ) for (ग्रहाक)
२. वलनद्या (ग) चलनज्या for (वलनाद्या) ३. रवेः (ग) (च) (ङ)(रवे)
(ग) ४. प्रभृति for (पभृति) (च) २. चलनद्यां for (वलनाद्या)
(ङ) ५. ग्रास for (व्यास) २. वलनज्या for (वलनाद्या)
६. विक्षेपश्चापरतो for (विक्षेपाश्चापरतः) ४. भवति for (प्रभृति)

दिनदलविभक्तजित्त[1]गुणदिनगतशेषाल्पजीव[3]येष्टगुणम् ।
त्रिज्यार्द्ध[4]मधिकमंगुल[5]लिप्तास्त्रिग्रह[2]ज्यया भक्तम् ॥ ११ ॥
योन[5]चेत्या[1] द्वितया द्वितया[7] दंगुललिप्ता[2] स्त्रिसंगुणाष्ट[8]हतात्[2] ।
ज्याद्वितीय[3]युक्तिभक्तात्त[6]द्वितुष[7] वयो दरैः[4] षड्भिः ॥ १२ ॥
व्यास वलनापर्वन[1] मेकेनेष्टेना[2] चार्य[5]मितरेषाम् ।
अंगुलकलाभिरेवं शशिसित[4]परिलेख[3] सूत्राणाम् ॥ १३ ॥

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११. (घ) १. जिन (ग) (च) (ङ) for (जित्त) २. स्त्रिगृह (च) for (स्त्रिग्रह)
(ग) ३. जीवयेषु (ङ) for (जीवयेष्ट) ४. तृज्यार्द्ध for (त्रिज्यार्द्ध)
५. मंडल for (मंगुल)
(ङ) ४. त्रिज्यार्ध for (त्रिज्यार्द्ध)

१२ (घ) १. चेत्पाद्वितया for (चेत्याद्वितयाद्वितया)
२. हृतात् (ग) स्त्रिहृतात् for (हृतात्)
३. द्वितय (ग) for (द्वितीय)
४. यवोदारैः (ग) यवोदरैः (ङ) for (वयोदरैः)

(ग) ५. ज्योना for (योन) १. चेज्याद्वितीयदंगुल for (चेत्या द्वितया द्वितया)
६. भक्तात् (ङ) for (भक्तात्त) ७. वितुषक for (द्वितुष)

(च) १. चेनत्याज्या for (चेत्या) ५. ज्योना for (योन)

(ङ) ५. ज्याना for (योन) ७. द्वितीय for (द्वितयाद्वितया)
८. संगणात् for (संगुणाष्ट) २. त्रिहृतात् for (हृतात्)
३. ज्याद्वितययुक्ति for (ज्याद्वितीययुक्ति)

१३. (घ) १. वलनापवर्त्तन (ग) वलनाप्रवर्त्तन for (वलनापर्वन)
२. नवार्य for (नाचार्य) (ग) न कार्यमीतरेपाम् for (नाचार्यमितरेपाम्)
३. परिलेष (ग) (च) for (परिलेष)

(च) १. पर्वत for (पर्वन) २. मेकेनेष्टेनवर्य for (मेकेनेष्टेनाचार्य)
४. नित for (सित)

(ङ) १. वलनापवर्त्तन for (वलनापर्वन) २. मेकेनेष्टेन for (मेकेनेष्टेना)
५. कार्य for (चार्य)

प्रथमे वलनज्याभिर्द्विशो[3] द्वितीयं[1] यथादिशं भानोः ।
आद्यंतौ विक्षेपौ मध्यान्मध्योन्यथा शशिनः[2] ।। १४ ।।
विक्षेपाग्रात्[1] ग्राह्यं परिलिष्य[3] ग्राहकप्रमाणेन[4] ।
प्रग्रहमोक्षग्रासामुपरिलेख[2] भवंत्येवम् ।। १५ ।।
पश्चापग्रहणे[1] प्राग्मोक्षे[4] रविबिम्बं[2] मध्यतो बाहुः ।
स्ववलन सिद्धायां[5] दिशि विपरीत[6]शीतकरणमध्यात्[3] ।। १६ ।।
भानुमते[1] बाह्वग्राद्यधा[2] दिशं कोटिरन्यथा[3] शशिनः[4] ।
रविशशिमध्यात् कर्णस्तिर्यक्कर्णा[5]ग्रकोटियुतेः ।। १७ ।।

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१४. (ग) १. द्वितीये (ङ) for (द्वितीयं) २. राशिनः for (शशिनः)
(ङ) ३. र्द्दिशो for (र्दिशो)

१५. (घ) १. विक्षेपाग्राद्ग्राह्यं (ग)······विक्षेपाग्राह्यं for (विक्षेपाग्रात्ग्राह्यं)
२. भूपरिलेखे (ग) भूपरिलेषे for (भुपरिलेख)
(ग) ३. पिरिलिख्य for (परिलिष्य)
४. यहां 'प्रमाणेन' के साथ विसर्ग भी लगे हैं ।
(च) १. विक्षेपाग्राद्ग्राह्यं for (विक्षेपाग्रात्ग्राह्यं)
२. भूपरिलेषे for (भुपरिलेखे)
(ङ) १. शशिविक्षेपाग्रेभ्यः ग्राह्यं for (विक्षेपाग्रात्ग्राह्यं)
३. परिलिख्य for (परिलिष्य) २. भूपरिलेखे for (भुपरिलेखे)

१६. (घ) १. पश्चात्प्रग्रहणे (ग) पश्चात्प्रग्रहणात् for (पश्चापग्रहणे)
२. बिंब (ग) (च) (ङ) for (बिम्बं)
३. शीतकत (ग) शीतकरमध्यात् (ङ) for (शीतकरणमध्यात्)
(ग) ४. प्राक् मोक्षे for (प्राग्मोक्षे) ५. सिद्धज्या (ङ) for (सिद्धायां)
६. विपरीतः (ङ) for (विपरीत)
(च) १. पश्चाप्रग्रहणे for (पश्चापग्रहणे)
(ङ) १. पश्चात्प्रग्रहणे for (पश्चापग्रहणे)

१७. (घ) १. भानुमतो (ग) (च) (ङ) for (भानुमते)
२. बाह्वग्रा (ग) (च) for (बाह्वग्राद्यथा)
(ग) ३. कोटिरं for (कोटि) ५. तियकर्णा for (तिर्यक्कर्णा)
(ङ) भानुमतो for (भानुमते)

परिलेख[1] ग्राह्यस्य ग्राहकमानेन पूर्ववत्कृत्वा ।
तात्कालिकसंस्थानं निमीलनोन्मीलने चैवम् ॥ १८ ॥
विक्षेपगुण[1]त्रिज्या मानैक्यार्द्धो द्धृताप्तचापांशाः ।
आद्यंतयोर्यथादिशमर्कस्येंदौ[2] विपर्यस्थाः[3] ॥ १९ ॥
तत्स्ववलनांशक[1]योगांतर जीवाग्राह्यमानदलघ्नातात्[2] ।
त्रिज्यालब्धज्याग्रे[3] प्रग्रह[5]मोक्षौ प्राग्वर्कें[4]द्वोः ॥ २० ॥
हु[4]तया व्यासार्द्धेनार्कचन्द्रमानार्द्धलिप्तिका[1] गुणया ।
मध्य[5]वलनछाया[2] दक्षिणोत्तरा दिगत[3]वामध्यात्[6] ॥ २१ ॥

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१८. (घ) १. परिलेषं (ग) (च) for (परिलेखं)

१९. (घ) १. गुणा (ग) गुण्या for (गुण)
२. मर्कस्येंदो (ग) (ङ) for (मर्कस्येंदौ)
३. विपर्ययस्ता (ग) विपर्यस्ताः (ङ) for (विपर्यस्थाः)
(च) १. गुणा for (गुण) २. मर्क्कस्येंदौ for (मर्कस्येंदौ)
३. विपर्ययस्ताः for (विपर्यस्थाः)
१. विक्षेपगुणा for (विक्षेपगुण)

२०. (घ) १. वलनांशयोगान्तर (ग) (ङ) for (वलनांशकयोगान्तर)
२. घातात् (च) (ङ) for (घ्नातात्)
३. ग्रें (च) (ङ) for (ग्रे) ४. प्राग्वदर्कें‍द्वोः (ग) for (प्राग्वर्केन्द्वोः)
(च) १. वलनांशयोगांतर for (वलनांशकयोगांतर)
४. प्राग्वदर्क्केंद्वोः for (प्राग्वर्केंद्वोः)
(ङ) ५. ग्रहमोक्षौ (प्रग्रहमोक्षौ) ४. प्राग्वदर्केन्द्वोः for (प्राग्वर्केंद्वोः)

२१. (घ) १. लिप्तका (च) for (हुतया) २. ज्यया (ग) for (छाया)
२. दिगनया (ग) दिगमनया मध्या for (दिगतवा)
(ग) ४. हृतव्यासार्द्धेनार्कं for (हुतयाव्यासार्द्धेनार्क)
(च) ४. दूतया व्यासार्द्धेनार्क्क for (हुतया व्यासार्द्धेनार्क)
३. दिगनया for (दिगतवा)
(ङ) १. हृतया for (हुतया) ५. मध्यमवलनज्या for (मध्यवलनछाया)
३. दिग्गमनया for (दिगमया) ६. मध्या for (मध्यात्)

[४]प्राग्वत् प्रसार्यं विक्षेपलिप्तिका ग्राहकप्रमाणेन ।
विक्षेपायाद्[१]ग्राह्यं परिलिख्य[२] ग्राह्य[३]संस्थानम् ॥ २२[५] ॥
त्रिज्या[५] विक्षेपगुणा[१] भक्तेष्टग्रास[२]कर्णलिप्ताभिः ।
प्राग्वत् फलचाप[३] स्वबलनांश योगांतरं तज्या[४] ॥ २३ ॥
मानार्द्ध गुणाव्यासार्द्ध[३]भाजिता पूर्ववत् प्रसार्या स्यात् ।
कर्णं प्रसार्य मध्यादग्रं[१] मध्येन कर्णाग्रात्[२] ॥ २४ ॥
तात्कालिकसंस्थानं परिलिख्य[१] ग्राहकप्रमाणेन ।
ग्राह्येन[२] मीलोन्मीलने[४] परिलेख[३] एवं वा ॥ २५ ॥

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२२. (घ) १. विक्षेपाग्राद्ग्राह्यं (ग) for (विक्षेपायाद्ग्राह्यं)
२. परिलिष्य (ग) परिलेक्ष for (परिलिख्य)
३. ग्रास (ग) (च) (ङ) for (ग्राह्य)
(ग) ४. प्राग्प्रसार्यं for (प्राग्वत् प्रसार्यं)
(च) १. विक्षेपाग्राद्ग्राह्यं for (विक्षेपायाद्ग्राह्यं)
२. परिलिष्य for (परिलिख्य)
(ङ) १. विक्षेपाग्रात् for (विक्षेपायाद्)

२३. (घ) १. गुणाः (च) for (गुणा)
(ग) २. व्यास for (ग्रास) ३. चार्या for (चाप)
४. यथाजिवा for (तज्या)
(च) ५. त्रिद्या for (त्रिज्या) ४. तद्या for (तज्या)
(ङ) ४. तथा जीवा for (तज्या)

२४. (ग) १. दग्रकर्णेन for (दग्रं मध्येन) २. मध्याग्रात् for (कर्णाग्रात्)
३. ३+गुणा व्यासार्द्ध+
(ङ) १. दग्रं कर्णेन for (दग्रं मध्येन) २. मध्याग्रात् for (कर्णाग्रात्)

२५. (घ) १. परिख्य (च) for (परिलिख्य)
२. निमीलनोन्मीलने च (ग)........ नमीलनोन्मीलने च for (ग्राह्येन मीलोन्मीलने च)
(ग) ३. परिलेष for (परिलेख)
(च) ४. +व+
(ङ) २. एवं निमीलनोन्मीलने for (ग्राह्येन मीलोन्मीलने)
४. +च+

प्राच्यपरिविपरिते विपरीतं मध्यवलनमर्केंद्वोः ।
पूर्वदन्यत् सर्वं फल कोष्टौ ग्रहणपरिलेखः ॥ २६ ॥
दृग्गणितप्रग्रहयोरंतरघटीका फलं ग्रहे मध्यौ ।
देशांतरं धनं प्राक् प्रग्रहणे त क्षयः पश्चात् ॥ २७ ॥
प्रग्रहणांतर घटिकाभूपरिधिहता विभाजयेत् षष्ट्या ।
फलयोजनेश्चवंत्या प्राग्वत् प्रागपरयोर्देशः ॥ २८ ॥
पातोनखेर्भार्द्धात् च्चक्रोच्चोनाधिकाः कलाभक्ताः ।
तद्गतियुत्याप्तदिनै रासन्ने र्कस्य मासांते ॥ २९ ॥

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२६. (घ) १. विपरीते (ङ) for (विपरिते) २. फलकेष्टौ (ग) for (फलके स्वे)
३. परिलेखाः (ग) (च) (ङ) for (परिलेखः)
(ग) ४. पार for (परि) ५. विपरितं for (विपरीतं)
(च) ४. पर for (परि) १. विपरीते for (विपरिते)
५. मर्क्केंद्वोः for (मर्केंद्वोः) ७. स्थर्वं for (सर्वं)
२. फलकौष्टौ for (फलकोष्टौ)
(ङ) ४. प्राच्यपरे for (प्राच्यपरि) ८. पूर्ववदन्यत् for (पूर्वदन्यत्)
२. फलके स्वे for (फलकोष्टौ)
२७. (घ) १. प्रग्रयो for (प्रग्रहयो) २. घटिका (च) for (घटीका)
३. मध्ये (ङ) for (मध्यौ) ४. तत्क्षयः for (तक्षयः)
(ग) ५. फलग्रहमध्ये for (फलंग्रहेमध्यौ) ६. 'त' लुप्त है ।
(च) १. प्रग्रयो for (प्रग्रहयो) ३. मध्यो for (मध्यौ)
(ङ) २. घटिका for (घटीका) ४. क्षयं for (तक्षयः)
७. +तत्+
२८. (घ) १. योजनेष्ववंत्याः (ङ) for (योजनेश्चवंत्या)
(च) १. योजनेश्ववंत्याः for (योजनेश्चवंत्या)
२९. (घ) १. प्रतौनखेभार्द्धा (ग) पातार्कयुतेभार्द्धाच्च for (पातोनखेर्भार्द्धात्)
२. रासन्नेऽर्कस्य for (रासन्नेर्कस्य)
(ग) ३. क्रार्द्धो (घ) चक्राद्यौ for (चक्रोच्चो)
४. कलाभक्ता (ङ) for (कलाभक्ताः) ५. मासांत्ये for (मासांते)
(च) ३. चक्रार्चेनाधिकाः for (चक्राच्चोनाधिकाः) २. ऽर्क्कस्य for (र्कस्य)
(ङ) १. पातार्क युतिभार्धात् for (पातोनखेर्भार्द्धात्)
३. चक्राद्यनाधिका for (चक्रोच्चोनाधिकाः)
२. रासन्नोऽर्कस्य for (रासन्नेर्कस्य)

पर्वेंदोः[1] पक्षांते प्रागा[2]धिकोना युति[4]र्भवति पश्चात् ।
तन्मध्ये न ग्रहणं यदि भानोः पंच जिनभरसाः[3] ।। ३० ।।
इंदोर्विषया[3] द्वि[1]तमा दिवाकरा त्रिवि[4]षया[5]स्तदुच्चस्य ।
व्योमातिधृ[6]तिद्वियु[2]गानि रसश[7]रांश्चन्द्रपातस्य ।। ३१ ।।
ख[8] नंदा द्वियमाः[4] खा[5]ब्धयो ग्र[1]हाद्या यथेष्ट पर्वगुणाश्रे[2]प्याः ।
पर्वा[3]ण्यिष्यति शोध्याः[6] पा[7]तेऽन्यथातीते ।। ३२ ।।

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३० (घ) १. पर्वेंदाः for (पर्वेंदोः) २. प्रागधिको (ग) (च) for (प्रागाधिको)
(ग) ३. रसा for (रसाः)
(ङ) २. प्रागधिकोना for (प्रागाधिकोना) ४. "युतिर्" लुप्त
३१ (ङ) १. द्वियमा (ग) (च) (ङ) for (द्वितमा)
२. द्वियुगानि (ङ) द्वियुगानि for (द्वियुगानि)
(ग) ३. विषया for (विषया) ४. स्त्रिविषया (ङ) for (त्रिविषया)
५. स्तदुस्तदुच्चस्य । ५ । २२ । १२ । ४३ । for (स्तदुच्चस्य)
६. घृते for घृति
७. सरा-। १६ । ४२ । ५६ श्चन्द्र for (शरांश्चन्द्र)
(ङ) ५. स्तदुच्चस्य । ५ । १२ । १२ । ५३ for (स्तदुच्चस्य)
७. रसशराश्चन्द्रपातस्य ० । १६ । ४२ । ५६ । ३१ for (रसशरांश्चन्द्रपातस्य)
३२. (घ) १. गृहा (ग) (च) for (ग्रहा)
२. क्षेप्याः (ग) for (श्रेप्याः) द्वितीय पंक्ति का आरम्भिक पद
१. पर्वण्ये (ग) पर्वणोष्यति for (पर्वाण्यिष्यति)
(ग) ४. ':' विसर्ग लुप्त है
५. खध्वयो० । ६ । २२ । ४० for (खाब्धयो)
१०. स्तथेष्ट foi (यथेष्ट)
६. शोध्या मध्ये क्षतिक्रांते for (शोध्याः पातेऽन्यथातीते)
७. 'शोध्याः' से आगे के पद लुप्त हैं ।
(च) २. पर्वगुणाः क्षेप्याः ıor (पर्वगुणा श्रेप्याः)
३. पर्वाण्येष्यति for (पर्वाण्यिष्यति)
(ङ) ८. खं for (ख) ५. खाब्धयो० । ६ । २२ । ४० for (खाब्धयो)
१. गृहाद्या for (ग्रहाद्या) १०. स्तथेष्ट for (यथेष्ट)
६. गुणाः for (गुणा) वि० यहां श्लोकार्ध समाप्त
२. क्षेप्याः for (श्रेप्याः) (वि० श्लोक की दूसरी पंक्ति का आरम्भ)
३. पर्वंण्येष्ये for (पर्वाण्यिष्यति) ६. शोध्या for (शोध्याः)
७. मध्ये for (पाते) ११. त्वतिक्रांते for (ऽन्यथातीते)

गृहणे यथा[1] रवींद्वोः स्पष्टीकरणाद्य मुक्तवत्कृत्वा[2]
एवं पर्वज्ञानं गृहणज्ञानं[3] स्फुटं गणितात् ।। ३३ ।।
चत्वारि त्रयुवर्त्त[1] गृहणात्यर्कस्य[2] सप्तचन्द्रस्य[4] ।
द्रष्टोदयास्त[3]मययोर्क[5]रात्रिदलयोश्च केंद्रस्य ।। ३४ ।।
सर्वपादानामंतो[1] तिथ्यंत[3]ज्ञानमिंदुभास्करयोः ।
गृहणे च त्तते[2] स्पष्टे जिष्णुसुतब्रह्मगुप्तेन ।। ३५ ।।

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३३. (ग) १. यथरविद्वोः for (यथा रवींद्वोः)
२. ज्ञात्वा for (कृत्वा) ३. "ग्रहणज्ञानं" लुप्त पद हैं

(च) ३. ग्रहणज्ञानस्फुटं for (ग्रहणज्ञानं स्फुटं)

(ङ) २. मुक्तवज् ज्ञात्वा for (मुक्तवत् कृत्वा)

३४. (घ) १. त्रपुवर्त्त (ग) त्रपुवत्त for (त्रयुवर्त्त)
२. ग्रहणान्यर्कस्य (ग) (च) (ङ) for (ग्रहणात्यर्कस्य)
३. द्दष्टो (ग) इंद्वोदयास्त समयायार्क for (द्रष्टोदयास्त)
४. शीतरश्मेश्च (ङ) for (सप्तचन्द्रस्य)

(च) १. त्रपुवर्त for (त्रयुवर्त्त) ३. द्दष्टो for (द्रष्टो)

(ङ) १. चत्वारोऽत्रपर्त्त for (चत्वारित्रयुवर्त्त)
३. द्दष्टवोदयास्त for (द्रष्टोदयास्त)
५. समया तथाऽर्क for (मययोर्क)

३५. (घ) १. मंते (ग) पदानामन्ते (च) for (पादानामंतो)
२. कृते (ग) चक्रते for (चत्तते)

(घ) ३. तिथ्ये for (तिथ्यन्त)

(च) २. कृते (ङ) for (त्तते)

(ङ) १. सर्वपदानामन्ते for (सर्वपादानामन्तो)
३. तिथ्यन्ते for (तिथ्यंत)

दुरभ्रष्टे[1] ग्रहणे श्रे[2]षेणार्यभटविष्णुचन्द्रस्य[3] ।
दृग्गणित[5]विसंवादः[4] काकतालीयम्[6] ॥ ३६ ॥
स्फुटतिथ्यंतज्ञानं यन्नार्य[1]भटादिभिः कृतमतीतैः ।
ब्राह्मे स्फुटं कृतं तज्जिष्णुसुतब्रह्मगुप्तेन ॥ ३७ ॥
ब्रह्मोक्तोर्केन्दु[2] तदुच्चपातदेशांतरस्फुटीकरणैः[3] ।
स्फुटसिद्धर्कं[1] ग्रहणद्वयं[4] स्फुटमतीतोक्तम्[5] ॥ ३८ ॥
विक्षेपाग्रेषु त्रीन्बिन्दून् प्रग्रहणमध्यमोक्षेषु ।
कृत्वा[1] तन्मन्यद्वय[2]मध्यगयोः[3] सूत्रयोर्योगात् ॥ ३९ ॥

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३६. (घ) १. दूरभ्रष्टे (च) (ङ) for (दुरभ्रष्टे)
२. श्रीषेणार्य (ग) खेणार्य (ङ) for (श्रेषेणार्यभट)
३. चंन्द्रेषु (ग) (च) (ङ) for (चन्द्रस्य)
४. विसंवादात्संवादः (च) for (विसंवादः)
(ग) ५. ग्रहगणितविसंवादात्संवादः for (दृग्गणितविसंवादः)
(च) २. श्रीषेणार्य for (श्रेषेणार्य)
(ङ) ५. ग्रहगणित for (दृग्गणित) ४. विसंवादात् संवादः for (विसंवादः)
६. काकतालीयः for (काकतालीयम्)

३७. (घ) १. यत्रार्य for (यन्नार्य)

३८. (घ) १. मिंद्वर्क (घ) मिंद्वर्क for (सिद्धर्कं)
(ग) २. ब्रह्मोक्तार्केंदुस्तदुच्च for (ब्रह्मोक्तोर्केंदु)
३. स्फुटिकरणैः for (स्फुटीकरणैः) ४. द्वितयं न for (द्वयं)
५. स्फुटमतीवोक्तम् for (स्फुटमतीतोक्तम्)
(च) २. ब्रह्मोक्तार्क्केंदु for (ब्रह्मोक्तोर्केन्दु) १. मिंद्वर्क्क for (सिद्धर्कं)
(ङ) २. ब्राह्मोक्तार्केन्दु for (ब्रह्मोक्तोर्केंदु) १. मिंद्वर्कं for (सिद्धर्कं)
४. ग्रहणद्वितयं for (ग्रहणद्वयं)

३९. (घ) १. कृत्पा for (कृत्वा)
२. तन्मत्स्यद्वय (ग) तन्मत्सद्वय for (तन्मन्यद्वय)
३. मध्यमयोः for (मध्यगयोः)
(च) १. क्रत्या for (कृत्वा) २. तन्मत्स्य for (तन्मन्य)
(ङ) २. तन्मत्स्य for (तन्मन्य)

बिंदु [1]परिलेखरेखा ग्राहकमार्गः प्रसार्य सूत्रे द्वे ।
आद्यंताभ्यां [4]मध्यम[2]माछेद्य [3]स्थुल [5]एवं वा ।। ४० ।।
बिन्दु [2]द्वयांतरं स्थितिदलेन [3]हृतमिष्ट[4]नाडिकागुणितम् ।
[6]ग्राह्यफलांगुल[5]स्थं ग्राहकमानेन [1]परिलेखः ।। ४१ ।।
इष्ट [1]ग्रासोर्केद्वोर्निमीलनोन्[2]मीलनं च [5]भानुमतः ।
[3]त्रषुवर्तः प्राग्मध्यात् [4]पश्चाद्विष्टांगुले स्थेन ।। ४२ ।।

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४०. (घ) १. परिलेषरेषा (ग) for (परिलेखरेखा)
२. माछोद्य (ग) माछाद्य for (माछेद्य)
३. स्थूल (ग) (च) (ङ) for (स्थुल)

(च) १. परिलेषरेषा for (परिलेखरेखा)

(ङ) ४. मध्यग for (मध्यम) २. मुच्छाद्य for (माछेद्य)
५. मेवं वा for (एवं वा)

४१. (घ) १. परिलिख्य (ग) परिख्यः for (परिलेखः)

(ग) २. बिंदुद्वयान्तर for (बिन्दुद्वयांतरं) ३. हृत (च) (ङ) for (हृत)
४. नालिका for (नाडिका) ५. छा for (स्थं)

(च) १. परिलेख्य for (परिलेखः)

(ङ) १. परिलिख्य for (परिलेखः) ६. ग्राह्यं for (ग्राह्य)

४२. (घ) १. ऽर्केद्वो (ग) इष्टग्रार्कंदो for (इष्टग्रासोर्केद्वो)
२. मीलने (ग) मिलने for (मीलनं)
३. त्रपुवर्त्तः (ग) (च) for (त्रषुवर्तः)
४. पश्चाद्द्वेष्टांगुल (ग) (च) for (पन्चाद्विष्टांगुले)

(च) १. ऽर्क्केद्वो for (ऽर्केद्वो) २. मीलने (ङ) for (मीलनं)

(ङ) १. ऽर्केन्द्वो for (र्केद्वो) ५. भानुमतोः for (भानुमतः)
३. उर्वरितः for (त्रषुवर्तः)
४. पश्चाद्वेष्टाङ्गुल for (पश्चाद्विष्टांगुले)

मध्यस्य[1] दिनांत्य नवांतरं[2] मिष्टघटिकाभिः[4] ।
स्थित्यर्द्धनाडिकाद्रत[3]मृणधन[5]मूनाधिके मध्ये ॥ ४३ ॥
आद्यन्ते वान्कृत्वा[2] विक्षेपः[1] कोटिरूक्तवद्ग्रासः ।
विक्षेपान्तरमेवं गुणमिष्टग्रासलिप्ताभिः[3] ॥ ४४ ॥
मध्यग्रासकला ह्लतमृणधन[1] चोक्त[4]वत्स्व[5]विक्षेपः[2] ।
तेन ग्रासात्कालः कालादस[6]कच्च[3] विक्षेपः ॥ ४५ ॥
गृहणोत्तरं न देयं शपथैरपि दत्त सुकृत्[4] नाशाद्यैः ।
गृहणं स्फुट[1]मिहा[2]स्फुटमार्यभटाद्यै[5]र्यतस्तंत्रैः[3] ॥ ४६ ॥

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४३. (घ) १. मध्यस्याद्येनांत्ये (ग) मध्यस्याद्येनांते for (मध्यस्यदिनांत्य)
२. गुणितमिष्ट (ग) गुणीतमिष्ट for (मिष्ट)
३. द्धृत (ग) हृत for (द्रत)
(ग) ४. घटिभि for (घटिकाभिः) ३. धनमृण for (मृणधन)
(च) १. मध्यस्याद्येनांत्यनवांतरं for (मध्यस्य दिनांत्य नवांतरं)
२. गुणितमिष्टघटिकाभिः for (मिष्टघटिकाभिः) ३. हृत for (द्रत)
(ङ) १. मध्यस्याद्येनान्तेन for (मध्यस्यदिनांत्य न)
२. वाऽन्तरं गुणित for (वांतरं) ३. हृत for (द्रत)

४४. (घ) १. विक्षे (ज्ञे) यः for (विक्षेपः)
(ग) २. वा कृत्वा for (वान्कृत्वा) ३. विलिकाभिः for (लिप्ताभिः)
(ङ) २. च पृषत्के for (वान्कृत्वा)

४५. (घ) १. हृतमृणंधनं (ग) हृतमृणधन (च) for (ह्लतमृणधन)
२. विक्षेण (ग) विक्षेपं for (विक्षेपः)
३. दसकृच्च (ङ) (च) for (दसकच्च)
(ग) ४. वोक्त for (चोक्त) ५. ख for (स्व)
६. कालदसत्कृच्चविक्षेप for (कालादसकच्च विक्षेपः)
(च) २. विक्षे for (विक्षेपः)
(ङ) १. हृतमृणंधनं for (ह्लतमृणधन)

४६. (ग) १. 'स्फुट' लुप्त है । २. 'मिहा' लुप्त है ।
३. तंतैः for (तंत्रैः)
(च) ४. सुकृत for (सुकृत) १. स्पष्ट for (स्फुट)
(ङ) ४. सुकृतनाशाय for (सुकृत्नाशाद्यैः) २. मार्यभट for (मिहास्फुट)
५. श्रीषेणाद्यै for (मार्यभटाद्यै) ३. र्यतस्तन्न for (र्यतस्तंत्रैः)

परिलेखो[1] बलिनज्या[5] विक्षेपाद्येषु षोड़षोऽध्यायः[2] ।
गृहणोत्तरमर्केन्द्वोः[3] षट्चत्वारिंशदार्याणाम् ॥ ४७ ॥

[4]इति श्री ब्रह्मगुप्ते ग्रहणाधिकारः
षोडशोऽध्यायः समाप्तः

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४७. (घ) १. परिलेषो (ग) परिलेष for (परिलेखो)
२. षोडशोऽध्यायः (ङ) for (षोडशोऽध्यायः)
३. मर्केंद्वो for (मर्केंद्वोः)
४. 'इति' से 'समाप्तः' तक पाठ अंकित नहीं ।

(ग) ५. वलन for (बलिन)
४. इति श्री ब्रह्मसिद्धांते ग्रहणोत्तराध्यायः षोडशः for (इति श्री ब्रह्मगुप्ते ग्रहणाधिकारः षोडशोऽध्यायः समाप्तः)

(च) १. परिलेषो for (परिलेखो) ५. वलनद्या for (वलिनज्या)
२. षोडशो for (षोडषो) ३. मर्क्कैंद्वोः for (मर्केंद्वोः)
४. 'इति' से 'समाप्तः' तक लुप्त ।

(ङ) १. परिलेख for (परिलेखो) ५. वलनजीवा for (बलिनज्या)
४. इति श्री ब्राह्मस्फुट सिद्धान्ते ग्रहणोत्तराध्यायः षोडशः for (इति श्री ब्रह्मगुप्ते ग्रहणाधिकारः षोडषोऽध्यायः समाप्तः)

अथ शृङ्गोन्नत्युत्तराध्यायः

सप्तदशः

भुजकोटिशशिमान[१] शुक्लपरिलेख[२] सूत्रपरिलेखान्[३] ।
प्रतिदिवसं प्रतिघटिकं यो वेत्तीं[४]दुद[५] यज्ञः सः ।। १ ।।
पराच्य[१] परादिगभिमुखं[५][२] शुक्लेतर[६]पक्षयोर्लिखेतं[३] भूमौ ।
अपवर्त्तेष्टेनैकेन[७] राशिना[८] कोटिभुजकर्णात्[४] ।। २ ।।
परिकल्पार्कं[६] बिन्दु[३] तस्माद्बाहुं यथादिशं[४] कृत्वा[७] ।
बाहुग्रा[१]त्प्राच्यपरां कोटिं[५] तिर्यक्स्थं[२] कर्णः ।। ३ ।।

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१. (घ) १. छेदभुजकोटिकर्णशशि (ग) भुजकोटिकर्णशशि for (भुजकोटिशशि)
२. परिलेष for (परिलेख) (ग) 'परिलेख' लुप्त है ।
३. परिलेषान् (ग) परिलेखात् for (परिलेखान्)
(ग) ४. वेत्तं for (वेत्ती) ५. हृदयज्ञः for (दुंदयज्ञः)
(च) १. भुजकोटि कर्णशशिमान for (भुजकोटिशशिमान)
२. परिलेष for (परिलेख) ३. परिलेषान् for (परिलेखान्)
४. वेत्तीदूंदं for (वेत्तींदुद)
(ङ) २. सित for (परिलेख) ३. लेखात् for (लेखान्)
४. वेत्ति for (वेत्ती) ५. स तन्त्रहृदयज्ञः for (दुंदयज्ञः सः)

२. (घ) १. प्राच्य (ग) (च) (ङ) for (पराच्य)
२. मुंषं for (मुखं) ३. लिषेत (ग) लिखेद्भूमौ for (लिखेत भूमौ)
४. कर्णान् (ङ) (च) for (कर्णात्)
(ग) ५. पदिगभि मुखं for (परादिगभिमुखं)
६. तरतर for (तर) ७. अपवर्त्त्यैकेनेष्टेन (ङ) for (अपवर्त्तेष्टेनैकेन)
८. वाशिना for (राशिना)
(च) २. मुषं for (मुखं) ३. लिषेत् for (लिखेत)
(ङ) ४. लिंखेत् (लिखेत)

३. (घ) १. बाह्वग्रात् (ग) (ङ) for (बाहुग्रात्)
२. तिर्यक् स्थतं (ग) तिर्यक्स्थितं कर्णम् ।। ३ ।।
(ग) ३. बिंदुं (ङ) for (बिन्दु) ४. यथादिशिं (यथादिशं) ५. कोटि for (कोटिं)
(च) ६. परिकल्पार्क्कं for (परिकल्पार्कं) २. तिर्यक्स्थं for (तिर्यक्स्थं)
(ङ) ६. परिकल्प्यार्कं for (परिकल्पार्कं)
७. दत्त्वा for (कृत्वा) २. तिर्यक्स्थितंकर्णं for (तिर्यक्स्थं कर्णः)

कर्णाग्रे चन्द्रमसं परिलेख्य सितं प्रवेश्यकर्णेन ।
शशिबिंबे शुक्लाग्रात्परिलेखसमेन सूत्रेण ॥ ४ ॥
कर्णगतस्थेनेन्दो शुक्ल परिलेख्य पश्चिमाभिमुखः ।
राशिषु मेषतुलादिषु संशोध्य दिवाकरं चन्द्रात् ॥ ५ ॥
पूर्वाभिमुखः कर्कटमकरादिषु भवति शुक्लसंस्थानम् ।
एवं वा संस्थानं परिलेख्येन्दु प्रसाध्य दिशः ॥ ६ ॥
बाहुज्येंदुदलगुणाकर्णविभक्ता भुजोन्यदिक् चन्द्रे ।
कर्णोभुजाग्रतश्चन्द्रमध्यगः पूर्वच्छेषम् ॥ ७ ॥
प्राच्यपरे विपरीते फलकेन्यत्सर्वमुक्तवत्कार्यम् ।
शृङ्गोन्नतिपरिलेखाश्चत्वारः शीतकिरणस्य ॥ ८ ॥

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४. (घ) १. कर्णाग्र for (कर्णाग्रे) २. परिष्य (ग) परिलिख्य for (परिलेख्य)
(ग) ३. बिंबे सूत्रां for (बिंबे शुक्ला)
(च) २. परिलेष्य for (परिलेख्य) ४. परिलेष for (परिलेख)
(ङ) २. परिलिख्य for (परिलेख्य)
५. (घ) १. कर्ण गतिस्थे (ग) (ङ) for (कर्णगतस्थे) २. मेख for (मेष)
(ग) ३. नेंशे for (नेंन्दो) ४. परिलिख्य (ङ) for (परिलेख्य)
५. मुखम् (ङ) for (मुखः) ६. दिकारं for (दिवाकरं)
(च) १. कर्णगतिस्थेनेदो for (कर्णगतस्थेनेंदो)
४. शुक्लं परिलेख्य for (शुक्लं परिलेख्य)
(ङ) ३. नैशे for (नेंन्दो) ७. शुक्ले for (शुक्ल)
६. (ग) १. परिलेखेन्दु for (परिलेख्येन्दु)
(च) २. कर्क्कट for (कर्कट) १. परिलिख्येंदु for (परिलेख्येन्दु)
(ङ) ३. मुखं for (मुखः) १. परिलिख्येन्दु for (परिलेख्येन्दु)
७. (घ) १. पूर्ववछेषम् (ग) पूर्ववछेशम् for (पूर्वछेषम्)
(ग) २. भुजात्य दिक्केद्रे for (भुजोन्यदिक्चन्द्रे) ३. मध्यतः (ङ) for (मध्यगः)
(ङ) २. भुजान्यदिक् for (भुजोन्यदिक्) १. पूर्ववच्छेषम् for (पूर्वछेषम्)
(च) १. पूर्ववछेषं for (पूर्वछेषम्)
८. (ग) १. प्राच्यररे for (प्राच्यपरे) २. विपरिते for (विपरीते)
३. मुक्तवछेषम् for (मुक्तवत्कार्यम्) ४. सीत for (शीत)
(च) ५. फलकेन्य सर्वमुक्त for (फलकेन्यत्सर्वमुक्त)
(ङ) ६. वच्छेषम् for (वत्कार्यम्)

ग्रहयोगेंदुच्छाया ग्रहदयोस्तमयभग्रहयुतीनाम् ।
तत्स्वक्रान्तिज्याद्युत्तराणि भग्रहयुतौ न पृथक् ।। ९ ।।
इति परिलेखाध्यायः शशांक शृंगोन्नतेर्भुजाद्येषु ।
शशिशृङ्गोन्नत्युतरमार्यादशकेन सप्तदशः ।। १० ।।

इत्ति सप्तदशाध्यायः समाप्तः

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९. (ग) १. ग्रहोदयास्त (च) (ङ) for (ग्रहदयोस्त)
२. मुनिनां for (युतीनाम्) ३. तत्क्रान्तिज्याप्पा (घ) for (तत्क्रान्तिज्याद्यु)
४. प्रथक् for (पृथक्)

(च) ५. द्या for (ज्या)

(ङ) २. ग्रह मुनीनां for (ग्रह युतीनां)
३. तत्क्रान्तिज्या for (तत्स्वक्रान्तिज्या)
५. प्रश्नोत्तराणि for (द्युत्तराणि)

१०. (घ) १. भुजोज्येषु (ग) भुजाद्येषु for (र्भुजाद्येषु)
२. 'इति' से 'समाप्त' तक अंकित नहीं है ।

(ग) ३. : लुप्त हैं ५. शृंगोन्युत्तर for (शृङ्गोन्नत्युतर)
६. मार्यादसकेन for (मार्यादशकेन)
२. इति ब्रह्मसिद्धांते सप्तदशोध्यायः for (इत्ति सप्तदशाध्यायः समाप्तः)
४. राशि for (शशि)

(च) २. 'इति' से 'समाप्तः' तक लुप्त

(ङ) २. इति श्रीब्राह्मस्फुटसिद्धान्ते शृङ्गोन्नत्युत्तराध्यायः सप्तदशः
for
(इति सप्तदशाध्यायः समाप्तः)

अथ कुट्टकाध्यायः

अष्टादशः

प्रायेण यतः प्रश्नाः[4] कुदाकाराद्[1]व्रतेन[2] शक्यंते ।
ज्ञातुं वक्षामि[3] ततः कुदाकारं[5] सह प्रश्नैः ॥ १ ॥
कुदकर्ण[1] धनाव्यक्त मध्यमाहरण[6] वंर्ण्यता[2] वितर्कैः ।
आचार्यैस्तंत्रविदां[3] ज्ञातैर्वर्ग[4] प्रकृत्याच्च[5] ॥ २ ॥
अधिकाग्रभागहारा[4] दूनाग्रछेदभाजिता[6] शेषम्[1] ।
यत्तत्परस्य ह्रतं[2] लब्धमध्योधः[3] पृथक्[5] स्थाप्यम् ॥ ३ ॥
शेषं तथेष्टगुणितं यथाग्रयोरंतरेण[2] संयुक्तम् ।
शुध्यति गुणकः स्थाप्यो लब्धं चांत्यादुपांत्यगुणाः[1] ॥ ४ ॥

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१. (घ) १. २ कुट्टाकाराहृते (ग) कुट्टाकाराहृते for (कुदाकाराद्व्रते)
३. वक्ष्यामि (ग) (च) (ङ) for (वक्षामि)
(ग) ४. प्रश्ना for (प्रश्नाः) ५. कुट्टाकारं (ङ) for (कुदाकारं)
(च) २. हृतेन for (व्रतेन)
(ङ) १. कुट्टाकाराहृते for (कुदाकाराद्व्रते)

२. (घ) १. कुट्टकर्ण for (कुदकर्ण)
(ग) १. कुट्टकखर्णधना for (कुदकर्णधना)
२. कर्णभावितर्कैः (ङ) for (वंर्ण्यतावितर्कैः)
३. विदा for (विदां) ४. वर्ग्र for (वंर्ग)
(च) ५. च for (च्च)
(ङ) १. कुट्टकखर्ण for (कुदकर्ण) ६. हरणैक for (माहरण)

३. (घ) १. छेषम् (च) (ङ) for (शेषम्)
२. यत्तत्परस्परहृतं (ग) यत्परस्परहृतं (ङ) for (यत्तत्परस्यह्रतं)
३. मध्येधः (ग) मधोऽधः (ङ) for (मध्योधः)
(ग) ४. भावहारा for (भागहारा) ५. प्रथक् for (पृथक्)
(च) ३. मध्येधः for (मध्योधः)
(ङ) ६. दूनाग्रच्छेद for (दूनाग्रेछद)
४. (ग) १. गुणः (ङ) for (गुणाः)
(ङ) २. यथाऽग्रयो for (यथाग्रयो)

स्तोद्धांत्ययुतोग्रातो हीनाग्रछेदभाजितः शेषम् ।
अधिकाग्रछेदाहतमधिकाग्रयुतं भवत्यग्रम् ॥ ५ ॥
छेदवधस्य द्वियुगछेद वधोयुगतं द्वयोरग्रम् ।
बुधकारेणैवं त्र्यादिग्रहयुगगतानयनम् ॥ ६ ॥
यो जानाति युगादिं ग्रहयुगपातैः पृथक् पृथक् तिथितैः ।
द्वित्रिचतुः प्रभृत्तिनां कुट्टाकारं स जानाति ॥ ७ ॥

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५. (घ) १. स्वोद्धांतियुतो (ग) स्वोर्थात्ययुतो for (स्तोद्धांत्ययुतो)

(ग) २. ग्रांतो for (ग्रातो) ३. हृत for (हृत)

(च) १. स्तोद्धांत for (स्तोद्धांत्य)
(ङ) १. स्वोर्ध्वोऽन्त्ययुतो for (स्तोद्धांत्ययुतो)
२. ऽग्रान्तो for (ग्रातो) ३. च्छेदहृत for (छेदाहत)

६. (घ) १. द्वियुगं (ग) (च) (ङ) for (द्वियुग)
३. रर्ग्रम् for (रग्रम्) २. युगगतं (ग) युगमतं for (युगतं)
४. कुधकारेणैवं (ग) कुट्टाकारेणैवं (ङ) for (बुधकारेणैवं)

(ग) ५. छोदवहो for (छेदवधो)

(च) २. युगगतं (ङ) for (युगतं) ४. कुद्यकारेणैवं for (बुधकारेणैवं)

७. (घ) १. प्रभृतीनां (ङ) (ग) प्रभृतिनां for (प्रभृत्तिनां)

(ग) (वि०—यह श्लोक इस प्रति में श्लोक संख्या १५ पर है)
२. युगादीग्रह for (युगादिग्रह) ३. युगजातैः for (युगपातैः)
४. प्रथक् २ for (पृथक् पृथक्) ५. कथितैः for (तिथितैः)
६. कुट्टकारं for (कुट्टाकारं) ७. जाति for (जानाति)

(च) ३. युगः यातैः for (युगपातैः)
४. पृथक्प्रथक्कतिथितैः for (पृथक् पृथक् तिथितैः)
१. प्रभृतीनां for (प्रभृत्तिनां)
२. युगादि for (युगादिं) ३. ग्रहयुगयातैः for (ग्रहयुगपातैः)
(वि०—श्लोक संख्या १५ है)

भगणादिशेषमग्रं छेदहृतं[1] ख[2] चर[5] दिनजशेषहृतम्[3] ।
अनयोरग्रं भगणादि दिनजशेषोद्धृतं[6] द्यगुणः[4] ॥ ८ ॥
अथवा जिनज[2]भगणादिशेषं येन गुणं मंडलादि शेषोनं[3] ।
शुध्यति विभाजितं स्वेन भागहारेण सद्यगुणः[1] ॥ ९ ॥
मंडल राश्यंशकला विकलाशेषादभिष्टतः[1] कथितान ॥
आनयति दिनगणं यः कुठाकारं[2] स जानाति ॥ १० ॥

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८. (घ) १. छेदहृतं (ग) (च) (ङ) for (छेदहतं)
२. खंच (यहां मूल में 'र' नहीं है) for (खचर)
३. हृतम् (च) (ङ) for (ह्रतम्)
४. क्वगणः (ग) द्युगणः for (द्यगुणः)
(ग) ५. च for (चर)
६. भगणादिघृतं for (भगणादिदिनजशेषोद्धृतं)
(वि०—इसकी श्लोक संख्या ७ है) (ङ)
(च) २. खच for (खचर) ४. द्युगणः (ङ) for (द्यगुणः)
(वि०—इसकी क्रमसंख्या ७ है)

९. (घ) १. गणः for (गुणः)
(ग) २. यह श्लोक 'दिनज' से आरम्भ होता है, (ङ)
३. शेषकयोः (ङ) for (शेषोनं)
दूसरी पंक्ति बिल्कुल भिन्न है—
"सदृशछेदो घृतयोस्तद्धातमहर्गंण द्यमतः" ।।८।।
(च) १. सद्युगणः for (सद्यगुणः)
(ङ) २. 'अथवा' लुप्त, दिनज for (जिनज)
दूसरी पंक्ति निम्नांकित—
सदृशच्छेदोद्धृतयोस्तद्घातमहर्गणाद्यमनः for (शुध्यति विभाजितं स्वेन भागहारेण सद्यगुणः)
(वि—इसकी क्रमसंख्या ८ है)

१०. (घ) १. दभीष्टतः कथितान् for (दभिष्टतः कथितान)
२. कुट्टाकारं for (कुठाकारं)
(च) १. दभीष्टतः for (दभिष्टतः) २. कुट्टाकारं for (कुठाकारं)
(ङ) श्लोक उपलब्ध नहीं।

यो जानाति[2] युगगतं कथितादयिमास[4] शेषकादिष्टात् ।
अवभाव[1] शेषतो वा तद्योगाद्वासकुट्टज्ञः[3] ॥ ११ ॥
एकेष्टदिवसघटिका विनाडिका मंडलादिशेषकयोः ।
सद्रश[1]छेदो धृतयो[2]स्तघात्[3] महर्गणाद्यमतः ॥ १२ ॥
हतयो[3]परस्परं यछेषं[4] गुणकारभागहारकयोः ।
तेन हतौ[2] निछेदौ[5] तावेव परस्परं हतयोः[1] ॥ १३ ॥
लब्धमध्येधः[3] स्थाप्यं तथेष्ट गुणकारसंगुणं शेषम्[4] ।
शुध्यति तथैक[1]हीनं गुणकः स्थाप्यः[2] पलं चांत्यात्[5] ॥ १४ ॥

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११. (घ) १. अवमाव (ग) (च) (ङ) for (अवभाव)
(ग) (वि०—इसकी श्लोक संख्या २५ है)
२. यो युगगतं for (यो जानाति युगगतं)
(च) ३. कुदज्ञ: for (कुट्टज्ञः)
(ङ) (वि---श्लोक संख्या २५ है)
२. जानाति यो for (यो जानाति) ४. दधिमास for (दयिमास)
१२. (घ) १. सदृश (च) for (सद्रश) २. हृतयो (च) for (धृतयो)
३. स्तद्यात for (स्तघात्)
(ग) यह श्लोक इस प्रति में उपलब्ध नहीं है ।
(च) ३. तद्यात् for (तघात्)
(ङ) श्लोक अनुपलब्ध है ।
१३. (घ) १. हृतयोः (ग) (ङ) for (हतयोः)
२. हृतौ (ग) (च) for (हतौ)
(ग) ३. हृतयोः (च) for (हतयो)
(वि०—इसकी श्लोक संख्या ६ है) (ङ)
(ङ) ३. हृतयोः for (हतयो) ४. यच्छेषं for (यछेषं)
५. निश्छेदौ for (निछेदौ)
१४. (घ) १. यथैक (च) (ङ) for (तथैक)
२. स्थाप्यपलं (ग) स्थाप्यफलं for (स्थाप्यः पलं)
(ग) ३. लब्धमध्योध for (लब्धमध्येधः) ४. शेषे for (शेषं)
५. वांत्यात् for (चांत्यात्)
(वि०—इसकी श्लोक संख्या १० है) (ङ)
(च) ५. चाप्तात् or चात्यात् for (चांत्यात्)
(ङ) ३. लब्धमधोऽधः for (लब्धमध्येधः)

[1]अग्रांत्य[6]मुपांत्येना [2]स्वार्द्धो [7]गुणितोंत्य संयुतो [3]भगणः ।
[4]छेदभागहारेणैवं स्थिर[5]कटुकः शेषम् ।। १५ ।।
[7]इष्टभगणादिशेषात् स्व[1]कुटक[2]गुणात् स्वाभागहार [3]हृतात् ।
शेषं [4]द्युगणोहृत [5]निरपर्वत गुणभागहारं[6] युतः ।। १६ ।।

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१५. (घ) १. अग्रांत (ग) (च) (ङ) for (अग्रांत्य)
३. भक्तः (ग) (च) for (भगणः)
४. निछेदभागहारे for (छेदभागहारे)
५. कुट्टकः (ङ) for (कटुकः)
७. गुणितोप्त (त्य) (च) for (गुणितोंत्य)

(ग) २. स्वेर्धो for (स्वार्द्धो)
६. मुपांत्येन (ङ) for (मुपांत्येना)
(वि०—इसकी श्लोक संख्या ११ है)
४. निछेद for (छेद) ५. कुदकः for (कटुकः)

(ङ) २. स्वोर्ध्वो for (स्वार्द्धो) ३. भक्तः for (भगणः)
४. निः शेष for (छेद)

१६. (घ) १. कुट्टक (ङ) for (कुटक)
२. गुणात्स्वभाग (ग) गुणान् स्वभाग for (गुणात्स्वाभाग)
३. हृताद् (ग) हृतान् for (हृतात्)
४. गत (ग) भगणोगत for (द्युगणोहृत)
५. निरपवर्त्त (ग) (च) (ङ) for (निरपर्वत)
६. भागहारयुतः (ग) गुणभागहारयुता for (गुणभागहारंयुतः)

(ग) (वि०—इसकी श्लोक संख्या १२ है)

(च) ७. दष्ट for (इष्ट) १. कुदक for (कुटक)
२. गुणात्स्वभाग for (गुणात्स्वाभाग)
३. हृताद् for (हृतात्) ४. गत for (हृत)
६. गुणभागहारयुतः (ङ) for (गुणभागहारंयुतः)

(ङ) २. गुणात्स्वभाग for (गुणात्स्वाभाग) ४. गत for (हृत)

एवं समेषु विषमेष्वृणं[1] धनं धनमृणं यदुक्तं तत् ।
ऋणधनयोर्व्यस्तत्वं[4] गुण्यप्रक्षेपयोः[5] कार्यम्[2] ॥ १७ ॥
गुणकच्छेदः[1] छेदो गुणको धनमृणधनं[3] कार्यम् ।
वर्गं[4] पदं पदकृति[6] रंताद्वैपरित[5] माद्यं[2] तत् ॥ १८ ॥
अंशक शेषा त्र्यूनास्तप्त[2] हतान्मूल[1] मूनमष्टाभिः ।
नवभिर्गुणं सरूपं कदा शतं बुधदिने सवितुः ॥ १९ ॥

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१७. (घ) १. विषमेष्वृणं (ग) पुणधन for (विषमेष्वणं)
(ग) ४. व्यस्तत्वं for (व्यस्तत्वं) ५. गुण्यम् for (गुण्य)
(वि०—इसकी श्लोक संख्या १३ है) (ङ)
(च) १. विषमेष्वृणं for (विषमेष्वणं) २. प्रक्षेपयो for (प्रक्षेपयोः)
(ङ) १. विषमेष्वृणं for (विषमेष्वणं)

१८. (घ) १. छेदः (ग) छेद (च) for (छेदः छेदो)
२. वैपरीत for (वैपरित)
(ग) ३ मृणमृणं for (मृण) ४. वागपदं for (वर्गपदं)
५. रंत्याद्विपरित for (रंताद्वैपरित)
(वि०—इसकी श्लोक संख्या १४ है) (ङ)
(ग) +तिथिमानदिनेष्विष्टा ये ऽर्काद्यास्ते पुनः कदा तेषु ।
इष्टग्रहवारे यः कथयति कुट्टकज्ञः सः ।। ८ ।।+
इसकी श्लोक संख्या १८ के स्थान में ८ लिखी गई प्रतीत होती है ।
(च) 'श्लोक' लुप्त
(ङ) (वि०—इसकी क्रमसंख्या १८ है)
१. ग्रहवारेषु for (ग्रहवारे)
(च) ४. वर्गं पदं for (वर्गपदं) ६. पदेकृति for (पदकृति)
५. रंताद्वैपरीत for (रंताद्वैपरितं)
(ङ) १. गुणकश्छेदश्छेदो for (गुणकच्छेदः छेदो)
४. वर्गः पदं पदं for (वर्गपदं पद)
५. रन्त्याद्विपरीत for (रंताद्वैपरित)

१९. (घ) १. हृतान् for (हतान्)
(ग) (वि०—इसकी श्लोक संख्या २७ है)
(ङ) (वि०—इसकी श्लोक संख्या २७ है)
२. शेषात्त्र्यूनात् for (शेषात्र्यूनाम्)
१. सप्तहृतात् for (तप्तहतान्)

ऱ्यूनाधिमासः[५] शेषात्[१] मूलघ्व्यधिकं[२] विभाजितं षड्भिः ।
घ्रूनं[६] वर्जित[३] मधिकं नवभि र्नवति[४] कदा भवति ॥ २० ॥
अवमावशेष[४] वर्गोन्येको[५]विंशति विभाजितोघ्व्यधिक[१] ।
अष्टगुणे[६] दशभक्ते[२] द्वियुते[३] ष्टादशकदा भवति ॥ २१ ॥
इष्टभगणादिशेषा[४] द्युगणस्तत्कुट्टकेन[१] संयुक्तः
तच्छेद[५]दिनैस्तावद्दिनवारो यावदिष्टस्य[२ ३] ॥ २२ ॥

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२०. (घ) १. शेषान्मूलं (ग) for (शेषात् मूल) २. द्वयधिकं (ग) (च) for (घ्व्यधिकं)
३. वर्गित (ग) (च) for (वर्जित) ४. न्नवतिः (ग) नवभिः for (नवतिः)
(ग) (वि०—इसकी श्लोक संख्या २८ है)
५. न्यूनाधिमास for (ऱ्यूनाधिमास) ६. द्वयूनं २ for (घ्रूनं)
(च) १. शषान्मूलं for (शेषात्मूल) २. द्वयधिकं for (घ्व्यधिकं)
४. न्नवतिः for (नवति)
(ङ) (वि०—इसकी श्लोक संख्या २८ है)
५. न्यूनाधिमास for (ऱ्यूनाधिमासः)
१. शेषान्मूलं for (शेषात्मूल) २. द्वयधिकं for (घ्व्यधिकं)
६. द्वयूनं for (घ्रूनं) ३. वर्गित for (वर्जित)
४. नवतिः for (नवति)

२१. (घ) १. द्वयधिकः (ग) (च) (ङ) for (घ्व्यधिकः)
१. देशभक्तो (ग) (च) for (दशभक्तो)
३. द्वियुतोऽष्टादश (ग) (च) for (द्वियुते)
(ग) (वि०—इसकी श्लोक संख्या २९ है)
४. शेषे for (शेष) ५. व्येको for (न्येको)
६. गुणो for (गुणे)
(ङ) ५. व्येको for (न्येको)
(वि०—इसकी श्लोक संख्या २९ है)

२२. (ग) १. कुटकेन for (कुट्टकेन) २. दिष्टः for (दिष्ट)
३. स्यात् for (स्य)
(वि०—इसकी श्लोक संख्या १९ के स्थान में ९ है)
(च) १. कुदकेन for (कुट्टकेन)
(ङ) (वि०—श्लोक संख्या १९ है)
४. शेषाद् for (शेषा) ५. तच्छेद for (तछेद)
२. ३. यावदिष्टः स्यात् for (यावदिष्टस्य)

भगणाद्यमिष्टशेषं कदेंदुदिवसे खेर्गुरू दिने वा।
ज्ञदिने [3]वायः [1]कथयति [2]कुदाकारं स जानाति ॥ २३ ॥
ज्ञदिने यदंशशेषं विकलाशेषं कदा [1]न दिंदु दिने।
भानोरथवा शशिनो यः कथयति [2]कुटकज्ञः सः ॥ २४ ॥
इष्टेषुमान दिवसे [4]द्वि[1]मासान्मून [5]रात्रिशेषे वा।
भूयस्ते यः कथयति [2]पृथग् पृथग वा [3]कुदज्ञः ॥ २५ ॥

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२३. (घ) १. कथति (च) for (कथयति)
२. कुट्टाकारं (ग) कुट्टकारं for (कुदाकारं)
(ग) ३. ज्ञदिनैराशयः for (ज्ञदिनेवायः)
(वि०—इसकी श्लोकसंख्या १६ के स्थान में केवल ६ लिखी है)
(च) १. कुट्टाकारं ror (कुदाकारं)
(ङ) (वि०—श्लोकसंख्या १६ है)
३. राशीन् for (वायः) २. कुट्टाकारं for (कुदाकारं)

२४. (घ) १. तदिंदु (ग) (च) (ङ) for (नदिंदु)
२. कुट्टकज्ञः (ग) for (कुटकज्ञः)
(ग) (वि०—इसकी श्लोक संख्या १७ के स्थान में ७ है)
(च) २. कुदकज्ञः for (कुटकज्ञः)
(ङ) (वि०— क्रमसंख्या १७ है)
१. कुट्टकज्ञः for (कुटकज्ञः)

२५. (घ) १. मासन्मून for (मासान्मून)
२. पृथगपृथग्वा (ग) प्रथक् पृथग् वा स for (पृथग् पृथग वा)
३. कुदज्ञः (ग) for (कुदज्ञः)
(ग) (वि०—इसकी श्लोक संख्या २६ है)
१. न्यून for (न्मून)
४. दिवसेष्वधिमास for (दिवसे द्विमास)
(च) १. मासन्मून for (मासान्मून) २. पृथगपृथग्वा for (पृथग् पृथगवा)
(ङ) (वि०—इसकी क्रमसंख्या २६ है)
४. दिवसेष्वधि for (दिवसे द्वि) १. मासन्यून for (मासान्मून)
५. रात्र शेषे for (रात्रिशेषे) २. पृथक् for (प्रथग्)
२. पृथग् वा for (पृथग वा) ३. स कुट्टज्ञः for (कुदज्ञः)

निछेदभागहाराद्राश्यादि कलानाहताद्भुक्तात् ।
भगणकलाभिर्लब्धं मंडलशेषं दिनगणोस्मात् ॥ २६ ॥
एवं राश्यंश कलाशेषाण्यहर्गणः प्राग्वत् ।
नष्टस्थानेष्विष्टानं कान् कृत्वोक्त वछेशषम् ॥ २७ ॥
यो राश्यादीन् द्रष्ट्वा मध्यस्येष्टस्य कथयति द्युगुणम् ।
घ्व्यधिग्रहयोगाद् ग्रहांतराद्वा स कुटज्ञः ॥ २८ ॥

२६. (घ) १. कलादिनाहताद्भुक्तात् (ग) कलादिना हृताद्भुक्तात् for (कलानाहताद्भुक्तात्)
(ग) (वि०—इसकी श्लोक संख्या २१ है ।) २. (लब्धं भमंडल for (लब्धं मंडल)
(च) १. कलादिनाहताद्भुक्तात् for (कलानाहताद्भुक्तात्)
(ङ) (वि०—इसकी क्रम संख्या २१ है
४. निश्छेद for (निछेद) १. कलादिना for (कलाना)
३. हताद्भुक्तात् for (हताद्भुक्तात्)
५. दिनगणोऽस्मात् for (दिनगणोस्मात्)

२७. (घ) १. हर्गऽणः for (हर्गणः) २. छेषम् for (छेशषम्)
(ग) (वि—इसकी श्लोक संख्या २२ है ।) ३. कलाविकला (ङ) for (कला)
४. शेषादहर्गणः (ङ) for (शेषाण्यहर्गणः)
(च) २. वछेषं for (वछेशषम्) १. हर्ग्गणः for (हर्गणः)
(ङ) (वि० इसकी क्रम संख्या २२ है)
५. नष्टस्थेष्विष्टान् for (नष्टस्थानेष्विष्टानं)
६. तान् for (कान्) ७. कृत्वा भक्त्वोक्त for (कृत्वोक्त)
२. वच्छेषम् for (वछेशषम्)

२८. (घ) १. द्युगणम् (ग) (च) (ङ) for (द्युगुणम्)
२. द्व्यादि for (घ्व्यधि) (ग) द्व्यादिग्रहसंयोगात् for (घ्व्यधिग्रहयोगाद्)
३. गुहांततरात् (ग) ग्रहांतरद्वा for (ग्रहांतराद्वा)
४. कुट्टकज्ञः (ग) for (कुटज्ञः)
(ग) (वि—इसकी श्लोक संख्या २० है परंतु लिखी हुई १० है ।)
५. दृष्ट्वा (च) (ङ) for (द्रष्ट्वा)
(च) २. द्व्यादिग्रह for (घ्व्यधिग्रह) ४. कुदज्ञः for (कुटज्ञः)
(ङ) (वि०—इसकी क्रम संख्या २० है)
२. द्व्यादिग्रह संयोगात् for (घ्व्यधिग्रहयोगाद्)
४. कुट्टज्ञः for (कुटज्ञः)

येन गुणे[1] शेषयुते[2] छेदः शुध्यति ह्रत[4] स्वगुणकेन ।
तद्भ्रुक्तं[5] शेषं फलमेव[6] शेषाद्ग्रह[7]द्युगुणैः[3] ॥ २९ ॥
राश्यंशकला[3] विकला शेषात्कथितादभीष्टतोनष्टात्[7] ।
यः साधयद्युपरिमान[1] समध्यमा[4] कुदकज्ञः[2] स ॥ ३० ॥
इति श्री[5] कुट्टक[6] प्रकरणम्

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२९. (घ) १. गुण (ग) गुणः for (गुणे) २. युतछेद (ग) हृताछेदः for (युते छेदः)
३. गणैः (ग) गणौ for (गुणैः)

(ग) (वि०—इसकी श्लोक संख्या २४ है) ४. हृदः for (ह्रत)
५. न तदुक्तं for (तद्भ्रुक्तं) ६. फलमेवं for (फलमेव)

(च) १. गुणों शेषयुतां for (गुणे शेषयुते)
४. हृतः for (ह्रत) ३. द्युगणैः for (द्युगुणैः)

(ङ) १. (वि०—इसकी क्रम संख्या २४ है)
१. गुणः for (गुणे) २. युतश्छेदः for (युते छेदः)
४. हृतः for (ह्रत) ७. शेषाद्ग्रह for (शेषाद्ग्रह)
३. द्युगणौ for द्युगुणैः)

३०. (घ) १. त्युपरिमान् (ग) त्युपरिधमान् for (द्युपरिमान्)
५. वि०—मूल में 'इति श्री' पद नहीं है ।
२. कुट्टकज्ञः (ग) for (कुदकज्ञः स)

(ग) (वि—इसकी श्लोक संख्या २३ है)
३. विकलांशशेषात् for (विकलाशेषात्)
४. समध्यमान् for (समध्यमा)

(च) १. साधयत्युपरिमान् for (साधयद्युपरिमान्)
४. समध्यमात् for (समध्यमा) ५. 'इति श्री' लुप्त
६. कुदक for (कुट्टक)

(ङ) (वि०—इसकी क्रमसंख्या २३ है)
७. नष्टान् for (नष्टात्) १. साधयत्युपरितनान् for (साधयद्युपरिमान्)
४. समध्यमान् for (समध्यमा)
२. कुट्टकज्ञः for (कुदकज्ञः) ५. 'इति - से—णम्' तक सब लुप्त ।

अथ[५] धनर्ण श्रुत्यानां[१] संकलना[६]

धनयोर्धनमृणयोर्[८]धनर्णयोर्[७]रंतरं समैक्य[२]खं[६] ।
वर्णैक्य[३]मृणं[१०] धनशून्ययोः द्वूनं[४] शून्ययोः शून्यम् ।। ३१ ।।
ऋण[१]मधिकाद् विशोध्यं धनं धनादृणमृणादधिकमूनात् ।
व्यस्तं तदंतरं वा ऋणं[२] धनं[४] न मृणं[३] भवति ।। ३२ ।।

३१· (घ) १. शून्यानां for (श्रुत्यानां)
२. समैक्यं (ग) for (समैक्य)
३. खर्णैक्य (ग) स्वर्णैक्यमृण for (वर्णैक्यमृणं)
४. द्वनं (ग) for (द्वूनं)

(ग) (वि०—इसकी श्लोक संख्या ३० है)
५· 'अथ' से 'संकलना' तक लुप्त है ।
६· स्वं for (खं)

(च) ५. अथधनर्ण्य for (अथधनर्ण)
१. शून्यानां संकलनाः for (श्रुत्यानां सकलना)
७. धनर्ण्ययो for (धनर्णयो) — २. समैक्यं for (समैक्य)
३. खवर्ण्यैक्य for (वर्णैक्य) — ४. द्वनं for (द्वूनं)

(ङ) १. शून्यानां for (श्रुत्यानां) — ४. "द्वूनं" लुप्त
६. सङ्कलनम् for (संकलना)
८.+मृण+ — २. समैक्यं for (समैक्य)
३. ऋणमैक्यं च for (वर्णैक्य) — १. धनमृण for (मृणं)

३२. (घ) १. ऊन (ग) (च) (ङ) for (ऋण)
२. स्वादृणं (ग) (च) for (वा ऋणं)
३. 'ण' को लिखना भूल गया

(ग) (वि०—इसकी श्लोक संख्या ३१ है)
४. धनं धनमृणं भवति for (धनं न मृणभवति)

(च) ३. नमृभति for (न मृणभवति)

(ङ) २. स्यादृणं for (वा ऋणं) — ३. धनमृणं for (नमृण)

शून्यविहीनमृणमृणं धनं धनं भवति शून्यमाकाशम् ।
शोध्ये यदा धनमृणादृणं धद्धातदश्रेय्यम् ॥ ३३ ॥
प्रत्युत्पन्नः ऋणमृणधनयोर्घाते धनमृणयोर्धन वधोवनं भवति ।
शून्यण्ययोः स्वधनयोः खशून्ययो र्वा वध शून्यम् ॥ ३४ ॥

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३३. (घ) १. दृणं (ग) (च) (ङ) for (दणं)
२. धनाद्वा (ग) (ङ) for (धद्धा)
३. क्षेप्यम् (ग) तदा क्षेप्यम् for (तदश्रेय्यम्)
(वि०—इसकी क्रमसंख्या ३४ लिखी है)

(ग) ४. विहिन for विहीन ५. शोध्यं (च) (ङ) for (शोध्ये)
(वि०—इसकी संख्या ३२ है)

(च) २. धट्वा for (धद्धा) ३. तदश्रेप्यं for (तदश्रेय्यम्)
(वि०—यहां क्रमसंख्या ३४ अंकित है)

(ङ) ७. तदा for (तद) ३. क्षेप्यम् for (श्रेय्यम्)

३४. (घ) १. शून्यर्णयोः (ग))ङ) for (शून्यण्योः)
२. वधः (ग) (च) (ङ) for (वध)
(वि०—इसका संख्याक्रम ३५ लिखा है।)

(ग) (वि०—इसकी श्लोक संख्या ३३ है, परन्तु 'प्रत्युत्पन्न' यहां लुप्त है) (ङ)
ऋणमृणधनयोर्घातौ धनमृणयोर्धनवधो धनं भवति ।
शून्यर्णयोः खधनयोः खशून्ययोर्वा वधः शून्यम् ॥ ३३ ॥
३. घातो (ङ) for (घते) ४. खधनयोः for (स्वधनयोः)

(च) ३. घतो for (घते) ५. द्धंन for (धंन)
१. शून्यर्ण्ययोः for (शून्यण्योः)
५. (वि०—यहां क्रमसंख्या ३५ अंकित है)

(ङ) ७. 'प्रत्युत्पन्नः' लुप्त

धनभक्तं धनमृणहृतं[1] मृणं[2] धन भवति खंखभक्तम्[5] ।
खंभक्तमृणे[5] धनधनमृणधनेन[6][7][3] हृतमृणमृणं[4][8] भवति ।। ३५[9] ।।
खोद्धृतमृणधनं[4] वा तच्छेदं[5] खमृणधन विभक्तं[1] वा ।
धनमृणधनयोर्वर्गः[6] खं[7] खस्यपदं कृतियत्तत[2] ।। ३६[3] ।।
योगोत्तर युतहीनो[5] द्विहतः[1] संक्रमणमंतरविभक्तम्[7] ।
वार्गान्तिरमंतर[2] युतहीनं द्विहतं[3] विषमकर्म[4] ।। ३७[6] ।।

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३५. (घ) (वि०—इस श्लोक की दूसरी पंक्ति का आरंभिक 'ख' पहली पंक्ति का अंतिम शब्द है)

१. हृतमृणं (ग) (ङ) (च) for (हृतंमृणं)

२. धनं (ग) (च) (ङ) for (धन) ३. मृणं (ग) (च) (ङ) for (मृण)

४. हृत (ग) (च) (ङ) for (हृत)

(वि०—इसका संख्याक्रम ३६ लिखा है)

(ग) ५. भक्तं खम् । यहां 'खं' पहली पंक्ति का अंतिम पद है । दूसरी पंक्ति 'भक्त' से आरम्भ होती है । इसकी क्रमसंख्या ३४ है । (ङ)

६. मृणेन (ङ) for (भक्तमृणे) ७. 'धन' यह पद लुप्त है (ङ)

८. मृणधनं भवति for (मृणमृणं)

(च) १. यहां क्रमसंख्या '३६' अंकित है ।

३६. (घ) १. वा: for (वा)

(वि०—इसका संख्याक्रम ३७ लिखा है)

(ग) २. कृतिर्यत्कृत् for (कृतियत्तत्)

(वि०—इसकी श्लोक संख्या ३५ है)

(च) ३. (वि०—यहाँ क्रमसंख्या ३७ अंकित है)

(ङ) ४. मृणं for (मृणं) ५. तच्छेदं for (तच्छेदं)

६. ऋणधनयो for (धनमृणधनयो)

७. स्वं खं for (खं) २. यत्तत् for (यत्तत)

३७. (घ) १. हृतः (ग) (च) (ङ) for (हृतः)

२. वर्गान्तर (ग) (च) (ङ) for (वार्गान्तर)

३. हृतं (ग) (च) (ङ) for (हृतं) ४. कर्म्मः (ग) (च) for (कर्म)

(वि०—इसका संख्याक्रम ३८ लिखा है)

(ग) ५. युतहिनो for (युतहीनो) (वि०—इसकी श्लोक संख्या ३६ है)

(च) ६. (वि०—यहां क्रमसंख्या ३८ अंकित है)

(ङ) ७. +वा+

करार्णलंबस्तत्कृति रिष्टहृतेष्टोन संयुतोऽल्पोभूः ।
अधिको द्विहृतो बाहु संक्षेप्यावद्वधो वर्गः ॥ ३८ ॥
इष्टोद्धृत करार्णी पदक्रतियुतिरिष्टगुणितांतरकृतिर्वा गुण्यः ।
स्तिर्यगधोधो गुणकः समसद्गुणः सहितः ॥ ३९ ॥
सेष्टर्णछेदगुणो भाज्यछेदौ पृथक् युतावसकृत् ।
छेदैकगत हृतौर्द्धो भाज्यो वर्गः समद्विवधः ॥ ४० ॥

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३८. (घ) १. करणी (ग) (ङ) for (करार्ण)
२. हृतो (ग) (च) for (हृतो) ३. बाहू (ग) बाहुः (ङ) for बाहु
(वि०—इसका संख्याक्रम ३९ है ।)
(ग) ४. हृते (च) for (हूते) ५. संयुताल्पोभूः for (संयुतोऽल्पोभूः)
६. संक्षेप्या यद्वधो for (संक्षेप्यावद्वो)
(च) १. करणी for (करार्ण) ७. (यहां क्रमसंख्या ४९ अंकित है)
(ङ) ५. संयुताऽल्पा भूः for (संयुतोऽल्पोभूः) ६. संक्षेप्पो यद्वधो for (संक्षेप्यावद्वधो)

३९. (घ) १. करणी (ग) (च) (ङ) for (करार्णी)
२. 'गुण्य' यह पद दूसरी पंक्ति के आरम्भ में है (ग)
(वि०—इसका संख्याक्रम ४० है)
(ग) ३. पदयूतिक्रति for (पदक्रतियुति) २. गुणास्ति for (गुण्यः)
४. गुणक (ङ) for (गुणकः) ५. समस्तद्गुण सहितः ॥ ३८ ॥ for (समसद्गुणः सहितः ॥ ३९ ॥)
(च) २. र्वागुण्य for (र्वागुण्यः) ६. (यहां क्रमसंख्या ४० अंकित है)
(ङ) ३. पदयुतिकृति for (पदक्रतियुति) २. 'गुण्यः' दूसरी पंक्ति का आरम्भिक पद ।
५. समस्तद्गुणः for (समसद्गुणः)

४०. (घ) हृतो (ग) (च) (ङ) for (हूतौ)
२. समद्विवधः (ग) समिद्विविधः for (समद्विवधः)
(वि०—इसका संख्याक्रम ४१ है)
(ग) ३. गुणौ for (गुणो) ४. प्रथक् for (पृथक्) ५. वा भाज्यो (ङ) for (र्द्धोभाज्यो)
(वि०—इसकी क्रमसंख्या ३९ है) (ङ)
(च) ३. सेष्टर्ण्यछेदगुणो for (सेष्टर्णछेदगुणो) ६. भाद्यछेदौ for (भाज्यछेदौ)
५. र्द्धोभाद्यो for (र्द्धोभाज्यो) २. समद्विवधः for (समद्विवधः)
७. (वि०—यहां क्रमसंख्या ४१ अंकित है)
(ङ) ३. च्छेदगुणौ for (छेदगुणो) ७. युजावसकृत् for (युतावसकृत्)
२. समद्विवधः for (समद्विवधः)

इष्टकरन्[1]यूनाया रूप[4]कृतैः पद[5]युतोनरूपार्द्धे ।
[2]प्रथमे रूपाण्यन्य[3]हिना [6]द्वितीयं करण्यसकृत् ॥ ४१ ॥[7]
अव्यक्तवर्ग[1]धनवर्ग[2]वर्गं पंचगत[3]षङ्गतादीनाम् ।
तुल्यानां [4]संकलित [5]व्यवकलिते [6]पृथगतुल्यानाम् ॥ ४२[7] ॥
सदृश [2]द्विवधो वर्गश्यादिवधस्तद्गतो[3]ऽन्यरूपवधः ।
[4]अन्योन्य[1]वर्गघातो भावितकः पूर्ववच्छे[6]षम् [5]॥ ४३ ॥

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४१. (घ) १. करण्यूनाया (ग) (च) (ङ) for (करन्यूनाया)
२. प्रथमं (ग) (ङ) for (प्रथमे) ३. द्विना (ग) द्वितिय for (हिना)
(वि०—इसका संख्याक्रम ४२ है)
(ग) ४. रूपकृतेः (ङ) for (रूपकृतैः) ५. यूतो for (युतो)
६. 'द्वितीयं' लुप्त है
(वि०—इसकी श्लोक संख्या ४० है)
(च) ३. रूपाण्यन्यद्विना for (रूपाण्यन्यहिना)
(वि०—यहां क्रमसंख्या ४२ अंकित है)
(ङ) १. ण्यूनाया for (न्यूनाया) ३. ततो for (हिना)

४२. (घ) (वि०—इसका संख्याक्रम ४३ है।)
(ग) १. घनवर्ग (ङ) for (धनवर्ग) २. यहां एक 'वर्ग' लुप्त है।
३. गतः for (गत) ४. संकलिते for (सङ्कलित)
५. 'व्यवकलिते' लुप्त है
६. प्रथग for (पृथग)
(वि०—इसकी श्लोक संख्या ४१ है)
(च) ७. (वि०—यहां क्रमसंख्या ४३ अंकित है)
(ङ) (वि०—क्रमसंख्या ४१ है)

४३. (घ) (वि०—इसका संख्याक्रम ४४ है)
१. वर्ण (ग) (ङ) for (वर्ग)
(ग) २. द्विधो for (द्विवधो) ३. न्यवधः for (ऽन्यरूपवधः)
४. सन्योन्य for (अन्योन्य)
(वि०—इसकी श्लोकसंख्या ४२ है)
(च) १. वर्ण्य for (वर्ग)
५. (वि०—यहां क्रमसंख्या ४४ अंकित है)
(ङ) ३. ऽन्यजातिवधः for (ऽन्यरूपधः) ६. पूर्ववच्छेषम् for (पूर्ववंछेषम्)

'इति धनर्णादीनां सङ्कलित व्यवकलितादि'

मंडलशेषाद्युनान्मूलं[1] व्येकं दशाधृतं[2] द्वियुतम् ।
मंडलशेषं व्येक[3] भानोर्ज्ञदिने कदा भवति ॥ ५०[4] ॥
अधिमास शेषपादा[6] न्यूनाद्वर्गो[1]धिमासशेषसमः[2] ।
अवमावशेषतो[3] वा वमवशेषसमः[4] कदा भवति ॥ ५१[5] ॥
आद्याद्वर्णादन्यान् व्यस्तान्[8]प्रोह्याद्यमानमाद्य[6]हूतात्[1] ।[7]
सद्रशा[2] छेदान्[3] सकृत् द्वौ व्यस्तौ उदको[4]बप्पू[5] ॥ ५२[8] ॥

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५०. (घ) (वि०—इसकी क्रमसंख्या ५१ है)
१. द्व्यू (ग) द्युनामूलं for (द्युनान्मूलं)
२. हृतं (ग) हृतं for (धृतं) ३. व्येकं (ग) (ङ) for (व्येक)
(ग) . (वि०—इसकी श्लोक संख्या ४६ है)
(च) १. द्व्यूनान् for (द्युनान्) २. हृतं for (धृतं)
४. (वि०—इसकी क्रमसंख्या ५१ अंकित है)
(ङ) १. द्व्यूनान्मूलं for (द्युनान्मूलं) २. दशाहृतं for (दशाधृतं)

५१. (ग) (वि०—इसकी क्रमसंख्या ५२ है)
(ग) १. न्यूनाद्वर्गा for (न्यूनाद्वर्गो) २. यमः for (समः)
६. अमावशेषतो for (अवमावशेषतो) ४. 'व' लुप्त है (ङ)
(वि०—इसकी श्लोक संख्या ५० है)
(च) १. द्वर्गोऽधिमासशेषः for (द्वर्गोधिमासशेष)
५. (वि०—क्रमसंख्या ५२ अंकित है)
(ङ) ६. पादात् for (पादा) १. न्यूनाद्वर्गो for (न्यूनाद्वर्गो)

१. हृतात् (च) for हूतात्) २. सदृस (ग) सदृशा for (सद्रशा)
३. नसकृत (ग) for (नसकृत्)
४. कुट्टको (ग) (ङ) for (उदको) ५. बहुषु (ग) (ङ) for (बप्पू)
(वि०—इसकी श्लोक संख्या ५३ है)
(ग) (वि०—इसकी श्लोक संख्या ५१ है)
६. मद्य for (माद्य) ६. तत् for (तात्)
(च) २. सदृस for (सद्रशा) ३. नसकृत् for (नृसकृत्)
५. बप्पु for (वप्पू) (वि०—यहां श्लोक संख्या ५३ अंकित है)
(ङ) शीर्षक + इदानीमनेकवर्णसमीकरणमाह +
८. वर्णान् for (व्यस्तान्) २. सदृश for (सद्रशा)
१. हृतम् for (हूतात्) ३. च्छेदावसकृदद्वौ for (छेदान् सकृत्द्वौ)

गतभगणयुता[5] द्यु गुणा[1] तद्द्वेषयुता[2] तदैक्य[3]युताद्वा[6] ।
तद्योगाद्वा[7] द्यु गुणो[4] यः कथयति कुट्टक्ज्ञः[8] सः ।। ५३[9] ।।
गतभगणोना[3] द्यु ना[1] गणातच्छेषो[2] ना तदैक्यहीनाद्वा[5] ।
तद्विवराद्वा[4] द्विगुणं यः कथयति कुट्टकज्ञः[6] सः ।। ५४[7] ।।

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५३. (घ) १. गणात्त (ग) द्युगुणात् for (द्युगुणा)
२. छेष (ग) for (तद्द्वेष) २. त्तदैक्य (ग) for (तदैक्य)
४. गणं for (गुणो)
(वि०—इसकी क्रमसंख्या ५४ लिखी है)
५. गतभंगयुतात् for (गतभगणयुता)
६. संयुक्तात् (ङ) for (युताद्वा) ७. तद्योगाद्यु गुणं for (तद्योगाद्वाद्यु गुणो)
८. कुट्टकज्ञः (ङ) for (कुट्टक्ज्ञः)
(वि०—इसकी श्लोक संख्या ५२ है)
(च) १. द्यु गणा for (द्यु गुणा) २. त्तछेषयुता for (तद्द्वेषयुता)
६. युक्ताद्वा for (युताद्वा) ७. ताद्योगाद्वा for (तद्योगाद्वा)
४. द्यु गणं for (द्यु गुणो) ८. कुदकज्ञ for (कुट्टक्ज्ञः)
१. (वि०—यहां श्लोक संख्या ६४ अंकित है)
(ङ) ५. भगणयुताद् for (भगणयुता) १. द्युगणात् for (द्यु गुणा)
२. तच्छेषयुतात् for (तद्द्वेषयुता)
४. द्यु गणं वा for (वा द्यु गुणो)

५४. (घ) (वि०—इसकी क्रमसंख्या ५५ है)
१. द्यु गणात्त (ग) द्युगणात्त्त for (द्युनागणा)
२. छोषानात्तदैक्य (ग) छेशोना for (छेषोना)
(ग) ३. नात् (ङ) नाद् for (ना) ४. तद्विवराद्युगणं for (तद्विवराद्वा)
(वि०—इसकी श्लोकसंख्या ५३ है)

राश्याद्यैस्त छेशैश्चैवं भुक्ताधिमास हीनदिनैं[1] ।
तच्छेषैश्चयुगगतं[2] य कथयति कुट्टकज्ञः सः ।।५४।।

(ङ) १. दिनहीनैः for (हीनदिनैः) २. तच्छेषैश्च for (तछेषैश्च)
(च) १. द्यु गणा for (द्यु नागणा) ५. त्तदैक्य for (तदैक्य)
६. कुदकज्ञ for (कुट्टकज्ञ) ७. (वि०—यहां क्रमसंख्या ५५ अंकित है)
(ङ) ३. द्युगणात् for (द्यु नागणा) २. तच्छेषोनात् for (तछेषोन)
४. द्युगणं वा for (वाद्विगुणं)

अंशक शेषेण युता[५] स्त्रिप्ता[१] शेषात्र[२] तदंतरादथवा ।
भानोर्ज्ञदिने द्यु[३]गुणं यः कथयति कुटकज्ञः[४] सः ।। ५५[६] ।।
अंशक शेषं[२] त्रियुतं लिप्ता शेषं कदा रवेर्ज्ञ दिने षट्[३] ।
सप्ताष्टोन[४] वा[१] कुर्वन्नावत्सराद्गणकः ।। ५६[५] ।।
अंशसम[६] मंशके[१] कलासमं[७] वा कला[२] कदा[३] शेषम् ।
दिवसकरस्येष्ट[४] दिने कुर्वन्नावत्सराद्[५]गणकः ।। ५७ ।।

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५५. (घ) (वि०—इसकी क्रमसंख्या ५६ है)
१. लिप्ता (ग) (च) for (स्त्रिप्ता) ३. द्युगणं (च)(ङ) for (द्युगुणं)
२. शेषात्तदंतरा (ग) (च) for (शेषात्रतदंतरा)
४. कुट्टकज्ञ (ग) कुट्टकज्ञः for (कुटकज्ञः)
(ग) ५. हृता for (युता) (वि०—इसकी श्लोक संख्या ५५ है)
(च) ४. कुदकज्ञः for (कुटकज्ञः) (वि०—इसकी क्रमसंख्या ५६ अंकित है)
(ङ) ५. युतात् for (युता) लिप्ता for (स्त्रिप्ता)
२. शेषात् for (शेषात्र)
५६. (घ) (वि०—इसकी क्रमसंख्या ५७ है) १. नं वा (ग) नावां for (नवा)
(ग) २. शेषं (ङ) for (शेष)
३. 'षट्' दूसरी पंक्ति का प्रथम पद है (ङ)
४. सप्तष्टौ for (सप्ताष्टो)
(वि०—इसकी श्लोकसंख्या ५६ है)
(च) १. सप्ताष्टोनं for (सप्ताष्टोन)
५. (वि०—इसकी क्रमसंख्या ५७ अंकित है)
(ङ) १. नव वा for (न वा) ४. सप्ताष्टौ for (सप्ताष्टो)
५७. (घ) (वि०—इसकी क्रमसंख्या ५८ है)
१. मंशाशकला for (मंशके) २. कदा (ग) for (कला)
६. कला (ग) for (कदा) ४. दिवसरस्येष्ट for (दिवसकरस्येष्ट)
५. त्स्थराद्गणकः for (त्सराद्गणकः)
(ग) ६. अंशयुगमंशशेषं for (अंशसममंशके) ७. कलासमांश for (कलासमं)
(वि०—इसकी क्रमसंख्या ५८ है, संख्या ५७ अंकित करना भूल गया)
(च) १. मंशशे for (मंशके) २. ३. कदा कलाशेषं for (कलाकदाशेषम्)
४. दिवसरस्येष्ट दिने for (दिवसकरस्येष्ट दिने)
५. स्थराद्गणकः for (सराद्गणकः)
(ङ) १. मंशशेषं for (मंशके) ३. 'कदा' लुप्त

अवमावशेषमवमैरधिमासकशेषमधिकमासैर्वा[3] ।
इष्टयुतोनं तुल्यं कुर्वन्नावत्सर[1]गणकः ।। ५८ [2]।।
निछेद[3] भागहारो[1] भानो[4] सप्तति[2]गुणोंशशेषोनः ।
शुध्यत्ययुत विभक्तः कुर्वन्नावत्सराद्गणकः ।। ५९ [5]।।
भावितकरूप गुणना साव्यक्तवधेष्टभाजिताप्वासौ[1] ।
अल्पाधिके[2] धिकोल्पेक्षेप्यौ[3] भावितहृतौ[4] व्यस्तौ[5] ।। ६० [6]।।

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५८ (घ) (वि०—इसकी क्रमसंख्या ५९ है)
१. सराद्गणकः for (सरगणकः)

(च) १. सद्गणकः for (सरगणकः)
२. (वि०—यहां क्रमसंख्या ५९ अंकित है) ३. र्वाः for (र्वा)

(ङ) ३. मधिमासैः for (मधिकमासैर्वा) १. सराद्गणकः for (सरगणकः)

५९. (घ) (वि०—इसकी क्रमसंख्या ६० है)
१. भागहारो (ङ) (मागहारो) २. गुणोऽंश for (गुणोंश)

(ग) ३. निश्छेद (ङ) for (निछेद) ४. भानोः (च) (ङ) for (भानोः)
(वि०—क्रमसंख्या ५९ है)

(च) २. गुणोऽंशशोषोनः for (गुणोंशशेषो नः)
(वि०—क्रमसंख्या ६० अंकित है)

६० (घ) (वि० – इस श्लोक की क्रमसंख्या ६१ है)
१. भाजितेऽष्टयाप्तौ (ग) भाजितेष्टाप्त्योः (ङ) for (भाजिताप्वासौ)
२. अल्पऽधिकोऽधिको (ग) अल्पेऽधिकल्पः for (अल्पाधिकोधिकोल्पे)
३. थौ (ग) क्षेप्यो for (क्षेप्यौ) ४. हृतौ (च) (ङ) for (हृतौ)

(ग) ५. व्यस्तम् (ङ) for (व्यस्तौ)

(च) १ भाजिष्टयाप्तौ for (भाजिताप्वासौ)
६. (वि०—यहां क्रमसंख्या ६१ अंकित है)

(ङ) शीर्षक—+अथ भावितबीजम्+
२. अल्पेऽधिकोऽधिकेऽल्पः for (अल्पाधिकोधिकोल्पे)
३. क्षेप्या for (क्षेप्यौ)

भानोराश्य शवधा[२] त्रिचतुर्गुणितान्विशोध्यराश्यंशात्[३] ।
नवति[१] द्रष्ट्वा[४] सूर्यं कुर्वन्नावत्सराद्गणकः ॥ ६१[५] ॥
भावितके[३] तद्यातो[६] विनष्ट[१] वर्णेन तत्प्रमाणानि ।
ऋत्वेष्टानि[२] तदाहत[४] वर्णैक्यं भवति रूपाणि ॥ ६२[५] ॥
वर्णप्रमाणभावितघातो[४] भवतीष्ट[१]वर्णसंख्यैवम्[२] ।
सिध्यति विनापि भावितसम[३]करणात् किंकृतं तदतः ॥ ६३[५] ॥
मूल[१]द्विधेष्ट[६]वर्गागुण[२]गुणादियुत[७]विहीनाच्च[८] ।
आध्यवधो[३] गुणक गुणः[९] संहांत्पवातेन[४] पमत्यम्[५] ॥ ६४[१०] ॥

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६१. (घ) (वि० इस श्लोक की क्रमसंख्या ६२ है) १. नर्वति (ग) नति for (नवति)
(ग) २. वधात्ति (ङ) for (वधात्रि) ३. राश्यंशान् for (राश्यंशात्)
(च) १. नर्वति for (नवति) ४. दृष्ट्वा (ङ) for (द्रष्ट्वा)
५. (वि०—यहां क्रमसंख्या ६२ अंकित है) (ङ) १. नर्वति for (नवति)

६२. (घ) (वि०—इसकी श्लोकसंख्या ६३ है) १. विनष्टे (च) for (विनष्ट)
२. कृत्वेष्टानि (ग) (च) (ङ) for (ऋत्वेष्टानि)
(ग) ३. भाविक यद्धातो for (भावितके तद्यातो)
(च) ५. (वि०—इसकी क्रमसंख्या ६३ अंकित है)
(ङ) ६. यद्घातो for (तद्यातो)

६३. (घ) (वि०—इसकी क्रमसंख्या ६४ है)
(ग) १. भवतिष्ट for (भवतीष्ट) २. संख्यैक्यम् for (संख्यैवम्) ३. काम for (सम)
(च) ४. द्यातो for (घातो) ५. (वि० इसकी क्रमसंख्या ६४ अंकित है)

६४. (घ) (वि०—इस श्लोक की क्रम संख्या ६५ है)
१. मूलं (ग) for (मूल) २. वर्गाद्गुण (ग) वर्गात् गुणक for (वर्गागुण)
३. आद्य (ग) (च) (ङ) for (आध्यवधो)
४. सहांत्यघातेन (ग) संहृत्य घातेन for (संहात्पवातेन)
५. पमंत्यम् (ग) मन्त्यम् for (पमत्यम्)
(ग) ३. द्विधेष्ठ for (द्विधेष्ट) ७. गुणादिष्टयुत for (गुणादियुत)
८. विहिनाच्च for (विहीनाच्च) ९. गुण for (गुणः)
(च) २. वर्गाद्गुण for (वर्गागुण) ४. सहांत्यघातेन for (संहांत्यवातेन)
५. पमंत्ययं for (पमत्यम्) १०. (वि०—इसकी क्रम संख्या ६५ अंकित है)
(ङ) श्री —+अथ वर्ग प्रकृतिः+
२. वर्गाद् गुणक for (वर्गागुण) ७. गुणादिष्ट for (गुणादि)
४. सहान्त्यघातेन for (संहांत्पवातेन) ५. कृतमन्त्यम् for (पमत्यम्)

वज्ञावाधैक्यं[1] प्रथमं प्रक्षेपः क्षेप्य शोध्य[3]तुल्यवधः ।
प्रक्षेपशोधकहृते[2] मूले प्रक्षेपके रूपे[4] ॥ ६५ ॥
रूप[3]प्रक्षेपपदे पृथगीष्ट[1]क्षेप्य[4]शोध्यमूलाभ्याम् ।
कृत्वाद्योत्पाद्य[2]पदे[7] प्रक्षेपे शोधने वेष्टु[5] चतुरधिके[6] ॥ ६६ ॥
इत्य[4]पदकृतिस्त्र्यूना[6] दलितांत्य पदगुणात्पदम्[1] ।
अंत्यपदकृति[5]र्व्येका[7] द्विहता[3]द्यपदा[6] हताद्यपदम्[8] ॥ ६७ ॥

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६५. (घ) (वि०—इस श्लोक की क्रम संख्या ६६ है)
१. वज्रवधैक्यं (ग) वज्रमधैक्यं for (वज्ञावाधैक्यं)
२. हृते (ग) तुहृते for (हृते)
(ग) ३. 'शोध्य' पद लुप्त है ।
(च) १. वज्ञवाधैक्यं for (वज्ञावाधैक्यं)
२. हृते for (हृते) ४. (वि०—यहाँ क्रमसंख्या ६६ अंकित है ।)
(ङ) १. वजवधैक्यं for (वज्ञावाधैक्यं)
३. क्षेपवधतुल्यः for (क्षेप्यशोध्यतुल्यवधः) २. हृते for (हृते)

६६. (घ) (वि०—इस श्लोक की क्रम संख्या ६७ है)
१. पृथगिष्ट (ग) (च) (ङ) for (पृथगीष्ट)
२. ऽद्योत्पाद्य (ग) कृत्वाद्यांशाद्य पदे for (कृत्वाद्योत्पाद्यपदे)
(ग) ३. रूपं for (रूप) ४. 'क्षेप्य' पद लुप्त है ।
५. वेष्टे (यहाँ श्लोक समाप्त है), 'चतुरधिके' ६७ वें श्लोक का आरंभ है ।
(च) ४. रूपप्रक्षेपदे for (रूपप्रक्षेपपदे) २. ऽद्योत्पाद्य for (द्योत्पाद्य)
५. वेष्टे for (वेष्टु) ६. रधिकें for (रधिके)
(ङ) २. कृत्वाऽन्त्याद्यपदे for (कृत्वाद्योत्पाद्यपदे)
७. +ये+ ५. वेष्टे for (वेष्टु) ६. "चतुरधिके" लुप्त

६७. (घ) (वि०—इसकी श्लोक संख्या ६७ है)
१. गुणांत्यपदं (ग) for (गुणात्पदम्)
२. व्येंका (च) (ङ) for (व्येका) ३. हृता (ग) (च) (ङ) for (हता)
(ग) ४. चतुरधिकेत्य for (इत्य) ५. पदं for (पद)
६. पादा for (पदा)
(च) ६. स्त्र्यिना for (स्त्र्यूना) १. गुणांत्यपदं for (गुणात्पदं)
७. व्येंका for (व्येका) ८. (वि०—क्रमसंख्या ६८ अंकित हैं)
(ङ) ४. चतुरधिकेऽन्त्य for (इत्य) १. गुणाऽन्त्यपदम् for (गुणात्पदम्)

चतुरूनेंत्यपद[4] कृता[7]ग्रेक[1]युतेवधदलं प्रथग्वेकम्[2] ।
व्येका[3]ध्व्यहृतमंत्यं पदवधगुण मन्यदाद्यहृदम्[5] ।। ६८ ।।[1]
वर्ग[3] गुणकः[4] क्षेप; केनचिदुद्धृत[5] युतोन[7] को दलितः ।
प्रथमोंत्ये[6] मूलमन्यो गुणर[1]पदोद्धृत[2] प्रथमम् ।। ६९ ।।[7]
गुणके[5] वर्गछिन्ने[6] छेदपदे यो धृतपदं[1] प्रथम[2]वर्गः[3] ।
छेत्रे[4] क्षेपे तन्मूले छेदपद गुणिते ।। ७० ।।[7]

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६८. (घ) (वि०—इसकी श्लोक संख्या ६९ है) १. श्र्येक for (श्रेक)
२. पृथग् (ग) for (प्रथग्) (च) ३. द्याहृ (ग) (ङ) for (ध्व्यहृ)
(ग) ४. चतुरूनोंत्यपदकृतित्येकयुते for (चतुरूनेंत्यपदकृता श्रेकयुते)
५. मन्यथाद्यपदम् for (मन्यदाद्यपदम्)
(च) १. श्र्येकयुते for (श्रेकयुते) ३. द्याहृत for (ध्व्यहृत)
(ङ) ७. कृती for (कृता) १. श्र्येकयुते for (श्रेकयुते)
२. पृथग्यव्येकम् for (प्रथग्वेकम्) ५. माद्यमान्त्य for (मन्यदाद्य)

६९. (घ) (वि०—क्रम संख्या ७० है) १. गुणकार (ग) (ङ) for (गुणर)
२. पदोद्धृतः प्रथमम् (ग) धृतप्रथमः for (पदोद्धृत प्रथमम्)
(ग) ३. वर्गेण for (वर्गे) ४ गुणके (च) (ङ) for (गुणकः)
५. दुद्धृतो नितोदलतः for (दुद्धृ तयुतोनको दलितः)
६. प्रथमोंत्य (ङ) for (प्रथमोंत्ये)
(च) २. पदोद्धृतः for (पदोद्धृत) ७. (वि०—क्रम संख्या ७० अंकित है)
(ङ) ७. युतोनितोदलितः for (युतोनको दलितः)
२. पदोद्धृतः प्रथमः for (पदोद्धृत प्रथमम्)

७०. (घ) (वि०—इसकी क्रमसंख्या ७१ है)
१. धृतं for (धृतपदं) २. प्रथमं for (प्रथम)
३. 'वर्ग' (यह शब्द दूसरी पंक्ति का आरंभिक पद है) ४. छिन्ने for (क्षेत्रे)
(च) ६. वर्गछोन्न for (वर्गछिन्न) १. द्धृतपदं for (धृतपदं)
३. वर्ग for (वर्गः) ४. छेन्न for (छेत्रे)
७. (वि०—यहाँ क्रम संख्या ७१ अंकित है)
(ङ) 'वर्गच्छिन्न गुणके प्रथमं तन्मूलभाजितं भवति ।
वर्गच्छिन्ने क्षेपे तत्पदगुणिते तदा मूले ।। ७० ।।
for
गुणके वर्गच्छिन्ने छेदपदे यो धृतपदं प्रथमवर्गः ।
क्षेत्रे क्षेपे तन्मूले छेद पद गुणिते ।। ७० ।।

शशिलिप्ता शेषकृति[1]द्विनवति[5] गुणिता अशिति[2] गुणितं[3] वा ।
सैकाङ्ग[6] दिने वर्गं[7] कुर्वन्नावङ्परा[4]द् गणकः ॥ ७१[8] ॥
इष्टभगणादि शेषं द्विनवत्यूनं त्र्यशिति[1] संगुणितम् ।
रूपेण युतेन[2] वर्गं[3] कुर्वन्नावत्सराद् गणकः ॥ ७२[4] ॥
भगणादिशेषवर्गं चतुर्गुणं पंचषष्टिसंयुक्तम् ।
षष्ट्यूनं वा वर्गं कुर्वन्नावत्सराद् गणकः ॥ ७३[1] ॥

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७१. (घ) १. कृतिः (ग) कृति for (कृति) (वि०—इसकी क्रम संख्या ७२ है)
२. अशीति (ग) त्र्यशीति for (अशिति) ३. गुणितां for (गुणितं)
४. कुर्वन्नावत्सराद्गणक: (ग) for (कुर्वन्नावङ्पराद्गणकः)
(ग) ५. द्विनवगुणितं for (द्विनवतिगुणिता) ६. सैकं for (सैक)
७. वर्गे for (वर्गं)
वि०—इसके आगे "गुणितं वा । सैकंङ्ग दिने वर्ग कुर्वन्ना० ॥ ७५ ॥"
लिखा है ।
(च) १. कृतिः for (कृति) ५. द्विनवति गुणितां for (द्विनवतिगुणिना)
२. अशीति for (अशिति) ३. गुणितां वा for (गुणितं वा)
४. कुर्वन्नावत्सराद्गणक: for (कुर्वन्नावङ्पराद्गणकः)
८. (वि०—यहाँ क्रमसंख्या ७२ अंकित है)
(ङ) वि यह श्लोक इस प्रति में उपलब्ध नहीं है ।

७२. (घ) (वि०—इसकी क्रमसंख्या ७३ है)
१. त्र्यशीति (ग) त्र्यशीति for (त्र्यशिति)
२. युतं (ग) (ङ) for (युतेन)
(ग) ३. वग्र for (वर्गं) (वि०—इसकी श्लोकसंख्या ७७ है)
(च) १. त्र्यशीति for (त्र्यशिति) २. युतं for युतेन
४. (वि०—क्रम संख्या ७३ अंकित है)
(ङ) १. त्र्यशीति for (त्र्यशिति)

७३. (घ) (वि०—इसकी क्रम संख्या ७४ है)
यह श्लोक १९०२ में बनारस से मुद्रित प्रति में ७८ संख्या पर है
(ग) (वि०—यह श्लोक 'ग' में उपलब्ध नहीं है)
(च) (वि०—क्रमसंख्या ७४ अंकित है)
(ङ) (वि०—इसकी क्रमसंख्या ७८ अंकित है)

भगणादिशेष वर्गं त्रिभिर्गुणं संयुतं शतैर्नवभिः[1] ।
वर्गोष्टशतोनं[3] वा कुर्वन्नावत्सराद् गणकः ।। ७४[2] ।।
अधिमासशेषवर्गं[3] त्र्योदशगुणं[1] त्रिभिर्युक्तम्[4] ।
त्रिघनोनं वा वर्गं[5] कुर्वन्नात्सराद्[2] गणकः ।। ७५[6] ।।
अवमावशेषवर्गं द्वादशगुणितं शतेन संयुक्तम् ।
त्रिभिरूनं वा वर्गं कुर्वन्नावत्सराद् गणकः ।। ७६[1] ।।

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७४. (घ) (वि०—इसकी क्रमसंख्या ७५ है)

(ग) १. शतैर्न्नवभिः for (शतैर्नवभिः)
(वि०—इसकी क्रमसंख्या ७८ है)

(च) २. (वि०—क्रमसंख्या ७५ अंकित है)

(ङ) ३. कृतिमष्ट for (वर्गोष्ट)

७५. (घ) (वि०—इसकी क्रमसंख्या ७६ है)
१. त्रयोदश (ग) for (त्र्योदश) २. कुर्वन्नावत् (ग) (ङ) for (कुर्वन्नात्)

(ग) ३. वग्र्ग for (वर्गं) ४. त्रिभिः शतैर्युक्तम् (ङ) for (त्रिभिर्युक्तम्)
५. वग्र्ग for (वर्गं)
(वि०—इसकी क्रमसंख्या ७९ है)

(च) १. त्रयोदश (ङ) for (त्र्योदश)
६. (वि०—यहां क्रमसंख्या ७६ अंकित है)

७६. (घ) (वि०—इसकी क्रमसंख्या ७७ है)

(च) (वि०—इसकी क्रमसंख्या ७७ है)

(ङ) (वि०—इसकी क्रमसंख्या ८२ है)

(ग) (वि०—इसकी क्रमसंख्या ८० है)

७६. संख्या पर अंकित निम्नांकित अतिरिक्त श्लोक है—

सूर्यादि विलिप्ताशेषं पंचभिरूनादुगतं तथा दशभिः ।
वर्ग्गो बृहस्पति दिने कुर्वन्नावत्सराद् गणकः ।। ७६ ।।

(वि०—यह श्लोक इस प्रति में क्रमसंख्या ७६ पर है)
१. सूर्य for (सूर्यादि) २. रूनाहतं for (रूनादुगतं)
३. वर्ग for (वर्ग्गो)

गुणकयुतिरष्टगुणिता गुणि[1]कांतरवर्गभाजिता राशिः ।
गुणकौ त्रिगुणौ व्यस्ताधिकौ हृता[3]वंतरेण पदे ॥ ७७ ॥[2]
इन्दुविलिप्ताशेषं सप्तदशगुणं[2] च[1] यो दशगुणं च[5] ।
[3]पृथगेयुतं वर्गं कुर्वन्नावत्सराद् गणकः[4] ॥ ७८ ॥
वर्गो[2]नकृतियुतो ना[1]नगास्तत्संयो[6]तरार्द्धकृति[3]भक्तः ।
तद्[4]गुणकौ युतिवियुतौ वर्गो[5] घाते च रूपयुते ॥ ७९ ॥[5]

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७७ (घ) (वि०—इसकी क्रमसंख्या ७८ है)
१. गुणकांतर (ग) (ङ) (च) for (गुणिकांतर)
३. हृतावतरेण (ग) हृतावंतरेण (च) (हृतावंतरेण)
(ग) (वि०—यह श्लोकसंख्या इस प्रति में ७० पर, तथा बनारस में मुद्रित प्रति में ७१ पर अंकित है)
(च) (वि०—यहां क्रमसंख्या ७८ अंकित है)
(ङ) (वि०—इसकी क्रमसंख्या ७१ है)

७८. (घ) (वि०—इसकी क्रमसंख्या ७९ है)
१. त्रयोदशं for (चयोदश) (ग) 'च'से 'च' तक लुप्त
(ग) ३. गुणितं वा for (गुणं च) ३. पृथगेक (ङ) for (पृथगे)
(वि०—इसकी क्रमसंख्या ८१ है)
(च) १. त्रयोदश (ङ) for (चयोदश)
४. (वि०—क्रमसंख्या ७९ अंकित है)
(ङ) ५. चापि for (च)

७९.(घ) (वि०—इसकी क्रमसंख्या ८० है)
१. नगांस्तत्सांयातरार्द्ध (ग) नस्तत् संयोगांतरार्द्ध for (नानगास्तत्संयोतरार्द्ध)
(ग) २. न्यकृति for (नकृति) ३. कृतिर्भक्तः for (कृतिभक्तः)
४. तद्गुणितौ (ङ) for (तद्गुणकौ)
(च) २. वर्गोन्यकृति for (वर्गोनकृति)
१. नगांस्तत्संयोतरार्द्ध for (नानगास्तत्संयोतरार्द्ध)
४. तद्गुणको for (तद्गुणकौ)
५. (वि०—यहां क्रमसंख्या ८० है)
(ङ) (वि०—इसकी क्रमसंख्या ७२ है)
२. वर्गोऽन्यकृति for (वर्गोनकृति) १. नस्तत् for (नानगास्तत्)
५. वर्गौ for (वर्गो) ६. संयोगान्तरार्ध for (संयोंतरार्द्ध)

यैरूनो यैश्चयुतो रूपैर्वर्गस्[1]तदैक्यमिष्टहृतम्[2] ।
इष्टोनं तद्दलकृतिरूनाभ्यधिका भवन्ति[3] राशिः[4] ॥ ८० ॥[5]
याम्यां कृतिरधिकोनस्तदंतरं हृत[3]युतो न मिष्टेन[4] ।
तद्दलकृतिरधिके[1] न्यूना[5]भ्यधि भवति[6] राशि[2] ॥ ८१ ॥[7]
ज्ञदिनेऽर्क[1] कलाशेषं गुरू दिन[2]विकलावशेष युक्तोनम् ।
वर्गोविधं[3] च सैकं कुर्वन्नावत्सराद् गणकः ॥[4] ८२ ॥

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८०. (घ) (वि०—इसकी क्रमसंख्या ८१ है)
१. वंर्ग (ग) (ङ) for (वर्ग) २. हृतं (ग) (ङ) for (हृतम्)
३. भवति (ग) (च) (ङ) for (भवन्ति)
४, राशिम् (च) for (राशिः)
(ग) (वि०—इसकी क्रमसंख्या ७२ है)
(च) १. वंर्गस्तदैक्य for (वर्गस्तदैक्य) ५. (वि०—इसकी क्रमसंख्या ८१ अंकित है)
(ङ) (वि०—इसकी क्रमसंख्या ७३ है) १. वंर्गस् for (वर्गस्)

८१. (घ) १. रधिकेन for (रधिके) (वि०— इसकी क्रमसंख्या ८२ है)
२. राशिः (ग) (च) (ग) for (राशि)
(ग) १. रधिकोना धिकयोरधिकोनयो राशिः for (रधिके न्यूनाभ्यधि भवति राशि)
३. हृत (ङ) (च) for (हृत) ४. मीष्टेन for (मिष्टेन)
५. ६. 'न्यूनाभ्यधि' 'भवति' पद लुप्त हैं ।
(च) १. रधिकेन for (रधिके) ५. न्यूनाभ्यधिका for (न्यूनाभ्यधि)
७. (वि०—क्रमसंख्या ८२ अंकित है)
(ङ) १. रधिकोना for (रधिके)
५. ऽधिकयोरधिको for (न्यूनाभ्यधि) ६. नयो for (भवति)

८२. (घ) (वि० इसकी क्रमसंख्या ८३ है)
(ग) (वि०—इसकी क्रमसंख्या ८२ है)
१. ज्ञदिनेर्क for (ज्ञदिनेऽर्क) २. दिने for (दिन)
३. वर्ग्र धन for (वर्गोविधं)
(च) १. ज्ञदिनेर्क्क for (ज्ञदिनेऽर्क) २. दिनविवला for (दिनविकला)
३. वर्गोवधं for (वर्गोविधं) ४. (वि०—क्रमसंख्या ८३ अंकित है)
(ङ) (वि०—इसकी क्रमसंख्या ८३ है)
३. वर्गं वधं च for (वर्गो विधंच)

विकलाशेषं[3] सहितं त्रिवत्या[1]ऽ३ सप्तषष्टि[2]हीनं च
भानोर्ज्ञदिने वर्गं कुर्वन्नावत्सराद् गणकः ॥ ८३[4] ॥
ज्ञदिनेऽर्क[1] कलाशेषं[2] वर्गो[3] द्वादशभिः संयुतं त्रिषष्टया च ।
षष्टयाष्टाभिश्चोनं कुर्वन्नावत्सराद् गणकः ॥ ८४[5] ॥
इन्दु[2] विलिप्ता[5] शेषं[1] मंत्राशेषं वा ।
अथवा मध्यमिष्टं[3] कुर्वन्नावत्सराद् गणकः ॥ ८५[4] ॥
जीवविलिप्ता[2] शेषा कुर्जमिदुं[3] भौमलिप्तिकाशेषात् ।
रविर्मिदभाग[1]शेषा[4] कुर्वन्नावत्सराद्[5] गणकः ॥ ८६[6] ॥

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८३. (घ) (वि०—इसकी क्रमसंख्या ८४ है)
१. ६३ (च) for (ऽ३) २. +६७+(च)
(ग) ३. शेषसहितं for (शेषं सहितं)
(च) ४. (वि०—क्रमसंख्या ८४ अंकित है)
(ङ) १. 'ऽ३' लुप्त ।

८४. (घ) (वि०—इसकी क्रमसंख्या ८५ है)
(ग) १. २. 'ऽर्ककला' पद लुप्त है । ३. वग्र for (वर्गो)
(च) १. ऽर्क्क for (ऽर्क) ४. (वि०—क्रमसंख्या ८५ अंकित है)
(ङ) ३. 'वर्गो' (लुप्त)

८५. (घ) (वि०—इसकी क्रमसंख्या ८६ है)
१. शेषामंशशेषं वा (ग) शेषाद्रविलिप्ताशेषमंशशेषं वा for (शेषं मंत्राशेषं वा)
(ग) २. इदं for (इंदु)
(च) १. शेषामंशशेषं वा for (शेषं मंत्राशेषं वा)
३. मध्यममिष्टं for (मध्यमिष्टं) ४. (वि०—यहां क्रमसंख्या ८६ अंकित है)
(ङ) ५. +शेषाद् रविलिप्ता+ १. शेषमंशशेषं for (शेषं मंत्राशेषं)
३. मध्यममिष्टं for (मध्यमिष्टं)

८६. (घ) (वि०—इसकी क्रमसंख्या ८७ है)
१. मिंदु (ग) (ङ) for (मिंद)
(ग) २. जीवविप्ताशेषं for (जीवविलिप्ताशेषा)
३. विलिप्तिका for (लिप्तिका) ४. शेषात् (ङ) for (शेषा)
(च) १. द्रविर्मिदुभाग for (रविर्मिदभाग)
५. कुर्वन्नोवत्सराद्गणक: for (कुर्वन्नावत्सराद्गणकः)
७. (वि०—क्रमसंख्या ८७ अंकित है)
(ङ) २. विलिप्ताशेषात् for (विलिप्ताशेषा)

इष्टग्रहेष्ट[5]शेषा द्युगणो गत[2]निरपवर्त[1]यं [3]संगुणितैः ।
छेददिनैरधिकोस्मादन्यग्रहशेषमिष्टो वा ॥ ८७[4] ॥
निच्छेद[7]भागहारौ ग्रहयो[8]र्भगणादि [3]शेषयोर्द्यु[1]गुणात् ।
[4]यस्मात्तं [6]निच्छेदे[2]नोद्धृतयो[5]र्लब्धयोर्गुणितौ ॥ ८८[6] ॥
[6]निच्छेदभागहारौ विपरीतौ तद्युता[1]त्फलस्तस्मात् ।
[4]शेषेद्यु[2]गुणादेवं [3]त्र्यादिना प्राग्वदिष्टदिने ॥ ८९[5] ॥

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८७. (घ) (वि०—इसकी क्रमसंख्या ८८ है)
१. 'यं' यह मूलपाठ में उपलब्ध नहीं (ग)
(ग) २. निरवर्त for (निरपवर्तयं) ३. संगुणतैः for (संगुणितैः)
(च) २.निरपवर्त्तसंगुणितैः for (निपर्वतयं संगुणितैः)
४. (वि०—क्रमसंख्या ८८ है)
(ङ) ५. शेषाद् for (शेषा)
८८. (घ) (वि०—इसकी क्रमसंख्या ८९ है)
१. र्कगणात् for (र्द्युगुणात्) २. द्धृतयो (ग) धृताया for (द्धृतयो)
(ग) ३. शेषवो द्युगणात् for (शेषयोर्द्युगणात्)
४. यस्मात्तन्न for (यस्मात्तं)
५. लब्धसंगुणितौ for (र्लब्धयोर्गुणितौ)
(च) १. र्द्युगणात् (ङ) for (र्द्युगुणात्) २. नोद्धृतयो for (नोद्धृतयो)
६. (वि०—क्रमसंख्या ८९ अंकित है)
(ङ) ७. निश्छेद for (निछेद) १. निश्छेदे for (निछेदे)
८. विपरीतौ for (र्भगणादि)
५. र्लब्धसंगुणितौ for (र्लब्धयोर्गुणितौ)
३. ग्रहयो for (शेषयो)
८९. (घ) (वि०—इसकी क्रमसंख्या ९० है)
१. पुन (ग) पुनः शेषे for (फलस्तस्मात्)
२. द्युगणादेवं (च) (ङ) for (द्युगुणादेवं)
३. त्र्यादीनां (ग) (ङ) for (त्र्यादिना)
४. ३ द्युगणादैवत्यादीनां for (शेषेद्युगुणादेवंत्र्यादिना)
(ग) (वि०—दूसरी पंक्ति "द्युगणा" से आरम्भ होती है)
(च) १. पुनस्तस्मात् (ङ) for (फलस्तस्मात्)
५. (वि०—क्रमसंख्या ९० अंकित है)
(ङ) ६. निश्छेद for (निछेद)

द्यु[1]गुणमवशेषाद्रविचंद्रौ[2] मध्यमौ स्फुटादथवा[3] ।
एवं तिथिं ग्रहं वा कुर्वन्नावत्सराद् गणकः ॥ ९०[4] ॥
एकदिनावमशेषं[3] षट्[1] गणमेकरविचन्द्रभगणोनम्[2] ।
शुध्यति भूदिनभक्तं[4] व्येकं चांद्रैस्तदुक्तिरियम् ॥ ९१[5] ॥
इषुशरकृताष्टदिग्भिः[4] १०८४५५ संगुणितादवमशेषाद्[5] भक्तात्[1] ।
रूपाष्टरसवेदरस[2]शून्यशरगुणैः[6] ३५०६४८१ दिनगणः[3] शेषम् ॥ ९२ ॥[8]

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९०. (घ) (वि०—इसकी क्रमसंख्या ९१ है)
१. गण for (गुण) (ग) द्युगणमवमासशेषा for (द्युगुणमवशेषा)
२. मध्यमौं (च) for (मध्यमौ)
(ग) ३. स्फुटावथवा for (स्फुटादथवा) (वि०—इसकी क्रमसंख्या ९० है)
(च) १. द्युगण for (द्युगुण)
४. (वि०—क्रमसंख्या ९१ अंकित है)
(ङ) १. गुणमवमावशेषा for (गुणमवशेषा)

९१. (घ) (वि०—इसकी क्रमसंख्या ९२ है)
(ग) १. चट्गुण for (षट्गुण) २. सगणोना for (भगणोनम्)
३. एकादिना for (एकदिना) ४. भूदिभक्तं for (भूदिनभक्तं)
(च) ५. (वि०—यहां क्रमसंख्या ९२ अंकित है)
(ङ) ३. एकदिनमवमशेषं for (एकदिनावमशेषं)
१. यद्गुणमेक for (षट्गणमेक)

९२. (घ) (वि०—इसकी क्रमसंख्या ९३ है)
१. दवमवशेषकाद् for (दवमशेषाद्भक्तात्)
२. रूपाष्ट वेदरसशून्य (ग) for (रूपाष्टरसवेदरसशून्य)
३. दिनगणः (ङ) (च) for (दिनगणः)
(ग) ४. इष्टशरकृताष्टदिग्भिः for (इषुशरकृताष्टदिग्भिः)
५. देवमशेषकाभक्तात् for (दवमशेषाद् भक्तात्)
६. रगुणो for (शरगुणैः)
(च) १. दवमवशेषकाद्भक्तात् for (दवमशेषाद्भक्तात्)
२. वेदरस (ङ) for (रसवेदरस)
८. (वि०—क्रमसंख्या ९३ अंकित है)
(ङ) १. शषेकाद्भक्तात् for (शेषाद्भक्तात्)

जिनरस गोब्धिरद्[1]गुणा ३२४[4]६६२४ छशि[5] वसुकृत रसखभुत[2]रामहूतान्[3] ।
इष्टावमशेषाद्य[6]छेषं रविभगण शेषं तत्[7] ॥ ६३ ॥
गोगेंदुखेश[3] ११०१७६[4] गुणितद्भुक्तान्नखपक्षयम[1] रसेषु[5] गुणैः[7] ३५६२२२०[2] ।
शेषमवमावशेषात्तिथयो[6] वमशेषकाद्विकलम्[8] ॥ ६४ ॥
भागकलाविकलैक्यं दृष्ट्वा विकलांतरं न[1] के शेषैः[6] ।
ऐक्यं द्विधांतरा[3]धिकहीनं द्विविभाजितं[4] शेषम्[2] ॥ ६५ ॥

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६३. (घ) (वि०—इसकी क्रमसंख्या ६४ है)
१. रदगुणा (ग) रसगुणा for (रद्गुणा)
२. भूत (ग) (ङ) for (भुत)
३. हूतान् । ३५६४८१ (ग) राहूतात् for (रामहूतान्)
(ग) ४. (वि०—संख्या के अंक लुप्त हैं) ५. शशि (ङ) for (छशि)
५. शेषाद्या for (शेषाद्य)
(च) १. रदगुणा for (रद्गुणा) २. भूत for (भुत)
३. रामहूतान् for (रामहूतान्) ७. वि०—यहां क्रमसंख्या ६४ अंकित है)
(ङ) १. गोऽब्धिरद ३२४६६२४ गुणात् for (गोब्धिरद्गुणा ३२४६६२४)
३. हूतात् for (हूतान्) ६. शेषाद्य्शेषं for (शेषाद्यछेषं)
६४. (घ) (वि०—इसकी क्रमसंख्या ६५ है)
१. गुणिताद्भुक्ता (ग) (च) (ङ) for (गुणितद्भुक्ता)
२. '३५६२२२०' दूसरी पंक्ति का आरंभ (य) संख्या लुप्त
(ग) ३. गोगेदुशेख for (गोगेंदुखेश) ४. संख्या के अंक लुप्त हैं
५. नाख for (न्नख) ६. शेषावमाव for (शेषमवमाव)
(च) ७. गणैः for (गुणैः)
(वि०—यहां क्रमसंख्या ६५ अंकित है)
(ङ) ३. गोऽगेंदु for (गोगेन्दु)
६५. (घ) (वि०—इसकी क्रमसंख्या ६६ है)
१. वके शेषे (ग) च के शेषे for (नके शेषैः)
२. शेषे (ग) (ङ) for (शेषम्)
(ग) ३. द्विघातरा for (द्विधांतरा) ४. द्विभाजितं for (द्विविभाजितं)
(च) १. वकेशेषे for (नके शेषैः) २. शेषे for (शेषम्)
(वि०—क्रमसंख्या ६६ अंकित है)
(ङ) १. च for (न) ६. शेषे for (शेषैः)
३. द्विधाऽन्तरा for (द्विधांतरा) ४. च द्विभाजितं for (द्विभाजितं)

तद्वर्गांतरमाद्यं[५] तदंतरं [१]चांतरोद्धृतयुतोनम् ।
वर्गांतरं विभक्तं[२] ताभ्यां[३] शेषोन्यतो[६] द्युगणः ।। ९६ ।।[४]
[४]कृतिसंयोगाद्द्विगुणा[१] छेष[२]युतिकृति विशोध्य मूलेन ।
शेष युतिर्युत हीनाद्[३]द्विहता शेषे पृथक् [५]युक्त्या ।। ९७ ।।[७]
शेषवधाद्द्विकृति[१] गुणा छेषांतर[६]वर्गसंयुतान्मूले[२] ।
शेषांतरीन[३]युक्तं दलितं शेषे पृथगभिष्टे[४] ।। ९८ ।।[५]

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९६. (घ) (वि०—इसकी क्रमसंख्या ९७ है)

१. चांतरोद्धृत (ग) (ङ) for (चांतरोद्धृत्र)

२. द्वा द्वाभ्यां for (ताभ्यां) ३. शेषे ततो (ग) (ङ) for (शेषोन्यतो)

(च) १ चांतरोद्धृत for (चांतरोद्धृत) ४. (वि०—क्रमसंख्या ९७ है)

३. शेषो ततो द्युगणः for (शेषोन्यतो द्युगणः)

(ङ) ५. माद्य for (माद्यं) २. द्वाभ्यां for (ताभ्यां)

९७. (घ) (वि०—इसकी क्रमसंख्या ९८ हैं)

१. द्विगुणा (ग) (च) for (द्विगुणा)

२. छष for (छेष) (ग) छेष कृतियुतिं for (छेषयुतिकृति)

३. विहृता (ग) विज्ञता for (द्विहृता)

(ग) ४. कृत संयोगा for (कृतिसंयोगा) ५. पृथग्युक्त्या for (पृथक् युक्त्या)

(च) ६. द्विहृता for (द्विहृता)

६. (वि०—क्रमसंख्या ९८ अंकित)

(ङ) कृतिसंयोगाद् द्विगुणाद्युतिवर्गं प्रोह्य शेषमूलं यत् ।
तेन युतोनो योगो दलितः शेषे पृथगभींष्टे ।। ९८ ।।

for

(कृतिसंयोगाद्द्विगुणा छेषयुतिकृति विशोध्य मूलेन
शेषयुतिर्युतहीना द्विहता शेषे पृथक् युक्त्या ।। ९७ ।।)

९८. (घ) (वि—इसकी क्रमसंख्या ९९ है)

१. विकृति (ग) for (द्विकृति) मूलम् (ग) (ङ) for (मूले)

३. शेषांतरोन (ग) (ङ) for (शेषांतरीन युक्तं)

४. पृथगगभीष्टे (ग) (ङ) for (पृथगभिष्टे)

(ङ) १. कृति for(कृति) २. मूलं for (मूले)

४. पृथगभीष्टे for (पृथगभिष्टे)

५. (वि०—क्रमसंख्या ९९ अंकित है)

(ङ) १. वधाद् द्विकृतिगुणात् for (वधाद्विकृतिगुणा) ६. शेषांतर for (छेषान्तर)

सुखमात्रममी प्रश्ना प्रश्नान्यात्सहस्रशः कुर्यात् ।
अन्यैर्दत्तात्प्रश्नानुक्तं वा साधयेत्करणैः ॥ ९९ ॥
जन संसदि दैवविदां तेजो नाशयति भानुरिव भानाम् ।
कुट्टाकारप्रश्नैः पठितैरपि किं पुनर्ज्ञातैः ॥ १०० ॥
प्रतिसूत्रममी प्रश्नाः पठिताः सोद्देशकेषु सूत्रेषु ।
आयाणां अधिकशते कुट्टकोष्टादशोऽध्यायः ॥१०१॥
इति श्री ब्रह्मगुप्ते अष्टादशोऽध्यायः ।

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९९ (घ) (वि०—इसकी क्रमसंख्या १०० है)
१. प्रश्नानन्या (ग) प्रश्तानन्यान् (ङ) for (प्रश्नान्यात्)
(ग) देव्यात्र for (सुखमात्र) ३. दंत्तान् for (दत्तात्) ४. त्करणैः for (करणैः)
(च) १. प्रश्नानन्यान्सहस्रशः (प्रश्नान्यात्सहस्रशः)
(वि०—इसकी क्रमसंख्या १०० अंकित है)
(ङ) २. हृदि घात्रममी for (सुखमात्रममी) ६. प्रश्नाः for (प्रश्ना)
३. अन्यैर्दत्तान् for (अन्यैर्दत्तात्) ७. प्रश्नानुक्त्यैवं for (प्रश्नानुक्तं वा)
४. करणैः for (करणैः) (वि०—३. 'हृतान्मात्रममी' इति सुधाकरः)

१००. (घ) (वि०- इसकी क्रम संख्या १०१ है)
१. पुनर्ज्ञातैः (ग) (च) for (पुनर्ज्ञातैः) २. भारिव for (भानुरिव)
३. कुदाकारं for (कुट्टाकार) ४. प्रस्नैः for (प्रश्नैः)
(च) ३. कुदाकार प्रश्न्नैः for (कुट्टाकार प्रश्नैः)
५. (वि०—यहाँ क्रम संख्या १०१ अंकित है)
(ङ) १. पुनः शतशः for (पुनर्ज्ञातैः)
१०१. (घ) (वि०—इसकी क्रम संख्या १०२ है)
१. आर्याणाम् (ग) आर्या for (आयाणां) २. शतेन कुष्ट for (शते कुट्ट)
३. 'इति' से 'अध्यायः' तक अंकित नहीं है ।
(ग) २. समी प्रश्नाः for (ममी प्रश्नाः) २. शतेन for (शते)
३. इति श्रीब्रह्मसिद्धांते कुट्टकाध्यायाष्टदशमः ॥ १८ ॥ for (इति श्रीब्रह्मगुप्ते-अष्टादशोऽध्यायः)
(च) १. आर्याणां for (आयाणां)
३. "इति" से "अध्यायः" लुप्त (केवल "श्री" अंकित है)
५. (वि०—क्रमसंख्या १०२ अंकित है)
(ङ) १. आर्या for (आयाणां) २. अधिकशतेन for (अधिकशते)
६. कुट्टश्चाष्टादशो for (कुट्टकोष्टादशो)

अथ शंकुच्छायादिज्ञानाध्यायः

एकोनविंशः

द्दष्ट्वा दिनार्द्धघटिका योर्कजो[1] क्षांशकान्[3]वीजानाति[2] ।
उदयांतरघटिकाभिर्ज्ञाता[4] ज्ञेयं स तन्त्रज्ञः ॥ १ ॥
अस्तांतर्घटिकाभिर्यो[1] ज्ञाताज्ञेयमानयति[6] तस्मात् ।
मध्यगति[2] ग्रहभगणाननयति[3][4] तया[5] स तंत्रज्ञः ॥ २ ॥
आनयति यस्तमो रविशशांक मानानि दिप कौच्यतलात्[1] ।
शंकुतलांतरभूमिं[2] ज्ञाने छायां स तन्त्रज्ञः ॥ ३ ॥
छायाद्वितीयाग्रांतर[1] विज्ञाने[4] वेत्ति दीपौच्ये[2] ।
शंकु छायाज्ञो[5] वा यच्छायौच्ये[3] स तंत्रज्ञः ॥ ४ ॥

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१. (घ) १. ऽर्कज्ञो (ग) (ङ) for (योर्कजो) २. विजानाति (ग) for (वीजानाति)
(च) १. योऽर्क्कजो for (योर्कजो) २. विजानाति for (वीजानाति)
(ङ) ३. ऽक्षांशकान् for (क्षांशकान्) २. विजानाति for (वीजानाति)
४. र्ज्ञाताज्ज्ञेयं for (र्ज्ञाता ज्ञेयं)

२. (घ) १. अस्तांतर (ग) for (अस्तांतर्) २. मध्यगतिं (च) (ङ) for (मध्यगति)
(ग) ३. युगभ (ङ) for (ग्रहभ) ४. नानयति (च) (ङ) for (ननयति)
५. ततः (ङ) for(तया) (वि०—इसकी क्रम संख्या १ लिखी है)
(च) १. अस्तांतर घटिकाभिर्यो (ङ) for (अस्तांतर्घटिकाभिर्यो)
(ङ) ६. ज्ञाताज्ज्ञेय for (ज्ञाताज्ञेय)

३. (घ) १. दीपाक्यें वचच्यतलात् (ग) दीपक शिखोन्याः for (दिपकौच्यतलात्)
(ग) २. भूमि (ङ) for (भूमिं) (वि०— इसकी क्रमसंख्या २ लिखी है)
(ङ) १. दीपकशिखोच्च्यात् for (दिपकौच्यतलात्)

४. (घ) १. छायाद्वितया (ग) for (छायाद्वितीया)
२. भूमिदीपौच्ये (ग) दीप्यौच्ये for (दीपौच्ये)
(ग) ३. परभूमेत्छायां for (यच्छायौच्ये) (वि०— इसकी श्लोक संख्या ५ है)
(च) १. द्वितया for (द्वितीया)
(ङ) १. छायाद्वितीयभाग्रान्तर for (छायाद्वितीयाग्रांतर)
४. विज्ञानेन for (विज्ञाने) २. दीपौच्यम् for (दीपौच्ये)
५. शङ्कुच्छायाज्ञो for (शंकुछायाज्ञो) ३. भूमेश्छायां for (यच्छायौच्ये)

दृष्टि[४] गृहौच्यज्ञो[६] यः स्तदंतरज्ञो[१] नराक्रते[२] नुजले।
गृहभित्यग्[३] दर्शयति[५] दर्प्पणे वा स तंत्रज्ञः ॥ ५ ॥
हगृहतलांतरजले[१] यो[४] दृष्ट्वाग्[५] गृहस्य[२] भूमिज्ञः।
वेत्ति गृहौच्यं[३] दृष्ट्वा तैलस्थं वा[६] स तंत्रज्ञः ॥ ६ ॥
वीक्ष[६] गृहाग्[१] सलिले प्रसार्य सलिलं पुनश्चभूज्ञाने[४]।
आनयति जलाद्भू[२]मि गृहस्य[३] चौच्यं[५] स तंत्रज्ञः ॥ ७ ॥
ज्ञातै[४] छाया पूरुषै[५] विज्ञाते[६] तोय कुघयो[१] विवरे।
कुट्टर्क[२] तेजसो यो वेत्थारुढ़ः[३] स तंत्रज्ञः ॥८॥

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५. (घ) १. नरात्कृते (ग) for (नराकृते) २. तु (ग) (ङ) for (नु)
३. गृहभित्यर्गं (ग) गृहभित्यग्र (ङ) for (ग्रहभित्यग्रे)
(ग) ४. इष्टग्रहौच्यज्ञो for (दृष्टिगृहौच्यज्ञो) ५. दर्पणे (ङ) for (दर्प्पणे)
(वि०—इसकी श्लोक संख्या ४ है)
(च) १. नराकृते for (नराक्रते)
(ङ) ४. इष्टगृहौच्यज्ञो for (दृष्टिगृहौच्यज्ञो) ६. यस्तदन्तरज्ञो for (यः स्तदंतरज्ञो)
१. निरीक्ष्यते for (नराक्रते)
६. (घ) १. नृगृह दृग्ग्रहनलांतर (ङ) for (ह्लग्रह तलांतर)
२. गृहस्य (ग) (च) (ङ) for (ग्रहस्य)
३. गृहोच्यं (ग) गृह्यौच्यं (च) (ङ) for (ग्रहौच्यं)
(ग) ४. जलयो for (जले यो) ५. दृंष्ट्वाग्रं (ङ) for (दृष्ट्वाग्रं)
६. व for (वा)
(च) १. दृग्गृहतलांतर for (हृग्रहतलांतर)
(ङ) १. दृष्ट्वा गृहतलान्तर for (हृग्रहतलांतर) ४. जालभो for (जले यो)
७. (घ) १. गृहाग्रं (ग) (च) (ङ) for (ग्रहाग्रं) २. भूमिं (ग) (च) (ङ) for (भूमि)
३. गृहस्य (ग) (च) (ङ) for (ग्रहस्य)
(ग) ४. पुनः स्वभूज्ञाने (ङ) for (पुनश्च भू ज्ञाने) ५. वौच्यं for (चौच्यं)
(ङ) ६. वीक्ष्य for (वीक्ष)
८. (घ) १. कुडचयोर्विवरे (ङ) for (कुघयोर्विवरे)
२. कुडचर्के (ग) कुधेर्का for (कुट्टर्के)
३. वेत्यारूढ़ि (ग) वेत्त्यारूढ़ैः for (वेत्थारूढ़ैः) (ग) ४. ज्ञाते for (ज्ञातै)
५. पुरुषै (ङ) for (पूरुषै) ६. विज्ञातै for (विज्ञाते)
(च) १. कुडचयो for (कुघयो) २. कुट्टेऽर्के for (कुट्टर्कें)
(ङ) १. ज्ञातैश्छाया for (ज्ञातै छाया)
२. कुडचेर्के for (कुट्टर्के) ३. वेत्यारूढ़ि for (वेत्थारूढ़ैः)

इष्ट दिवसार्द्ध घटिका घटिका च[1] दशकांतरं[2] प्राणाः ।
तद्दिवसचरप्राणास्तैरक्षं साधयेत्प्राग्वत्[3] ।। ९ ।।
ज्ञातः सभार्द्ध उदयैरस्तांतरनाडिकाभिरधिको नः ।
ज्ञातात्पूर्वापरयोर्ज्ञेयो[1] भार्द्धोनके[2] ज्ञयः[3] ।। १० ।।
[2]ज्ञातज्ञेय[3]ग्रहयोरूदयांतरनाडिकाभिरधिकोनः[4] ।
उदयैर्ज्ञातो[5] ज्ञाताज्ञेये[6] प्रागधरयोर्ज्ञेयः[1][7] ।। ११ ।।[8]
ज्ञातं कृत्वा मध्यं भूयोन्यदिने तदंतरं भुक्तिः ।
त्रैराशिकेन मुत्तया[1] कल्पग्रहमंडलानयनम् ।। १२ ।।
स्थित्यर्द्धाद्विपरीतं तमः प्रमाणं स्फुटं ग्रहणे[1] ।
मानोदयाद्रवींद्वोर्घटिकावयवेन भोदयतः ।। १३ ।।

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९. (घ) १. पंचदशकांतर for (चदशकांतरं)
(ग) २. दशांतर for (दशकांतरं)
३. प्रास्नात् for (प्राग्वत्)
(ङ) शी० + अथोत्तराणि +
१. २. पंचदशांतर for (चदशकांतरं)
१०. (च) (वि०—यह श्लोक यहां ११ वीं क्रमसंख्या पर अंकित है)
१. ज्ञेये for (ज्ञेयो) २. भार्द्धोनको for (भार्द्धोनके)
३. ज्ञेयः (ङ) for (ज्ञयः)
(ङ) (वि०—यहां इसकी क्रमसंख्या ११ है)
११. (घ) १. परयो for (धरयो) (ग) प्रागपरो for (प्रागधरयो)
(ग) २. स्थान रिक्त है, ३. 'ज्ञेय' अक्षर लुप्त है ४. नम् for (नः)
५. ज्ञातो for (ज्ञातो) ६. ज्ञाताज्ञेय for (ज्ञाताज्ञेये)
७. ज्ञेयः for (ज्ञेयः)
(वि०—इसकी क्रमसंख्या १० है)
(च) १. प्रागपरयो for (प्रागधरयो)
८. (वि०—इसकी क्रमसंख्या १० अंकित है)
(ङ) ६. ज्ञाताज्ज्ञेयः for (ज्ञाताज्ञेये)
१२. (घ) १. भुत्तया (ग) (च) (ङ) for (मुत्तया)
१३. (घ) १. शशिग्रहणे for (स्फुटं ग्रहणे)

दीपतलशंकुतलयोरंतरमिष्टप्रमाणशंकुगुणम् ।
दीपशिखौच्याच्छंकु[4][1] विशोध्य शेषोद्धृतं[2] छाया[3] ॥ १४ ॥
शंक्वंतरेण गुणिता छाया छायांतरेण भक्ता भूः ।
स छाया[3] शंकुगुणा दीपोच्यं[1] छायया भक्ता[2] ॥ १५ ॥
ज्ञात्वा शंकुछाया[3] मनुपातात्[2]साधयेत्समुछ्रायान्[4] ।
गृहचैत्यतरू नगानामौच्यं[5] विज्ञायवच्छायाम्[1] ॥ १६ ॥
दृष्टि[4] गृहौच्यैक्य[1] हृता[2]तदन्तर[5]धरादगौच्य[3] गुणिता[6] ।
फलभून्यस्ते[7] तोये प्रतिरूपाग्रं गृहस्य नरात् ॥ १७ ॥

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१४. (घ) १. छंकु for (च्छंकु)
(ग) १. शिखौच्यात् शंकु for (शिखौच्याच्छंकु)
२. हृतं (च) for (द्धृतं) ३. छायाः for (छाया)
(च) ४. दीपशिषौच्या for (दीपशिखौच्या)
(ङ) ४. शिखौच्च्याच्छङ्कुं for (शिखौच्याच्छंकु)

१५. (घ) १. दीपौच्यं (ग) (ङ) for (दीपौच्च्यं)
(ग) २. भक्ताः (च) for (भक्ता)
(ङ) ३. सच्छाया for (सछाया)

१६. (घ) १. वा (ग) (च) (ङ) for (व)
(ग) २. मनुपातान् for (मनुपातात्)
(ङ) ३. शङ्कुच्छाया for (शंकुछाया)
४. समुच्छ्रायान् for (समुछ्रायान्)
५. मौच्च्यं for (मौच्यं)

१७. (घ) १. गृहोच्चैक्य (ग) ग्रहौच्येक for (गृहौच्यैक्य)
(ग) २. हृता (च) (ङ) for (हूता)
३. दृगौच्यमं for (धरादगौच्य)
(च) १. गृहोच्चैक्य for (गृहौच्यैक्य)
३. दृगौच्य for (दगौच्य) (ङ) ४. युतदृष्टि for (दृष्टि)
१. गृहौच्च्य for (गृहौच्यैक्य) ५. ह्यन्तर for (तदन्तर)
३. भूमिदृगौच्च्य for (धरादगौच्य) ६. संगुणिता for (गुणिता)
७. न्यस्ते for (न्यस्ते)

गृह पुरूषांतर सलिले विक्ष्य गृहाग्रं द्दगौच्य संगुणितम् ।
गृहतोयांतरमौच्यं गृहस्य नृजलांतरेण हृतम् ॥ १८ ॥
प्रथम द्वितीय नृजलांतरांतरेणोद्धृता जलाय सृतिः ।
द्दष्टौच्य गुणोछ्रायस्तोयानृजलांतरगुणा भूः ॥ १९ ॥
छाया पुरूषछिन्नं जल कुधांतर मवाप्तमारूढ़िः ।
अध्याये विंशत्यार्याणामेकोनविंशोयम् ॥ २० ॥

इति ब्रह्म गुप्ते छायाध्यायः

एकोनविंशोऽध्यायः समाप्तः

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१८. (घ) १. वीक्ष्य (ग) (च) (ङ) for (विक्ष्य)
२. गृहाग्रं (ग) (च) (ङ) for (ग्रहाग्रं)
३. हृतम् (ग) (च) (ङ) for (हूतम्)
(ग) ४. सलिल for (सलिले)
५. व्यसंगुणितम् for (द्दगौच्यसंगुणितम्)
६. नृतलांतरेण for (नृजलोन्तरेष)
(च) ५. द्दगौच्च्य for (द्दगौच्यं)
७. मौच्च्यं for (मौच्यं)

१९. (घ) १. जलापसृतिः (ग) (ङ) for (जलाय सृतिः)
(ग) २. नृजलांतरांतरा for (नृजलांतर) ३. छाया for (छ्राय)
४. स्तोयन्नृजलांतर for (स्तोयानृजलांतर)
(च) ५. प्रथ for (प्रथम) ६. द्वितिय for (द्वितीय)
(ङ) ७. द्दष्टचौच्च्य for (द्दष्टौच्य) ३. गुणोच्छ्राय for (गुणोछ्राय)

२०. (घ) १. बल foı (जल) ३. कुटचांतर (च) for (कुधांतर)
३. अध्यायो (ग) अध्याय for (अध्याये)
४. 'इति' से 'समाप्त' तक पाठ उपलब्ध नहीं (ग)
(ग) ५. मवामारूदिः for (मवाप्तमारूदिः) ६. विशत्यार्याणा for (विंशत्यार्याणां)
७. मेकान विंशोयम् for (मेकोनविंशोयम्)
(च) ३: अध्यायो (ङ) for (अध्याये) ४. 'इति' से 'समाप्त' तक पाठ लुप्त ।
(ङ) ८. च्छिन्नं for (छिन्नं) २. कुड्यान्तर for (कुधांतर)
४. इति श्री ब्राह्मस्फुटसिद्धान्ते शंकुच्छायादिज्ञानं नामैकोनविंशोऽध्यायः for (इति ब्रह्मगुप्ते छायाध्यायः)

अथ छन्दश्चित्युत्तराध्यायो

विंशतितमः

ऋग्वर्गः पर्यायः समूह योगो वयुक्षु युग्मेषु ।
सोपाः प्राग्वत्पादाश्चतुष्कका शेष युक्तोंत्यः ॥ १ ॥
एकैक युत विहीना वाद्यंतौ तद्विपर्ययो यावत् ।
वर्गादिष्व समयुजः क्रमोक्रमाद्वर्द्धयेत्पादान् ॥ २ ॥
एकैकेनद्वाद्या न सोयेष्टधिकेषु तत्प्रविष्टेषु ।
वर्गादिरीष्टांत प्रस्तारो भवति यवमध्यात् ॥ ३ ॥

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१. (घ) १. रिग्वर्गः (ग) ऋग्वर्कः for (ऋग्वर्गः)
२. पर्यायः (ग) (च) (ङ) for (पर्यार्यः) ३. योगा (ङ) for (योगो)
४. वयुत्कु (ग) वपुक्ष for (वयुक्षु)
५. चतुष्कका: (ग) (च) (ङ) for (श्चतुष्कका)
(ग) ६. प्रागृत for (प्राग्वत्) ७. युक्तोत्यः for (युक्तोंत्यः)
(ङ) ८. सोयाः for (सोपाः) ९. प्राप्तादा for (पादा)

२. (घ) १. विहीनाद्यंतौ (ग) वाद्यंते for (वाद्यंतौ)
२. क्रमोत्क्रमाद् (ग) क्रमात् (ङ) for (क्रमोक्रमाद्)
(ग) ३. एकादि (ङ) for (एकैक) ४. तद्विपर्यायौ for (तद्विपर्ययो)
५. वर्गादिषु (ङ) for (वर्गादिष्व) ६. विषमयुजाक्रमो for (समभुजः)
(च) २. क्रमोत्क्रमाद्वर्द्धयेत् for (क्रमोक्रमाद्वर्द्धयेत्)
(ङ) ४. तद्विपर्ययौ for (तद्विपर्ययो) ६. विषमयुजां for (समभुजः)

३. (घ) १. सोपेश्वधिकेषु for (न सोयेष्टधिकेषु)
२. भीष्टां (ग) वर्गादिरभीष्टांतः for (वर्गादिरीष्टांत)
(ग) ३. द्व्याव्याः for (द्वाद्या) ४. सोपेप्पधिकेषु for (न सोयेष्टधिकेषु)
५. तत्प्रतिष्ठेषु (ङ) for (तत्प्रविष्टेषु)
६. मध्यः (ङ) for (मध्यात्)
(च) १. नसोपेष्वधिकेषु for (नसोयेष्टधिकेषु)
(ङ) ३. द्व्याद्व्याः for (द्वाद्या) १. सोप्पप्पधिकेषु for (न सोपेष्टधिकेषु)
२. वर्गाद्रिरभीष्टान्तः for (वर्गादिरीष्टांत)

न्यूनोचोद्विपदाग्रं विपदाद्या नामतः पृथक् संख्या।
तछोधोथेव्येकः पृथगंतापमूर्द्धं युतम् ॥ ४ ॥
यावत्पादाव्येका गछद्वर्गोष्वथैकं वृद्धेषु।
रूपाद्युद्धृतघाते वर्गाद्यानां परा संख्या ॥ ५ ॥
रूपाधिकयोर्द्धं विषमे पूर्वः समेषु पादार्द्धं।
आघा द्विगुणाव्येकां गुलान्यधस्तस्य सर्वेषाम् ॥ ६ ॥
मध्येस्तथार्द्धहीनैः क्रमपादैर्व्यस्त तुल्य पादाद्यैः।
विषमेष्वेकं मध्ये प्रोह्याद्यान्यतः कुर्यात् ॥ ७ ॥

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४. (घ) १. न्यूनोन्यो (ग) न्यूनोद्विपादाग्रं for (न्यूनो चो)
२. ताश्चांधोध्योव्येक for (तछोधोथेव्येकः) ३. 'थे' लुप्त
(ग) ४. त्रिपदाद्यानाममधः for (विपदाद्यानामतः) २. व्यव्येकः for (व्येकः)
५. पृथगंताद्रूपमूर्द्धयुतम् for (पृथगंतापमूर्द्धयुतम्)
(च) १. न्यूनोंचो for (न्यूनोचो) २. ताँछोधोथे for (तछोधोथे)
५. पृथगंताद्रूमपूर्द्धयुतं for (पृथगंतापमूर्द्धयुतम्)
(ङ) १. सूनोन्त्यो for (न्यूनो चो)
४. त्रिपदाद्यानामधः for (विपदाद्यानामतः) २. तच्छोध्यो for (तछोधोथे)
५. पृथगन्ताद्रूपमूर्ध्वयुतम् for (पृथगंतापमूर्द्धयुतम्)
५. (घ) १. चैक for (थैक)
(ग) २. व्येको for (व्येका)
३. गच्छद्वर्गोप्यथैकवृद्धेषु for (गच्छद्वर्गोष्वथैकवृद्धेषु)
(ङ) ४. गच्छाद् for (गच्छेद्) ५. रूपाद्युतघाते for (रूपाद्युद्धृतघाते)
६. (घ) १. रूपाधिकपादार्धे (ङ) (ग) रूपाधिकापादार्धे for (रूपाधिकयोर्द्धं)
३. अज्या for (आघा)
(ग) २. विषमेषूर्द्धस्समेषु पादा for (विषमेपूर्वः)
३. अर्द्धाद्विगुणाव्येकां (ङ) for (आघाद्विगुणाव्येकां)
(च) १. रूपाधिकपादार्द्धं for (रूपाधिकयार्द्धं) ३. अद्या for (आद्या)
(ङ) २. विषमेषूर्ध्वः for (विषमेपूर्वः) ४. युलान्यधस्तस्य for (गुलान्यधस्तस्य)
७. (घ) १. (मध्यै) (ग) मध्यै for (मध्ये) २. मधे for (मध्ये)
२. प्रोच्याद्यान्यन्यतः for (प्रोह्याद्यान्यतः) ४. र्यात् for (कुर्यात्)
(ग) ५. व्यस्तुल्य for (व्यस्ततुल्य)
(ङ) १. माध्यै for (मध्ये) ६. पादाद्यः for (पादाद्यैः)
७. विषमेरव्येकं for (विषमेष्वेकं)

सैवक्रम[3] तुलाद्यै[1]र्न्यासोप्य[2]धिको विशोधितश्चाधः ।
सांख्यैक्यं[4] तादृक्[5] तादृक्[7] प्रथमस्त्रि[6]रहितो नष्टे ॥ ८ ॥
माध्यैः[1] कृतैश्चदलितै[4] सम संख्यायां क्रमोक्रमा[2]क्षेप्यम्[5] ।
विषमायां व्येकायां दलं क्रमादुक्रमात्[3] सैकम् ॥ ९ ॥
समसंख्यायां[1] सोपात्[7] क्रमोक्रमाभ्यां[2] तथैव विषमायाम्[8] ।
कल्पोपविते[3] हृष्टे[5] प्रथमः शेषाक्षराण्यंते[6][4] ॥ १० ॥
समदलसम विषमाणां संख्यापादार्द्धं[1] सर्वकल्पवधः ।
स्वाद्य[2] वधोन्यैः पादैः स्वपरस्य प्राग्वधः सैकैः ॥ ११ ॥

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८. (घ) १. तुल्याद्यै (ग) (ङ) for (तुलाद्यै)
२. व्यधिको (ग) र्नसोभ्यधिको (ङ) for (र्न्यासोप्यधिको)
(ग) ३. सैकक्रमं for (सैवक्रम) ४. संख्यैक्य (ङ) for (सांख्यैक्य)
५. तादिक् यादिक्च for (तादृक् तादृक्) ६. यस्त्रि for (प्रथमस्त्रि)
(च) ३. सैकक्रम (ङ) for (सैवक्रम) ४. सोख्यैक्य for (सांख्यैक्य)
(ङ) ७. यादृक् for (तादृक्)
९. (घ) १. माध्येः (ग) मध्यैः for (माध्यैः)
२. क्रमोत्क्रमा (ग) (च) for (क्रमोक्रमा)
३. दुत्क्रमात् (च) for (दुत्क्रमात्)
(ग) ४. दलितैः (च) (ङ) for (दलितैं) ५. त्क्षेप्यम् for (क्षेप्यम्)
(ङ) २. क्रमोत्क्रमात् for (क्रमोक्रमा) ५. क्षेप्पम् for (क्षेप्यम्)
१०. (घ) १. संक्षाया for (संख्यायां)
२. क्रमोत्क्रमाभ्यां (ङ) (ग) क्रमत्क्रमाभ्यां for (क्रमोक्रमाभ्यां)
३. कल्पोपवितो (ग) कल्पोपचिते for (कल्पोपविते)
४. शेषात्कराण्यंते for (शेषाक्षराण्यन्ते)
(ग) ५. हिष्टे for (हृष्टे) ६. शेषाः for (शेषा)
(च) २. क्रमोत्क्रमाभ्यां for (क्रमोक्रमाभ्याम्)
(ङ) ७. सोपान for (सोपात्) ८. विषमाभ्याम् for (विषमायाम्)
३. कल्प्यापचिते for (कल्पोपविते)
११. (घ) १. संक्षापार्द्ध (ग) सख्यापा for (संख्या)
(ग) २. स्वाद्य for (स्वाद्य)
(ङ) १. संख्यापादार्ध for (संख्यापादार्द्ध)
२. स्वाद्यवधोऽन्यैः for (स्वाद्यवधोन्यैः)

आद्यादनंतरोध[६]: कल्पोत्य[१] तुल्य माद्य कल्प[५] प्राक् ।
न्यासो[२] वर्गोन्योन्य[३] प्रस्तारेर्द्ध[४] समविषमाणाम् ॥ १२ ॥
नष्टांत्पास्वाधस्थो[१] न कल्प[४] घातो अर्द्धं[२] तुल्य[५] विषमाणाम् ।
व्येकः पृथक् स्ववर्गोद्धृतः[३] फलं[६] तुल्य कल्पानाम् ॥ १३ ॥
उद्दिष्टे[४] कल्प कृतो[१] तीतै प्रथम[६] फलस्वरूपेन्यः[२] ।
असकृद्वर्गांश[३] युते सैके वार्द्ध[५] सम विषमाणाम् ॥ १४ ॥

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१२. (घ) १. कल्पोऽनु (ग) कल्पोन्य for (कल्पोत्य)
२. न्यास्पोवर्ग्रो (ग) न्यासो च गोन्यो न for (न्यासोवर्गो)
३. न्योत for (न्योन्य)
४. प्रस्तारेऽर्ध (ग) (च) for (प्रस्तारेर्द्ध)
(ग) ५. कल्पः for (कल्प)
(च) १. काल्पोऽन्यतुल्य for (कल्पोत्यतुल्य) ३. न्योन for (न्योन्य)
(ङ) ६. दनन्तरोऽधः for (दनंतरोधः)
१. कल्प्पोऽन्यतुल्यमाद्यः for (कल्पोत्यतुल्यमाद्य)
५. 'कल्प' लुप्त ।
४. प्रस्तारोऽर्ध for (प्रस्तारेर्द्ध)
३. ऽन्योनः for (न्योन्य)

१३. (घ) १. नष्टांत्याश्चोस्थोन for (नष्टांत्पास्वाधस्थोन)
२. र्द्ध (ग) (च) (ङ) ऽर्ध for (अर्द्ध) ३. वर्ग्रो for (वर्गो)
(ग) १. नाष्टंत्यात् for (नष्टांत्) ५. ककल्प for (नकल्पा)
६. तुविषमाणाम् for (तुल्यविषमाणाम्) ७. द्धृतफलः for (द्धृतः फलं)
(ङ) १. नष्टेऽन्त्यात् for (नष्टांत्पा)

१४. (घ) १. कृतेऽतीतैः (ग) हृतेतीतैः (ङ) for (कृतोतीतै)
२. फले (ङ) for (फल)
३. वग्रांश (ग) व्यसकृद्वर्गांश for (असकृद्वर्गांश)
(ग) ४. उद्दिष्ट for (उद्दिष्टे) ५. चार्ध for (वार्द्ध)
(च) १. कृतेऽतीतैः for (कृतोतीतै)
(ङ) ६. प्रथमः for (प्रथम) ५. वार्ध for (वार्द्ध)

कल्पेषु पृथुगुरू लघुतुल्यवधैक्यं गुरु लघुनि यवमध्ये ।
दलसम विषम लघूनि स्वद्य लघूनानि विषमेषु ॥ १५ ॥
ध्व्यापाः कोष्टक वृद्ध्या लघु संख्यैकादि भाजिताः प्राग्वत् ।
विषमे ज्याघल ध्नूनो लघूनो लघुभिर्मेरुः समादीनाम् ॥१६॥
एकद्विकयोः परतो द्वि संगुणो नंतरो द्विरूपोधः ।
वर्गापराद्योनोदल समविषमाणां ध्वजो लघुभिः ॥ १७ ॥
लघु संख्यादौ परतो दलिता धोधश्च शुध्यति हृताद्यैः ।
द्विगुणांतैः संख्यै शुद्धैर्वर्ग परैर्मंदरो लघुभिः ॥ १८ ॥

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१५. (घ) १. कल्पपृथुगुरू for (कल्पेषु) २. लघूनि for (लघुनि)
३. स्वाद्य (च) for (स्वद्य)
(ग) १. कल्प्पेषु for (कल्पेषु) ४. पृथग्गुरुलघु (ङ) for (पृथुगुरुलघु)
५. संख्यैकादिभाजिताः प्राग्वत् (ङ) for (तुल्यवधैक्यं गुरुलघुनि यवमध्ये)
६. विषमेष्वाद्यलघूनो लघुभिर्मेरुः समादीनाम् ॥ १५ ॥ (ङ)
for
(दलसम विषमलघूनि स्वद्य लघूनानि विषमेषु)
(च) २. लघूनि for (लघुनि)

१६. (घ) १. द्वयाद्याः (च) for (ध्व्यापाः) २. वृद्धा (च) for (वृद्ध्या)
३. लघू (च) for (लघु) ४. ज्याद्य for (ज्याघ)
(च) ४. द्याद्यल for (ज्याद्यल) ५. 'लघूनो' लुप्त ।
(ङ) यह श्लोक यहां उपलब्ध नहीं ।

१७. (घ) १. वर्ग्र (ग) for (वर्गा)
(ग) २. द्वितयोः (ङ) for (द्विकयोः) ३. चराद्यो for (पराद्यो)
(च) १. वर्ग (ङ) for (वर्गा) ४. पराद्यां for (पराद्यो)
(ङ) (वि०—इसकी क्रमसंख्या १६ है) ४. ऽनन्तरा for (नंतरो)

१८. (घ) १. यरै for (परै)
(ग) २. संख्यापद दलिता परतो (ङ) for (संख्यादौ परतो दलिता)
३. हृताद्यैः for (हताद्यैः) ४. द्विगुणानांतैः for (द्विगुणान्तैः)
५. शुद्धैः वर्ग्र for (शुद्धैर्वर्ग)
(च) ६. ध्येधश्च for (धोधश्च) ७. लघुभि for (लघुभिः)
(वि०—इसकी क्रमसंख्या १७ है) ३. हृतायैः for (हताद्यैः)
६. ऽधोऽधश्च for (धोधश्च) ८. 'संख्यै' लुप्त ।

कृत्वा[५]धोधः कल्पान्ये [१]काद्येकोत्तरानधः[२] शेषात् ।
खात्परतां[३] तैकमधः प्रस्तारा द्युक्त [४]वदीहाद्यैः ।। १९ ।।
गुरूषष्ट्यैका[७] विघटि[१] द्विगुणा[८] व्येकांगुलानि संख्याद्वा[२] ।
विंशति[६] रार्या विंश[३] छंदश्चितुत्तराध्यायः[४] ।। २० ।।
[५]इत्ति ब्रह्म गुप्ते छंद श्चित्युत्तराध्यायः ।।२०।। अध्यायः समाप्तः
विशंतितमः समाप्तः ।

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१९. (घ) १. कल्पानेका for (कल्पान्येका)
२. धनः (ग) नघस्तेषाम् (ङ) for (नधः शेषात्)
३. खात्पतोंत्यैक (ग) खात्परतोत्यैक्यमधः for (स्वात्परतो ऽन्यैक्यमधः)
४. वदिहाक्षैः (ग) वदेहाद्यैः for (वदीहाद्यैः)

(च) ५. ध्येधः for (धोधः)
१. कल्पानेकाद्येकोत्तरानधः for (कल्पान्येकाद्येकोत्तरानधः)
३. परतांत्यैकमधः for (परतांतैकमधः)
४. वदिहाद्यैः for (वदीहाद्यैः)

(ङ) (वि०—इसकी क्रमसंख्या १८ है)
१. कल्प्यान्येका for (कल्पान्येका) ४. दुक्तवदिहाद्यैः for (द्युक्तवदीहाद्यैः)

२०. (घ) १. विघटी द्विगुणाद्वच (ग) विघटी for (विघटि) २. स्या (ग) for (द्वा)
३. विशश्छंद (ग) विशच्छंद for (विंशछैद)
४. श्चित्युत्तरोऽध्यायः (ग) (ङ) (श्चित्युत्तरोऽध्यायः)
५. 'इति' से 'समाप्त' तक पाठ उपलब्ध नहीं है । (ग)

(ग) ६. विशति for (विंशति)

(च) १. विघटी for (विघटि) २. संख्याध्या for (संख्याद्वा)
३. श्चित्युत्तराध्यायः for (श्चितुत्तराध्यायः)
५. 'इति' से 'समाप्त होने तक लुप्त ।

(ङ) (वि०—इसकी क्रमसंख्या १९ है)
७. गुरुषष्टचेका for (गुरुषष्ट्यैका)
१. निघटीद्विगुणा for (विघटिद्विगुणा)
८. न्येकांगुलानि for (व्येकांगुलानि) २. संख्या स्यात् for (संख्याद्वा)
६. द्राविंशतिरार्याणां for (विंशतिरार्याविंशं)

अथ गोलाध्यायो नाम

एकविंशतितमः

ग्रह नक्षत्रभ्रमणं न समं सर्वत्र [3]भवति भूस्[1]थानम् ।
तद्विज्ञानं गोलाद्यतस्ततो गोलमभिधास्ये[2] ।। १ ।।
शशि बुध सिता[4]र्क कुज गुरु शनि क[1]क्षवि[2]ष्टितोभ[3] कक्षांतः ।
भूगोलः सत्वानां शुभाशुभैः कर्मभिरूपात्तः ।। २ ।।
खेभूगोलस्तदुपरि मेरौ देवाः स्थिता[3]स्तले दैत्याः
खे[1] भगणाक्षाग्र[2]स्तावु पर्यू धश्चा ध्रुवो[4] तेषाम् ।। ३ ।।
ध्रुवयो विद्वं[1]स व्यगम मराणां क्षिति[2]जसंस्थमुडुचक्रम् ।
अपसव्यगमसुराणां भ्रमति प्रवहानि लाक्षिप्तम् ।। ४ ।।

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१. (घ) १. भूस्थानाम् (ङ) for (भूस्थानम्)
२. धास्येः for (धास्ये)
(ग) ३. 'भवति' पद यहां अंकित नहीं है ।

२. (घ) १. कक्ष्या (ग) कक्षा for (कक्ष)
२. चेष्टितो (ग) वेष्टितो for (विष्टितो)
(ग) ३. भक्षांत for (भकक्षांतः)
(च) ४. सिताक्कं for (सितार्कं)
१. कक्ष्यावेष्टितो for (कक्षविष्टितो)
(ङ) १. कक्षावेष्टितो for (कक्षविष्टितो)

३. (घ) १. षे for (खे)
२. स्थावुपर्यंधश्च (ङ) (ग) तावुपर्यंधश्च for (स्तावुपर्यूधश्चा)
(ग) ३. स्थिताः स्तल for (स्थितास्तले) ४. ध्रुवौ for (ध्रुवो)
(च) २. क्षाग्रस्थावुपर्युधश्चा for (क्षाग्रस्तावुपर्यूधश्चा)

४. (घ) १. वंद्वंस (ग) वंद्धः for (विद्वंस)
(ग) २. ःक्षिति for (क्षितिज)
(च) १. वंद्वंस for (विद्वंस)
(ङ) १. वंद्धं for (विद्वं)

अन्यत्र सर्वतो दिशि[1]मुन्नमति[2]भयं जरोध्रुवो भ्रमति[3] लंकायाः[4] ।
मुहु[5] चक्रं पूर्वापरगं ध्रुवौ क्षितिजे ॥ ५ ॥
देवा[1] सव्यगम सुराः[5] पश्यंत्यपसव्यगं[2] रविं क्षितिजे ।
विषुवति समपश्चिमगं निरक्ष[3]देशास्थिताः[4] पुरुषाः[6] ॥ ६ ॥
• सौम्यमपमण्डलार्द्धं[2] मेषाद्यं[3] सव्यंगसदा[4]देवाः ।
पश्यंति तुलाद्यर्द्धं दक्षिणमप सव्यगं दैत्याः[1] ॥ ७ ॥
पश्यंति देवदैत्या रविवर्षार्द्धं[3]मुदितं सकृत्सूर्यम् ।
शशिगाः सशि[1]मासार्द्धं पितरोभूस्था नराः स्वदिवम्[2] ॥ ८ ॥
भूपरिधि तूर्यभागै[1] लंका[4]भूमस्तका[6]क्षिति[5]तलाच्च ।
लंकोत्तरतोवंती[2] भूपरिधेः पंच दशभागैः[3] ॥ ९ ॥

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५. (घ) १. दिश (ग) दिशिषुन्नमति for (दिशिमुन्नमति)
२. तपंजरो for (भयंजरो) २. नमति (ग) (ङ) for (भ्रमति)
४. 'लंकाया' दूसरी पंक्ति का पहलापद (ग) (ङ)
५. मुडुचक्रं (च) (ङ) for (मुहुचक्रं)
(च) ३. नमति for (भ्रमति)
४. लंकाया (ङ) for (लंकायाः) ५. मुडुचक्रं for (मुहुचक्रं)
(ङ) १. दिशमुन्नमति for (दिशिमुन्नमति) २. भपंजरो for (भयंजरो)
६. (घ) १. देवाः (ग) (च)(ङ) for (देवा) २. सव्य गरविं for (सव्यगं रविं)
३. तिरक्ष for (निरक्ष) ४. देशस्थिताः (ग) (च) (ङ) for (देशास्थिताः)
(ग) ५. सुरा for (सुराः) (च) ६. पुरुषाः for (पुरूषाः)
७. (घ) १. दैत्या (च) for (दैत्याः) (ग) २. नंगुलार्द्धं for (मंडलार्द्ध)
३. मेखाद्यं for (मेषाद्यं) ४. मंसदा for (गंसदा)
(ङ) २. मपमंडलार्धं for (मपमंडलार्द्धं)
८. (घ) १. शशि (ग) शशि (च) (ङ) for (सशि)
२. स्वदिनम् (ङ) for (स्वदिवम्) (ङ) ३. वर्षार्ध for (वर्षार्द्ध)
९. (घ) १. चतुर्भागे (ग) तुर्य for (तूर्यभागै)
२. ऽवंती (ङ) (ग) लंकोत्तरोवन्ती for (लंकोत्तरतोवन्ती)
३. भगैः (ग) for (भागैः) (ग) ४. लंका for (लङ्का)
५. त्क्षिति for (क्षति) (च) १. चतुर्भागै for (तूर्यभागै)
२. ऽवन्ती for (वन्ती) (ङ) १. तुर्यभागे for (तूर्यभागै)
६. भूमस्तकात् for (भूमस्तका) ३. दशभागे for (दशभागैः)

अक्षांश[1]भूपरिधि वधान्मंडलभागा [2]सयोजनै [3]विंषुवत् ।
[4]तत्भाग योजनैरेवमुपरि[5]स्तयोन्य [6]दनुपातात् ॥ १० ॥
अंबरयोजनपरिधिः शशिभगणाः शून्यखखजिनाग्नि गुणाः[2] ।
यस्य भगणै [1]विभक्तास्तत्[3]कक्षार्को[4]भषष्ट्यंशे ॥ ११ ॥
[3]भूपरिधि [4]समान [5]षष्ट्या [1]ख परिधि तुल्यानि कल्परविवर्षैः ।
गच्छंति योजनानि ग्रहाः [2]स्वकक्षास्तु तुल्यानि ॥ १२ ॥
भगण[2]स्याधः शनिगुरु भूमिजरविशुक्र सौम्य[1]चंद्राणाम् ।
[3]कक्षाक्रमेण शीघ्राः शनैश्चराद्याः कलाभुक्त्या ॥ १३ ॥

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१०. (घ) १. कुपरिधि (ग) (च) (ङ) for (भूपरिधि) २. प्त (ग) (ङ) for (स)
३. विंषुवत् (ग) (ङ) for (विंषुवत्) ४. नत (ग) (ङ) for (तत्)
५. सूर्योन्य (च) for (स्तयोन्य)
(ग) ६. दनुपात् for (दनुपातात्)
(च) २. भागाप्तयोजनै for (भागासयोजनै)
३. विंषुवत् for (विंषुवत्) ४. नतभाग for (तत्भाग)
(ङ) (ङ) सूर्योऽन्य for (स्तयोन्य)

११. (घ) १. विंभक्तस्तत् कक्षार्कोभ for (विभक्तास्तत् कक्षार्कोभ)
(ग) २. +३३२४०००+
(च) ३. कक्षार्क्कोभषष्ट्य्ंशे for (कक्षार्कोभषष्ट्य्ंशे)
(ङ) ३. कक्षाऽर्को for (कक्षार्को) ४. भषष्ठ्यंशः for (भषष्ट्यंशे)

१२. (घ) १. भ for (ख) २. स्वकक्षासू for (स्वकक्षास्तु)
(ग) ३. भपरिधि for (खपरिधि)
४. समानि (ङ) for (समान)
५. षष्ट्य for (षष्ट्या)
(च) ५. खष्ट्याष for (षष्ट्या ख)
(ङ) २. स्वकक्षासु for (स्वकक्षास्तु)

१३. (घ) १. चंप्राणां for (चन्द्राणाम्)
(ग) २. भगणस्याधिः for (भगणस्याधः)
(ङ) ३. कक्षाः for (कक्षा)

लघवोल्पो[1] राश्यंशा[2] महति महतो[3] ऽल्पवृ[6]त्तमल्पेन[7]।
पूरयंस्तींदुर्[4]महता कालेन महाशनैश्चारी[5] ॥१४॥
यन्मूलं तध्वासो[1] मंडललिप्ता कृतेर्दश[2]हृतायाः।
तस्यार्द्धं[3] व्यासार्द्धं[4] योजनकर्णं[5]प्रमाथार्थम्[6] ॥ १५ ॥
भगणकलाव्यासार्द्धं भवति कलाभिर्यतो[2] न सकलाभिः[3]।
ज्यार्द्धानि न स्फुटानि[1] ततः कृतं व्यासदलमन्यत् ॥ १६ ॥
राश्यष्टांशेष्टांकांत्यद[1]संधिभ्यः[4] क्रमोक्रमाक्रत्वा[2]।
बध्नीयात् सुत्राणि[3] द्वयोर्द्वयो र्ज्यास्तदर्द्धानि ॥ १७ ॥

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१४. (घ) १. लघवोऽल्पे for (लघवोल्पो) २. राशंशा (च) for (राश्यंशा)
३. महांतो (ग) (ङ) for (महतो)
४. पूरयतींदुर्म्महता (ग) पूरयतींदुर्महता (ङ) for (पूरयंस्तींदुर्महता)
५. महशनैश्चारी (ग) महछनैश्चारी (ङ) for (महाशनैश्चारी)
(ग) ६. ल्पवृत्त for (ऽल्पवृत्त) ७. मन्येन for (मल्पेन)
(च) ४. पूरयंती दुर्म्महता for (पूरयंस्तींदुर्महता)
५. महशनैश्चारी for (महाशनैश्चारी)
(ङ) १. लघवोऽल्पे for (लघवोल्पो)

१५. (घ) १. तद्व्यासो (ग) (ङ) for (तध्वासो) २. कृतेर्द्दश (ग) for (कृतेर्दश)
३. नस्यार्द्धं for (तस्यार्द्धं) ४. व्यार्द्धं for (व्यासार्द्धं)
५. कर्णमाणार्थम् (ग) (च) कर्ण प्रमाणार्थम् for (कर्ण प्रमाथार्थम्)
(च) १. तद्व्यासो for (तध्वासो) २. ईशहृतायाः for (र्दशहृतायाः)
४. दयासार्द्धं for (व्यासार्द्धं)
(ङ) ६. प्रमाणार्थम् for (प्रमाथार्थम्)

१६. (घ) १.+(च)+(ङ)
(ग) २. र्यतोर्यतो for (र्य तो न)
(ङ) ३. सविकलं हि for (सकलाभिः)

१७. (घ) १. ष्वंकान्पद (ग) for (शेष्टांकांत्यद)
२. क्रमोत्क्रमात्कृत्वा (ग) (ङ) for (क्रमोक्रमाकृत्वा)
३. सूत्राणि (ग) (च) (ङ) for (सुत्राणि)
(च) १. ष्वंकान्पद for (ष्टांकांत्यद) ग. क्रमोत्क्रम। कृत्वा for (क्रमोक्रमा क्रत्वा)
(ङ) १. राश्यष्टांशेष्वङ्कान् for (राश्यष्टांशेष्टांकांत्)
४. पदसन्धिभ्यः for (यदसंधिभ्यः)

ज्यार्द्धानि ज्यार्द्धानां ज्याखंडान्यंतराणि तन्ये[1] च ।
व्यस्तान्यं[3] तदेथ विषुरू[2] क्रमज्या धनुस्ताभ्याम् ॥ १८ ॥
एक द्वित्रि[3] गुणाया व्यासार्द्ध क्रतेः[1] पृथक् चतुर्थेभ्यः ।
मूलान्यष्ट[4] द्वादश षोडष[2] षडान्यतो[5] न्यानि ॥ १९ ॥
तुल्यक्रमोक्रम[1] समज्या[6] खंडक[4] वर्ग युतिर्भगिम्[2] ।
प्रोह्यानष्टं[3] व्यासार्द्ध वर्गतस्तत्पदे[5] प्रथमं ॥ २० ॥
तद्दलखण्डानि तदुन[1] जिन समानि द्वितीयमुत्पत्तौ[2] ।
कृतयमलैक दिगीशेषु सप्तरसगुणा[3] नवादीनाम् ॥ २१ ॥
एवं जीवा खंडान्यल्पानि बहुनि[1] वाद्यखण्डानि[2] ।
ज्यार्द्धानि[3] वृत्तपरिधेः षष्टचतुर्थत्रिभागानाम् ॥ २२ ॥

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१८. (घ) १. तान्येव (ग) (ङ) (च) for (तन्ये च)
२. वेषु (ग) पादथतेषु for (विषुरूक्रमज्या)
(ग) ६. व्यस्तान्यत् for (व्यस्तान्यं) ३. व्यस्तान्यतादथ तेषु for (व्यस्तान्यं तदेथ विषु)
२. तेषुरुत्क्रमज्या for (विषुरुक्रमज्या)
(ङ) ३. व्यस्तान्यन्त्यादथ for (व्यस्तान्यं तदेथ)
२. वेषुरुत्क्रमज्या for (विषुरूक्रमज्या)
१९ (घ) १. कृतेः (ग) (च) (ङ) for (कृतेः) २. षोडश (ग) (च) (ङ) for (षोडष)
(ग) ३. द्विगुणया for (द्वित्रिगुणाया) ४. मूलात्यष्ट for (मूलान्यष्ट)
५. षंडान्यतो for (षडान्यतो)
(ङ) ५. खण्डान्यतोऽन्यानि for (षडान्यतोन्यानि)
२०. (घ) १. तुल्यकूमोत्कूम (ग) (च) (ङ) for (तुल्यकूमोकूम)
२. चतुर्भगिम् (ङ) for (र्भगिम्)
३. प्राज्यानष्टं (ग) प्राह्यानष्टं for (प्रोह्यानष्टं)
(ग) ४. खंड for (खंडक) ५. वर्ग्रस्तत्पदे for (वर्गतस्तत्पदे)
(च) ३. प्रोज्यानष्टं for (प्रोह्यानष्टं) (ङ) ६. ज्यासम for (समज्या)
२१. (घ) १. तदून (ग) (च) (ङ) for (तदुन)
(ग) २. (वि०—'द्वितीय' पद लुप्त है)
(च) ३. गुणनवादीनाम् (ङ) for (गुणानवादीनाम्)
२२. (घ) १. बहूनि (ग) (च) (ङ) for (बहुनि) २. षंडानि (च) for (खण्डानि)
(ग) ३. ज्यार्धनिवृत्तिपरिधेः for (ज्यार्द्धानिवृत्तपरिधेः)
(ङ) २. वाऽद्यखण्डानि for (वाद्यखण्डानि) ३. ज्यार्धानि for (ज्यार्द्धानि)

उत्क्रम[4] समखण्ड[5] गुणाढ्यासादथवा[1] चतुर्थभागाद्यम् ।
कृत्वोक्त खण्डकानि[2] ज्यार्द्धानयनं[6] नलध्वमस्मात्[3] ॥ २३ ॥
कक्षा[1]मंडल[2]भूमध्ये[3] मध्यमः स्वकक्षायाम् ।
अनुलोमं मंदोच्चात्प्रतिलोमं भ्रमति शीघ्रोच्चात् ॥ २४ ॥
त्यक्तं[1] तत्परिधौ प्रतिलोमं मन्दोच्चा भ्रमति शीघ्रोच्चात् ।
अनुलोमं मध्यस्थसमं[2] भूस्थः पश्यति यतोनकक्षायाम् ॥ २५ ॥

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२३. (घ) १. गुणाढ्यासादथवा (ग) (च) (ङ) for (गुणाढ्यासादथवा)
२. षंडकानि (च) for (खंडकानि)
३. लद्यस्मात् (ग) लघ्वमस्तात् for (लघ्वमस्मात्)
(ग) ४. उत्क्रम (च) (ङ) for (उक्रम) ५. खण्डा for (खण्ड)
६. यामार्द्धनयनं for (ज्यार्द्धानयनं)
(च) २. नलघ्वमस्मात् for (नलध्वमस्मात्)
(ङ) ७. भागाद्यत् for (भागाद्यम्) ३. लघ्वस्मात् for (लघ्वमस्मात्)
२४. (घ) १. कक्ष्या for (कक्षा) २. मंडलमध्यं (ग) for (मडलभूमध्ये)
(च) १. कक्ष्या for (कक्षा) २. मंडलमध्यं for (मंडल)
(ङ) शी० + अथ स्फुट गतिवासना + ३. मध्यं भूमध्ये for (भूमध्ये)
२५. (घ) १. (वि०—यहाँ श्लोक की तीन पंक्तियाँ हैं।
"नीचोच्चवृत्तमध्यं मध्ये तद्भ्रमति मध्यमः स्वोच्चात्" (च) (ङ) for (त्यक्तं तत्परिधौ प्रतिलोमं मंदोच्चा भ्रमति शीघ्रोच्चात्)
२. मध्यसमं (ग) (च) (ङ) for (मध्यस्थसमं)
(ग) १. "नीचोथवृत्तमध्यं मध्ये तद्भवति मध्यमः स्वोच्चात् ।"
तत्परिधौ प्रतिलोमं मंदोच्चात् भवति शीघ्रोच्चात् ॥ २५ ॥
for
(त्यक्तं तत्परिधौ प्रतिलोमं मंदोच्चा भ्रमति शीघ्रोच्चात् । अनुलोमं मध्यस्थसमं भूस्थः पश्यति यतो न कक्षायाम् ॥ २५ ॥)
(च) इस प्रति में 'घ' की भाँति श्लोक में तीन पंक्तियाँ हैं—पहली पंक्ति है : —'नीचोच्चवृत्तमध्यं मध्ये तद्भ्रमति मध्यमः स्वोच्चात्"
(ङ) (वि०—इस प्रति की पहली पंक्ति 'नीचोच्चवृत्तमध्यं तद् भ्रमति मध्यगः स्वोच्चात्" उपर्युक्त प्रतियों में छूट गई। और दो श्लोकों की चार पंक्तियों में से केवल तीन को सम्मिलित करके एक श्लोक माना गया। आगे के श्लोकों में फलतः सर्वत्र इस प्रति की दृष्टि से पूर्व श्लोक का उत्तरार्ध + अग्रिम श्लोक का पूर्वार्ध मिलाकर श्लोकों की व्यवस्था की गई है।

स्पष्टं[1] तन्मध्यांतरमृणं धनं वा तप्तो[2] मध्ये ।
कोटिफलं व्यासार्द्धात्पदयोराद्यं तयो भवत्युपरि[3] ॥ २६ ॥
द्वितृतीययोर्यतोऽधस्ताष्टक्तोनं[1] तरतः[2] कोटिः[3] ।
कर्णस्तद्भुजफलकृतिसंयोग[4] पदं तदुद्धृता त्रिज्या ॥ २७ ॥
भुजफल[6] गुणिताप्तधनु[1] गुणिते चैवं[2] फलं शींघ्रे ।
त्रिज्याभक्तः[3] कर्णः परिधिगुणे[4] बाहुकोटिः[7] गुणाकारः[5] ॥ २८ ॥

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२६. (घ) १. अष्टं for (स्पष्टं)
२. ततो (ग) गृहे मध्ये ॥ २६ ॥ for (तप्तो मध्ये)
३. भंवत्युपरि (ग) (च) (ङ) for (भवत्युपरि)
(ग) इस श्लोक की पहली पंक्ति २६ वें श्लोक की दूसरी पंक्ति है ।
इस श्लोक की दूसरी पंक्ति २७ वें श्लोक की पहली पंक्ति हैं—
(च) २. ततो for (तप्तो)
(ङ) दे० वि० नोट २५ वें श्लोक के अन्तर्गत टिप्पणी में ।
२. ग्रहे मध्ये for (तप्तो मध्ये)

२७. (घ) १. तद्युक्तोनं (ङ) for (ताष्टक्तोनं) २. ततः (ङ) for (तरतः)
(ग) ३. कोटिः ॥ २७ ॥ (ङ) for (कोटिः)
(वि०—इस श्लोक की दूसरी पंक्ति—२८ वें श्लोक की प्रथम पंक्ति है—
४. फलसंयोगं for (फलकृति संयोग)
(च) १. ऽधस्तद्युक्तोनं for (ऽधस्ताष्टक्तोनं)

२८. (घ) १. धनुर्गुणिते for (धनुगुणिते) (ग) गंणितेनैवं फलं शीघ्रे ॥ २८ ॥
२. नैवं for (चैवं)
३. विज्या for (त्रिज्या)
४. गुणो (ग) (ङ) for (गुणे)
५. गुणकारः (ग) (ङ) for (गुणाकारः)
(ग) इस श्लोक की पहली पंक्ति २८ वें श्लोक की द्वितीय पंक्ति है ।
६. भुजफ for (भुजफल) ७. कोटि (ङ) for (कोटिः)
(च) १. गुंणिते for (गुणिते) ४. परिधोगुणो for (परिधिगुणे)
७. कोटि for (कोटिः) ५. गुणकारः for (गुणाकारः)
(ङ) १. धनुर्गणिते for (धनुगुणिते) २. नैवं for (चैवं)

असकृत्[1]मांदे तत्फलमाद्य[3]समं नात्र कर्णो[4]स्मात् ।
प्रतिपादनार्थ[2]मुच्चं प्रकल्पितं ग्रहगतेस्तथा पातः ॥ २९ ॥
भुक्ते[1]रूनाधिकना[1]मानस्यच भवति कर्ण[2]वशात् ।
कक्ष्या[3] व्यासार्द्धगुणा मंडललिप्ता विभाजिताकर्णः ॥ ३० ॥
स्वकलाकर्णेन गुणः कर्णस्त्रिज्याहृ[1]तः स्पष्टः ।
मद्[2]हृन जलम[4]यानं विष्[5]कंभा योजनैः कनें[3]दुना ॥ ३१ ॥

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२९. (घ) १. असकृन्मां (ग) असकृन्मांद्य for (असकृत् मांदे)
२. प्रतिपदेनार्थमुच्चं for (प्रतिपादनार्थमुच्चं)
(ग) ३. सम for (ममं)
४. कर्णोस्मात् ॥ २९ ॥ (ङ) for (कर्णोस्मात्)
इस श्लोक का उत्तरार्ध, ३० वें श्लोक का पूर्वार्ध है ।
(च) १. असकृन्मांदे for (असकृत्मांदे)
४. कर्णोस्मात् for (कर्णोस्मात्)
(ङ) २. असकृन्मान्दे for (असकृत्मांदे)
३०. (घ) १. तामानस्य (ग) for (नामानस्य)
(ग) २. व स्यात् ॥ ३० ॥ for (वशात्)
३. कक्षा (ङ) for (कक्ष्या)
इस श्लोक का उत्तरार्ध, ३१ वें श्लोक का पूर्वार्ध है ।
(च) १. तामानस्य for (नामानस्य)
(ङ) १. रूनाधिकता for (रूनाधिकना)
४. +इति स्फुटगतिवासना+
३१. (घ) १. हृतः (ग) हृतस्पष्टः ॥ ३१ ॥ for (हृतः)
२. मृद्हृन (ग) (ङ) for (मद्हृन)
३. क्निनेन्दूनाम् (ग) केनेदूनाम् for (कनेंदुना)
(ग) ४. मायानां for (मयानं)
इस श्लोक की दूसरी पंक्ति अगले श्लोक की पहली पंक्ति है ।
(च) हृतः for (हृतः)
२. मृद्हृन (ङ) for (मद्हृन)
४. जलमयानां (ङ) for (जलमयानं)
३. क्निनेंदुनां for (कनेंदुना)
(ङ) ५. विष्कंभो for (विष्कंभा)
३. द्विनेंदूनां for (कनेंदुना)

शशि[६]वसुतिथिभि यम[१]पक्षशररसैः शून्य वस्तु[२] वेदैः ।
व्यर्क[३] व्याप्तांतर[४] गुणमिंदु स्फुट कर्णमर्ककर्णहृतम्[५] ॥ ३२ ॥
प्रोह्य भुवो भुछाया[१] विष्कंभश्चंद्रकक्षायाम्[२] ।
तद्गुणितं व्यासार्द्धं शशिकर्णहृतं ततः[३] प्रमाणकलाः ॥ ३३ ॥
एवं त्रिज्या[१] रविशशि विष्कंभगुणाः[६] स्वकर्णहताः[२] ।
भूछायेंन्दुश्चंद्र[४]सूर्यं[३] छादयति मानयोगार्द्धात् ॥ ३४ ॥[५]

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३२. (घ) १. यंम (ग) यमपक्षरासैः ६५२२ for (यमपक्षशररसैः)
२. वसु (ग) वसुवेदैः (ङ) for (वस्तुवेदैः)
३. कर्क for (व्यर्क) ४. व्यासांतर (ग) for (व्याप्तांतर)
५. हृतम् (ग) for (हृतम्)
(ग) ६. राशिवसुतिथिभिः १५८१ for (शशिवसुतिथिभिः)
(वि०—इस श्लोक के पूर्वार्ध की समाप्ति पर ३२ संख्या होनी चाहिए परन्तु लिखी हुई ३३ है)
(च) १. यंम for (यम) २. वसु for (वस्तु)
३. व्यर्क्क for (व्यर्क) ४. व्यासांतर for (व्याप्तांतर)
५. मर्क्क कर्णहृतं for (मर्ककर्णहृतम्)
(ङ) १. यंम for (यम)
३३. (घ) १. भूछाया (ग) for (भुछाया)
२. कक्ष्यायाम् (ग) कक्षायाम् ॥ ३४ ॥ for (कक्षायाम्)
३. तमः (ग) (च) (ङ) for (ततः)
(ग) इस श्लोक का उत्तरार्ध अगले श्लोक का पूर्वार्ध है।
(च) १. प्रोज्यभुवोभूछाया for (प्रोह्यभुवोभुछाया)
(ङ) १. भूच्छाया for (भुछाया)
३४. (घ) १. तृज्याशशि for (त्रिज्यारविशशि) २. हृताः (ग) हृता ॥३५॥ for (हताः)
३. सूर्यं (ग) (च) (ङ) for (सूर्यं)
४. भूछायेंदु चंद्रः (ग) भूछायेंदूचंद्रः for (भूछायेन्दुश्चंद्र)
५. (वि०—यहां पर कोई अंक संख्या नहीं दी)
(ग) ६. गुणः for (गुणाः)
(वि०—इस श्लोक का उत्तरार्ध ३६ वें श्लोक का पूर्वार्ध है)
(च) २. हृताः for (हताः) ४. भूछायेंदुचंद्रः for (भूछायेंदुश्चन्द्र)
५. (वि०—यहां पर क्रमसंख्या लुप्त है)
(ङ) ४. भुच्छायेंदु चन्द्रः for (भूछायेंदुश्चन्द्र) ६. गुणा for (गुणाः)

विक्षेपो[६] यद्यूनः शुक्लेतर पंच[३] दृश्यंते[१] ।
महदिदो[७] रावणं[४] कुठ[५] विषाणो यतो संछन्नः[२] ॥ ३५ ॥[८]
अर्द्धछिन्नो[५] भानुस्तिक्षण[१] विषाणस्ततो स्यात्पे[२] ।
यदि राहुः प्राग्भार्दिदु[३] छादयति किं तथा नार्कम् ॥ ३६ ॥[४]

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३५. (घ) १. दश्यंते (ङ) for (दृश्यन्ते)
(यहां ३५ की संख्या अङ्कित है)
२. र्द्धसंछन्नः (ग) र्धसंछन्नः (ङ) ऽर्ध सञ्छन्नः for (संछन्नः)
(ग) ३. पंचं for (पंच)
१. द्दिश्यंते ॥३६॥ for (दृश्यंते)
४. रादरणं for (रावणं)
५. कुठ (ङ) for (कुठ)
वि०—इस श्लोक का उत्तरार्ध ३७ वें श्लोक का पूर्वार्धं है)
(च) ६. विक्ष्येपो for (विक्षेपो)
३. पंद्दश्यंते ३५ for (पंचदृश्यंते)
७. महर्दिदो (ङ) for (महदिदो)
२. यतोर्द्ध for (यतो)
८. (वि०—यहां कोई क्रमसंक्या अंकित नहीं है)
(ङ) ४. रावरणं for (रावणं)

३६. (घ) १. स्तीक्ष्ण (ग) (ङ) for (स्तिक्षण)
२. ततोऽस्याल्पम् (च) (ङ) for (ततोस्याल्पे)
(वि०—यहां क्रमसंख्या ३६ दी है)
३. प्राग्भागार्दिदु (ग) प्राग्भार्दिदुं for (प्राग्भार्दिदु)
(ग) २. ततोऽस्याल्पी ॥३७॥ for (ततोस्याल्पे)
(वि०—इस श्लोक का उत्तरार्धं ३८ वें श्लोक का पूर्वार्धं है)
(च) १. स्तीक्ष्ण for (स्तिक्षण)
४. (वि०—यहां कोई क्रमसंख्या नहीं दी, क्योंकि इस प्रति के अनुसार यहां का उत्तरार्धं ३७ वें श्लोक का पूर्वार्धं है ।
(ङ) ५. अर्धच्छन्तो for (अर्द्धछिन्नो)
२. प्राग्भागादिन्दुं for (प्राग्भार्दिदु)

स्थित्यर्द्धं[1] महदिन्दो यथा[5] तथा किन्न सूर्यस्य[2] ।
किं प्रतिविषयं[3] सूर्यो[4]राहुश्चान्यो यतो रविग्रहणे ॥ ३७ ॥[6]
ग्रासान्यत्वं न ततो राहुक्रतं[1] ग्रहण मर्कंद्धोः[2] ।
एवं वराहमिहिरश्रीषेणार्य[3]भटविष्णुचंद्राद्यैः ॥ ३८ ॥[4]
लोक विरूद्धमभिहितं वेदस्मृति[1]संहिताबाह्यम्[4] ।
यद्येवं[5] ग्रहणफलं गर्गाद्यैः संहितामु[2]दयभिहितम्[3] ॥ ३९ ॥

३७. (घ) १. स्थित्यद्धं for (स्थित्यद्धं)
२. सूर्यः स्य (यहां क्रमसंख्या ३७ दी है) (ग) सूर्यस्य ॥३८॥ for (सूर्यस्य)
३. विषग्रं (ग) विखयं for (विषयं)
(ग) (वि०—इस श्लोक का उत्तरार्ध ३९ वें श्लोक का पूर्वार्ध है ।
४. सूयो for (सूर्यो)
(च) ५. यंथा (ङ) for (यथा)
२. (वि०— यहां क्रमसंख्या ३७ अंकित है)
६. वि०—यहां कोई क्रमसंख्या नही दी है, क्यों कि इस श्लोक का उत्तरार्ध, ३९ वें श्लोक का पूर्वार्ध है । (ङ) १. स्थित्यर्धं for (स्थित्यद्धं)
३८. (घ) १. कृतं (ग) (च) (ङ) for (क्रतं)
२. मर्केद्वोः (ग) मर्केद्वोः ॥३९॥ for (मर्कंद्धो) (यहां ३८ संख्या दी है)
(ग) ३. श्रीषेणाचार्यं for (श्रीषेणार्यं)
इस श्लोक का उत्तरार्ध, ४० वें श्लोक का पूर्वार्ध है ।
(च) २. मर्क्केद्वोः for (मर्कंद्धो.) (वि०—यहां श्लोक संख्या ३८ अंकित है)
४. यहां क्रमसंख्या लुप्त है, क्योंकि यह ३९ वें श्लोक का पूर्वार्ध है ।
(ङ) २. मर्केन्द्वोः for (मर्कंद्धोः)
३९. (घ) १. स्त्रिम्मृवि for (स्मृति) (यहाँ संख्या ३९ है)
२. संहितासु (ग) (ङ) for (संहितामु)
३. यदि भिहितम् (ग) for (दयभिहितम्)
(ग) ४. संहिताद्वाह्यम् ॥ ४० ॥ for (संहिताबाह्यम्)
५. यद्येव ग्रहफलं for (यद्येवं ग्रहणफलं)
(वि०—इस श्लोक का उत्तरार्ध ४१ वें श्लोक का पूर्वार्ध है ।
(च) ४. यहाँ '३९' की क्रमसंख्या अंकित है । परन्तु उत्तरार्ध के अन्त में कोई क्रमसंख्या अंकित नहीं, क्योकि उत्तरार्ध, ४० वें श्लोक का पूर्वार्ध माना जाता है ।
(ङ) ३. यदभिहितम् for (दयभिहितम्)

तदभावे[2] होमजपः[3] स्नानादि[4] फलस्य[5] चाभावः।[7]
राहुक्रतं[1] ग्रहणद्वय मागोपालांगनादि[2] सिद्धमिदम् ॥ ४० ॥[8]
बहुफलमिदमपि[1] सिद्धं जपहोमस्नानफलमत्र[2]।
स्मृतीषुक्तं[3] न स्नानं राहोरन्यत्र दर्शनाद्रात्रौ ॥ ४१ ॥
राहुग्रस्ते सूर्यं[1] सर्वं गंगासमं तोयम्[2]।
स्वर्भानुरास्तुरिरिनं[3] तमसा वित्याध[4]वेदवाक्यमिदम् ॥ ४२ ॥

४०. (घ) (वि०—यहाँ प्रथम पंक्ति के अन्त में ४० संख्या दी है)
१. कृतं (ग) for (क्रतं)
(ग) २. तदभावो for (तदभावे) ३. लुप्त पद है। ४. लुप्त पद है।
५. फलस्याभावः ॥ ४१ ॥ for (फलस्य चाभावः)
(वि०—इस श्लोक का उत्तरार्ध, अगले श्लोक का पूर्वार्ध है)
६. माग्गो पालाऽगना for (मागो पालांगनादि)
(च) ७. यहाँ '४०' क्रमसंख्या अंकित है। ८. यहाँ कोई संख्या अंकित नहीं, क्योंकि यह उत्तरार्ध भाग ४१ वें श्लोक का पूर्वार्ध माना जाता है।
(ङ) ४. जप for (जपः) ५. स्नानादीनां फलाभावः for (स्नानादि फलस्य चाभाव)

४१. (घ) १. बाहु for (बहु)
२. मंत्र (यहाँ क्रमवंख्या ४१ दी है) (ग) मत्र ॥ ४२ ॥ for (मत्र ॥ ४१ ॥)
३. स्मृतिषूक्तं (ग) (ङ) for (स्मृतीषुक्तं)
(ग) इस श्लोक का उत्तरार्ध ३३ श्लोक का पूर्वार्ध है
(च) २. यहाँ '४१' क्रमसंख्या दी गई है। ३. स्मृतीषूक्तं for (स्मृतीषुक्तं)
(वि०—इस प्रति के अनुसार इस श्लोक का उत्तरार्ध ४२ वें श्लोक का पूर्वार्ध है अतः यहाँ अन्त में क्रमसंख्या अंकित नहीं है)

४२. (घ) १. सूर्ये (ग) (च) (ङ) for (सूर्यं)
२. (वि०—यहाँ क्रमसंख्या ४२ (ग) ४३ दी है)
३. रासुरि (ग) रासुरि न तमसा for (रास्तु)
४. विच्याध (ग) विव्याध (ङ) for (वित्यधा)
(ग) इस श्लोक का उत्तरार्ध अगले श्लोक का पूर्वार्ध है।
(च) २. (वि०—यहाँ क्रमसंख्या ४२ अंकित है) ३. रासुरिरिन for (रास्तुरिरिनं)
४. विव्याध for (वित्याध)
यहाँ श्लोक के अन्त में कोई क्रमसंख्या अंकित नहीं क्योंकि यह उत्तरार्ध माना जाता है।
(ङ) ३. रासु for (रास्तु)

श्रुतिसंहितास्मृतीनां भवति तथैक्यं[1] तदुक्तिरतः[3] ।[2]
राहुस्तच्छादयति प्रविशति यच्छुक्ल[4] पंच दृश्यन्ते ।। ४३ ।।
भूछाया तमसींदो[4] वंरप्रदानात्कमलजस्य[5] ।[1]
चन्द्रोवुभयोधस्थो[2][3] यदग्निमय[6] भास्करस्य मासांते ।। ४४ ।।
छादयति शमिततयो[3] राहु छादयति[6] तत्सवितुः[4] ।[1]
भूछाया व्याससमः[2] शशिकक्षायां स्थितः शशिग्रहणे[5] ।। ४५ ।।

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४३. (घ) १. यथैक्यं (ग) (च) (ङ) for (तथैक्यं)
२. (वि०—यहाँ क्रमसंख्या ४३ दी है) (च) (ङ)
(ग) ३. रंतः ।। ४४ ।। for (रतः)
४. यत् शुक्ल पंच दृश्यंते for (यच्छुक्ल पंचदृश्यन्ते)
(च) (वि०—यहाँ इस श्लोक के अन्त में कोई क्रमसंख्या अंकित नहीं क्योंकि यह उत्तरार्ध यहाँ ४४ वें श्लोक का पूर्वार्ध माना जाता है)
(ङ) ४. यच्छुक्ल for (यच्छुक्ल)

४४. (घ) १. (वि०—यहां क्रमसंख्या ४४ दी है) (च) (ङ)
२. वुमयो (ग) चंद्रोबुमयोधस्थः for (चन्द्रोवुभयोधस्थो)
३. घस्थो for (ऽधः स्थो)
(ग) ४. नभसींदो for (तमसींदो)
५. त्कमलाया ने ।।४४।। for (कमलजस्य). ६. यदग्नियम for (यदग्निमय)
(वि०—इस श्लोक का उत्तरार्ध ४५ वें श्लोक का पूर्वार्ध है)
(च) (वि०—इस श्लोक का उत्तरार्ध ४५ वें श्लोक का पूर्वार्ध है) अतएव यहां अन्त में कई क्रमसंख्या अंकित नहीं ।
(ङ) ५. कमलयोनेः for (कमलजस्य)
२. छन्द्रोऽम्बुमयोऽधः स्थो for (चन्द्रोवुभयोधस्थो)

४५. (घ) १. (वि०—यहां क्रमसंख्या ४५ अंकित है) (च) (ङ)
२. सम for (समः)
(ग) ३. शमिततापो (ङ) for (शमिततयो)
४. तच्छवितुः ।।४५।। for (तत्सवितुः)
(वि०—इस श्लोक का उत्तरार्ध, ४६ वें श्लोक का पूर्वार्ध है) (च)
(च) ३. शमितताया for (शमिततयो) ५. क्रम संख्या लुप्त
(ङ) ६. राहुश्छादयति for (राहुछादयति)

राहु छादयतींदु सूर्यग्रहणेर्कमिंदु समः ।
यत्तदधिकं तमोमयराहुव्यासस्य सूर्यं द्रष्टं तत् ॥ ४६ ॥
नश्यति भूछायेंदु व्यास समोस्माद् भवति राहुः ।
भूछायानेंदुमतो ग्रहणे छादयति नार्कबिंदुर्वा ॥ ४७ ॥
तत्स्थस्तध्व्याससमो राहु छादयति शशिसूर्यौ ।
प्राच्यपरं सममंडलमन्यद्याम्योत्तरं क्षितिजमन्यत् ॥ ४८ ॥

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४६. (घ) १. मिंदुं समः (ग) (च) (for मिंदुसमः)
(वि०—यहां क्रमसंख्या ४६ अंकित है)
२. द्दष्टं तत् (ग) for (द्रष्टं तत्)
(ग) ३. छादयतींदुं for (छादयतींदु) ४. सूर्यं for (सूर्य)
५. 'सूर्यं' लुप्त पद है ।
(वि०—श्लोक का उत्तरार्ध ४७ वें श्लोक का पूर्वार्ध है) (च)
(च) २. द्दष्टं for (द्रष्टं) ६. क्रमसंख्या लुप्त
(ङ) ३. राहुश्छादयतीन्दुं for (राहुछादयतीन्दु) २. द्दष्टत्वात् for (द्दष्टंतत्)
४७. (घ) १. समोऽस्माद् (च) for (समोस्माद्)
(वि०—यहां क्रमसंख्या ४७ दी है)
२. भूछाययेंदु for (भूछायानेंदुमतो)
(ग) ३. राहुः ॥४७॥ for (राहुः)
४. मिंदुर्वा for (बिंदुर्वा)
(वि०—इस श्लोक का उत्तरार्ध, ४८ वें श्लोक का पूर्वार्ध है) (च)
(च) २. भूछायातेंदुमतो for (भूछायानेंदुमतो) ४. नार्क्कमिंदुवति for (नार्कबिंदुर्वा)
५. क्रम संख्या लुप्त
(ङ) ६. भूछायेन्द्वोर्व्यास for (भूछायेंदुव्यास)
२. भूछायेन्दुमतो for (भूछायानेंदुमतो)
४८. (घ) १. तद्व्यास (ग) (ङ) for (तध्व्यास) २. राहुं for (राहु)
३. (वि०—यहां क्रमसंख्या ४८ अंकित है) (च)
(ग) ३. सूर्यैः ॥४८॥ for (सूर्यौ)
(वि०—इस श्लोक का उत्तरार्ध ४९ वें श्लोक का पूर्वार्ध है) (च)
(च) १. स्छस्तद्व्यास for (तत्स्थस्तध्व्यास) ४. क्रमसंख्या लुप्त
(ङ) (वि०—प्रथम पंक्ति समाप्ति पर 'ग्रहण वासना' समाप्त)
+अथगोलबन्धाधिकारः+आरम्भ ।
२. राहुश्छादयति for (राहुछादयति)

परिकरवत्तन्मध्ये भूगोलस्थित[1]द्रष्टुः ।
पूर्वापरयोर्लग्नं याम्योत्तरयोर्न्न[2]तोन्नतं क्षितिजात् ।। ४९ [3]।।
स्वाक्षांशै[5]रुन्मंडल[1]महर्निशो वृ[6]द्धिहानिकरम् ।[2]
विषुवन्मंडलमूर्द्धं सममंडल[3]स्थितं स्वकक्षांशैः[4] ।। ५०[7] ।।
याम्येनोत्तरतोधः[2] क्षितिजे[3] प्राच्यपरयो लग्नम्[1] ।
विषुवन्मंडललग्नं मेषतुलावावुदकुलीरादौ[4] ।। ५१[5] ।।

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४९. (घ) १. भूगोलस्तस्थित द्रष्टुः (ङ) for (भूगोलस्थितद्रष्टुः)
(वि०—यहां कोई क्रमसंख्या नहीं दी गई) (च)
(ग) १. स्थस्थितद्रष्टुः ।।४९।। for (स्थितद्रष्टुः)
२. याम्योत्तरयोर्नतं क्षितिजात् for (याम्योत्तरयोर्न्नतोन्नतं क्षितिजात)
(वि०—इस श्लोक का उत्तरार्ध ५० वें श्लोक का पूर्वार्ध है) (च)
(च) १. स्तस्थित for (स्थित) ३. क्रमसंख्या लुप्त ।

५०. (घ) १. रुन्मंडल (ग) for (रुन्मंडल)
२. (वि०—यहां क्रमसंख्या ५० दी हुई है) (ग) (च)
३. मंडलः (ग) मंडलवत्स्थितं for (मंडलस्थितं)
४. स्वकक्षोंशैः for (स्वकक्षांशैः)
(ग) ५. स्वक्षांशैः for (स्वाक्षांशै)
(वि०—इस श्लोक का उत्तरार्ध, ५१ वें श्लोक का पूर्वार्ध है) (घ)
(च) ३. सममंडलः for (सममंडल) ७. क्रमसंख्या लुप्त
(ङ) ६. महर्निशोर्हानिवृद्धिकरम् for (महर्निशोर्वृद्धिहानिकरम्)
३. सममंडलतः for (सममंडल)
४. स्वकाक्षांशै for (स्वकक्षांशैः)

५१. (घ) १. (वि०—यहां क्रमसंख्या ५१ दी है) (ग) (च)
(ग) २. याम्यो for (याम्ये) ३. क्षितिज for (क्षितिजे)
४. रकुलीरादौ for (कुलीरादौ)
(वि०—इस श्लोक का उत्तरार्ध ५२ वें श्लोक का पूर्वार्ध है) (घ)
(च) ४. वुदक्कुलीरादौ for (वुदकुलीरादौ) ५. क्रमसंख्या लुप्त ।
(ङ) २. याम्येनोत्तरतोऽधः for (याम्येनोत्तरतोधः)
४. वुदक् कुलीरादौ for (वुदकुलीरादौ)

जिन[५]भागैर्यम्येन[१] मृगादावपमंडलमिहार्कः[२] ।
पात[३]श्चंद्रादिनां भ्रमंति[६] भार्द्धे[४] खेश्च भूछाया ।। ५२[७] ।।
पातदयमंडल[१] वद्वि मंडलानि[३] स्वविक्षेपैः[२] ।
सौम्यं विमंडलार्द्धं प्रथमं याम्यं द्वितीयमेतेषु[४] ।। ५३[५] ।।
चन्द्रकुज जीवमंदा भ्रमंति शीघ्रेण बुधशुक्रौ[१] ।
दृग्मंडलार्द्धं मूर्द्धं[३] यत्तत्परिधि स्थितं ग्रहं द्रष्टाः[२] ।। ५४[४] ।।
पश्यति यतः क्षितिस्थस्तद्भ्रमंति[२] ततो ग्रहाभिमुखं[१] ।
क्षितिजापमंडलयुतिर्लग्नं लग्नाग्रतो[३] दिशंवलनं[५] ।। ५५[४] ।।

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५२. (घ) १. यंमोन for (यम्येन)
२. (वि० – यहां क्रमसंख्या ५२ दी हुई है) (ग) (च)
३. पाताश्चंद्रादीनां (ग) (ङ) for (पातश्चन्द्रादिनां)
४. भाद्धे for (भार्द्धे) (ग) ५. निज for (जिन)
६. भ्रमंते for (भ्रमंति)
(वि०—इस श्लोक का उत्त रार्ध ५३ वें श्लोक का पूर्वार्ध है) (च)
(च) ३. पाताश्चंद्रादीनां for (पातश्चंद्रादिनां) ७. क्रमसंख्या लुप्त
५३. (घ) १. पातादषमंडल (ग) पातादपमंडलवत् for (पातदयमंडलवद्)
२. (वि०—यहां क्रमसंख्या ५३ दी है) (ग) (च)
(ग) ३. विमंडलानि for (द्विमंडलानि)
(वि०—इस श्लोक का उत्तरार्ध ५४ वें श्लोक का पूर्वार्ध है) (च)
४. द्वितीयामातष्ट for (द्वितीयमेतेपु)
(च) १. पातदपमंडल for (पातदयमंडल) ५. क्रमसंख्या लुप्त
(ङ) १. पातादपमंडलवद् for (पातदयमंडलवद्)
५४. (घ) १. (वि०—यहां क्रमसंख्या ५४ दी है) (ग) (च)
२. द्रष्टा (ग) दृष्टा for (द्रष्टाः) (ग) ३. भूर्द्ध for (मूर्द्धं)
(वि०—इस श्लोक का उत्तदार्ध ५५ वें श्लोक का पूर्वार्ध है) (च)
(च) २. द्रष्टा for (दृष्टाः) ४. क्रमसंख्या लुप्त
(ङ) ३. मूर्ध्वं for (मूर्द्धं) २. द्रष्टा for (द्रष्टाः)
५५. (घ) १. (वि०—यहां क्रमसंख्या '५५' दी गई है) (ग) (च)
(ग) २. तद्वमति for (तद्भ्रमति) ३. यादिशं for (तोदिशं)
(वि०—इस श्लोक का उत्तरार्ध ५६ वें श्लोक का पूर्वार्ध है) (च)
(च) ४. क्रमसंख्या लुप्त (ङ) ३. लग्नाग्रया for (लग्नाग्रतो)
५. दिशा लग्नम् for (दिशंवलनं)

हृक्षेपं[2] मंडलं दक्षिणोत्तरं[3] वित्रिभ[1] विलग्नम्[4] ॥ ५६ ॥
विषुवदुदग्बध्नीया[3] क्रन्त्यांशसमांतरेष्वजादीनाम्[1] ।
वृत्ततृतीयं[4] व्यस्तं कर्कादीनां[2] तुलादीनाम् ॥ ५७ ॥
विषुवद्दक्षिणतो न्यन्मकरादीनां[3] तदेव विपरीतम् ।
स्वाहोरात्रान्येषां[1] व्यासा[4] पृगवेव[2] भिन्नमपि ॥ ५८ ॥
लंका समपश्चिमगं प्राणेन कला[1]भूमंडलं[3] भ्रमति ।
अपमंडलस्यराशिर्द्वादशभागाः[4] क्षितिजलग्नाः[2] ॥ ५९ ॥

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५६. (घ) १. तृभ विलग्ने (ग) for (वित्रिभविलग्नम्)
(ग) २. दृक्षेपमंडलं for (हृक्षेपं मंडलं)
३. दक्षणोत्तरं for (दक्षिणोत्तरं)
(च) २. दृक्षेपमंडलं for (हृक्षेपं मंडलं)
४. विलग्ने for (विलग्नं)
(ङ) २. दृक्क्षेपमंडलं for (हृक्षेपं मंडलं)
१. वित्रिभविलग्ने for (वित्रिभ विलग्नम्)

५७. (घ) १. क्रांत्यंश (ग) (च) (ङ) for (क्रन्त्यांश)
२. कर्क्यादीनां (ङ) for (कर्कादीनां)
(ग) ३. विषविदुदग्बध्नीयात् for (विषुवदुदग्बध्नीया)
४. वृत्तत्रितयं (ङ) for (वृत्ततृतीयं)
(च) २. कक्कादीनां for (कर्कादीनां)
(ङ) ३. विषुबदुदग्बध्नीयात् for (विषुवदुदग्बध्नीया)

५८. (घ) १. रात्राण्येषां (ग) (च) (ङ) for (रात्रान्येषां)
२. पृथगेव (ग) (ङ) for (पृगवेव)
४. व्यासाः (ङ) for (व्यासा)
(च) २. पृथगेव for (पृगवेव)
(ङ) ३. दक्षिणतोऽन्यन् for (दक्षिणतोन्यन्)

५९. (घ) १. कलां (ग) (ङ) for (कला)
२. जलग्नः for (जलग्नाः)
(ग) ३. भमंडनं for (भूमंडलं) ४. भाग for (भागाः)
(ङ) ३. भमण्डलं for (भूमण्डलं) ४. भागः for (भागाः)

यात्यूदयं[१] मेषाद्या यत[२]स्ततस्तदुदया[५]न[३]कालसमाः ।
क्रांतिवशाल्लंकायां[४] तदूनताधिक्यमक्ष[६]वशात् ॥ ६० ॥
क्षितिजोन्मंडलयोर्यत्[३]स्वाहोरात्रांतरं[१] चरदलं तत् ।
क्षितिजेऽग्रा[४]प्राच्यपर[२] स्वाहोरात्रांतरांशज्या ॥ ६१ ॥
स्वाहोरात्रे क्षितिजाद्[१] दिनगतशेषोन्न[२]तारवेः[३] शंकुः ।
तस्माद्[५] दिनगतशेषं शंकु कुमध्यांतरं दृग्ज्या[४] ॥ ६२ ॥
दृग्मंडले[१] नतांशज्या दृग्ज्या शंकुरुन्नतांशज्या ।
अर्कोदयास्त[५]सूत्रा[३]दिनशंकोःर्दक्षिणे[२] नूतलम्[४] ॥ ६३ ॥
क्षितिजे भू[२]दललिप्ताः कक्षायां दृग्गति[३]नभो मध्यात् ।
अवनति लिप्ता याम्योत्तरारर्क[१] ग्रहवदन्यतः[४] ॥ ६४ ॥

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६०. (घ) यांत्युदयं (ग) यात्युदयं (च) for (यात्यूदयं) २. अत for (यत)
३. 'न' यहाँ लुप्त है ४. ल्लंकायां (ग) (ङ) for (लंकायां)
(ग) ५. 'ततस्' पद लुप्त है ६. मज्ञ for (मक्ष)
(च) ४. ल्लंकायां for (लंकायां)
(ङ) १. यान्त्युदयं for (यात्यूदयं) ५. तदुदया for (ततस्तदुदया)
६१. (घ) १. रात्रेतरं for (रात्रांतरं) २. रपस्वाहो for (परस्वाहो)
(ग) ३. यत for (यंत्) (च) १. रात्रेतरं for (रात्रांतरं)
(ङ) ४. क्षितिजेऽग्रा for (क्षितिजेग्रा)
६२. (ग) १. जात्दिन for (जाद्दिन) २. श्च for (च्च)
३. ताखे for (तारवे) ४ 'दृग्ज्या' पद लुप्त । यहाँ...कुछ अंश छूटा हुआ है
(च) ५. तस्मा दिनगत for (तस्माद्दिनगत)
(ङ) १. जितिजाद्दिन for (क्षितिजाद्दिन)
६३. (घ) १. दृन्मंडले (ग) दृग्मंडल for (दृग्मंडले)
२. शकोर्दक्षिणेन (ङ) (च) for (शंकोःर्दक्षिणेन्)
(ग) ३. सूत्रान् for (सूत्रादिन) ४. दक्षिणानतलम् for (र्दक्षिणेनूतलम्)
(च) ५. अर्क्कादयास्त for (अर्कोदयास्त)
(ङ) ३. सूत्राद्दिन for (सूत्रादिन)
६४. (घ) १. स्युरर्क (ग) रविग्रहवदन्यत् ॥ ६५ ॥ for (रर्कग्रहवदन्यतः)
(ग) (वि०—इसकी क्रमसंख्या ६५ है) २. 'भू' लुप्त है) ३. दृक्नति for (दृग्गति)
(च) ३. दृग्गतिन्नभोमध्यात् for (दृग्गतिनभोमध्यात्)
(ङ) ३. दृङ्नतिर् for (दृग्गति) १. रवि for (रर्क) ४. वदन्यत्र for (वदन्यतः)

दृश्याद्दृश्यं[1] दृग्गोलार्द्धं[2] भूव्यासदलविहीन[3]युतम्[4] ।
दृष्टा[5]भूगोलोपरि यतस्ततो लंबनावनति[6] ।। ६५ ।।
सत्रिग्रह[1] क्रांतिरूदग्[5]दक्षिणयोस्त्रिज्यया हतं[2] वलनम् ।
विक्षेपगुणमृणधनं[6] ग्रहे[3]न्यद्दृक्कर्म्म[4] चरदलवत् ।। ६६ ।।
कक्षा[1]मंडलतुल्यं प्राच्यपरं[2] दक्षिणोत्तरं क्षितिजम्[3] ।
उन्मंडलविषुवन्मंडले स्थिराणि ग्रहर्क्षाणाम् ।। ६७ ।।
मंदोच्याना[1] सप्तोच्चनीच वृत्तानि पंचशीघ्राणाम् ।
प्रतिमंडलानि चैवं प्रत्येकां[2] भास्करादीनाम् ।। ६८ ।।
दग्मंडल[5]दग्क्षेपाप[1]मन्डलानि क्षपा[6]करादीनाम् ।
षट्कं विमण्डलान्यं[2] चलवृत्या[3]नेक पंचाशत्[4] ।। ६९ ।।

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६५. (घ) १. दृश्यो for (दृश्याद्दृश्यं)
(ग) (वि०—इसकी क्रमसंख्या ६४ है)
२. गोलार्द्ध for (दृग्गोलार्द्ध) ३. विहीनम् for (विहीन)
४. दृष्टो for (दृष्टा) (वि०—दूसरी पंक्ति 'भूगोल' से आरम्भ है)
५. 'दृष्टा' लुप्त है ६. नती ।।६४।। for (नति ।।६५।।)
(च) २. दृग्गेलार्द्ध for (दृग्गोलार्द्धं)
(ङ) (वि०—यह श्लोक उपलब्ध नहीं)
६६. (घ) १. गृह (च) (ङ) for (ग्रह) २. हृतं (च) (ङ) for (हतं)
३. गृहे (च) for (ग्रहे) ४. न्यद्दक्कर्म (ग) (ङ) for (न्यद्दकर्म)
(ग) ५. रुदक् for (रूदग्) ६. गुणधनं for (गुणमृणधनं)
६७. (ग) १. कक्ष्या for (कक्षा) २. प्राक्यरं for (प्राच्यपरं)
३. क्षिजम् for (क्षितिजं)
६८. (घ) १. मंदोच्चानां (ग) (च) (ङ) for (मंदोच्याना)
(ग) २. प्रत्येकं (च) for (प्रत्येकां)
६९. (घ) १. दृक्षेपाप (ग) विक्षेपाप) (ङ) for (दग्क्षेपाप)
२. विमंडलानां (ग) (ङ) for (विमंडलान्यं)
३. वृत्तान्येक (ग) वलवृत्तान्येक for (चलवृत्यानेक)
४. पंचाशतः for (पंचाशत्)
(ग) ५. दृग्मंडल (ङ) for (दग्मंडल)
६. क्षिपा for (क्षपा)
(च) १. विक्षेपाप for (दग्क्षेपाप) २. विमंडलानां for (विमंडलान्यं)

यत्स्पष्टीकरणाद्यं गोलादुत्क्षेपतत्कृतं सर्वं गोलाध्यायः ।
सप्तत्यार्याणामेक विंशोयम् ।। ७० ।।
मध्याद्यमिह यदुक्तं तत्प्रत्यक्षमिव दर्शयति यस्मात् ।
तस्मादाचार्यत्वं गोलविदो भवति नान्यस्य ।। ७१ ।।
आचार्येण ज्ञातः श्रीषेणार्यभटविष्णुचंद्राद्यैः ।
गोले यस्मात्तस्माद् ब्राह्मे गोलः कृतः स्पष्टः ।। ७२ ।।
गणितज्ञो गोलज्ञो गोलज्ञो ग्रहगतिं विजानाति ।
यो गणितगोलबाह्यो जानाति ग्रहगतिं सः कथम् ।। ७३ ।।

इति ब्रह्मगुप्ते गोलाध्यायः (२१ अध्यायः समाप्तः)

एक विंशतितमः समाप्तः

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७०. (घ) १. दुत्प्रेक्ष (ग) दुत्प्रेक्ष्य (ङ) for (दुत्क्षेप)
२. (वि०— यह दूसरी पंक्ति का आरम्भिक शब्द है) (ग) (ङ)
(ग) ३. सर्वा for (सर्वं) ४. समाप्ति सूचक ।।छः।। ।।छः।। ।।छः।।
(च) १. दुत्प्रेक्षतत्कृतं for (दुत्क्षेपतत्कृतं)
(ङ) +इति श्री ब्राह्मस्फुट सिद्धान्ते गोलाध्यायो नामैकविंशतितमो ऽध्यायः+ (वि०—वस्तुतः गोलाऽध्याय यहां ७० वें श्लोक पर समाप्त हो गया है। परन्तु उपर्युक्त प्रति में यन्त्राध्याय के पहले तीन श्लोक मिलाकर ७३ पर समाप्त किया है)
७१. (घ) १. गोलो भवति for (गोलविदो भवति) (वि०—इसकी क्रमसंख्या १ है)
(ङ) वि०—यह 'यन्त्राध्याय' का प्रथम श्लोक है)
७२. (घ) १. आचार्यैर्न (ङ) for (आचार्येण) (ग) २. ज्ञाता for (ज्ञातः)
३. 'विष्णु' पद लुप्त है। ४. गोलो (ङ) (च) for (गोले)
५. ब्राह्मो (ङ) for (ब्राह्मे) (वि०—इसकी क्रमसंख्या २ है)
१. आचार्यैर्न for (आचार्येण) (ङ) (वि०—यह यन्त्राध्याय का द्वितीय श्लोक है)
७३. (घ) १. इति भट्ट जिष्णुसुतब्रह्मगुप्त विरचिते ब्रह्मस्फुट सिद्धांतो गोलाध्यायः एक विंशतितमः। for (इति ब्रह्मगुप्ते गोलाध्यायः)
(ग) २. ग्रहति for (ग्रहगतिं) ३. स (ङ) (च) for (सः)
१. ये पद लुप्त है (वि० – इसकी क्रमसंख्या ३ है)
(च) १. इति भट्ट जिष्णुसुत ब्रह्मगुप्त विरचिते ब्राह्मे स्फुटसिद्धांतो गोलाध्यायः एक विंशतितमः for (इति ब्रह्मगुप्ते गोलाध्यायः २१ अध्यायः समाप्तः)
(ङ) (वि०— यह यन्त्राध्यायः का तीसरा श्लोक है)

अथ यन्त्राध्यायो नाम

द्वाविंश:

कालस्य[2] परिच्छेदः[4] कर्तुं यंत्रं विना[1] यतो शक्यः[3] ।
संक्षिप्तं स्पष्टार्थं यंत्राध्यायं ततो वक्ष्ये ॥ १ ॥
सप्तदशकालयंत्राण्यतो धनुस्तुर्यगोलकश्चक्रम्[4] ।
यष्टिः[5]शंकुर्घटिका[1] कपालकं कर्त्तरि[2]कीटम्[3] ॥ २ ॥
सलिल[1]भ्रमो[2]वलंबः कर्णछाया[3] दिनार्द्धमर्कोक्षः[6] ।
नव[4]काल ज्ञानार्थं[5] तेषां संसाधानान्यष्टौ ॥ ३ ॥

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१. (घ) १. विना (ग) (च) (ङ) for (विना)
(ग) २. गोलस्य (ङ) for (कालस्य)
३. यतोऽशक्यः (ङ) for (यतोशक्यः)
(वि०—इसकी श्लोक संख्या ४ है)
(ङ) (वि०—श्लोक संख्या ४ है इसके पूर्ववर्ती तीन श्लोकों को गोलाध्याय के अंत में रख दिया गया है)
४. परिच्छेदः for (परिच्छेद)

२. (घ) १. वंटिका for (घंटिका) २. कर्त्तरी . (ग) (च) (ङ) for (कर्त्तरि)
३. फीटं (ग) पीठम् for (कीटम्)
(ग) ४. गोलकं चक्रम् for (गोलतश्चक्रम्)
५. यष्टिः (च) (ङ) for (यष्टि)
(वि०—इसकी श्लोक संख्या ५ है)
(च) ३. फीटा for (कीटम्)
(ङ) ३. पीठम् for (कीटम्)

३. (ग) १. सलिलं (ङ) for (सलिल) २. वमो for (भ्रमो)
३. कर्णश्छाया (ङ) for (कर्णछाया) ४. नय for (नव)
५. यहां अनुस्वारलुप्त है ।
(वि०—इसकी श्लोक संख्या ६ है)
(च) २. ऽवलंबः for (वलंबः) ६. मर्क्कोक्षः for (मर्कोक्षः)
(ङ) २. भ्रमोऽवलम्बः for (भ्रमोवलंबः)
६. मर्कोऽक्षः for (मर्कोक्षः) ४. नल for (नव)

सलिले न समं साध्यं [१]आमणवृत्तमवलंब [४]केनोर्द्धम् ।
[५]तिर्यक [२]कर्णोनान्यैः कथितैश्च नव [३]प्रसाध्यति ।। ४ ।।
धार्यं धनुस्तथा[१]ग्रछायासाम्यं यथोन्नता [२]भागाः ।
दिनगतशेषा घटिका[४]श्चलंबमुक्ता [३]धनुर्मध्यात् ।। ५ ।।
[४]धार्यं समं तथा वा ज्या छाया [१]पृथगा यथा भवति [२]अग्रादम् ।
[६]शक घटिका ज्यामध्य[३]छायया [५]मुक्ता ।। ६ ।।
[४]घटिका स्वशंकुभागैः [७]पृष्टगतैं [५]लंब [६]भूसमं समज्याद्धात् ।
[१]सशिति [२]शतांशकं [३]चक्रास्यार्द्धं धनुर्यंत्रम् ।। ७ ।।

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४. (घ) १. भ्रमेण (ग) (ङ) for (आमण)
२. तिर्यङ्कर्णोनान्यैः (ग) (ङ) तिर्यक्कर्णोनान्यैः for (तिर्यककर्णोनान्यैः)
३. प्रसाध्यानि (ग) प्रवक्षामि for (प्रसाध्यति)
(ग) ४. केनोर्ध्वम् (ङ) for (केनोर्द्धम्) ५. तिर्यक् (ङ) for (तिर्यक)
(वि०—इसकी श्लोक संख्या ७ है)
(च) ५. तिर्यकर्णोनान्यैः for (तिर्यककर्णोनान्यैः)
३. प्रसाध्यानि for (प्रसाध्यति) (ङ) ३. प्रवक्ष्यामि for (प्रसाध्यति)

५. (ग) १. तथान्य for (तथाग्र) (वि०—इसकी श्लोक संख्या ८ है)
२. भागम् for (भागाः) ३. धनुर्मुक्तान् for (धनुर्मध्यात्)
(ङ) १. तथाऽन्यत् for (तथाग्र) ४. स्वलम्बभुक्ता for (श्चलंबमुक्ता)

६. (घ) १. पृष्टगा (ग) for (पृथगा) २. (वि०—दूसरी पंक्ति का आरम्भिक पद) (ग)
३. छायाया (ग) छाया यथा for (छायया) (ग) ४. धार्यं (ङ) for (धार्यें)
२. अग्रादश for (अग्रादम्) ५. भुक्ताः ।।९।। (ङ) for (मुक्ता)
(वि०—इसकी श्लोक संख्या ९ है) (च) ३. छायाया for (छायया)
(ङ) १. मध्यगा for (पृथगा) २. अग्रादिष्टा for (अग्रादम्) ६. 'शक' लुप्त

७. (घ) १. सशीति (ग) साशीति (ङ) for (सशिति)
२. शतांशाकं (ग) शाकं (ङ) for (शतांशकं)
३. चक्रस्यार्द्धं (ग) for (चक्रास्यार्द्धं) (ग) ४. घटिकाः (च) for (घटिका)
५. लंब (ङ) for (लंब) ६. 'समं' पद लुप्त है ।
(वि० इसकी श्लोकसंख्या १० है)
(च) १. सशीति for (सशिति) २. शतांशाकं for (शतांशकं)
३. चक्रस्याद्धं for (चक्रास्याद्धं) (ङ) ७. पृथग्गतैं for (पृष्ठगतैं)
६. भू for (भूसमं)

मध्यादिनो[3]न्नतांशे दिनार्द्ध नाड्यो[4] वदंति तुल्या ये[5]।
ते सूर्यास्त[6] छादष्ट[1] छाया समान यतः[2] ।। ८ ।।
जीवा स्वाहोरात्रं[6] परिकल्पाग्रा[4] नतोन्नतत्रिज्या[1] ।
अनुपातात्[5] तत्कार्या सूर्यगोलके[2] चक्रे[3] चैवम् ।। ९ ।।
दिन घटिकांकितपृष्टे[3] व्यस्त[4] न तज्याग्रो[5]न्नतज्या[1] ।
चदिग्मध्ये[2] च शलाकात[6]छायाग्रं[7] न तानाड्यः ।। १० ।।

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८. (घ) १. दृष्ट (ग) छायादृष्ट for (छादष्ट) २. समानयत for (समानयतः)
(ग) ३. मध्यदिनोन्नतांशे for (मध्यादिनोन्नतांशे)
४. नाडी for (नाड्यो) ५. तुल्यायै for (तुल्याये)
६. मूर्षास्त for (सूर्यास्त) (वि०—इसकी श्लोक संख्या ११ है)
(च) १. छादृष्ट for (छादष्ट) २. युतः for (यतः)
(ङ) ३. मध्यदिवसोन्नतांशे for (मध्यादिनोन्नतांशे)
४. नाडीर्वदन्ति for (नाड्योवदन्ति) ६. ते मूर्खास् for (ते सूर्यास्)
१. तच्छाया इष्ट for (तछादष्ट)

९. (घ) १. अतो (ग) नतेन्नत for (नतोन्नत) २. स्तुर्या (ग) स्तुर्यं for (सूर्यं)
३. चक्रके (ङ) for (चक्रे)
(ग) ४. प्रकल्प्यग्रो for (परिकल्पाग्रा)
५. अनुपातातात्कार्या for (अनुपातात्तत्कार्या)
(वि०—इसकी श्लोक संख्या १२ है)
(च) १. न्नतोन्नतत्रिद्या for (नतोन्नतत्रिज्या) २. स्तुर्यगोलके for (सूर्यगोलके)
(ङ) ६. जीवां स्वाहोरात्रे for (जीवास्वाहोरात्रं)
४. (परिकल्याग्रा) for (परिकल्पाग्रा)
१. अतोन्नतविज्याः for (नतोन्नतत्रिज्या)
२. कार्यास्तुर्यगोलके for (कार्यासूर्यगोलके)

१०. (घ) १. (च) (वि०—पहली पंक्ति का अंतिम पद) (ङ)
२. 'दिग्मध्ये' से आरम्भ (ग) दिनमध्ये for (दिग्मध्ये)
(ग) ३. पृष्टि for (पृष्टे) ४. व्यस्तनज्याग्र for (व्यस्तनतज्याग्रो)
५. उन्नतज्या च for (ग्रोन्नतज्या) ६. शिलाका for (शलाका)
७. यान्नता नाड्यः for (ग्रं नतानाड्यः)
(वि०—इसकी श्लोक संख्या १३ है)
(ङ) ३. पष्टे for (पृष्टे)
५. ग्रमुन्नतज्या for (ग्रोन्नतज्या) ७. तच्छायाग्राम्नता for (तछायाग्रंनता)

पृष्टो नेष्टो वेध्यो ज्यामध्यसंस्थाया ।
द्रष्टृचा द्रष्टांतरं न तज्या धनुषि छायोन्नत ज्याया ॥ ११ ॥
ज्यार्द्धे द्रष्टि द्रग्ज्यान्नत जीवा शंकुमुन्नतज्या च ।
धनुषि प्रकल्पयोज्यां यष्टृयुक्तं नाडीकाद्यंता ॥ १२ ॥
अवलंबनं शलाकां ज्यार्द्धं यष्टि प्रकल्पवा धनुषि ।
भुम्यूछ्रायं बहुशो यष्टयुक्तै रानयेत्कर्णैः ॥ १३ ॥

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११. (घ) १. धनुषपृष्टेनेष्टौ वेध्यो (ग) धनुष प्रिष्ट नेष्टौवेध्यो for (पृष्टोनेष्टौ वेध्यो)
२. संस्थया (ग) (च) (ङ) for (संस्थाया)
३. द्दष्टृचा (ग) द्दष्टृचा (ङ) for (द्रष्टृचा) (वि—पहली पंक्ति का अंतिम पद)
४. इष्टांतरं (ग) (ङ) for (द्रष्टांतरं) ५. ज्यायाः (ङ) for (ज्याया)
(ग) (वि०—इसकी क्रमसंख्या १४ है)
(च) १. धनुषपृष्टे for (पृष्टो) ३. द्दष्टृचा for (द्रष्टृचा)
६. तद्या for (तज्या) ५. ज्यायाः for (ज्याया)
(ङ) १. धनुषः पृष्ठे द्रष्ट्रा for (पृष्टो नेष्टो) ७. वेध्या for (वेध्यो)
३. ४. इष्टांतरं for (द्रष्टृचा द्रष्टांतरं) ३. द्दष्टृचा for (द्रष्टृचा)

१२. (घ) १. द्दष्टिं (ग) यष्टि for (द्रष्टि) २. द्दग्ज्या (ग) द्दग्ज्यां (ङ) for (द्रग्ज्या)
३. नाडिकाद्यन्ता (ग) नाडिकाद्यं च for (नाडिकद्यंता)
(ग) ४. ज्यार्द्धं (ङ) for (ज्यार्द्धे) ५. नतजीवां for (न्नतजीवा)
६. ज्यां च for (ज्याच) ७. प्रकल्प्य for (प्रकल्प)
८. योज्यं for (योज्यां) (वि०—इसकी श्लोकसंख्या १५ है)
(च) १. द्दष्टि for (द्रष्टि) २. द्दग्ज्या for (द्रग्ज्या)
५. न्नतजीवां for (न्नतजीवा) ६. ज्याव for (ज्याच)
(ङ) १. द्दष्टे र् for (द्रष्टि) ६. यद्युक्तं for (यष्टृयुक्तं)

१३. (घ) १. ज्यार्द्धे for (ज्यार्द्धं)
२. भूम्युछ्रायं (ग) भूम्युछ्राया for (भूम्युच्छ्रायं)
(ग) २. अवलंबन for (अवलंबनं) ४. प्रकल्प्य (ङ) for (प्रकल्प)
५. द्वाहुःशो for (बहुशो) ६. येष्टयुक्तै for (यष्टयुक्तै)
(वि० —इसकी श्लोक संख्या १६ है)
(च) २. भूम्युछ्रायं for (भूम्यूछ्रायं) ७. करर्णैः (ङ) for (कर्णैः)
(ङ) २. भूम्युच्छ्राया for (भूम्यूच्छ्रायं) ५. ल्लम्बो for (बहुशो)

यष्टि व्यासार्द्धं[4] तु विवृत्तं भगणांशांकितं[1] कृत्वा[7] ।
यष्टि[2]कीलप्रोते मूले[5] पृथग्भग्रयो[6] विद्धे[3] ॥ २१ ॥
ताभ्यां[1] सूर्यशशांकौ वेध्यावर्ग[4]स्थितेन सूत्रेण ।
सूत्रज्यायांतरांशा[2] येतेऽर्क[5] विभाजिता स्थितयः[3] ॥ २२ ॥
सूत्रार्द्धगुणा त्रिज्या यष्टिहृता[1] फलधनुर्द्विगुणितं[2] वा ।
रविचंद्रांतर[4]मिष्टव्यासार्द्धोल्लित[3]वृत्तस्य ॥ २३ ॥
मध्यधृतायायष्टे लंबकशंकुप्रवेशनिर्गमने ।
क्रांतिवशात्प्राच्यपरे मत्साद्याम्योतरे[1] साध्ये ॥ २४ ॥

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२१. (घ) १. भगणांशकांकितं (ग) (च) for (भगणांशांकितं)
२. यष्टी (ग) (ङ) (च) for (यष्टि)
३. विद्धे (ग) विधिः (विधेः) for (विद्धे)
(ग) ४. व्यासार्द्धाद्भुवि (ङ) for (व्यासार्द्धंतुवि)
५. मूल for (मूले) ६. प्रथग्रयो (च) for (पृथग्भग्रयो)
(वि०—इसकी श्लोकसंख्या २४ है)
(च) ४. भुविवृत्तं for (तुविवृत्तं)
७. क्रत्वा for (कृत्वा) ३. विर्द्धे for (विद्धे)
(ङ) १. भगणांशकं for (भगणांशांकितं) ६. पृथगग्रयो for (पृथग्भग्रयो)
३. बंद्धे for (विद्धे)

२२. (घ) १. वाभ्यां for (ताभ्यां)
२. ज्ययांतरांशा (ग) (च) (ङ) for (सूत्रज्यायांतरांशा)
३. स्तिथयः (ग) (च) (ङ) for (स्थितयः)
(ग) ४. वग्र (च) (ङ) for (वर्ग) ५. येनेऽर्क for (येतेऽर्क)
(वि०—इसकी श्लोसंख्या २५ है)
(च) ५. येतेऽर्कं for (येतेऽर्क)

२३. (घ) १. हृता (ग) (ङ) (च) for (हृता)
२. द्विगुणितं (ग) (ङ) (च) for (द्विगुणितं)
३. व्यासार्द्धोल्लिखित (ग) (ङ) (च) for (व्यासार्द्धोल्लित)
(ग) ४. रविचंद्रांतर (च) for (रविचंद्रातर) (वि०—इसकी श्लोकसंख्या २६ है)

२४. (घ) १. मत्स्याद्यामोत्तरे (ङ) (ग) मतस्याद्याग्योत्तरे for (मत्साद्याम्योत्तरे)
(ग) २. (वि०—इसकी श्लोकसंख्या २७ है)
(च) १. मत्स्याद्यामोत्तरे for (मत्साद्यामोत्तरे)

शंकुतलानांतरयुतिरन्यैकदिशोभुजो[1][2] भुजस्य कृतिम् ।
दृग्ज्या कर्णकृतेः[3] प्रोह्यपद[4]पूर्वापरा कोटिः[5] ॥ २५ ॥
उदयास्तसूत्रशंक्वंतरं हृतं[1] शंकुनार्कसंगुणितम्[2] ।
विषुवच्छायैयं[3] वा दिनोदयास्तमयसूत्रेण[4] ॥ २६ ॥
प्राच्यपरा शंकुतलांतरयुति[4][1] समान्यदिशो[2] ।
द्वादश[5]गुणिता[6] विषुवच्छाया शंक्वंतरविभक्ता[3] ॥ २७ ॥

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२५. (घ) १. शकुंतलाग्रांतर (ङ) (ग) शंकुतलग्नांतर for (शंकुतलानांतर)
२. दिशा (ग) दिशोर्भुजो (ङ) for (दिशोभुजो)
३. कृतिः (ग) कृतेः (ङ) for (कृतेः) ४. पदं (ग) प्रोंश्चपदं for (पद)
(ग) ५. कोटि for (कोटिः)
(वि०—इसकी श्लोकसंख्या २८ है)
(च) १. शंकुतलग्नांतर for (शंकुतलनांतर) २. दिशौ for (दिशो)
३. कृतेः for (कृतेः) ४. प्रोज्यपद for (प्रोह्यपद)
(ङ) ४. पदं for (पद)

२६. (घ) १. शंक्वंतरहृतं (ग) हृतं for (हृतं)
२. नार्क १२ संगुणितम् (ग) शंकुनार्क संगुणितम् for (शंकुनाऽर्कसंगुणितम्)
३. छायायैवं (ग) विषुवच्छायेव वा for (विषुवच्छायैयं)
(ग) (वि०—इसकी श्लोक संख्या २९ है)
४. विनोदयास्तमयसूत्रेण (ङ) for (दिनोदयास्तमयसूत्रेण)
(च) १. हृतं for (हृतं)
२. शंकुनार्क्क १२ for (शंकुनार्क)
३. विषुवछायैव for (विषुवछायैयंवा)
(ङ) ३. विषुवच्छायैवं for (विषुवछायैयं)

२७. (घ) १. युतिः (च) (ङ) for युति)
२. दिशोः (च) (ङ) for (दिशो)
३. विभक्ताः for (विभक्ता)
(ग) (वि०—इसकी श्लोक संख्या ३० है)
४. द्वयांतरयुति (ङ) for (युति)
५. द्वादभक्ता for (द्वादश) ६. 'गुणिता' पद लुप्त है ।

शंकुप्राच्यपरांतर शंक्वग्रं क्यमुदयांतरं याम्ये ।
लब्धगुणं यष्टिगुणं क्रांति ज्यातो रविः प्राग्वत् ।। २८ ।।
अपसृतिरन्यशलाका गुणाशलाक्यांतरेण भक्ता भूः ।
भू स्वशलाका गुणिता गुणिताद्रष्टि विभक्ता ।। २९ ।।

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२८. (घ) १. हृतं (ग) for (गुणं)
(ग) २. प्राच्या for (प्राच्य)(वि०—इसकी श्लोक संख्या ३१ है)
३. मुदगंतरं यामे for (मुदयांतरं याम्ये)
(च) १. हृतं (ङ) for (गुणं)
(ङ) ३. मुदगंतरं for (मुदयांतरं)
४. लम्बगुणं for (लब्धगुणं)

२९. (घ) १. शलाक्य तरेण (ग) शलाकांतरेण (ङ) for (शलाक्यांतरेण)
२. 'गुणिता' लुप्त
३. दृष्टि (ग) द्रिष्टि for (द्रष्टि)
(वि०—इसकी क्रमसख्या ३० है)
(ङ) ६. भूः for (भू)
३. ४. यष्टि विभक्ता गृहाद्यौच्यम् for (गुणिता द्रष्टि विभक्ता)
(ग) (वि०—इसकी श्लोकसंख्या ३२ है)
४. 'गृहाद्यौच्यम्' पंक्ति का अंतिम शब्द । ३. दृष्टि for (द्रष्टि)
५. (वि०—इसकी क्रमसंख्या ३० अंकित है)
४. + 'ग्रहाद्यौ च्यं' यह पद पृष्ठ के नीचे अन्य हाथ से लिखा हुआ है ।
दृष्ट्या गुणितापसृति दृष्टि विशेषभाजिता भूमिः ।
भूमिस्व द्रिष्टिभक्ता शलाकाया संगुणोत्छ्रायम् ।। ३३ ।।
(च) यह अतिरिक्त श्लोक यहां पृष्ठ के निम्नोपांत पर अन्यहस्तसे लिखा हुआ है ।
१. दृष्टि for (दृष्टि) २. भूः for (भूमिः)
३. द्रष्टि for (द्रिष्टि)
४. शलाकया (ङ) for (शलाकाया)
५. संगुणोछ्राय (ङ) for (संगुणोत्छ्रायम्)
(वि०—इसकी भी क्रमसंख्या ३० अंकित है)
(ङ) १. दृष्टि विशेषेण for (दृष्टिविशेष) ७. भूमिः for (भूमि)
३. दृष्टि for (द्रिष्टि)

लंबनिपातांतरकं लंबौच्यांतरविभक्तमधिकगुणम् ।
भूर्लंबांतरगुणिता लंबनिपातांतरविभक्ता ।। ३० ।।
लब्धोनाद्रक् लम्बोदग्लम्बा दग्रलंबके हीने ।
अधिकेऽधिको ग्रहोच्यं तलाग्रवेध द्वया षष्ट्या ।। ३१ ।।
दृष्टिर्द्रक् लंबगुणा विभाजिताद्यः शलाकया भूमिः ।
सकलशलाका गुणिता भूमिदृष्ट्या हतोच्छ्रायः ।। ३२ ।।

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३०. (घ) १. भूर्ल्लंबांतर for (भूर्लंबांतर)
२. लंबनिपातांतर for (लंबनिपातांतरकं)
३. विभक्ता: for (विभक्ता)
(वि०—इसकी क्रमसंख्या ३१ है)
(ग) (वि०—इसकी श्लोकसंख्या ३४ है)
(च) १. भूर्ल्लंबातर for (भूर्ल्लंबातर)
४. (वि०—यहां क्रमसंख्या ३१ अंकित है)
३१. (घ) १. लब्धोनाद्दक् (ग) सशेनो द्रिग् for (लब्धोनाद्रक्)
२. लंबोद्दग्लंबा (ग) (च) (ङ) for (लंबोदग्लंबा)
३. ग्रहौच्यं (ग) (च) (ङ) for (ग्रहोच्यं)
४. तलग्रेवेध (ग) तलाग्रवे बध्यया for (तलाग्रवेध)
५. द्वया यष्ट्या (ग) द्रिष्ट्या ।। ३५ ।। for (द्वयाषष्ट्या)
(वि०—इसकी क्रमसंख्या ३२ है)
(ग) (वि०—इसकी श्लोक संख्या ३५ है)
(च) १. नाद्दकं for (नाद्रक्) ५. द्वया यष्ट्या for (द्वया षष्ट्या)
६. (वि०— क्रमसंख्या ३२ अंकित है)
(ङ) १. लब्धोनोद्दग् for (लब्धोनाद्रक्) ४. तलाग्रके for (तलाग्र)
५. विद्धया दृष्ट्या for (वेधद्वयाषष्ट्या)
३२. (घ) (वि०—इसकी क्रमसंख्या ३३ है)
१. यष्टियैलग्नंबगुणा (ग) दृष्टिर्द्दग्लंबगुणा for (दृष्टिर्द्रक्लंबगुणो)
२. विभाजिताधः (ग) (च) (ङ) for (विभाजिताद्यः)
३. गुणिताः (च) for (गुणिता) ४, भूमिर्द्दष्ट्या (ङ) for (भूमिदृष्ट्या)
५. हृतोच्छ्रायः (ग) (च) (ङ) for (हतोच्छ्रायः)
(ग) (वि० — इसकी श्लोकसंख्या ३६ है)
(च) १. द्रष्टिद्रक् for (दृष्टिर्द्रक्) ६. (वि० —यहाँ क्रमसंख्या ३३ अंकित है)
(ङ) १. दृष्टिर्द्दग्लम्ब for (दृष्टिर्द्रक्लम्ब)

मित्वाग्रहैकदेशे विद्वेष्ट शलाकया न्ययासर्वम् ।
प्रथमशलकाभक्तं मीत द्वितीया गुणितमौच्यम् ।। ३३ ।।
षष्टयाहूता शलाका त्रिज्याघात धनु गृहांतरकं ।
यैरूक्तं मूर्खास्ते यतो न द्रष्टयंतरं द्रग्ज्या ।। ३४ ।।
मूलेद्वंगुलविपुलः शुच्यग्रो द्वादशांगुलोछ्रायः ।
शंकुतलाग्रविद्धोग्रवेध लम्बाद्वार्यः ।। ३५ ।।

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३३. (घ) १. गृहैक (ग) (च) (ङ) for (ग्रहैक) (वि०—इसकी क्रमसंख्या ३४ है)
२. शलाका (ग) शिलाका for (शलका)
३. मिति (ग) मितं (ङ) for (मीत) ४. द्वितीयया for (द्वितीया)
५. गुणिताम्यौच्यम् for (गुणितमौच्यम्)
(ग) ६. देशं (च) for (देशे) ७. विधेष्ट for (विद्वेष्ट)
८. गृहम् for (न्यया) (वि०—इसकी श्लोकसंख्या ३७ है)
(च) ३. मित for (मीत) ४. द्वितिया for (द्वितीया)
५. गुणितम्यौच्यं for (गुणितमौच्यं) (ङ) ७. विद्वेष्ट for (विद्वेष्ट)
३४. (घ) १. यष्टयाहुता (ग) त्रिज्याहुत for (षष्टयाहूता)
२. घाता (ग) for (घात) ३. गृंहांतरकम् (च) for (गृहांतरकम्)
४. यैरुक्तं (च) for (यैरूक्तं) ५. दृष्टयंतरं (ग) (च) for (द्रष्टयन्तरं)
६. दृग्ज्या (ग) दृग्ज्याजुर्द्धा यः ।। ३८ ।। for (द्रग्ज्या)
(च) १. यष्टयाहुता for (षष्टयाहूता) ६. दृग्ज्या for (द्रग्ज्या)
७. (वि०—क्रमसंख्या ३५ अंकित है) (घ)
(ङ) १. यष्टयाहुताच्छलाका for (षष्टयाहूताशलाका)
२. घाताद्धनुगृंहान्तरकम् for (घातधनुगृहांतरकम्)
५. दृष्टांतरम् for (द्रष्टयंतरं) ७. दृग्ज्या for (द्रग्ज्या)
३५. (घ) १. द्विंगुल (ग) द्वयंगुल (ङ) for (द्वंगुल) (वि०—इसकी क्रमसंख्या३६ है)
२. शूच्यग्रोः (ग) शूच्यग्रो for (शुच्यग्रो)
३. शंकुस्तलाग्र (ग) for (शंकुतलाग्र) ४. दृजुर्धार्यः for (द्वार्यः)
(ग) ५. विपुल for (विपुलः) ६. विधोग्रवेध for (विद्धोग्रवेध)
७. लम्बादृजु र्द्धार्यः ।। ३१ ।। for (लम्बाद्वार्यः)
(वि०—इसकी श्लोक संख्या ३१ है)
(च) २. शूच्यग्रोः for (शुच्यग्रो) ८. छायः for (छ्रायः)
७. लम्बादजुर्द्धार्यः (लम्बाद्वार्यः) (वि०—क्रमसंख्या ३६ अंकित है)
(ङ) २. सूच्यग्रो for (शुच्यग्रो) ६. विद्धा for (विद्धो) ४. भृद्वुर्यः for (द्वार्यः)

छायांदृग्ज्या यष्टि छयाकर्ण मवलम्बकम् शंकु ।
परिकल्प्यां शंकु यंत्रे योज्यं घटिकादिषुष्टचुक्तम् ॥ ३६ ॥
घटिकाकलशार्द्धक्रतिताम्रं पात्रं तले गुरुछिद्रम् ।
मध्येतज्जलमज्जन षष्टचा द्युनिशं यथा भवति ॥ ३७ ॥
मध्याध्व्यस्तनतांशैः कपालकं दिवकत्थ सूत्रात् मग्रात् ।
व्यस्तोन्नतांशा विवरे सूत्रैक्या पाततो नाडचः ॥ ३८ ॥

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३६. (घ) (वि०—इसकी क्रम संख्या ३७ है)
१. छायाकर्ण (ग) (च) (ङ) for (छयाकर्ण)
२. परिकल्प्या (ग) परिकल्प्य (ङ) for (परिकल्प्यां)
३. घटिकादि पुष्टघ्युक्तम् (ग) घटिकादि यद्युक्तम् for (घटिकादि पुष्टच्युक्तम्)
(ग) ४. दृग्ज्यां (ङ) for (दृग्ज्या) (वि०—इसकी श्लोकसंख्या ४० है)
(च) २. परिकल्प्य शंकु for (परिकल्प्यांशंकु)
३. घटिकादिसंयुक्तम् for (घटिकादिषु ष्टच्युक्तम्)
(वि०—क्रमसंख्या ३७ अंकित है) (ङ) ५. दृष्टि for (यष्टि)

३७. (घ) (वि०—इसकी क्रमसंख्या ३८ है)
१. कलशार्द्धकृति (ग) कलाशतार्द्धा for (कलशार्द्ध)
(ग) २. क्रुतिताग्रं for (क्रतिताम्रं) ३. पृथु for (गुरू)
४. मज्ञान for (मज्जन) (वि०—इसकी श्लोकसंख्या ४१ है)
(च) २. क्रुतिताम्रं (ङ) for (क्रतिताम्रं)
(वि०—इसकी क्रमसंख्या ३८ अंकित है) (ङ) कलसार्धा for (कलशार्द्ध)
३. ऽपृथुच्छिद्रम् for (गुरुछिद्रम्)

३८. (घ) (वि०—इसकी क्रमसंख्या ३६ है)
१. द्व्यस्त (ग) मध्यद्व्यस्तनतांशै for (मध्व्यस्तनतांशैः)
२. दिवक्स्थ (ग) दिक्स्थ (ङ) for (दिवकत्थ)
३. सूत्रमग्राग्रात् (ग) मूत्रमग्रात् for (सूत्रात्मग्रात्)
(ग) (वि०—इसकी श्लोकसंख्या ४२ है)
४. व्यस्तोन्नत्यंश for (व्यस्तोन्नतांशा) (च) १. द्व्यस्त for (ध्व्यस्त)
२. दिक्स्थ for (दिवकत्थ) ३. सूत्रमग्राग्रात् for (सूत्रात्मग्रात्)
४. व्यस्तोन्नतांश for (व्यस्तोन्नतांशा) ५. विववरे for (विवरे)
६. (वि०—क्रमसंख्या ३६ for (३८)
(ङ) १. मध्याद्यस्वनतांशैः for (मध्याध्व्यस्तनतांशैः)
३. सूत्रमध्याग्रात् for (सूत्रात्मग्रात्) ४. व्यस्तोन्नतांश for (व्यस्तोन्नतांशा)

अथवा कपालके नाडिकादिसर्वं[2] धनुष्फक्त[3] कर्त्तरि यंत्रम्[4] ।
स्थुलं[1] कृतं यतोन्यैर्वदामि ततः[5] ।। ३९ ।।
दिक्स्थितफलकद्वियुतिस्तले तदग्रस्य सूत्रयोर्मध्ये ।
कीलस्तछायाग्रात्[1] कर्त्तयानाडिका[2] स्थूलाः ।। ४० ।।
दष्टौच्यं[1] समपठि[2] यष्टि व्यासार्द्ध मंकितं[5] परिधौ ।
दिग्भगणांशे[5] मूर्द्धन्यग्रा[4] घटिकादि यष्टयुक्तम्[3] ।। ४१ ।।
नलकोमूले विद्धस्तच्छूति[1][2] घटिकोद्धृत[4] समुछ्रायः[3] ।
लब्धांगुलैस्तुतैर्नाडिका क्रियायंत्रसिद्धिरतः ।। ४२ ।।

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३९. (घ) १. स्थूलं (ग) (ङ) for (स्थुलं) (वि०—इसकी क्रमसंख्या ४० है)
(ग) २. नाडिकादिकं सर्वम् for (नाडिकादिसर्वं)
३. था धनुष्युक्तं for (धनुष्फक्तं) ४. पत्रम् for (यंत्रम्)
(वि०—इसकी श्लोकसंख्या ४३ है) (च) १. स्थूलं for (स्थुलं)
५. (वि०—क्रमसंख्या अंकित है)
(ङ) ३. यथा धनुष्युक्तं for (धनुष्फक्त)
४. 'कर्त्तरियंत्रम्' दूसरी पंक्ति का आरम्भिकपद ।
४०. (घ) १. स्वछायाग्रा for (स्तछायाग्रात्) (वि०—इसकी क्रमसंख्या ४१ है)
२. कर्त्तर्या (ग) for (कर्त्तया) ३. नाडिकाः for (नाडिका)
(ग) (वि०—इसकी श्लोक संख्या ४१ है)
(च) २. कर्त्तर्यानाडिकाः for (कर्त्तयानाडिका) (वि०—इसकी क्रमसंख्या ४१ है)
(वि०—इसकी क्रमसंख्या ४१ है)
(ङ) २. कर्त्तयां for (कर्त्तया)
४१. (घ) (वि०—इसकी संख्याक्रम ४२ है)
१. दृष्टौच्यसमं (ग) दृष्टौच्यं (ङ) for (दष्टौच्यं)
२. पीठं (ग) (ङ) for (पठिं) (ग) ३. ष्युक्तम् for (यष्टयुक्तम्)
(च) १. दृष्टौच्यं समं for (दष्टौच्यं सम) २. पीठं for (पठिं)
४. मूर्द्धन्यग्रा for (मूर्द्धन्यग्रा) (वि०—इसकी क्रम संख्या ४२ है)
(ङ) ५ मन्तिकं for (मंकितं) ३. रुक्तम् for (यष्टयुक्तम्)
४२. (घ) (वि०—इसकी क्रमसंख्या ४३ है)
१. विद्धस्त (ग) विद्धस्तच्छूति for (विद्धस्तच्छूति) २. छ्रुति for (छूति)
३. द्धृतस्तदुछ्राय: for (समुछ्राय) (ग) ४. घटिकोद्धृतः (ङ) for (घटिकोद्धृत)
(वि०—इसकी श्लोक संख्या ४६ है) (च) (वि०—श्लोक संख्या ४३ है)
(ङ) १. तदुस्रुति for (तच्छूति)

घटिकांगुलांतरस्थै वयांगुटकै[1] घंटीधृतैरन्यः[2] ।
उपरिनरोतः[3] शुषिरस्तिर्यक्[4] कीलोस्य मुखमध्ये ॥ ४३ ॥
कीलो परिणामिन्यां वीर्यबिद्धं[1] सपारतम[6]लांबु[2] ।
स्त्रवति[3] जलो[4]क्षिपति नरो गुटिकां कुर्मोदयश्चैवम्[5] ॥ ४४ ॥
जलपूर्णकृतघटीभिस्तनस्य[1] कर्णादिभिर्जलं श्रिपति[3] ।
पुरुषोन्यर्द्धो[2] सत्वं चक्रचतुष्कस्य कृतमुपरि[4] ॥ ४५ ॥

४३. (घ) (वि०—इसकी क्रमसंख्या ४४ है)
१. वीर्यांगुटकै (ग) वीर्यांगुडकै for (वयांगुटकै)
२. घंटीधृतीरन्यः for (घंटीधृतैरन्यः) ३. उपरिनरांत for (उपरिनरोनः)
(ग) ४. सुषिरस्तिर्यक् (ङ) for (शुषिरस्तिर्यक्)
(वि०—इसकी श्लोक संख्या ४७ है)
(च) १. वीर्यां for (वयां)
(वि०—इसकी श्लोकसंख्या ४४ है)
(ङ) १. वीर्याङ्गुलकै for (वयांगुटकै)
३. नरोतः for (नरोनः)
४४. (घ) ((वि०—इसकी क्रमसंख्या ४५ है) १. चीर्यबिद्धं for (वीर्यबिद्धं)
२. लावु for (लांवु) ३. स्रवति (ग) (च) (ङ) for (स्त्रवति)
४. जले (ग) (च) (ङ) for (जलो)
५. कूर्मादयश्चैवम् (ग) कूर्मोदयाश्चैवम् ॥४८॥ for (कुर्मोदयश्चैवम्)
(वि० —इसकी श्लोक संख्या ४८ है)
(च) २. लावु for (लांबु)
५. कूर्मोदयश्चैवं for (कुर्मोदयश्चैवम्)
(ङ) १. चीर्यांद्यं for (वीर्यबद्धं)
२. लाबुतु for (लांबु) ६. द्वपारदम् for (सपारतम)
४५. (घ) (वि०—इसकी क्रमसंख्या ४६ है)
१. स्तनास्य (ग) (ङ) for (स्तनस्य)
२. पुरुषोऽन्यद्वासत्वं (ग) पुरुषोन्यर्द्धासित्व for (पुरुषोन्यर्द्धोसत्वं)
(ग) ३. क्षिपितम् for (श्रिपति) ४. जनमुपरि ॥४६॥ for (कृतमुपरि ॥४५॥)
(वि—इसकी श्लोक संख्या ४६ है)
(च) ३. क्षिपति for (श्रिपति)
२. ऽन्यर्द्धा for (न्यर्द्धो) क्रमसंख्या ४६ है ।
(ङ) ३. क्षिपति for (श्रिपति) २. पुरुषोऽन्यर्धासक्त for (पुरुषोन्यर्द्धोसत्वं)

एवं[1] वफवरं नाडिकांगुलैः संस्थिते[2]ऽतरे [3]योज्यम् ।
युद्धानि मल्लगज महिषमेष विविधयुधनृतां[4] च ।। ४६ ।।
निगिरति[1] च घटिकां गुलांकितैं[5] गंडिकैं[2] मंयुरोऽह्रीं[6] ।
वीर्यभ्रु[3]मेवं गुडकैरूपरिस्थै ब्रह्मचर्याद्यैः[4] ।। ४७ ।।
कालोक्षपाप्तिहितः[1] पटहः शब्द[3]करोति घंटा वा[4] ।
एवं यन्त्र[2] सहस्राण्यनेन बीजेन कार्याणि ।। ४८ ।।

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४६. (घ) १. वधूवरं (ग) (ङ) for (वफवरं) (वि०—इसकी क्रमसंख्या ४७ है।)
(ग) २. संयुतं for (संस्थिते) ३. चरे (वरे) for (ऽतरे)
४. विवधायुधभृतां च ।।५०।। (ङ) for (विविधयुधनृतां च)
(वि०— इसकी श्लोक संख्या ५० है)
(च) १. एवंच वरं for (एवं वफवरं)
४. विविधायुधभृतां च for (विविधयुधनृतां च) (वि० —श्लोक संख्या ४७ है)
(ङ) २. संयुता for (संस्थिते) ३. वरे योज्या for (ऽतरे योज्यम्)

४७. (घ) (वि०— इसकी क्रमसंख्या ४८ है)
१. निगिरति गिरति च (ग) निगिरति गिरति for (निगिरति)
२. गंडकैर्मयूरोऽहिम् (ग) खंडकै for (गंडिकैं)
३. वीर्यमेवं (ग) for (वीर्यभ्रुमेवं)
४. ब्रह्मचर्याद्यैः (ग) ब्रह्मचार्याद्यैः ।।५१।। (ङ) for (ब्रह्मचर्याद्यैः)
(ग) ५. गुलांकितैः for (गुलांकितैं) ६. मयूरोहिम् for (मंयूरोऽह्रीम्)
(वि०—इस की श्लोक संख्या ५१ है)
(च) २. गंडकै for (गंडिकैं) ६. मंयूरोऽहिं for (मंयुरोऽह्रीं)
३. वीर्यमिवं for (वीर्यभुमेवं) ४. ब्रह्मचर्याद्यैः for (ब्रह्मचर्याद्यैः)
(वि०— श्लोक संख्या ४८ है) (ङ) २. खण्डकैर for (गंडिकैं)
६. मंयूरोऽहिम् for (मंयूरोऽह्रीं) ३. चीर्यमिवं for (वीर्यभ्रुमेवं)

४८. (घ) (वि०—इसकी क्रमसंख्या ४९ है)
१. कालोत्क्षपाप्तिहितः (ग) कीलीत्क्षेपाभिहतः for (कालोक्षपाप्तिहतः)
२. यंत्रसहस्राण्यनेन (च) (ग) for (यंत्र सहस्राण्यनेन)
३. शब्दं (च) (ङ) for (शब्द)
४. 'वा' पद लुप्त है (वि०—इसकी श्लोकसंख्या ५२ है)
(च) १. कालोक्षेपाभिहतः for (कालोक्षपाप्तिहितः)
(वि०—इसकी श्लोकसंख्या ४९ है)
(ङ) १. कीलोत्क्षेपाभिहतः for (कालोक्षपाप्तिहितः)

[१]लघुदारुमयं [५]चक्रं [६]समशुषिरांतरं[२] पृथगराणाम् ।
[७]अर्धं [३]पारदपूर्णं [८]मध्ये [४]सुल्लिष्ट [९]कृतसंध्यौ ॥ ४९ ॥
तिर्यक् कीलोमध्ये[१]ध्व्याधारस्थो [२]स्यपा[५]रदे [६]व्रजति ।
[३]छिद्रान्यर्द्धं [७]चक्रक[४]र्मजभ्रमे वांबरे[८] भ्रमति ॥ ५० ॥

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४९. (घ) (वि०—इसकी क्रमसंख्या ५० है)
१. लघुदारमयं for (लघुदारमयं)
२. शुषिरांतरां for (शुषिरांतरं)
३. पारतपूर्णं (ग) परेतपूर्णो for (पारदपूर्णं)
४. सुश्लिष्ट (ग) सश्लिष्ट for (सुल्लिष्ट)
(ग) ५. चत्र for (चक्र)
६. दाम for (सम) ७. अर्द्धे for (अर्धं)
८. परिधौ for (मध्ये) ९. कृतं संधिः ॥५३॥ for (कृतसंध्यौ)
(वि०—इसकी श्लोकसंख्या ५३ है)
(च) १. लघुदारमयं for (लघुदारूमयं) ३. पारतपूर्णं for (पारदपूर्णं)
४. सुश्लिष्ट for (सुल्लिष्ट) (वि० – श्लोक संख्या ५० है)
(ङ) २. सुषिरारान्तरं for (सुषिरांतरं)
द्वितीयपंक्ति – अर्धेरसेन पूर्णो परिधौ संश्लिष्ट कृतसन्धिः ।
for
अर्धां पारदपूर्णं मध्ये सुल्लिष्ट कृतसंध्यौ ॥

५०. (घ) १. द्व्या (ग) (ङ) for (ध्व्या) (वि०—इसकी क्रमसंख्या ५१ है)
२. ऽस्य पारते for (स्यपारदे) ३. छिद्राण्यूर्ध्वं (ग) (ङ) for (छिद्रान्यर्द्धं)
४. चक्रकमजस्रमेवांबरे (ग) चक्रकमजभ्रमेवांबरे भ्रमति ॥५४॥ for (चक्रकर्मजभ्रमेवांबरे भ्रमति ॥५०॥)
(ग) ५. पारंते for (पारदे)
६. भ्रमति (ङ) for (व्रजति)
(वि०—इसकी श्लोकसंख्या ५४ है)
(च) १. द्वयाधारस्थो for (ध्व्याधारस्थो) २. ऽस्य for (स्य)
५. पारते for (पारदे) ३. छिद्राण्यर्द्धे for (छिद्रान्यर्द्धे)
(वि०—श्लोकसंख्या ५१ है)
(ङ) २. ऽस्य for (स्य)
५. पारदो for (पारदे) ७.+भ्रमति+
४. चक्रमजस्रमे for (चक्रकर्मजभ्रमे) ८. वाम्बरं for (वांबरे)

छिद्रे स्वधिया[५] क्षेप्यं[१] समं तथा[६] पारदं[२] यदा[३] भ्रमति ।
कालसममिष्टमानैश्चक्रकमुतान[४]मूर्द्धं[७] वा ॥ ५१ ॥
कीलस्योपरिगमिभिन[१] तिर्यक्[३] सूत्रके धृतमलाषु[२] ।
प्रागवन्नलके प्रक्षिप्य नाडिका श्रवति[४] पानीये ॥ ५२ ॥

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५१. (घ) (वि०—इसकी क्रमसंख्या ५२ है)
१. ब्येप्यं for (क्षेप्यं) (ग) 'क्षेप्यं' लुप्त है ।
२. पारतं (ग) (च) for (पारदं)
३. यथा (ग) (च) for (यदा)
मुत्तान (ग) (च) for (कमुतान)

(ग) ५. स्वधियां समं for (स्वधिया क्षेप्यं)
(वि०—इसकी श्लोक संख्या ५५ है)

(च) १. ब्येप्यम् for (क्षेप्यम्)
(वि०—श्लोक संख्या ५२ अंकित है)

(ङ) १. क्षिप्त्वा for (क्षेप्यं)
३. 'यदा' लुप्त ।
६. यथा (for) तथा
४. समुत्तान for (कमुतान)
७. मूर्ध्वं वा for (मूर्द्धं वा)

५२. (घ) (वि०—इसकी क्रम संख्या ५३ है)
१. गामिनि न (ग) गामिनितत्पर्यय for (गमिभिन)
२. मलाबु (ङ) मलाबु for (मलाषु)

(ग) (वि०—इसकी श्लोक संख्या ५६ है)

(च) १. परिगामिनि (ङ) for (परिगमिभिन)
(वि०—श्लोक संख्या ५३ अंकित है)

(ङ) ३. तत्पर्य for (तिर्यक्)
४. स्रवति for (श्रवति)

करणोंज्या क्षिप्रचलनमेव शरमोक्षशंस्वशबाश्च ।
अध्यायो द्वाविंशो यन्त्रेष्वार्यास्त्रिपंचाशत् ॥ ५३ ॥

इत्ति ब्रह्मगुप्ते यंत्राध्यायः (२२ वां अध्याय समाप्तः)

द्वाविंशः समाप्तः

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५३. (घ) (वि०—इसकी क्रमसंख्या ५४ अंकित है)

१. मेवं (ग) (च) (ङ) for (मेव) २. शंखशब्दाश्च (ग) for (शंस्वशबाश्च)

३. इति ब्राह्मस्फुटसिद्धांते यन्त्राध्यायो द्वाविंशतितमः (ग) for (इति श्री ब्रह्मसिद्धांते यन्त्राध्यायो द्वाविंशः)

(ग) ४. चालन for (चलन) ५. सप्त for (स्त्रि)

(वि०—इसकी श्लोक संख्या ५६ है)

(च) २. शंखशब्दाश्ब for (शंस्वशबाश्च)

(वि०—इसकी श्लोकसंख्या ५४ अंकित है)

३. इति ब्राह्मस्फुटसिद्धांते यंत्राध्याये द्वाशितितमः for (इत्ति ब्रह्मगुप्ते यंत्राध्यायः (२२ अध्यायसमाप्तः)

(ङ) ६. करणौर्ज्या for (करणोंज्या) २. खशब्दाश्च for (स्वशबाश्च)

७. शरमोक्षणं for (शरमोक्षशं)

३. इति ब्राह्मस्फुट सिद्धान्ते यन्त्राध्यायो नाम द्वाविंशोऽध्यायः for (इति ब्रह्मगुप्ते यन्त्राध्यायः)

अथ मानाध्यायो नाम

त्रयोविंशः

सौरेणाब्द मासतिथयश्चांद्रेण सावनैर्दिवसाः ।
दिनमासाब्द पमध्यानत द्विनार्केंदु मानाम्याम् ॥ १ ॥
मानाति सौरचन्द्रार्क्षसावनानि ग्रहानयनमेभिः ।
मानेन पृथक्वत्रुभिर्व्यवहारोत्र लोकस्य ॥ २ ॥
युगववर्ष विषुवदयनत्वहर्निशोर्वृद्धिहानयः ।
सौरात्तिथि करणाधिकमासोन रात्रपर्वक्रियाश्चांद्रात् ॥ ३ ॥
यसस्य वन प्रमाण ग्रहगतफपवास सूतक चिकित्साः ।
सावन मानात् ज्ञेया प्रायश्चित्त क्रियाश्चान्या ॥ ४ ॥

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१. (घ) १. सौरेणाब्दा (ग) सौरेणाब्दा (ङ) for (सौरेणाब्द)
२. मासास्तिथय (ग) (ङ) for (मासतिथय)
(ग) ३. मप for (पम) ४. तद्दिनार्केंदु for (तद्विनार्केंदु)
(च) १. सौरेणाब्द्वा for (सौरेणाब्द)
२. मासास्तिथयश्चांद्रेण for (मासतिथयश्चांद्रेण) ५. दिवसा for (दिवसाः)
२. (घ) १. चान्द्रार्क्ष (ग) चान्द्राक्ष for (चन्द्रार्क्ष)
२. मानैः (ग) च) (ङ) for (मानेन)
३. व्यवहारोऽत्र (ग) संव्यवहाराश्च for (व्यंवहारोत्र)
(ग) ४. पृथक् चतुर्भिः (ङ) for (पृथक्वत्रुभि)
(च) १. चान्द्रार्क्ष for (चन्द्रार्क्ष) ४. पृथक्चतुर्भि for (प्रथक्वतुभि)
(ङ) ५. मानानि for (मानाति) ३. संव्यवहारोऽत्र for (व्यंवहारोऽत्र)
३. (घ) १. युगवर्षे (ग) युगं वर्ष for (युगववर्ष) २. नंशो for (निशो)
३. हानियः for (हानयः)
(ग) ४. सौरानतिथि for (सौरात्तिथि)
(च) १. युगवर्षं (घ) for (युगववर्ष) ५. विषुचदय for (विषुवदय)
२. नर्स्त्वहर्निशो (ङ) for (नत्वहर्निशो)
४. (घ) १. यज्ञसवन (ग) for (यसस्य वन)
ग्रहत्युपवास (ग) ग्रहगत्युरुवास for (ग्रहगतफपवास) ३. ज्ञेयाः (ग) for (ज्ञेया)
(ग) ४. प्रायश्चि for (प्रायश्चित्त) ५. चान्याः ॥ ४ ॥ for (चान्या)
(च) १. यज्ञस्य for (यसस्य) २. ग्रहगत्युपवास for (ग्रहगतफपवास)
(ङ) १. यज्ञसवन for (यसस्य वन) २. गत्युपवास for (गतफपवास)
३. सावनमानाज्ज्ञेयाः for (सावनमानात्ज्ञेया) ५. चात्र for (चान्या)

नक्षत्रसावनदिनात् सूर्यादीनां स्वसावन दिनानि ।
यस्मात्तस्मादार्क्षं दुरधिगमं मन्दबुद्धिनाम्[1] ॥ ५ ॥
मानुष्य पित्रदेव[1] ब्राह्म्यान्यष्टा[2] वमूर्त्तकालस्य ।
उक्तानि ज्ञानार्थं बार्हस्पत्यं[3] नवममन्यत्[4] ॥ ६ ॥
द्वौ द्वौ राशि[1] मकराहृतवः[3] षट् सूर्यगति वशाद्योज्याः[5] ।
शशिरवसन्त[2] ग्रीष्मा वर्षा शरदौ[6] सहेमन्ताः[4] ॥ ७ ॥
भूव्यास गुणोभक्तः कर्क व्यासांतरेण रविकर्णं[2] भूमध्या
द्भू छाया दिर्घत्वं[1] चन्द्रकर्णोनं[3] शेषम्[4] ॥ ८ ॥

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५. (घ) १. मंदबुद्धीनाम् (ग) (ङ) for (मंदबुद्धिनाम्)
(च) १. बुद्धीनां for (बुद्धिनाम्)

६. (घ) १. पित्र्यदेव (ग) पित्र्यदिव्य for (पित्रदेव)
२. ब्राह्मयान्यष्टा (ग) for (ब्राह्मयान्यष्टा)
बर्हस्पत्यं (ग) वार्हस्पत्यं for (बार्हस्पत्यं)
(च) १. पित्र्यदेव for (पित्रदेव)
४. न्नवममन्यत् for (नवममन्यत्)
(ङ) २. दिव्यपित्र्य for (पित्रदेव) ब्राह्माण्यष्टा for (ब्राह्मयान्यष्टा)

७. (घ) १. राशी (ग) (ङ) for (राशि)
२. शशिबसंत (ग) शिशिरवसन्त (ङ) for (शशिरवसन्त)
(ग) ३. मकराहृतवः (ङ) (मकराहृतवः)
(च) १. राशी for (राशि)
३. मकराद्दतवः for (मकराहृतवः)
४. सहेमन्ता for (सहेमन्ताः)
(ङ) ५. वशाद्भाज्याः for (वशाद्योज्याः) ६. शरदः for (शरदौ)

८. (घ) १. दीर्घवत्वं (ग) दीर्घत्वम् (ङ) for (दिर्घत्वं)
२. 'कर्ण' तक पहली पंक्ति समाप्त (ग) कर्णः (ङ) for (कर्णं)
३. 'कर्णोनम्' तक दूसरी पंक्ति समाप्त (ग) (ङ)
४. 'शेषम्' अगले श्लोक का प्रथम पद है (ग) (ङ)
(च) १ दीर्घत्वं (ङ) for (दिर्घत्वम्)
४. ॥ ८ ॥ शेषं for (शेषं ॥ ८ ॥)

[१]व्यासगुणं [९]दीर्घत्व[२]हृतं शशांकक[३]क्षायाम् ।
तमसो व्यास[६] शशि कर्णा[५]द्धृत[७]स्त्रिज्यया गु[४]णा[८]लिप्ता ॥ ९ ॥
रविकर्ण [१]द्धृता [२]स्त्रिज्या कर्क व्यासान्तर[३] हृता शोध्या ।
त्रिज्याभूव्यास वधा[५] छशि कर्ण [४]हृतातमो व्यासः ॥ १० ॥
भू व्यासेंदुगति वधात् कर्क व्यासांतरार्कभुक्ति वधम् ।
प्रोह्यें[१]दुमध्यभुक्त्या तिथिगुणयाप्तं तमो व्यासः ॥ ११ ॥
[१]योधिकमासावमरात्र[६]सम्भवज्ञः सवे[२]त्रिमानानि ।
आर्याभिर्द्वा[३]दशाभिर्मानाध्यायस्त्रि[४]योविंशः ॥ १२ ॥
[५]इत्ति ब्रह्म गुप्ते मानाध्यायः (२३ अध्याय समाप्तः)

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९. (घ) १. यह पंक्ति 'शेषं से आरम्भ है शेषं 'पूव्यास' (ग) 'शेषं भू' लुप्त ।
२. हृतं (ग) (च) (ङ) for (हृतं) ३. कक्ष्यायाम् (च) for (कक्षायाम्)
४. गुणो (ग) (ङ) for (गुणो) ५. हृत (ग) (च) (ङ) for (द्धृत)
(ग) ६. व्यासः (ङ) for (व्यास) ७. स्त्रिज्यो for (स्त्रिज्यया)
८. लिप्ताः for (लिप्ता) ९. दीर्घत्वं for (दीर्घत्व)
(ङ) १. 'शेषं भू' लुप्त ७. स्त्रिज्या for (स्त्रिज्यया)
१०. (घ) ४. हृता (ग) (च) (ङ) for (द्धृता)
२. तृज्या (ग) त्रिज्या (ङ) for (स्त्रिज्या)
३. व्यासांतराहृता (ग) (च) for (व्यासांतरहृता)
४. हृतं (ग) हृतात्तमो for (हृतातमो)
(ग) ५. वधात् शशिकर्ण (ङ) for (वधाछशिकर्ण)
(च) २. त्रिज्या for (स्त्रिज्या) ४. हृतातमो for (हृतातमो)
(ङ) ६. व्यासांतराहता for (व्यासांतरहृता) ४. हृतात् for (हृता)
११. (घ) १. प्रोह्येन्दु for (प्रोह्येन्दु) (च) १. प्रोज्येन्दु for (प्रोह्येन्दु)
१२. (घ) १. योऽधिक (च) for (योधिक) २. वेत्ति (ग) (च) (ङ) for (वेत्रि)
३. द्वादशभि (ग) (च) for (द्वादशाभिर्)
४. स्त्रयोविंशः (ग) (च) (ङ) for (स्त्रयोविंशः)
५. 'इति' से 'समाप्त' तक लुप्त है ।
(ग) ६. सं भावज्ञः for (संभवज्ञः)
(च) ५. 'इति' से 'समाप्त' तक लुप्त है ।
(ङ) ३. आर्याद्वादशभिरयं for (आर्याभिद्वदिशाभिर्)

अथ संज्ञाध्यायो नाम

चतुर्विंशः

यस्मात्संप्रति पत्तिर्न संज्ञया संज्ञितो[1] विना तस्मात् ।
लोकप्रसिद्धसंज्ञारूपादीनां शशांकाद्याः ॥ १ ॥
युगपद्युगा[1]रूदया याम्यायां[3] भास्करस्य वारूण्याम् ।
राज्यर्धात्सौम्याया मस्तमया दिनदलादैन्द्राम्[2] ॥ २ ॥
अपमेवकृतः[3] सूर्येंदु पुलिश[1] रोमक वशिष्ट[5] यवनाद्यैः ।
यस्मात्तस्मादेकः सिद्धान्तो ग्रन्थ[2]रचना[4]न्याः ॥ ३ ॥
यदि भिन्नाः सिद्धान्त[2]भास्कर संक्रान्तयोपि भेदसमाः[3] ।
सस्पष्टः पूर्वस्यां विषुवत्पार्को[1]दयो यस्य ॥ ४ ॥
तन्त्र पक्षा[1]गणितं मध्यम गत्युत्तरादयः पञ्च ।
कुट्टाकारो[3] वेधः[4] छन्दश्चित्यू[2]तरं गोलः ॥ ५ ॥

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१. (घ) १. संज्ञिनो (ग) संज्ञिने for (संज्ञितो) (च) १. संज्ञिनो for (संज्ञितो)

२. (घ) १. द्युगादि (ग) युगपत् युगादिरुदयात् for (युगपद्युगारूदया)
२. द्विनदलादैन्द्रचाम् (ग) (ङ) for (दिनदलादैन्द्राम्)
(च) १. युगपद्युगादि for (युगपद्युगा) २. द्विनदलादै for (दिनदलाद्यै)
(ङ) १. द्युगादिरुदया for (द्युगारुदया) ३. द्याम्यायां for (याम्यायां)

३. (घ) १. पुलिस for (पुलिश) २. ग्रन्थः (च) for (ग्रन्थ)
(ग) ३. अयमेव for (अपमेव) ४. रचनान्या for (रचनान्याः)
(ङ) ५. वसिष्ठ for (वशिष्ट) २. विरचितो for (ग्रन्थरच)
३. नान्यः for (नान्याः)

४. (घ) १. विषुवत्यार्को (ग) (च) for (विषुवत्पार्को)
(ग) २. सिद्धान्ताः (ङ) for (सिद्धान्त) ३. समाम् for (समाः)
(ङ) ३. विभेद समाः for (पिभेद समाः) १. विषुवत्यर्कोदयो for (विषुवत्पार्कोदयो)

५. (घ) १. तन्त्रपरीक्षागणिते (ग) तन्त्रपरीक्षागणितम् for (तन्त्रपक्षागणितम्)
२. चित्युंत्तरं गोलः (ग) (च) for (चित्यूत्तरं गोलः)
(च) १. तन्त्रपक्षागणिते for (तन्त्रपक्षागणितं) ३. कुदाकरो for (कुट्टाकारो)
(ङ) १. तन्त्र परीक्षा for (तन्त्रपक्षा) ४. वेद्यश्छन्द for (वेधः छन्द)
२. श्चित्युत्तरं गोलः for (श्चित्यूत्तरं गोलः)

यंत्राणिमान संज्ञाश्चै[3]वाध्याया[4]श्चतुर्दश ब्रह्मो[1]ध्यायः[5] ।
चतुर्विंशतिराद्यं द्दंशभिः[2] सहाध्यायैः[6] ॥ ६ ॥
श्री चापवंश[5]तिलके श्री व्याघ्रमुखे नृपे शकनृपा[1]णाम् ।
पंचाशत्संयुक्तैः[2] वर्षशतैः[3] पंचभि[6]रतीतैः[4] ।५५०। ॥ ७ ॥
ब्रह्म[3]स्फुट[4]सिद्धांतैः सज्जनगणित[5]गोलवि[1]प्रित्यै ।
त्रिंशद्वर्षेण ततो[2] जिष्णुसुतब्रह्मगुप्ते[6] ॥ ८ ॥
गणितेन फलं[4] सिद्धं[2] ब्राह्मे ध्यान[3] ग्रहे यतो[6]ध्याये ।
ध्यानग्रहो द्विसप्तत्या[5]र्याणां न लिखितो[1]त्र मया ॥ ९ ॥

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६. (घ) १. ब्राह्मो अध्यायः for (ब्रह्मोध्यायः) (ग) ब्राह्मो for (ब्रह्मो)
(वि०—यहां प्रथम पंक्ति समाप्त)
२. दंशभिः (ग) (च) (ङ) for (द्दंशभिः)
(ग) ३. संज्ञारव्यौ for (संज्ञाश्चै) ४. चाध्याय for (वाध्याया)
५. 'अध्यायः' से दूसरी पंक्ति आरम्भ (ङ)
(च) ५. अध्यायाः for (ध्यायः)
(ङ) ३. ख्याता for (श्चैवा) १. ब्राह्मे for (ब्रह्मो)
६. र्युताध्यायैः for (सहाध्यायैः)

७. (ग) १. नृपानाः for (नृपाणाम्) २. पंचशत्संयुक्तै for (पंचाशत्संयुक्तैः)
३. वर्षशतैः for (वर्षशतैः) ४. '५५०' संख्या लुप्त है।
(घ) ५. श्रीचापविंशतिलके for (श्रीचापवंशतिलके)
६. पंचभिरतीतै for (पंचभिरतीतैः)
(ङ) ३. संयुक्तैवर्षशतैः for (संयुक्तैः वर्षशतैः)

८. (घ) १. विप्रीत्यै (ग) वित्प्रीत्यैः for (विप्रित्यै)
२. त्ततो (ग) कृतो (ङ) for (ततो) (ग) ३. ब्राह्मः (ङ) for (ब्रह्म)
४. स्फुटसिद्धांतः (ङ) for (स्फुटसिद्धान्तैः) ५. गणितश्च for (गणित)
६. गुप्तेन (ङ) for (गुप्ते) (च) ५. सज्जनगणित for (सज्जनगणित)
१. विप्रीत्यै for (विप्रित्यै) २. त्ततो for (त्ततो)
(ङ) १. वित्प्रीत्यै for (विप्रित्यै)

९. (घ) १. लिखितोऽत्र (ङ) for (लिखितोत्र) (ग) २. सिबं for (सिद्धं)
(च) ८. ब्रह्मे for (ब्राह्मे) (ङ) ४. फले for (फलं)
२. सिद्धिब्राह्मे for (सिद्धंब्राह्मे) ६. यतोऽध्याये for (यतोध्याये)
५. द्विसप्ततिरार्याणां for (द्विसप्तत्यार्याणां)

तिथिभोगनाडिकासु द्विगुणास्त्रिगुणा[1] खे शोध्याः ।
पंचाशीत्यंशोना[2]स्तिथि नाडी[3]शोधयेच्छशिनः ॥ १२ ॥
वेदहतौ नवभक्तौ राश्यादौ दिनकरोडुपकेंद्रम् ।
त्रिगुणं सप्त विभक्तं गजाद्रयोंशा रवेरुच्चम् ॥ १३ ॥
विकला[1] संयुक्त[2] नव बाणा लिप्तिकारवेर्भुक्तिः ।
खनवनगा शीतांशोः पंचत्रिंशद्विलिप्ताश्च ॥ १४ ॥
स्वोच्चोन[1]केंद्रमिनो[2] नवभिर्लिप्ता शतैं[3]जीवा ।
विषमे भुक्तस्य समे भोग्य[4] सदैव केंद्रपदे ॥ १५ ॥
त्रिंशत्सनवरसेंदुः[1] ॥ १६ ॥
गतभोग्य[2] खंडकांतरे दल ॥ १७ ॥

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१२. (ङ) १. रसगुणोद्धृताः शोध्याः for (स्त्रिगुणा खे शोध्याः)
२. पंचाशीत्यधिको for (पंचाशीत्यंशो) ३. नाडयः for (नाडी)

१३. (ङ) १. (वि०—इस श्लोक का उत्तरार्ध—१४ वें श्लोक का पूर्वार्ध भी है)
त्रिगुणं सप्त विभक्तं नगाद्रयोऽशा रवेरुच्चम् ।
विकलाष्टक् संयुक्ता नवबाणा लिप्तिका ५६।८ रवेर्भुक्तिः ॥ १३ ॥
for
(वेदहतौ नवभक्तौ राश्यादौ दिनकरोडुपकेंद्रम् ।
त्रिगुणं सप्त विभक्तं गजाद्रयोंशारवेरुच्चम् ॥ १३ ॥)

१४. (ङ) (वि०—इस श्लोक का पूर्वार्ध, १३ वें श्लोक का उत्तरार्ध भी है)
१. विकलाष्टक् for (विकला)
२. संयुक्ता for (संयुक्त)

१५. (ङ) १. स्वोच्चोनं for (स्वोच्चोन) २. मितो for (मिनो)
३. शतैस्ततो for (शतैंजीवा) ४. भोग्यस्य for (भोग्य)

१६. (ङ) १. त्रिंशत्सनवरसेन्दुर्जिनतिथि विषया गृहार्धचापानाम् ।
अर्धज्याखंडानि ज्याभुक्तैक्यं सभोग्य फलम् ॥ १६ ॥
for
(त्रिंशत्सनवरसेंदुः ॥ १६ ॥)
२. गतभोग्यखण्डकान्तरदलविकलवधाच्छतैर्नवभिराप्तैः ।
तद्युतिदलं युतोनं भोग्यादूनाधिकं भोग्यम् ॥ १७ ॥
for
(गतभोग्य खंडकांतरेदल ॥ १७ ॥)

स्पाप्तांशोना[1] सवितु द्विगुणा[2] ज्याशीतगौः[3] फलं लिप्ताः ।
स्वफलमृणं चक्रार्द्धादूने केंद्रे धिके धनं[4] मध्ये ॥ १८ ॥
नगभूहृद्रविभोग्यं खंडं चांद्रं मत्त[1] भागोनं ।
द्विगुणं[2] भुक्तिफलं स्वमृणं स्यात्कुलीरमकरादिकेंद्रे[3] ॥ १९ ॥
भांशोर्कफलस्येंदौ रविवद्दिशोद्धृतः[1] स्वोर्के रवि[2] ।
फलमिनवतिथौ[3] चांद्रव्यस्तः[4][5] स्फुटार्काप्तम् ॥ २० ॥
पंचेषु पंचयुगगुणयम चंद्रांशुचंद्रकेन्द्र[1] भफलानि[2] ।
[3]द्विद्विद्विद्विकुकुभुवः षटक्षर हिते त[4] सूर्यम् ॥ २१ ॥
[1]भान्यश्विन्यादीनि ॥ २२ ॥
[2]अर्कोनचंद्रलिप्ता ॥ २३ ॥

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१८. (ङ) १. स्वाष्टांशोना for (स्पांप्तांशोना)
२. द्विगुणा for (द्विगुणा)   ३. गोः for (गौः)
४. 'धनम्' पद लुप्त है ।
१९. (ङ) १. विव सुलवं for (मत्तभागोनं)
२. 'द्विगुणं' यहां यह पद प्रथम पंक्ति का समापक है ।
३. मकरादिके for (मकरादिकेंद्रे)
२०. (ङ) १. रविवद्द्या द्विशोधिते तथा स्वोच्चे for (रविवद्दिशोद्धृतः स्वोर्के)
२. यहां 'रवि' पद दूसरी पंक्ति का आरंभक है ।
३. नवच्च तिथौ for (नवतिथौ)   ४. चांद्रे for (चान्द्र)
५. व्यस्तं for (व्यस्तः)
२१. (ङ) १. चंद्रास्चन्द्र for (चन्द्रांशुचन्द्र)   २. ज for (भ)
३. द्विकुभुव खरहिते for (द्विद्विद्विद्वि कुकुभवः षटक्षरहिते)
४. तथा सूर्ये......for (तसूर्यम्)
२२. (ङ) १. अर्कोनचन्द्रलिप्ताः खयमस्वरभाजिताः फलं तिथयः ।
गतगम्ये षष्टिगुणे भुक्त्यन्तरभाजिते घटिकाः ॥ २२ ॥
for
(भान्यश्विन्यादीनि ॥ २२ ॥)
२. भान्यश्विन्यादीनि ग्रह लिप्ताः खखवसूद्धृता लब्धम् ।
भुक्तिहृते गतगम्ये दिवसाः षष्ट्याहते घटिका ॥ २३ ॥
for
(अर्कोन चन्द्रलिप्ताः ॥ २३ ॥)

[१]व्यर्केंदुफलाप्ताः ॥ २४ ॥

[२]रविचन्द्र योग लिप्ताः ॥ २५ ॥

इति तिथ्यधिकारः ॥

अंगै रुद्रैः सिद्धैर्गजै[१]र्जिनैरर्के वत्सरात् ॥ ६ ॥ ११ ॥ २४ ॥ ८ ॥ २४ ॥

शैलैर्वि[२]लैर्गुणै[३]रसवह्निभिर्यो[४]जयोद्धौमः ॥ ७ ॥ ९ ॥ ३२ ॥ २६ ॥

[१]शशिनोक्षितैः शराविरंकैः षड्वह्निभिर्हतानंदान् ।

शशिना[२]द्वियमै[३]श्चतुरविभिर्दिनैर्युतं भवति बुधशीघ्रम् ॥ २७ ॥

[१]रूपेण खेनकुयमै[२]रंगै[३]र्न[४]भसावकरणरब्यब्दात् ।

गुणिता युक्ता [५]वैदैः कुयमै[६]स्त्रियमैर्गुणैश्च गुरुः ॥ २८ ॥

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२४. (ङ) १. रविचन्द्र योगलिप्ताः खखवसुभिर्भाजिताः फलं योगः ।
गतगम्ये षष्टिगुणे गतियोनिभाजिते घटिकाः ॥ २४ ॥
for
(व्यर्केंदुफलाप्ताः ॥ २४ ॥)

२५. (ङ) १. व्यर्केन्दुकला भक्ताः खरसगुणैर्लब्धमूनमेकेन ।
चरकरणानि ववादीन्यगताच्छेषात् तिथिवदन्यत् ॥ २५ ॥
for
(रविचन्द्रयोगलिप्ताः ॥ २५ ॥)

२६. (ङ) १. यमैरर्कवत्सरान् गणयेत् for (जिनैरर्कवत्सरात्)
२. विश्वैर्गुणितै for (विलैर्गुणै) ३. रष्टवह्निभि for (रसवह्निभि)
४. योजयेत् for (योंजयोद्धौमः)

२७. (ङ) १. शशिना जिनैः रंकैः षड्वह्निभिर्हतादब्दात्
for
(शशिनोक्षितैः शराविरंकैः षड्वह्निभिर्हतानंदान् ।)
२३. द्विपैरर्यमैश्चतुरब्धिभिरन्वितं for (द्वियमैश्चतुरविभिर्दिनैर्युतं)

२८. (ङ) १. +१+ २. +२१+ ३. +६+
४. नवभिश्चकरणाब्दाः for (र्नभसावकरणरब्यब्दात्)
५. वेदैः for (वैदैः)
६. यमैश्च भवति गुरुः ॥ २८ ॥
for
(यमैर्गुणैश्च गुरुः ॥ २८ ॥)

शैलैस्तिथिभी रुद्रैर्यम विषयैरस्त[1] सागरैर्गुणिता ।
वसुभिरनलैर्जिनैः[2] खड्गुणैश्च[3] शुक्रा[4] भृगोः शीघ्रम् ॥ २९ ॥
शून्येन द्वादशभिर्द्वादशभिः ददिशिभिः[1] खेषुभिस्त्रयोदभिः ।
गुणिता युक्ता[2] रसरवितिथिविषयैर्वंशभिरर्कैः[3] ॥ ३० ॥[4]
गगने ननंद चन्द्रैः[1] कुयमैरसाब्धिभिरं[2] बरेण[3] हताः[4] ।
रुद्रैर्नृपैः[5] खवेदैर्युक्ता राश्यादिको[6] राहुः ॥ ३१ ॥
सर्वाणि स्थानानि क्रमात्स्वहरैर्नयेदुपर्युपरि[1][2] ।
एवं रव्यब्दांते ग्रहध्रुवास्[3]तत्परांशाः स्युः[4] ॥ ३२ ॥
पृथगर्को दिग्गुणितो[1] वसुशरचंद्रहृतः[2] फलेन युतः ।
दलितो भौमध्रुवके क्षिप्तः[3] स्यान्मध्यमो भौमः ॥ ३३ ॥
चतुराहतो विवस्वान[1] पृथक्सस्ताहतो[2] न विधृति विभक्तः[3] ।
फलसंयुक्तादेयो[4] ज्ञचलध्रुवके[5] ज्ञशीघ्रं स्यात् ॥ ३४ ॥

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२९. (ङ) १. 'रस्त' पद लुप्त है। २. रनिलै for (रनलै)
३. षड्गुणैश्च for (खड्गुणैश्च) ४. युक्तम् for (शुक्रा)

३०. (ङ) १. 'ददिशिभिः' पद लुप्त है। २. युता for (युक्ता)
३. रसैरब्धिभिस्त्रिविषयै for (रसरवितिथिविषयै)
४. र्राकिः ॥ ३० ॥ for रर्कैः ॥ ३० ॥

३१. (ङ) १. गगनेन नवचंद्रैः for (गगने ननंद चन्द्रैः)
२. रसाब्धिभिः for (रसाब्धिभि) ३. संवरेण for (रंबरेण)
४. हृताः for (हताः) ५. 'नृपैः' पद लुप्त है।
६. कः पातः ॥ ३१ ॥ for (कः पातः ॥ ३१ ॥)

३२. (ङ) १. क्रमतः for (क्रमात) २. नंयेदुपरि for (नंयेदुपर्युपरि)
३. ध्रुवा for (ध्रुवास्)
५. मध्यमाः स्युस्ते for (तत्परांशाः स्यु)

३३. (ङ) १. दशगुणितो for (दिग्गुणितो) २. चंद्रैर्हृतः for (चंहृतः)
३. क्षेप्यः for (क्षिप्तः)

३४. (ङ) १. ऽब्धिगुणितः for (विवस्वान) २. च सप्ताहतो for (सस्ताहतो)
३. ऽब्धिधृतिभक्तः for (न विधृतिविभक्तः)
४. संयुतो विधेयो for (संयुक्तादेयो)
५. ध्रुवको for (ध्रुवके)

भट ब्रह्माचार्येण[४] जिष्णुतनयेन[६] गणितगोलविदा ।
आर्याष्टसहस्रेण[१] स्फुटसिद्धान्ते[२] कृतो[३] ब्रह्मा[५] ॥ १० ॥
भग्रह[१] युति वतशंकु[२] वित्रिभलग्नाद्[६] रविग्रहोक्तसमः[७] ।
शशिनः[३] कर्मबहुत्वान्न[४] कृतातो[५] भास्करग्रहणे ॥ ११ ॥
आज्ञेयी[१] नैरुत्यो[६] रुद्दिष्टदिने[२] स्थितस्य[३] योऽर्कस्य ।
शंकुच्छाये कथयत्यब्दापि[४] वेत्ति सूर्यंशः[५] ॥ १२ ॥
अत्र[४] मया यन्नोक्तं गोलादप्रेक्ष्य[१] धिमतो[४] ह्यं तत्[५] ।
आर्यात्र्योदशोऽयं[२] संज्ञाध्यायश्चतुर्विंशः[३] ॥[४] १३ ॥

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१०. (घ) १. सहस्रेणः (ग) सहस्त्रेण for (सहस्रेण)
२. सिद्धंते (ग) सिद्धांतः (ङ) for (सिद्धान्ते) ३. कृतो (ग)(च)(ङ) for (क्रतो)
(ग) ४. ब्रह्माचायेण for (ब्रह्माचार्येण) ५. ब्राह्मः for (ब्रह्मा)
(च) १. सहस्रेणः for (सहस्रेण), (ङ) ६. जिष्णोस्तनयेन for (जिष्णुतनयेन)

११. (घ) १. नग्रह for (भग्रह) २. नार्च्छिकु for (वतशंकु)
३. शशन: for (शशिनः) ४. बहुत्वन्ने for (बहुत्वान्न)
५. कृतोऽतो (ङ) for (कृतातो), (ग) ६. वित्रिभलग्नात् for (वित्रिभलग्नाद्)
(च) ५. बहुत्वान्नक्ततोऽतो for (बहुत्वान्नकृतातो)
(ङ) २. वच्छंकु for (वतशङ्कु) ७. ग्रहोक्तिसमः for (ग्रहोक्तसमयः)

१२. (घ) १. आज्ञेयीनैज्ञत्यो (ग) आज्ञेयैनैऋत्यो for (आज्ञेयीनैरुत्यो)
२. रुद्दिष्टदिने for (रूद्दिष्टदिने) ३. स्वितस्य योऽर्कस्व for (स्थितस्य योऽर्कस्य)
४. कथयत्या ···(ग) कथयत्यब्दादपि for (कथयत्यब्दापि)
५. सः (ग) (ङ) for (शः), (च) १. आग्नेये for (आज्ञेयी)
६. नैऋत्ये for (नैरुत्यो) २. वेष्टदिने for (रूद्दिष्टदिने)
३. संस्थितस्य for (स्थितस्य) ४. कथयति वर्षादपि for (कथयत्यब्दापि)

१३. (घ) १. दत्प्रेक्ष्य (ग) दुत्प्रेक्ष्य for (गोलादप्रेक्ष्य)
२. आर्यात्रयोदशो (ग) आर्यत्रयोदशायं for (आर्यात्र्योदशोऽयं)
३. चतुर्विशः (ग) for (चतुर्विशः)
(ग) ४. (वि०—यहाँ समाप्तिसूचक ।।छः।। ।।छः।। ।।छः।। अंकित है)
(च) १. गोलादत्प्रेक्ष्य for (गोलादप्रेक्ष्य)
४. धीमती for (धिमतो) २. आर्यात्रियोदशोयं for (आर्यात्र्योदशोऽयं)
३. चतुर्विशः (ङ) for (चतुर्विंशः) (ङ) १. गोलादुत्प्रेक्ष्य for (गोलादप्रेक्ष्य)
४. धीमता for (धिमतो) ५. वोह्यम् for (ह्यं तत्)
(वि०+इति श्रीमदाचार्य जिष्णुसुतब्रह्मगुप्तविरचिते ब्राह्मस्फुटसिद्धान्ते संज्ञाध्यायश्चतुर्विंशतितमः सम्पूर्णतामगमत्+)

गणितं बहुप्रकारं गोलो यंत्राणि यत्र कथितानि ।
स ब्रह्मगुप्तविहितः[१] स्फुट सिद्धांतो[२] स्मृतो ब्रह्म[३] ॥ १४ ॥[४]
सिद्धांतेपि स[१] ब्राह्मयं तपसा भक्त्या वयो[२] महादेवम् ।
आराध्यकर[३] नमस्तस्मै श्री ब्रह्म गुप्ताय ॥ १५ ॥
इति श्री भिलमाचार्य[४]भट[५] जिष्णु सुत ब्रह्मगुप्तविरचिते ब्राह्म-
स्फुटसिद्धान्ते संज्ञाध्यायः
ब्रह्म गुप्त सिद्धांतः समाप्तः ॥

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१४. (घ) १. विहतः (च) for (विहितः) २. सिद्धांतः (च) for (सिद्धान्तो)
३. ब्रह्मः for (ब्रह्म) (ग) 'ग' में यह श्लोक अंकित नहीं है ।

(च) ३. ब्रमः for (ब्रह्म) ४. क्रमसंख्या—१ for (१४)

(ङ) श्लोक अनुपलब्ध है ।

१५. (घ) १. संब्राह्मय for (सब्राह्मय) २. (च) +च+
३. आराध्य च कर for (आराध्यकर) ४. भिल्लमा for (भिलमाचार्य)
५. भट्ट for (भट)
६. अतिरिक्तपाठ—चतुर्विंशतितमः समाप्तोयं श्रीब्रह्मगुप्तकृतो ब्रह्मस्फुट सिद्धांतः । ब्रह्मसिद्धांतबीजानि । खखखांक्र हृताप्येभ्योः । १२००० गतगम्यात्पात एव शून्य यमलहृता । २००, तल्लब्धं त्रि ३ सायक ५ हतं कलाभिरूनौ । सदार्केंदु विधुवद् जीवद्धि ।२। हृतंचंद्रोस्वतिथि १५ गुणं च शतशीघ्रे द्वीषु ५२ हतं स्वक् चलेद्विकु १ वेदधहृतं च पातकुजज्ञशनिषु २ कल्याणं भूयात् ।।१।। संवत् १५५४ वर्षे फाल्गुणवदि ४ चतुर्थी रवौ लिखितं भयपुरवास्तव्य रेवातटे वास्तव्य ब्रह्मसिद्धांतः । ग्रंथ संज्ञा ।

(ग) 'ग' में यह श्लोक अंकित नहीं है । (ङ) श्लोक अनुपलब्ध है ।
चतुर्विंशतितमः समाप्तोय्यं श्रीब्रह्मगुप्तकृतो ब्रह्मस्फुटसिद्धांतः । ब्रह्मसिद्धांत-बिजानि खखखांक्र हृताद्येभ्यो १२००० गतगम्यात्पात एव शून्य यमलहृता २०० तलब्धं त्रि ३ सायक ५ हतं कलाभिरूनौ सदार्केंदु विधुवत् जीवेद्धि २ हतं चन्द्रोस्वतिथि १५ गुणं च शतशीघ्रे द्वीषुं ५२ हतं स्वंक्चलेद्विकु १ वेद ४. हतं च पात कुजशनिषु । २ कल्याणं भूयात् १ श्री ॥ श्री ॥ for (ब्रह्मगुप्त सिद्धांतः समाप्तः)

अथ ब्रह्मगुप्तकृतो ध्यानग्रहोपदेशाध्यायः

॥ ॐ नमः श्री सरस्वत्यै ॥

पंचाशत्संयुक्तं वर्षशत[1] पंचभिर्विना शाकः ।
त्रिस्थोर्कै[2]र्वसुवेदैर्नवचन्द्रैस्ताडितः क्रमशः ॥ १ ॥
[1]समायकसंयुक्तः खजिन २४० विभागो नितः सयमवेदैः ।
मध्यमराशिः शशिविश्वभाजिततोह्यधिक मासा स्युः ॥ २ ॥
तैरुपरितनो युक्तो मासगणोभ्यधिक शेषके[1] शुद्धे[2] ।
घटिकादिक[3] भचक्राद्रविरवशेषो[4] भवद्भादि[5] ॥ ३ ॥
रूपेण रूपरामैः खसायकैस्ताडितो गुणो[1] युक्तः ।
षड्भिः करैश्च[2] दिग्भिराघटिकां[3] विघटिका स्युः ॥ ४ ॥
खखरसलब्धं घटिकासु नियोजये[1] तिथिध्र[2] ।
रव्यादिकस्तदुदये चैत्रदवेर्क[3] चन्द्रो[4] वा[5] ॥ ५ ॥

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१. (ङ) १. शतैः for (शतै)   २. त्रिष्ठोऽर्के for (त्रिस्थोर्कैं)

२. (ङ) १. पंचाब्धियुतोऽधः षष्टिभाजितो लब्धियुक् सरसवेदः ।
for
समायक संयुक्तः खजिन २४० विभागो नितः सयमवेदैः ।
२. मध्यमराशि विश्वैर्विभाजितोऽभ्यधिकमासाः स्युः ॥ २ ॥
for
मध्यमराशिः शशिविश्वभाजिततोह्यधिक मासा स्युः ॥ २ ॥

३. (ङ) १. शेषकः for (शेषके)   २. शुद्धः for (शुद्धे)
३. घटादिको for (घटिकादिक)   ४. रविशेषो for (खशेषो)
५. भवेद्भादिः ॥ ३ ॥ for (भवद्भादि) ॥ ३ ॥

४. (ङ) १. गणो for (गुणो)   २. वेदैर्घृत्या for (करैश्च)
३. वासरघटिका for (दिग्भिराघटिकां)

५. (ङ) १. नियोजयेत् for (नियोजये)   २. तिथिध्रुवकाः for (तिथिध्र)
३. चैत्रादावर्क for (चैत्रदवेर्क)   ४. चन्द्रौ for (चन्द्रो)
५. च for (वा)

मासगुणो[1] यमगुणितः पृथक् द्वितत[2]ोद्धृतः फलसमेतः ।
सार्धात्त[3]युतो वसुयम विभक्तः[4] शेषाघोः[5] केन्द्रम् ॥ ६ ॥
चैत्रादिमासगुणिते द्वे नक्षत्रे क्षिपेत्सहस्रांशौ ।
घटिकैकादशयुक्तः[1] सार्द्धेन व[2] पलेन रहिते[3] वा[4] ॥ ७ ॥
नाडयर्द्धेन समेतं द्वितयं प्रक्षिपेच्च शशिकेन्द्रे ।
रूपं रूप हुताशां[1]खशराश्च तिथिध्रुवे क्रमशः ॥ ८ ॥
वारं दद्यात्प्रतिदिनमब्धिपलोनां परित्यजे[1]न्नाडीम् ।
केन्द्रे क्षिपेद्भूमेकं सद्वियमलं[2] घटीचतुष्कमितौ[3] ॥ ९ ॥
उज्जयनी[1] याम्योत्तर रेखायाः प्राग्धनं क्षयः पश्चात् ।
योजनखाष्टि[2] ८० नाडी चरदलमपि सौम्य दक्षिणयोः ॥ १० ॥
तिथियो[1] दशभागो[2] रविधिष्ण्यसमन्विताः[3] शशीमध्यः[4] ।
तिथिभोग नाडिकोनं कर्त्तव्यं शीतगोः केन्द्रः ॥ ११ ॥

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६. (ङ) १. मासगणो for (मासगुणो) २. कुतस्वोद्धृतः for (द्वितत्तोद्धृतः)
३. सार्धाष्ट for (सार्धात्त)
४. ५. विभक्तशेषो विधोः for (विभक्तः शेषाघोः)

७. (ङ) १. युक्ते for (युक्तैः) २. फलेन for (वपलेन)
३. सहिते for (रहिते) ४. च for (वा)

८. (ङ) १. हुताशाः for (हुताशां)

९. (ङ) १. भद्वियमलं for (सद्वियमलं) २. मिते for (मितौ)

१०. (ङ) १. उज्जयिनी for (उज्जयनी)
२. षष्ट्या नाडी for (खाष्टि ८० नाडी)

११. (ङ) १. तिथयो for (तिथियो) २. भागोना for (भागो)
३. रविणा समन्विता for (रविधिष्ण्यसमन्विता)
४. शशी भवति मध्यः for (शशीमध्य)
दूसरी पंक्ति—तिथ्यंशाढ्या शोध्यास्तिथि भोगजनाडिकाः केन्द्रात् ।
for
तिथिभोगनाडिकोनं कर्त्तव्यं शीतगोः केन्द्रः ॥

सप्तह[1]स्त्रिवसुहृतो गुरोः शनिर्द्विगुणितो नवेषु हृतः ।
द्वि[2]गणितो रसधृतिहृद्राहो लिप्ता सुकृतलिप्ताः[3] ।। ३५ ।।
त्रिगुणो दलितः शु[1]द्धादशयुक्[2]सित चलध्रुवे देयः ।
तात्कालिकं चलं स्याद्रविरन्येषां ज्ञशुक्रौ सहः[3] ।। ३६ ।।
मं[1]दांशो नगरवयो भयमाः खनगेंदवः खनंदाश्च ।
यमतत्वानि तद्[2]ूनान्यथाज्ञात्[3]सूर्यवद्ग्राह्याः ।। ३७ ।।
रदगुणिता सप्तकृ[1]ता कुजस्य सौम्यस्य युगगुणा[2] गता[3]ः ।
द्विगुणै[4]व फलं सूरेर्द्विगुणा[5] त्रिभाजिताः स्फुजिताः[6] ।। ३८ ।।
त्र्यंशद्भागोनास्य त्रिगुणारविजाय मंदफलं लिप्ताः ।
मंदफलदलोनयुतं शीघ्रोच्चात् शोधयेन्मध्यः ।। ३९ ।।
तस्मात् शीघ्रफलदलं स्वमृणं वामंदसंस्कृतं[1] कृत्वा[2] ।
प्राग्वन[3]मंदफलमतः सकलं मध्यग्रहे[4] कुर्यात् ।। ४० ।।

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३५. (ङ) १. हृत for (हृस्त्रि) २. दिग्गुणितो for (दिग्गणितो)
३. लिप्तः for (लिप्ता)

३६. (ङ) १. स्वद्वादशांशयुक्तः for (शुद्धादशयुक)
२. सितचलं ध्रुवं स्यात् for (सितचलध्रुवे देयः)
३. स्तः for (सहः)

३७. (ङ) १. मंदाशा for (मंदांशो) २. तदूनान्मध्याज्ज्या for (तदूनान्यथाज्ञात्)
३. सूर्यवत् ग्राह्या for (सूर्यवद्ग्राह्याः)

३८. (ङ) १. हृता for (कृता) २. नगगुणा for (युगगुणा)
३. त्रिहृता for (गताः) ४. द्विगुणा हि for (द्विगुणैव)
५. गुणाग्निविभाजिता for (गुणात्रिभाजिताः)
६. स्फुजितः for (स्फुजिताः)

३९. (ङ) १. त्रिगुणा त्रिशद्भक्ता रविजस्य फलस्य मंदफललिप्ताः ।
मन्दफलयुतोनं स्वशीघ्रोच्चाच्छोधयेन्मध्यम् ।। ३९ ।।
for
त्र्यंशद्भागोनास्य त्रिगुणारविजाय मंदफलं लिप्ताः ।
मंदफल दलोनयुतं शीघ्रोच्चात् शोधयेन्मध्यः ।। ३९ ।।

४०. (ङ) १. संस्कृते for (संस्कृतं) २. दत्त्वा for (कृत्वा)
३. प्राग्वन्मंद for (प्राग्वनमंद) ४. मान्दग्रहात् for (मध्यग्रहे)

तस्मत्पृथक् स्थितादपि शीघ्रोच्चाद्दषितशोधिताच्चफलेन ।
सकलेन संस्कृतो मृदुफलस्फुटो जायते स्पष्टः ॥ ४१ ॥

भागीकृतचलकेन्द्रत्रिगुणंश्चद्युद्धृते फलं पिडा ।
षड्गाशधिकेन चक्राद्विशुद्धशेषे तथैव स्यात् ॥ ४२ ॥

पिडांतरेण गुणितं शाखं खाद्युद्धृतक्रमं वेयम् ।
उत्क्रमविधो विशोध्यं गतपिडे शीघ्रफलमेत् ॥ ४३ ॥

पिडतवि विकणं गुणौ यदाद्येन पिडके ततः ।
यल्लभ्यते खवेदैस्तदेव फलमत्र बोद्धयम् ॥ ४४ ॥

पिंडे चतुर्दशे विश्वपिडगुणितान्मखोद्धृताद्धि कलात् ।
लब्धेन विश्वपिडो रहितः शेषं फलं भवति ॥ ४५ ॥

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४१. (ङ) १. तस्मात् for (तस्मत्) २. सितादि for (स्थितादपि)
४. विवर्जितात् (स्फुटंकेन्द्रम्) for (आद्दपितशोधिताच्च फलेन)
५. तस्मात् शीघ्र फलेन संस्कृतः for (सकलेन संस्कृतो)
६. 'मृदुफल' पद लुप्त है।

४२. (ङ) १. केन्द्रे for (केन्द्र) २. त्रिगुणे for (त्रिगुणंश्)
३. खाग्न्युद्धृते for (च द्युद्धृते) ४. पिंडः for (पिडा)
५. षड्गश्यधिके for (षड्गाशधिकेन)
६. विशोध्य for (विशोध्य) ७. शेषेण for (शेषे)
८. पिंडः for (तथैव)

४३. (ङ) १. गुणिते for (गुणितं) २. शेषे for (शाखं)
३. खाब्ध्युद्धृते for (खाद्युद्धृत) ४. क्रमाद्देयम् for (क्रमंदेयम्)
५. विधौ for (विधो) ६. पिंडे for (पिडे)
७. मेतत् for (मेत्)

४४. (ङ) १. पिंडाभावे for (पिडतवि) विकलं for (विकणं)
२. गुणयेदाद्येन for (गुणौ यदाद्येन)
३. पिंडकेन for (पिडके) ४. गण्यंतेतु for (यल्लभ्यते)
५. बोद्धव्यम् for (बोद्धयम्)

४५. (ङ) १. चतुर्दश for (चतुर्दशे) २. विश्वैर्गुणिते for (विश्वपिंडगुणितान्)
३. नखोद्धृते विकलाः for (मखोद्धृताद्धि कालात्)

वसुवेदयुगेति—भौमस्य—४८ । ६४ । १४० । १८४ । २२८ । २७० । ३०६ ।
३३९ । ३५९ । ३६६ । ३४२ । २६८ । १०८ । ० ।

(नोट—रेखाङ्कित अङ्क कटे हुए हैं ।)

बुधस्य—३३ । ६६ । ९८ । १२८ । १५४ । १७७ । १९४ । २०४ । २०४ । १८८ । १५७ । १०७ । ३६ । ० ॥

गुरोः—१८ । ३६ । ५० । ६६ । ७८ । ८६ । ९० । ८८ । ८४ । ७४ । ५८ । ३६ । १६ । ० ॥

शुक्रस्य—५० । १०० । १५० । १९९ । २४६ । २९६[1] । ३३३ । ३३१[2] । ४०० । ४१८ । ४०८ । ३४० । १५० । ० ॥

शनेः—११ । २२ । ३१ । ३८ । ४४ । ४६[3] । ४८ । ४६ । ४२ । ३४[4] । २०[5] । । १६ । ६ । ० ॥

रूपगुणा ३१ वाणजिना २४५ । शर ५ । षट्नव ९६ । यम २। गुणा ३ क्रमशः ॥ मध्यमभुक्तिकलाः ॥ स्फुटषट् द्वि २६ रदा ३२ वसु ८ रवेशा १७ ।

पिंडकफलन[1] विभागो भागादि फल[2]गृहे[3] स्वमृणं तत् ।
चलकेंद्र[5]मेष[6]तुलादि[7] संस्थिते[8] कारयेत्क्रमशः ॥ ४६ ॥
वसुवेदायुगनंदाः खवेदचन्द्राः समुद्रवसुचंद्राः ।
वसुयमभलागगनाद्धृत[1] बाहवो रसनभो रामाः ॥ ४७ ॥

(ङ) १. २९० for (२९६) २. ३७१ for (३३१) ३. ४८ (४६)
४. ३५ for (३४) ५. २७ for (२०)

४६. (ङ) १. पिंडफल नवमभागो for (पिंडकफलनविभागो)
२. फलं for (फल) ३. ग्रहेषु वा for (गृहे)
४. स्वमृणम् for (स्वमृणंतत्)
५. चलकेंद्रे for (चलकेन्द्र) ६. मेषादौ for (मेष)
७. तुलादिके for (तुलादि)
८. 'संस्थिते' पदं लुप्त है ।

४७. (ङ) १. वसुयमयमा रसनभोरामा नन्दाग्निरामाश्च ॥ ४७ ॥
for
(वसुयमभलागगनाद्धृत बाहवो रसनभो रामाः ॥ ४७ ॥)

[1]वेदसुरोगोक्षगुणा रसरसरामविलोचना द्विगुणाः ।
[2]वसुरसयमा वसुदिशो नभस्य कुजशीघ्रपिंडा स्युः ॥ ४८ ॥
गुणरामाः षट्करसा वसुनंदा[1]रामलोचन शशांकाः ।
सागर विषयशशांका नगनगचन्द्राः कृतांकभुवः ॥ ४९ ॥
वे वनखा जलधिनखा वसुवसुचंद्रास्तुरंग विषयभुवः ।
तुरगदिशो रसरामा नभश्चपिंडास्तशशिसूनोः ॥ ५० ॥
[1]ध्रूरस्त्रिगुणाः खशराः [2]षड्रसा गजनगा [3]रसाप्तौ च ।
[4]खांका [5]भुजंगरसवः सागर वसवः समुद्रनगाः ॥ ५१ ॥
भुजगशरारस रामारसेंदवश्चं[1]द्रपिंडकाः सूरेः ।
[2]वक्राद्विशुद्धशेषः स्फुटो भवेत्सिंहिकासूनुः ॥ ५२ ॥
खशराः [1]शनंखति तिथयो [2]वसुवसुवंशः शरा विनाशत्याः ।
[3]शशिन वयमागुणसुराः [4]कुनवगुणाः शून्यखांबुधयः ॥ ५३ ॥

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४८. (ङ) १. मोक्षगुणा रसरसरामा विलोचनाब्धिगुणाः ।
for
(वेदसुरोगोक्षगुणा रसरसराम विलोचना द्विगुणाः ।)
२. वसुवसुयमा वसुदिशो नभश्च कुजशीघ्रपिंडाः स्युः ॥ ४८ ॥
for
वसुरसयमावसुदिशो नभस्य कुजशीघ्रपिंडा स्युः ॥ ४८ ॥

४९. (ङ) १. गजविलोचन for (रामलोचन)

५१. (ङ) १. धृतिरसगुणाश्च for (ध्रूरस्त्रिगुणाः)
२. षट्क for (षड्)
३. रसाष्टौ for (रसाप्तौ)
४. खाङ्काश्च for (खांका)
५. भुजगवसवः for (भुजंगरसवः)

५२. (ङ) १. 'चन्द्र' पद लुप्त है ।
२. रसेन्दवः पिण्डकाः for (रसेंदवश्चन्द्रपिंडकाः)
३. चक्रा for (वक्रा)

५३. (ङ) १. शतंखतिथ्यः for (शनंखतितिथयो)
२. सागरनन्देन्दवोऽङ्कजिनाः for (वसुवसुवंशः शरा विनाशत्याः)
३. गुणगुणरामाः for (शशिन वयमागुणसुराः)
४. कुनगगुणाः for (कुनवगुणाः)

कुंजरचन्द्र समुद्रागजाभ्रवेदानभो [1]बुधिज्वलनाः ।
गगनशिलीमुखचन्द्रा वियच्चर्पिडाः सुरारिगुरौ[2] ।। ५४ ।।
रुद्रा[1]यमाः कु[2]गणा वसुरामाः सागराम्बुनिधयश्च[3]ः ।
र[4]सवेदागज[5]वेगजवेदा[6]षडवयो लोचनांबुधयः ।। ५५ ।।
पंचगु[1]णा सप्तयमा रसचंद्राः ष[2]ण्णभश्च रविसूनोः ।
[3]अद्यतनस्वसूनयोर्ग्रहयोर्विवरं भवेद्भुक्तिः ।। ५६ ।।
[1]रूपगुणा बाणजिनाः शराः षडंकायमौ गुणाः क्रमशः ।
[2]मध्यमभुक्तिकलाः स्युरत्कृतिरदखास्तखेखरा विकलाः ।। ५७ ।।
[1]मंदस्फुट खंडगुणा भुक्ति खखनवहृतागतिज्या स्यात् ।
[2]ग्रहवत्तत्फलविधिमृदुकेंद्रवशाद्गतौ स्वमृणम् ।। ५८ ।।

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५४. (ङ) १. नभोऽम्बुधि for (नभोबुधि) २. गुरोः for (गुरौ)
५५. (ङ) १. द्वियमाः for (यमाः) २. कुगुणा for (कुगणा)
३. च for (चः) ४. वसुवेदा for (रसवेदा) ५. 'वेगज' लुप्त है ।
६. गजवेदाः for (गजवेगजवेदा) ७. षडब्धयो for (षडवयो)
५६. (ङ) १. पंचगुणाः for (पंचगुणा) २. षड्नभश्च for (षण्णभश्च)
३. रूपगुणा ३१ बाणजिनाः २४५ शर ५ षण्णव ९६ यम २ गुणाः ३ क्रमशः ।। ५६ ।।
for
(अद्यतन स्वसूनयोर्ग्रहयोर्विवरं भवेद्भुक्तिः ।। ५६ ।।)
५७. (ङ) १. मध्यमभुक्तिकलाः स्युः षड् द्वि २६ रदाः ३२ खंवसु ८ शका ११ विकलाः
for
(रूपगुणा बाणजिनाः शराः षडंकायमा गुणाः क्रमशः ।)
२. मन्दगुणिताभुक्तिः खखनवविहृताभुक्तिः स्यात् ।। ५७ ।।
for
(मध्यमभुक्तिकला स्युरत्कृतिरदखास्तखेखरा विकलाः ।। ५७ ।।)
५८. (ङ) १. ग्रहवत् तन्मन्दफलं मृदु केन्द्रवशात् स्वमृणं तदूनां च ।
for
(मंदस्फुट खंड गुणा भुक्ति खखनवहृतागतिज्यास्यात् ।)
२. शीघ्रगतिं सङ्गुणयेदेवं शीघ्रस्य खण्डेन ।। ५८ ।।
for
(ग्रहवत्तत्फलविधिमृदुकेन्द्रवशाद्गतौ स्वमृणम् ।। ५८ ।।)

न[1] द्रिहता शीघ्रगतिः संगुणाय शीघ्रभोग्यखंडेन ।
खार्के[2]विभजेल्लिप्ता भौमादीनामतिशीघ्रम् ॥ ५६ ॥
स्वमृणं[1] क्रमोत्क्रमविधौ चतुर्दशो विश्वपिंडको गुणकः ।
हारः[2] ख रसागगतिरे वक्रिणोद्वोधिता चक्रम् ॥ ६० ॥
भुक्तेरपि प्रदलिते द्वे सकलफले द्वे च कारयेद् ग्रहवत् ।
मांदंफलं त्रितयं वक्रोच्चस्य द्वितो व्यस्तम् ॥ ६१ ॥
नवतिथयो ६२ चरषंडा विज्यावत् ॥ ६३ ॥

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५६. (ङ) १. पिंडान्तरेण खार्कैः १२० लिप्ताद्यं स्यात् फलं गतेः शीघ्रम् ।
for
(नद्रिहता शीघ्रगतिः संगुणाय शीघ्रभोग्य खंडेन ।)
२. स्वमृणं क्रमोत्क्रमविधौ चतुर्दश विधिश्च पिंडको गुणकः ॥ ५६ ॥
for
(खार्केविभजेल्लिप्ता भौमादीनामतिशीघ्रम् ॥ ५६ ॥)

६०. (ङ) १. हरस्वगतिरेवं वह्वणात्याज्ये भुक्ते ।
for
(स्वमृणं क्रमोत्क्रमविधौ चतुर्दशो विश्वपिंडको गुणकः ।)
२. पददलिते द्वे द्वे सकाले कारयेत् स्फुटा भुक्तिः ॥ ६० ॥
for
(हारः खरसगगतिरेवक्रिणोद्वोधिता चक्रम् ॥ ६० ॥)
नोट—(नवतिपयोधिविभक्ता इत्यादि आर्यापट्कं खण्डखाद्याच्चिन्त्यम्)

६१. (ङ) १. नवतिथयो १५६ ऽष्टि १६ विभक्ताः,
पंचरसा ६५ वसु ८ हृता दश १० त्रिहृताः ।
विषुवच्छगुणिताः स्वदेशजाश्चरदलविनाड्यः ॥ ६१ ॥
for
भुक्तेरपि प्रदलिते द्वे सकल फले द्वे च कारयेद् ग्रहवत् ।
मांदं फलं त्रितयं वक्रोच्चस्य द्वितो व्यस्तम् ॥ ६१ ॥
(ङ) नोट—खण्डखाद्यस्य श्लोकाश्चैते ।

६२. (ङ) १. ज्या केन्द्रं स्फुटभानुं कृत्वा ये राशयश्चरार्धानि ।
भुक्तानि भोग्यगुणिताच्छेषात् खखधृतिहृतात्तुफलम् ॥ ६२ ॥
for
(नवतिथयो ॥ ६२ ॥)

६३. (ङ) गतिपादं पादोनां गतिं विशोध्यास्ततकाल उदये च ।
संसाधितस्य तस्य ग्रहस्य चरकर्म चान्यस्य ॥ ६३ ॥
for
(चरषंडा विज्यावत् ॥ ६३ ॥)

पंचदशहीनयुक्ता ६४ क्रांतिकालाद्विरसगुणाः ॥ ६५ ॥

त्रिज्यां विषुवच्छाया घातस्तच्छ्रुति विभाजिताश्चाप्तम् ।

अक्षो नित्यं याम्यो गोलवशाद्दिग्भवेत्क्रांतिः ॥ ६६ ॥

क्रांत्यक्षायुति[१] वियोगाद्[२]दक्षरणपदैः शोधितै[३]र्दिनदलाभाः[४] ।

भाश्रु तिकृत्योः कृतमनुयुतो [५]नयोस्तत्पदे व्यस्ते ॥ ६७ ॥

षड्गुणितागत शेषा नाड्यो [१]दिवसार्द्ध विभाजितात् स्यात् ।

दिनदलकर्ण[२]गुणाप्ता [३]तया [४]त्रिज्यया फलं कर्णः ॥ ६८ ॥

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६४. चरदल विनाडिकागति कलावधात् खखरसाग्नि ३६०० लब्धकलाः ।
ऋणमुदयेऽस्तमये धनमुत्तरगोलेऽन्यथा याम्ये ॥ ६४ ॥
for
(पंचदशहीनयुक्ता ॥ ६४ ॥)

६५. पंचदशहीनयुक्ताश्चरार्ध नाडीभिरुत्तरे गोले ।
याम्ये युक्त विहीना द्विसङ्गुणा रात्रिदिननाड्यः ॥ ६५ ॥
for
(क्रांतिकालाद्विरसगुणाः ॥ ६५ ॥)

६६. (ङ) १. मिश्रेष्टान्तरगुणिता भुक्तिर्दिवसे निशाद्दले प्रथमे ।
षष्ट्या विभज्य लब्धं विशोध्य तात्कालिको भवति ॥ ६६ ॥
for
(त्रिज्यां विषुवच्छाया घातस्तच्छ्रुति विभाजिताश्चाप्तम् ।
अक्षो नित्यं याम्यो गोलवशाद्दिग्भवेत्क्रांतिः ॥ ६६ ॥)

६७. (ङ) १. 'क्षा' लुप्त है ।
२. दक्षपदेः for (दक्षरणपदः) ३. शोधिते for (शोधितै)
४. दिनदलेभा for (दिनदलाभाः) ५. नयाकृत्वकर्षः स्यात् ॥ ६७ ॥
for
(नयोस्तत्पदे व्यस्ते ॥ ६७ ॥)
(क्रान्त्यक्ष युति वियौगाच्चक्रपदात्शोधिते दिनदले भा ।
भाश्रुतिकृत्योः कृतमनुयुतोनयोः कृतिरकर्षस्य ॥)
अयं पाठः साधुः

६८. (ङ) १. दिवसविभाजिता ज्यातत् for (दिवसार्द्ध विभाजितात् स्यात्)
२. कर्मगुणाः for (कर्मगुणा) ३. स्वानया for (प्तातया)
४. त्रिभज्याभक्तं for (त्रिज्यया)
(षड्गुणिता गतशेषा नाड्यो दिवसार्धभाजिता तज्ज्या ।
दिनदलकर्णगुणाऽप्तानया त्रिभज्या फलं कर्णः ॥ ६८ ॥) अयं पाठः साधुः

दिनदले[1] कर्णगुणे[2] त्रिज्या[3] निहते श्रवणोधृते फलस्य धनुः ।

द्युदलगुणं तिथिभक्तं दिनगतशेषावसः[5] क्रमशः ॥ ६९ ॥

[1]ज्याखंडोने शेषे ७० चापानयने नवशत ७१[2] ।

तिथिनक्षत्र ग्रहसंक्षिप्तोतिस्फुटश्चैवम् ॥ ७२ ॥

दुर्जनकृतघ्न शत्रु[1]प्रभृतीनामेषनि[2]वदातव्यः ।

ध्यानग्रहाधिकारो जिष्णुसुतब्रह्मगुप्तकृतः ॥ ७३ ॥

आर्याः १०९३ ॥ ॥ छः ॥ इति श्री ब्रह्मगुप्त सिद्धान्तः समाप्तः । श्रीरस्तु ॥ छः ॥ स्वस्ति श्री संवत् १६७८ वर्षे शाके १५४४ प्रवर्त्तमाने । उत्तरायने । वसंत ऋतौ । माहामङ्गलप्रदा । वैशाख शुदि १० बुधे, समये श्री राजनगरमध्य वातव्यं······लिखितमस्ति । स्वयं पठनार्थं । पठनार्थं तथा पुत्रपौत्र पठनार्थं तथा परोपकाराय । श्री कृष्णार्पणमस्तु । याद्रिशं पुस्त० । इत्यादि । भग्न द्रिष्टि । त्यादि । श्रीरस्तु ॥

इति समाप्तोऽयं ग्रन्थः ।

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६९. (ङ) १. दिनदलकर्णे for (दिनदलकर्णगुणे) २. त्रिभज्यागुणे for (त्रिज्या)

३. 'निहते' पद लुप्त है ।

४. श्रवणोद्धृते for (श्रवणोधृते) ५. शेषासवः for (शेषावसः)

७०. (ङ) १. ज्याखण्डोने शेषे गुणिते नवभिः शतैरशुद्धहृते ।

क्षेप्याणि शुद्धखण्डैर्गुणितानि शतानि नवचापम् ॥ ७० ॥ for

(ज्याखंडोने शेषे ॥ ७० ॥)

इति तिथिनक्षत्रदिनमाद्यादिकसिद्धौ ब्रह्मगुप्तेन ।

द्वासप्तत्यार्याणां संक्षिप्तोऽतिस्फुटश्चैषः ॥ ७० ॥ for

(चापानयने नवशत ॥ ७१ ॥)

२. ७२ वीं संख्या का श्लोक ७३ अंकित है । अगला पृष्ठ देखिये ।

७३. (ङ) इसकी श्लोक संख्या ७२ है ।

वामपार्श्वे लिखितम्] प्रथम दशध्याई पत्र प्रथम लितम् । पश्चात् कियत् दिवसे पंचदशाध्या इति लिखितमस्ति एवं पत्र ॥

१. प्रतिकञ्चुककारिणे for (प्रभृतीनामेष नि) २. न for (व)

३. +इति श्री ब्रह्मगुप्तकृतो ध्यानग्रहोपदेशाध्यायः समाप्तः ॥ +

अकारादिक्रमेण श्लोकानुक्रमणिका

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BRĀHMA-SPHUṬA SIDDHĀNTA

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श्रीब्रह्मगुप्ताचार्य-विरचित

ब्राह्मस्फुटसिद्धान्तः

(संस्कृत-हिन्दी-भाषायां वासनाविज्ञानभाष्याभ्यां समलंकृतः सोपपत्तिकः)

द्वितीय-भागः

प्रधानसम्पादक :

आचार्यवर पंडित रामस्वरूप शर्मा

(सञ्चालक-इंडियन इंस्टीटयूट आफ़ अस्ट्रानौमिकल एण्ड संस्कृत रिसर्च)

प्रकाशक :

इंडियन इंस्टीट्यूट आफ़ अस्ट्रानौमिकल एण्ड संस्कृत रिसर्च

गुरुद्वारा रोड, क़रौल बाग़, न्यू देहली-५ ।

प्रकाशक—
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२२३६, गुरुद्वारा रोड, करौल बाग,
नई दिल्ली-५ (भारत)

*

भारत सरकार के शिक्षा मन्त्रालय द्वारा प्रदत्त अनुदान से प्रकाशित।

*

सम्पादक मण्डल—

श्री रामस्वरूप शर्मा
प्रधान सम्पादक, सञ्चालक

श्री मुकुन्दमिश्र
ज्योतिषाचार्य

श्री विश्वनाथ झा
ज्योतिषाचार्य

श्री दयाशंकर दीक्षित
ज्योतिषाचार्य

श्री ओंदत्त शर्मा शास्त्री
एम. ए., एम. ओ. एल.

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प्रथम संस्करण
१९६६

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मूल्य रु० ६०.००

*

मुद्रक :
पद्म श्री प्रकाशन एण्ड प्रिण्टर्स
१२, चमेलियन रोड,
दिल्ली।

समर्पण :

श्रीयुत एस० के० पाटिल
यूनियन मिनिस्टर फ़ार रेल्वेज़
को
सादर समर्पित

Dedicated to

Shri S. K. Patil

Union Minister for Railways

विषयानुक्रमणिका

ब्राह्मस्फुटसिद्धान्तः

७

मध्यमाधिकारः

❀ श्रीगणेशाय नमः ❀

सकलगणकसार्वभौम-सर्वतन्त्रस्वतन्त्र-ग्रहादिवेधविधिज्ञ-श्रीब्रह्मगुप्ताचार्यप्रणीतः

ब्राह्मस्फुटसिद्धान्तः

विज्ञानभाष्योपपत्त्या तद्धिन्द्यनुवचनिकया च सहितः

मध्यमाधिकारः

तत्रादौ सकलगणकसार्वभौमः सर्वतन्त्रापरतन्त्रोऽद्वितीयो ग्रहादिवेधविधिज्ञो ब्रह्मगुप्ताचार्यो निर्विघ्नग्रन्थपरिसमाप्तये स्वेष्टदेमहादेवानुस्मरणरूपं मङ्गलाचरणमातनोति ।

जयति प्रणतसुरासुरमौलिगरत्नप्रभाच्छुरितपादः ।
कर्त्ता जगदुत्पत्तिस्थितिविलयानां महादेवः ।। १ ॥

अथ भाष्यकृद् मङ्गलं परामृशति

यद्दन्तोदन्तलक्ष्मीं दशसु विकरितुं दिक्षु सोमार्कतारा-
सारा स्फारप्रसारा अनुकलमुदयं यान्ति बिभ्राजमानाः ।
विघ्नक्षोणीध्रपक्षक्षपणनविमम्मुं मङ्गलोदञ्चिताङ्घ्रि-
न्यासं सिन्दूरभासं विनयविरचनैर्मन्महे सिन्धुरास्यम् ।। १ ॥

सूर्याब्जारबुधेन्द्रवन्द्यभृगुजच्छायासुतान् खेचरान्
वाग्देवीं च निधाय चेतसि मुदा रामस्वरूपो बुधः ।
ब्राह्मग्रन्थपयोधिलङ्घनचिकीर्षूणां कृते सश्रमं
सेवायामुपदीकरोति सुधियां विज्ञानभाष्यप्लवम् ।। २ ॥

आर्यब्रह्मवराहभास्करमुखास्त्रिस्कन्धविद्याचणा
भट्टः श्रीकमलाकरोऽथ विबुधौ श्रीसेनलल्लाभिधौ ।
भूपेन्द्रो जयसिंहनामभृदसौ यो यन्त्रशिल्पी नव-
स्ते चान्येऽपि मुनीश्वरप्रभृतयः श्रद्धास्पदं नः परम् ।। ३ ॥

गूढार्थैर्नु विसंज्ञतामुपगता श्रीब्रह्मणो भारती
तामुज्जीवयितुं श्रमेण मथितो ज्योतिस्त्रिपर्वाम्बुधिः ।
एतद्ध्यारुचि पीयताम्भुवि बुधै रामस्वरूपोदितम्
भूयो विज्ञमतल्लिकाभिरनघं विज्ञानभाष्यामृतम् ॥ ४॥

क्षीरमेव हि गृह्णन्ति हंसा सारविवेकिनः ।
एष्टुकामाः परे पङ्कं कोला लोला जलेष्वपि ॥ ५॥

वि. भा.—महादेवः (शङ्करः) जयति (सर्वोत्कर्षेण वर्त्तते), कीदृशः प्रणतसुरासुरमौलिगरत्नप्रभाच्छुरितपादः (प्रणता नतमस्तका ये सुरासुरा देवराक्षसास्तेषां मौलिगानि शिरोगतानि यानि रत्नानि हीरकादीनि तेषां प्रभाभिर्ज्योतिर्भिः, छुरितौ संमिश्रितौ पादौ चरणौ यस्य सः) पुनः कीदृश. जगदुत्पत्तिस्थितिविलयानां (जगतः संसारस्योत्पत्तिः प्रादुर्भावः स्थितिः संरक्षणमवस्थानं वा विलयो नाशस्तेषां कर्त्ता कारकोऽर्थात्संसारोत्पत्तिस्थितिविनाशानां कारणभूत इत्येतावता ब्रह्मगुप्तो महादेवमीश्वरं स्वीकरोतीति सिद्ध्यति, ईश्वरमन्तराऽन्येषां जगदुत्पत्तिस्थितिविनाशकरणसामर्थ्याभावात् । विषयस्यास्य दर्शनशास्त्रेण सम्बन्धोऽस्त्यतोऽत्र विशिष्य तद्विचारस्याऽवश्यकता नास्ति ॥ १ ॥

हि. भा.—प्रणाम करते हुए देवों और राक्षसों के मस्तक (शिर) पर स्थित रत्नों (हीरा आदि) की ज्योति से मिश्रित (मिले हुए) हैं दोनों चरण (पाँव) जिनके ऐसे महादेवजी सब तरह के उत्कर्ष से विद्यमान हैं. पुनः संसार की उत्पत्ति, स्थिति (अवस्थान) और विलय (नाश) के करने वाले हैं । ब्रह्मगुप्ताचार्य की इस उक्ति से महादेव में ईश्वरत्व सिद्ध होता है, क्योंकि जगत् की उत्पत्ति, स्थिति और विनाश करने की शक्ति ईश्वर से भिन्न किसी में नहीं हो सकती । इस विषय का दर्शन शास्त्रों से सम्बन्ध है इसलिए यहाँ उस पर विशेष विचार करने की आवश्यकता नहीं है ॥ १ ॥

इदानीं ग्रन्थारम्भप्रयोजनमाह ।

ब्रह्मोक्तं ग्रहगणितं महता कालेन यत् श्लथीभूतम् ।
अभिधीयते स्फुटं तज्जिष्णुसुतब्रह्मगुप्तेन ॥२॥

वि. भा.—ब्रह्मोक्तं (ब्रह्मणा कथितं) ग्रहगणितं (ब्रह्मसिद्धान्तः) यदस्ति महता कालेन श्लथीभूतं जातमर्थाद्बहुषु समयेषु व्यतीतेषु तत्र खिलीभूतत्वं समागतम् । तत् (तस्मात्कारणात्) जिष्णुसुतब्रह्मगुप्तेन (जिष्णुपुत्रब्रह्मगुप्त नामकेन मया) स्फुटं (स्पष्टं श्लथीभूतत्वरहितं वा) अभिधीयते । अधुनोपलब्धेषु ब्रह्मसिद्धान्तेषु शाकल्यसंहितान्तर्गत एकः, विष्णुधर्मोत्तरपुराणान्तर्गतो गद्यमयो द्वितीयः, पञ्चवर्षमययुगवर्णनात्मको वराहमिहिररचितपञ्चसिद्धान्तिकान्तर्गतस्तृतीयः । एतेषां मध्ये ब्रह्मगुप्तेन कतमः

स्फुटोऽभिधीयते इति स्पष्टं न कथ्यते, तथापि ग्रहभगणादिपठितमानानां समत्वाद्विष्णुधर्मोत्तरपुराणान्तर्गत एव ब्रह्मसिद्धान्तः प्रमाणीभूतत्वेन(आगमत्वेन) स्वीकृतो ब्रह्मगुप्तेन, 'युगमाहुः पञ्चाब्द' मित्यादिना पञ्चवर्षमययुगस्य तन्त्रपरीक्षाध्याये संहिताकारमतं वर्णयितुर्ब्रह्मगुप्तस्य मते ज्योतिषवेदाङ्गं ब्रह्ममतं नास्तीति स्पष्टम् । इदं वराहमिहिरमताद्भिन्नं सुगणकैर्बोध्यम् । सिद्धान्ततत्त्वविवेके 'अहो विष्णुधर्मोत्तरं चापि सम्यङ् न बुद्धमिति' कमलाकरोक्तादपि तदेव सिद्ध्यति। बहुषु समयेषु व्यतीतेषु तत्र ब्रह्मसिद्धान्ते कीदृशी श्लथीभूतता समागता तन्निराकृतिर्ब्रह्मगुप्तेन कीदृशी कृतेति ब्राह्मस्फुटसिद्धान्ते कुत्रापि नोपलभ्यते। तत्कथनं तथ्यमतथ्यं वेति विवेचका गाणितिका विवेचयन्त्विति ।। २ ।।

अब ग्रन्थारम्भ करने के कारण को कहते हैं।

हि. भा.—ब्रह्मा से कथित ग्रहगणित(ब्रह्मसिद्धान्त)जो है, बहुत समय में (कालान्तर में) उसमें खिलत्व आ गया है इसलिए मैं जिष्णुपुत्र ब्रह्मगुप्त उसको स्पष्ट कहता हूँ। इस समय ब्रह्मसिद्धान्त तीन प्रकार के उपलब्ध होते हैं। एक शाकल्यसंहितान्तर्गत, द्वितीय विष्णुधर्मोत्तरपुराणान्तर्गत गद्यमय और तृतीय पञ्चवर्षमययुगवर्णनात्मक वराहमिहिरकृत पञ्चसिद्धान्तिकान्तर्गत, इन तीनों में ब्रह्मगुप्ताचार्य किसको स्फुट करते हैं इस बात को स्पष्टरूप से नहीं कहते हैं तथापि पठित ग्रहभगणादिमानों के समत्व के कारण विष्णुधर्मोत्तरपुराणान्तर्गत ही ब्रह्मसिद्धान्त को ब्रह्मगुप्त आगमत्व करके स्वीकार करते हैं, पञ्चवर्षमय युग के तन्त्रपरीक्षाध्याय में 'युगमाहुः पञ्चाब्दं' इत्यादि से संहिताकार के मत को वर्णन करते हुए ब्रह्मगुप्त के मत में ज्योतिष वेदाङ्ग ब्रह्ममत नहीं है, यह स्पष्ट है। वराहमिहिराचार्य के मत से यह विरुद्ध है इसका गणक लोग विचार करें। सिद्धान्ततत्त्वविवेक में 'अहो विष्णुधर्मोत्तरं चापि सम्यङ् न बुद्धम्' इत्यादि कमलाकरोक्ति से भी स्पष्ट है। बहुत समय में (कालान्तर में) उस ब्रह्मसिद्धान्त में कैसी श्लथीभूतता आ गई और ब्रह्मगुप्त ने उनके निराकरण किस तरह किये, ये बातें ब्राह्मस्फुटसिद्धान्त में कहीं भी नहीं पाई जाती हैं, उनके कथन ठीक हैं या नहीं, विवेचक ज्योतिषी लोग विचार करें ।। २ ।।

इदानीं ज्योतिःशास्त्रमूलभूतस्य सग्रहस्य भचक्रस्य चलनमाह।

ध्रुवताराप्रतिबद्धज्योतिश्चक्रं प्रदक्षिणगमादौ ।
पौष्णाश्विन्यन्तस्थैः सह ग्रहैर्ब्रह्मणा सृष्टम् ॥३॥

वि. भा.—पौष्णाश्विन्यन्तस्थैः (पौष्णं रेवती, अश्विनी, तयोर्मध्य -(सन्धि-)-स्थितैः) ग्रहैः (सूर्यादिभिः) सह (साकं) ध्रुवताराप्रतिबद्धज्योतिश्चक्रं (ध्रुवद्वयगतरेखा ध्रुवयष्टी ध्रुवाक्षो वा तन्निबद्धं ज्योतिश्चक्रं ज्योतींषि तेजोमयानि नक्षत्राण्यन्यानि विशिष्टानि च तेषां चक्रं समूहं (भचक्रमित्यर्थः)

प्रदक्षिणगम् (दक्षिणावर्त्तक्रमेण चलायमानम्) आदौ (सर्वप्रथमं) ब्रह्मणा (जगदुत्पादकेन) सृष्टम् (रचितम्) अर्थादश्विन्यादौ स्थितैश्चन्द्रादिभिस्तदुच्चपातादिभिश्च साकं ध्रुवयष्ट्याधारेण भ्रमणशीलं ज्योतिर्मयपदार्थानां नक्षत्रादीनां चक्रं (गोलं) ब्रह्मणा रचितं यद्यप्यत्राचार्येणोच्चादीनां चर्चा न क्रियते तेषां स्वरूपाभावात् किन्तु सृष्ट्यादिकाले तेषामपि स्थानाङ्कनरूपसर्जनं कृतमिति ॥३॥

अत्र ज्योतिश्चक्रशब्देन भचक्रम् । भानां चक्रं भचक्रमेतावता यत्र भानि सन्ति स च गोलाकारः पदार्थः तदेव भचक्रशब्देन व्यवह्रियते, भचक्रे कथं गोलत्वं, भचक्रचलनज्ञानं, ग्रहाणां कथं पूर्वाभिमुखो गतिः चन्द्रादिग्रहाणां (चन्द्रबुधशुक्ररविकुजगुरुशनीनां) कथमेवमूर्ध्वाधः क्रमेण स्थितिरित्यादि-विविधविषयाणां विचारार्थं वटेश्वरसिद्धान्तोऽप्यवलोकनीयः भास्कराचार्येणापि 'सृष्ट्वा भचक्रं कमलोद्भवेन ग्रहैः सहैतद्भगणादिसंस्थै' रित्यादिना ब्रह्मगुप्तोक्तानुरूपमेव सर्वं कथितमिति ॥ ३ ॥

अब ज्योतिःशास्त्र के मूलभूत ग्रहसहित भचक्रचलन को कहते हैं।

हि. भा.—रेवती नक्षत्र और अश्विनी के मध्य में (सन्धि में) ग्रहों के साथ ध्रुवाक्ष (दोनों ध्रुवों में गई हुई रेखा) में बंधे हुए दक्षिणावर्त क्रम से भ्रमणशील ज्योतिश्चक्र (भचक्र) को सब से पहले ब्रह्मा ने बनाया अर्थात् अश्विन्यादि में स्थित चन्द्रादिग्रह और उनके उच्चादियों के साथ ध्रुवयष्टि के आधार पर भ्रमणशील नक्षत्र आदि ज्योतिर्मय पिण्डों के चक्र (गोल) को ब्रह्मा ने बनाया। यद्यपि यहां आचार्य उच्च आदि की चर्चा नहीं करते हैं क्योंकि उनके स्वरूप ग्रहों की तरह नहीं हैं किन्तु सृष्टि के आदिकाल में उनका भी स्थानाङ्कन किया ॥ ३ ॥

यहाँ ज्योतिश्चक्र शब्द से भचक्र समझना चाहिए। भचक्र (नक्षत्रों के गोल) शब्द से ज्ञात होता है कि नक्षत्र और ग्रह, सब जहां देखा जाता है गोलाकार पदार्थ है, उसी को भचक्र कहा गया है। भचक्र में गोलत्व क्यों है, भचक्रचलन क्या है और उसका ज्ञान कैसे होता है, ग्रहों की पूर्वाभिमुख गति क्यों है, ग्रहों (चन्द्र, बुध, शुक्र, रवि, भौम, गुरु, शनि) की इस तरह ऊर्ध्वाधः क्रम से स्थिति क्यों है, इत्यादि अनेक विषयों के विचार के लिए वटेश्वर सिद्धान्त का मध्यमाधिकार देखना चाहिए। भास्कराचार्य भी 'सृष्ट्वा भचक्रं कमलोद्भवेन ग्रहैः सहैतद्भगणादिसंस्थैः' इत्यादि से ब्रह्मगुप्त के अनुरूप ही कहते हैं ॥३॥

इदानीमनाद्यनन्तस्य कालस्य प्रवृत्तिमाह ।

चैत्रसितादेरुदयाद् भानोर्दिनमासवर्षयुगकल्पाः ।
सृष्ट्यादौ लङ्कायां समं प्रवृत्ता दिनेऽर्कस्य ॥ ४ ॥

वा. भा.—चैत्रशुक्लप्रतिपत्प्रभृति लंकोपलक्षितभूप्रदेशेऽर्कोदयाद्दिनोदयाः प्रवृत्ताः रविदिनवारः सृष्ट्यादौ कल्पादौ । ननु चैत्रादेरिति सिद्धं सितग्रहणमतिरिच्यते इति चेत्तन्न । यतोऽत्र विप्रतिपन्ना बहवः कृष्णप्रतिपदादिकं मासमिच्छन्ति तद्

व्युदासाय सितग्रहणम् ॥ ज्ञापकान्यत्र वेदस्मृतिवाक्यान्यपि योज्यानि "यासौ-वैशाखस्यामावास्या तस्यामादधीत सा रोहिण्या संपद्यते सोपरपक्षत्रैधीः प्रविशति, अपरपक्षे श्राद्धं कुर्वित्यादि" स्मृतिवाक्यानि योज्यानि । अथैवमुच्यते "एवमाह, संवत्सरस्य प्रथमरात्रिर्यत् फाल्गुनो पौर्णमासी, योत्तरा एषोत्तमा या पूर्वा" एतदपि वेदवाक्यमिति चेत्, अत्र पूर्वायाः फाल्गुन्याः पौर्णमास्या मासं प्रत्युत्तमत्वं न संभवति । यतो द्वितीयदिने या प्रतिपत्तस्या अपि फाल्गुनीत्वं न व्याहन्यते । तेन वाक्येन चाह । संवत्सरस्य प्रथमरात्रिर्यत्फाल्गुनी पौर्णमासी योत्तरेति । ततश्चादित्वमेवमस्यां वक्तुं शक्यते, द्वयोरपि तिथ्योः फाल्गुनीत्वात् । एतावदवगम्यते, गता फाल्गुनी पौर्णमासी नाद्यापि फाल्गुनो मासो गत इत्येवं स्थिते विचार्यते शेषवाक्यैः सह यत्राविरोधस्तत्रादित्वम् तदत्र स्वेच्छया न कलयितुं शक्यते । लङ्कायामित्यनेन ज्ञापयति क्व चेदृशे मध्याह्ने तत्रास्तमयेऽन्यत्रार्धरात्रेऽन्यत्राष्टघटिकाधिके गते काले कालादेः प्रवृत्त्या दिनप्रवृत्त्या मासादीनां प्रवृत्तिसिद्धौ पृथगुपादानं श्रावणादौ वर्षादिति वृत्त्यर्थम् ।

वि. भा.—सृष्ट्यादौ (सृष्ट्यादिकाले) चैत्रसितादेः (चैत्रशुक्लप्रतिपदादितः) लङ्कायां भानोरुदयात् (लङ्कासूर्योदयकालात्) अर्कस्य दिने (रविवारे) दिनमासवर्षयुगकल्पाः समं (एककालावच्छेदेन) प्रवृत्ता बभूवुरिति शेषः । व्यापकस्यानाद्यनन्तस्य कालस्य विभागो दिनमासवर्षयुगकल्पद्वारा लोकव्यवहारार्थं कृतोऽस्ति, एतेषामेव विभक्तकालावयवानां (दिनमासवर्षादीनां) सृष्ट्यादिकाले एककालावच्छेदेन प्रवृत्तिर्नामादिर्भवति, तथा च सृष्ट्यन्ते(प्रलयकाले) तेषामेव विभक्तकालावयवान्नामतो भवतीत्येतदनुसारेणैवावतरणे 'अनाद्यनन्तस्य कालस्य' इत्यादिलेखनं युक्तियुक्तं भवितुमर्हति, कथमन्यथा व्यापककालस्य प्रवृत्तिकथनं युक्तियुक्तं सङ्गच्छते । भास्कराचार्येणापि सिद्धान्तशिरोमणौ 'लङ्कानगर्यामुदयाच्च भानोस्तस्यैव वारे प्रथमं बभूव' इत्यादिना ब्रह्मगुप्तोक्तानुरूपमेव कथ्यत इति ॥ ४ ॥

अब अनादि (जिसका आदि नहीं) और अनन्त (जिसका अन्त नहीं है) इस काल की प्रवृत्ति कहते हैं ।

हि. भा.—चैत्र शुक्ल प्रतिपदादि से लङ्का में सूर्योदयकाल से रवि के दिन में सृष्ट्यादि (चैत्रशुक्ल प्रतिपदा रविवार लङ्कासूर्योदयकाल) में दिन मास वर्ष युग और कल्प इन सब की प्रवृत्ति एक ही समय में हुई । यहाँ व्यापक काल (जिसका आदि नहीं है और अन्त नहीं है) का विभाग दिन, मास, वर्ष, युग, कल्प के द्वारा लोकव्यवहार के लिए किया गया है । इन्हीं विभक्त कालावयवों (दिनमास-वर्ष आदि) की प्रवृत्ति सृष्ट्यादि काल में एक कालावच्छेदेन होती है और सृष्टि के अन्त (प्रलयकाल) में उन्हीं कालों का अन्त इसी के अनुसार अवतरण में, 'अनाद्यनन्तस्य कालस्येत्या'दि लिखना युक्तिसङ्गत होता है । ऐसा यदि नहीं होगा तो फिर व्यापक काल की

प्रवृत्ति कैसे युक्तियुक्त हो सकेगी । भास्कराचार्य भी सिद्धान्तशिरोमणि में 'लङ्कानगर्यामुदयाच्च भानोस्तस्यैव वारे प्रथमं बभूव' इत्यादि से ब्रह्मगुप्तोक्तानुरूप ही कहते हैं इति ॥ ४ ॥

वि. भा.—अथाऽत्र शास्त्रे पृथिव्याः सम्बन्धेनैव ग्रहादिकक्षादीनां सर्वोपयोगिविषयाणां ज्ञानं भवत्यत एतस्या आकृतिः कीदृशी तत्परिमाणं च कियदिति निर्णयार्थं विचारः । कुत्रचिद् वृक्षादिविरहितसमभुवि कियद्दूरस्थेष्टिकास्तम्भाग्रस्योद्दीपितशीशकघटप्रदीपं निशायां दृष्ट्वा किमिदमिति साशङ्को गतस्तत्संमुखम् । गत्वा चाऽऽसन्नं स्तम्भमूलेऽप्येकमन्यदीपमवलोक्य दृष्ट्यवरोधकाभावेऽपि कथं न दृष्टमिति विस्मितेन दृष्ट्यवरोधिका भूरेवेत्यनुमितमतो भूपृष्ठे वक्रत्वमस्तीति सिद्धम् ।

अथ सत्यपि वृक्षाग्राच्चतुर्दिक्षु समाऽऽकाशे भुव्येव पक्वं फलमेकं बहुत्र पतदवलोक्य भूपृष्ठनिष्ठाखिलबिन्दुष्वाकर्षणशक्तिरस्तीत्यनुमितम् । तथा मापनेन वृक्षाग्रात्पतनबिन्दुं यावत्सूत्रं < पतनेतरबिन्दुषु बद्धसूत्रेभ्य इति निर्णयात् भुवि बहिःस्थबिन्दोः पृष्ठस्थबिन्दुगरेखाणां बहिः खण्डेभ्योऽल्पं केन्द्रगरेखाबहिःखण्डमिति गोलीयनैसर्गिकधर्मदर्शनाद् गोलत्वमस्ति कच्चिदिति मतिः प्रासूत । अतस्तावद् गोलत्वं प्रकल्प्याऽत्र सन्ति गोलीयधर्मा न वेति परीक्षा क्रियते । कल्पनावशादुक्तापतनरेखा भूमध्यगैवातो भुवो मध्ये पृष्ठबिन्दुषु चाऽऽकर्षणशक्तिकल्पनया समकार्योत्पत्तेर्भूमध्य एव सर्वाधिका तच्छक्तिरस्तीति कल्प्यते । करोत्यवश्यं मतिमान् बहुभृत्यक्षमकार्यं यद्येकेन भवेत्तदा तत् । अतोऽवश्यं मतिमता ब्रह्मणा वस्त्वाकर्षणकार्ये भूपृष्ठबिन्दून् भृत्यान् विहायैक एव भूमध्यबिन्दुर्भृत्यो नियुक्तः ।

भुवि स्थानद्वये समस्तम्भद्वयमारोप्यैकस्तम्भस्य शीर्षशीर्षेतरबिन्दुभ्यां विद्धेऽन्यस्तम्भाग्रे जातत्र्यस्रे दृग्लग्नकोणे तदन्तःस्तम्भखण्डं च विज्ञाय कोणानुपातेन स्तम्भाग्रान्तरं विज्ञाय १८०—२ × एकस्तम्भाग्रलग्नकोण = वर्धितस्तम्भद्वयोत्पन्नभूमध्यलग्नकोण, उक्तत्रिभुजस्य समद्विबाहुकत्वात् । ततः कोणानुपातेन

$$\frac{\text{स्तम्भाग्रबद्धरेखा} \times \text{स्तम्भाग्रलग्नकोणज्या}}{\text{भूकेन्द्रलग्नकोणज्या}} = \text{भूव्यासार्ध} + \text{स्तम्भः} = \text{ज्ञातबाहु}$$

एवमन्येऽपि विषयाः ।

अथ विषुवांशयोरन्तरं क्रान्तिद्वयञ्च ज्ञात्वेष्टक्रान्त्यानयनार्थं परमक्रान्त्यानयनम् ।

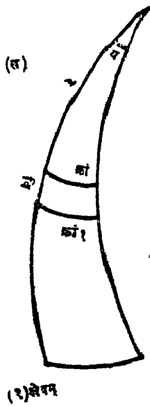
एतदानयनं वेधेन नव्यैः समुद्रयात्रादिना विलक्षणधियैव विहितं तत्तु सिद्धान्तसेतौ निवेशितम् । ततः ज्ञातबाह्वोः—स्तम्भौ = भूव्या $\frac{1}{2}$, एवं कृते

सर्वत्रैवमुपलब्धं फलसाम्यमतो भूर्गोलाकाराऽस्तीति सिद्धम् । न च यत्कल्पितं तत्सिद्धिरिति किं चित्रमतो नाऽस्या गोलत्वसिद्धिरिति वाच्यम् । गोलत्व-कल्पनया केवलं स्तम्भविशिष्टत्रिभुजे समद्विबाहुकत्वम् किन्तु सर्वत्र फलसाम्यं तु परीक्षामूलकमेव अतः शङ्का निरस्ता । वस्तुतस्तु भूर्दीर्घपिण्डानुकाराऽस्ति । परन्तु तत्र लघुव्यासबृहद्व्यासयोरत्यल्पान्तरत्वात्तयोः समत्वं कल्पितं सर्वैराचार्यवर्यैरिति ।

तत्र तावन्नाड़ीवृत्तं कालवृत्तं कथमित्युच्यते ।

प्रवहवायुना भ्राम्यमाणेऽपि भगोले बहुभिरपि वर्षैर्न खलु कासाञ्चित्तारकाणां स्थिरतयोपलब्धध्रुवताराङ्कितध्रुवस्थानाद् द्युज्याचापान्तरमुपलभ्यते । एतावतै-वावगतं यद् वास्तवभगोलपृष्ठनिष्ठस्थिरकेन्द्रोत्पन्ननाड़ीद्युनिशवृत्तयोर्धरातलस्थैर्यम्, तत्रैकरूपोपलब्धप्रवहवायुभ्राम्यमाणोक्तमण्डलद्वयस्यैवावलम्बेन कालगणनोचिता, अनाद्यनन्तस्याच्युतोपमकालस्यागमनिर्णीतसर्वदैकरूपत्वात् । इयमेव युक्तिः प्राचीनार्वाचीनघटीयन्त्रादिभिः कालावबोधेऽपीति ।

कदम्बाख्यताराया द्युज्याचापं स्थिरं कदम्बे ताराणां च चलं दृश्यते। तेन भचक्रस्य काचित्प्रवहेतरनिदानाऽपि गतिरस्तीत्यनुमितम् । सा च कदम्बोत्पन्न-महद्वृत्तरूपमार्गे स्यादिति गोलयुक्त्यैव स्फुटम् । अस्या आन्दोलिकाकारगतेः कारणं प्रवहाधिकरणकभचक्रत्यागकालिकस्रष्टृकराघातमेवेत्यनुमितम् । उक्तमहद्वृत्ते प्रवहप्रधानमार्गान्नाड़ीमण्डलात्प्रस्तुतगतिम् आन्दोलकं यावन्मितं भचक्रचलनसङ्कलनं तावदेवाचार्यैः प्रागपराख्या अयनांशाः परिभाषिताः । तत्साधनमुक्तमहावृत्ता-धिकरणकसार्वदिकावस्थानविशिष्टस्य पूर्णप्रकाशवतो नक्षत्रबिम्बस्य ग्रह-बिम्बस्य वाऽवलम्बेन कर्त्तुं शक्यम् अतस्तावत् सूर्यबिम्बस्यैव भचक्रचलनज्ञानं वेधेन निर्णीयते । तत्रोक्तमहावृत्तमार्गनिर्णयार्थं वेधगोलीयस्थिरगोलीय-(भगोलीय) नाड़ीवृत्तधरातलान्तरज्ञानेन वेधगोलीयक्रान्तिज्ञानेन च स्थिर-गोलीयक्रान्तिज्ञानं कथं भवेदित्यस्यैव ग्रन्थस्य चन्द्रभगणोपपत्तौ द्रष्टव्यम् । द्वितीयदिने षष्टिदण्डात्मककालेऽर्काधिष्ठानबिन्दुर्याम्योत्तरे (ध्रुवप्रोतवृत्ते तत्रैवागतोऽनन्तरं यावता कालेनार्को याम्योत्तरवृत्ते समागतस्तत्कालमानं षड्गुणितं रवेर्निरक्षोदययोर्विषुवांशयोरन्तरं स्याद्याम्योत्तरवृत्तस्य निरक्षदेशीय-क्षितिजत्वात् । क्रान्तिश्चोक्तयुक्त्या ज्ञाता । कृत्वैवं बहुषु दिनेषु गोलमेकं स्वाग्रे संस्थाप्य तत्र नाड़ीवृत्ताख्यं महद्वृत्तं विधाय तत्स्थेष्टबिन्दोः पूर्वपूर्वदिशि क्रमेण विषुवांशान्तरान् दत्वेष्टबिन्दौ प्रत्यग्र (दानाग्र) बिन्दौ च कृतध्रुवप्रोतवृत्तेषु तत्तत्क्रान्तो (प्रत्याह्निकक्रान्ती) र्दत्वा क्रान्तिद्वयाग्रलग्न महद्वृत्तकृतं तत्क्रान्त्यग्रेषु गतमित्युपलब्धम् । तेन रविभ्रमणमार्गो महावृत्तमिति सिद्धम् क्रान्त्यग्रे गतत्वा-त्तत्क्रान्तिवृत्तमिति संज्ञा शोभनेति ॥



नाड़ीक्रान्तिवृत्तयोरुत्पन्नकोणः=य=परमक्रान्तिः विषुवांशान्तरम्=वि. । मध्यावयवः=र तदा मध्यजा दोर्ज्यात्रिज्या गुणा प्रान्त्यस्पर्शरेखाहृतिर्भवेदिति नियमेन

$$\text{ज्यार}\times\text{त्रि}=\text{कोस्पय}\times\text{स्पक्रां}, \text{ तथा त्रि}\times\text{ज्या}(\text{र}+\text{वि})=\text{कोस्पय}\times\text{स्पक्रां}^{1}$$

$$\text{अतः}\frac{\text{ज्यार}\times\text{त्रि}}{\text{स्पक्रां}}=\frac{\text{ज्या}(\text{र}+\text{वि})\times\text{त्रि}}{\text{स्पक्रां}^{1}}$$

$$\text{ततः}\frac{\text{ज्यार}\times\text{स्पक्रां}^{1}}{\text{स्पक्रां}}=\text{ज्या}(\text{र}+\text{वि})$$

चापयोरिष्टयोर्दोर्ज्ये मिथः कोटिज्यकाहते, त्रिज्याभक्ते तयोरित्यादिना

$$\text{ज्या}(\text{र}+\text{वि})=\frac{\text{ज्यार}\times\text{कोज्यावि}+\text{कोज्यार}\times\text{ज्यावि}}{\text{त्रि}}=\frac{\text{ज्यार}+\text{स्पक्रां}^{1}}{\text{स्पक्रां}}$$

$$\text{ज्यार}\times\text{गु । अत्र }\frac{\text{स्पक्रां}^{1}}{\text{स्पक्रां}}=\text{गु}$$

पक्षौ त्रिगुणितौ तदा

$$\text{ज्यार}\times\text{कोज्यावि}+\text{कोज्यार}\times\text{ज्यावि}=\text{ज्यार}\times\text{गु}\times\text{त्रि} \text{ समशोधनेन}$$

$$\text{ज्यार}\times\text{गु}\times\text{त्रि}-\text{ज्यार}\times\text{कोज्यावि}=\text{कोज्यार}\times\text{ज्यावि}=\text{ज्यार }(\text{गु}+\text{त्रि}-\text{कोज्यावि})$$

$$\text{ततः}\quad\frac{\text{ज्यार}(\text{गु}\times\text{त्रि}-\text{कोज्यावि})}{\text{कोज्यार}}=\text{ज्यावि अतः}\frac{\text{ज्यार}}{\text{कोज्यार}}=\frac{\text{ज्यावि}}{\text{गु}\times\text{त्रि}-\text{कोज्यावि}}=\text{व्यक्त}$$

पक्षौ द्वादशभिर्गुणितौ तदा $\frac{\text{ज्यार}\times\text{१२}}{\text{कोज्यार}}$ =रतुल्याक्षदेशीयपलभा = १२ × व्यक्त, अस्या येऽक्षांशास्तदेव रमानम् । वा तावेव पक्षौ यदि त्रिगुणितौ तदा

$\frac{\text{ज्यार}\times\text{त्रि}}{\text{कोज्यार}}$ =रतुल्याक्षांशस्पर्शरेखा, स्पर्शरेखातः स्वापकरणेन रतुल्याक्षांशोऽर्थात्तद्देशीयाक्षांशमानमेव रमानम् । ततो य मानज्ञानं सुगममेवेति ॥

अथ यत्क्रान्तिवृत्ताधारं भचक्रचलनं तदेव निरूपितरविमार्गरूपक्रान्तिवृत्तमिति निर्णयः । ध्रुवस्थाने कदम्बं, याम्योत्तरवृत्तस्थाने कदम्बप्रोतवृत्तं, नाड़ीवृत्तस्थाने क्रान्तिवृत्तमक्षज्यास्थाने दृक्षेपञ्च नीत्वा चन्द्रभगणोपपत्तौ नाड़ीवृत्तधरातलान्तरज्ञानं ततो ग्रहगोलीयक्रान्त्यानयनार्थं या युक्तिः प्रदर्शिता सैवाऽत्राप्यनुसन्धेया

किन्त्वत्र 'लम्बरेखा ∽ अन्तर = ०' इत्युपलब्धमतः सिद्धम् ।

गोलद्वय (वेधगोलस्थिरगोल) केन्द्राभ्यां कदम्बे रेवत्याञ्च रेखे नीते तदा भूकेन्द्रलग्नकोणः = स्थिरगोलीया भगोलीया वा शरकोटिः = दृष्टिस्थानलग्नकोणः = वेधगोलीयशरकोटिः (कदम्बगतरेखयो रेवतीगतयोश्च रेखयोः समानान्तरत्वात्)। तद्नो नवत्यंशः = शरचापः = ०, इत्युपलब्धम् ।

अथ प्रकृतमनुसरामः ।

अथ गोलद्वयकेन्द्राभ्यां ध्रुवे रेवत्याञ्च रेखे नीते । तदा गोलद्वयकेन्द्रलग्नकोणमाने गोलद्वयीयद्युज्याचापमिते तुल्ये ध्रुवगतयो रेखयो रेवतीगतरेखयोश्च समानान्तरत्वात्, तेन ९० — रेवतीद्युज्याचापः = रेवतीक्रान्तिः

ततः $\frac{\text{त्रि} \times \text{ज्याक्रां}}{\text{ज्याजि}}$ = ज्याभु.

अस्याश्चापं रेवतीभुजांशाः = अयनांशाः । एते परमा = २७° भवन्ति ।

अत्र प्रसङ्गागतानां गोलद्वयीलग्नवित्रिभदृक्क्षेपचापाक्षांशचापादीनां समत्वोपपत्तिरूह्येति ।

अथ ग्रहाणां पूर्वाभिमुखगतिः कथमिति निर्णयः ।

प्रथमपदे ग्रहे तत्कालीनक्रान्तीनां वेधेन क्रमादधिकत्वं द्वितीयपदे ह्रासत्वं तृतीयपदे प्रथमपदवच्चतुर्थपदे च द्वितीयपदवद् दृश्यतेऽतो ग्रहाणां प्राग्गतित्वं सिद्धम् । ग्रहाणां बहुभिर्दिनैः प्रवहस्य त्वेकेनैवाह्ना भगणपूर्त्तिरतो ग्रहाणां तदल्पगतित्वं सिद्धम् ।

ग्रहपिण्डे गोलत्वं नवेत्येतदर्थं ग्रहाणाञ्चोर्ध्वाधररूपेणावस्थानमेतदर्थञ्च विचारः ।

गोलमेकं क्वापि संस्थाप्य दृष्टिस्थाने समायष्टित्रयस्तथा स्थापिता यथा गोलस्पर्शकराणि दृष्टिसूत्राणि भवेयुस्तानि च दृश्यवृत्ताधारसमसूचीकर्णगतानि, आधारवृत्तधरातलसमानान्तरं यष्ट्यग्रेषु मियोबद्धरेखात्रयजनितत्रिभुजोपरिष्ठवृत्तमुक्तसूच्याः कर्णाग्रेषु लगतीति सुस्पष्टम् । कृतवृत्तकेन्द्रगदृष्टिसूत्रं वर्धितं सदाधारवृत्तकेन्द्रगतञ्चैते गोलधर्माः । अथ तावद् ग्रहपिण्डे गोलत्वं प्रकल्प्योक्तगोलधर्मा दृश्यन्तेऽतो ग्रहपिण्डे गोलत्वं सिद्धम् । वेधेन ग्रहबिम्बीयकर्णानयनं कथं भवतीति मङ्गलगुरुशनीनां शीघ्रोच्चोपपत्त्यवसरेऽत्रैव ग्रन्थे प्रदर्शितम् । सर्वेषां ग्रहाणां तन्मानमतुल्यमायाति तेनैव हेतुना ग्रहाणां कक्षानिवेश ऊर्ध्वाधरक्रमेण (यस्य ग्रहस्य कर्णमानं यस्माद् ग्रहकर्णमानादधिकं तदीया कक्षा तद्ग्रहकक्षात उपरिगता भवतीत्यनुसारेण चन्द्रबुधशुक्ररविकुजगुरुशनिभानां कक्षाश्चन्द्रत उपरिक्रमेण) सर्वैराचार्यवर्यैः कृत इति ।

अथ सहग्रहैरिति कथं तदुच्यते ।

भूगर्भादिष्टव्यासार्धको हि गोलो भगोलः । भचक्रभगोलयोर्ध्रुवसूत्रयष्टिप्रोतत्वेन सहैवागमनादिभवनाद् भगोलसंसक्तयोर्मन्दगोलशीघ्रगोलयोर्ग्रहाधिकरणकयोरपि तेन सहैव गमनमिति सिद्धम् ।

ध्रुवसूत्राधिकरणकं पश्चिमाभिमुखं भचक्रभ्रमणम् । तत्सूत्रमध्ये स्रस्ट्रा कदम्बसूत्रं तथा निबद्धं यथा कदम्बसूत्रं भचक्रस्य पश्चिमाभिमुखभ्रमे विघ्नं न कुर्वत् स्रष्टृकराघातजनितभ्रमे भचक्रपृष्ठे कदम्बस्थाने खचितं भूत्वा स्थिरं भवति । तेन ध्रुवसूत्रध्रुवस्थानादुक्तवेगावरामान्तं प्रागपरदिशि २७° पर्यन्तं भचक्रपृष्ठं घर्षति । तेन ध्रुवतारा न स्थिरा केवलं ध्रुवस्थानमेव स्थिरमिति सिद्धमतस्तदन्ततारे च तथा ध्रुवत्वे इति भास्करोक्तं, ध्रुवतारां स्थिरां ग्रन्थे मन्यन्ते ते कुबुद्धय इति कमलाकरोक्तं च संगच्छत इति ।। एताभिरुपपत्तिभिः 'ध्रुवताराप्रतिबद्धज्योतिश्चक्रमि' त्याद्याचार्योक्तं सर्वं युक्तियुक्तमुपपद्यत इति ।।

हि. भा.—इस ज्योतिष सिद्धान्त में पृथिवी के सम्बन्ध ही से सर्वोपयोगी ग्रहादि कक्षा आदि का ज्ञान होता है, इसलिए इसकी आकृति कैसी है, उसका परिमाण कितना है, इन सब के निर्णय के लिए विचार करते हैं। किसी वृक्ष आदि से रहित समान पृथिवी में दूर में ईंटों के बने हुए खम्भ के अग्र में जलते हुए लालटेन को रात में देखकर 'क्या बात है' इस आशङ्का से उसकी तरफ चले, उसके समीप जाकर खम्भा के जड़ में भी जलती हुई एक लालटेन को देखकर दृष्टि के रोकने वाली चीजों के नहीं रहने पर भी क्यों देखने में नहीं आया यह शंका हुई और विचार करने पर मालूम हुआ कि दृष्टि को रोकने वाली पृथिवी ही है इसलिए पृथिवी के पृष्ठ में वक्रत्व है । यह सिद्ध हुआ ।

चारों तरफ आकाश के बराबर रहने पर पृथिवी ही के ऊपर बहुत जगह पके हुए फल को गिरता हुआ देखकर भूपृष्ठ-स्थित प्रत्येक बिन्दु में आकर्षण शक्ति है यह अनुमान किया गया। और मापन करने से वृक्ष के अग्र से गिरे हुए बिन्दु तक बद्धसूत्र $<$ फलों के गिरने के स्थानों से भिन्न बिन्दुओं से वृक्षाग्र तक सूत्र, इस निर्णय से पृथिवी में बहिःस्थित बिन्दु से पृष्ठस्थ बिन्दुगत रेखाओं के बहिःखण्डों से केन्द्रगत रेखा बहिःखण्ड अल्प होता है यह गोलसम्बन्धी स्वाभाविक धर्म देखने से इसमें किसी तरह का गोलत्व है यह मन में आया । इसलिए पहले इसमें गोलत्व कल्पना कर के देखना चाहिए कि इसमें गोलीय धर्म है या नहीं । पृथिवी के ऊपर दो स्थानों में समान दो खम्भों को गाड़कर एक खम्भा के शीर्ष स्थान से और शीर्ष स्थान से कुछ हट कर उसी खम्भा में दृष्टि स्थान रखकर दूसरे खम्भा के अग्र को वेध किए, दोनों खम्भा के अग्र में सूत्र बांध दिये तब जो एक त्रिभुज बनता है उसमें स्तम्भाग्र प्रथम दृष्टिस्थान और उस से भिन्न स्थल में जो दृष्टि स्थान रखे हैं इन दोनों दृष्टिस्थान लग्न कोणों को मापन द्वारा जानकर तथा दृष्टिस्थान द्वयान्तर्गत रेखा को भी मापन से जानकर कोणानुपात से खम्भों के अग्रान्तर समझकर $१८० - २ \times$ एक स्तम्भाग्रलग्नकोण $=$ वर्धितस्तम्भद्वयोत्पन्नभूकेन्द्रलग्नकोण क्योंकि दोनों खम्भों से और खम्भों के अग्रान्तर से जो त्रिभुज बनता है वह समद्विबाहुक है। तब कोणानुपात करते हैं—

$$\frac{\text{खम्भों के अग्रगत रेखा} \times \text{खम्भा के, अग्रलग्न कोणज्या}}{\text{भूकेन्द्रलग्न कोणज्या}} = \text{भूव्यासार्ध} + \text{खम्भा} = \text{ज्ञातबाहु}.$$

इसी तरह दूसरे स्तम्भ प्रमाण के लिए भी करना, उसका प्रमाण भी इतना ही आता है अतः दोनों ज्ञातबाहु—दोनों खम्भा = भूव्यासार्ध, इस तरह प्रत्येक जगह में फल (भूव्यासार्ध) बराबर आता है इसलिए पृथिवी गोलाकार है यह सिद्ध है। आनीत भूव्यासार्ध को दूना कर देने से भूव्यास होता है तब 'व्यासे भनन्दाग्निहते विभक्ते खबाणसूर्यैः' इससे भूपरिधि का ज्ञान होगा। वस्तुतः पृथिवी का पिण्ड दीर्घपिण्ड के आकार का है लेकिन इसके लघु व्यास, और बृहद्व्यास में बहुत ही कम अन्तर होने के कारण दोनों व्यासों को आचार्य ने बराबर मान लिया।

नाड़ीवृत्त कालवृत्त क्यों है यह कहते हैं।

प्रवह वायुद्वारा भगोल को घुमाने पर भी बहुत वर्षों में भी स्थिरता से प्राप्त ध्रुवतारा से चिह्नित ध्रुवस्थान से किसी तारा के अन्तर द्युज्याचाप उपलब्ध नहीं होता है, इसी से समझा गया कि वास्तव भगोल पृष्ठनिष्ठ स्थिर केन्द्र से उत्पन्न नाड़ीवृत्त और अहोरात्र वृत्त के धरातल में स्थिरता है वहां एक रूप से प्राप्त प्रवह वायुद्वारा घुमाये हुए उन्हीं दोनों वृत्तों की सहायता से कालगणना उचित है, क्योंकि जिस काल का न आदि है न अन्त है ऐसे काल का रूप आगम प्रमाण से सदा एक रूप है। यही युक्ति प्राचीन और नवीन घटीयन्त्रादि के द्वारा कालज्ञान के लिए है।

कदम्ब तारा का द्युज्या चाप स्थिर है और कदम्बस्थान में ताराओं को चल देखते हैं इससे सिद्ध होता है कि प्रवहगति के अलावा भी भचक्र की कोई गति है वह कदम्बोत्पन्न महद्वृत्त रूप मार्ग में होता है। इस आन्दोलिकाकार गति के कारण प्रवहाधार भचक्रत्यागकालिक ब्रह्मा के हाथ का आघात ही हो सकता है। उस महद्वृत्त में प्रवह के नाड़ीवृत्तरूप प्रधान मार्ग से प्रस्तुत गति के कारणभूत भचक्रचलन का सङ्कलन जितना होता है उतना ही आचार्य पूर्वायनांश और पश्चिमायनांश कहते हैं। उसके साधन पूर्वकथित महद्वृत्त के आधार पर बराबर रहने वाले अतिप्रकाशमान नक्षत्रबिम्ब के या ग्रहबिम्ब के अवलम्बन [आधार] से कर सकते हैं। अतः वेध से भचक्रचलन ज्ञान करते हैं। पूर्व-कथित महद्वृत्त मार्गनिर्णय के लिए वेधगोलीय और स्थिरगोलीय (भगोलीय) नाड़ीवृत्तधरातलान्तर ज्ञान से तथा वेधगोलीय क्रान्तिज्ञान से भगोलीय क्रान्तिज्ञानप्रकार इसी ग्रन्थ में चन्द्र भगण की उपपत्ति में देखना चाहिए।

द्वितीय दिन में षष्टि ६० दण्डात्मक काल में रवि जिस बिन्दु में प्रथम दिन में थे वह बिन्दु याम्योत्तरवृत्त (ध्रुवप्रोतवृत्त) में वहीं पर आया। उसके बाद जितने काल में रवि याम्योत्तरवृत्त में आये उस कालमान को छह से गुणने से रवि के निरक्षदेशीय उदयमानद्वय (विषुवांशद्वय) का अन्तर होता है, क्योंकि याम्योत्तरवृत्त निरक्षदेशीय क्षितिज वृत्त है। पूर्व युक्ति से क्रान्तिज्ञान भी कर लिया; इस तरह अनेक दिनों में करके अपने आगे

एक गोल को रखकर उसमें नाड़ीवृत्त संज्ञक महद्वृत्त की रचना कर उसके किसी इष्ट-बिन्दु से पूर्व पूर्वदिशाक्रम से विषुवांशान्तर दान देकर इष्टबिन्दु और प्रत्येक दानाग्र बिन्दुगत ध्रुवप्रोत वृत्तों में प्रत्येक दिन की क्रान्ति दान देकर दो क्रान्तियों के अग्रगत जो महद्वृत्त किया जायगा वह प्रत्येक क्रान्ति के अग्रगत होता है ऐसा उपलब्ध होता है इसलिए रवि का भ्रमण-मार्ग महद्वृत्त सिद्ध हुआ और वह वृत्त प्रत्येक क्रान्ति के अग्र में गया हुआ है, इस लिए उसका नाम क्रान्तिवृत्त है । इति ।

अब विषुवांशद्वय के अन्तर और क्रान्तिद्वय जानकर इष्टक्रान्तिज्ञान के लिए परम क्रान्ति का आनयन करते हैं ।

यहां संस्कृत में इसी की उपपत्ति में (१) क्षेत्र को देखिये । नाड़ीवृत्त और क्रान्तिवृत्त से उत्पन्न कोण=परमक्रान्ति=य विषुवांशान्तर = वि, मध्यावयव = र, तब 'मध्यजा दोर्ज्या त्रिज्या गुणा प्रान्त्यस्पर्शहतिर्भवेत्' इससे ज्यार × त्रि = कोस्पय × स्पक्रां, तथा त्रि × ज्या (र + वि) = कोस्पय × स्पक्रां₁ । यहां प्रथम क्रान्ति = क्रां । द्वितीय-क्रान्ति = क्रां₁

$$\therefore \frac{\text{ज्यार} \times \text{त्रि}}{\text{स्पक्रां}} = \text{कोस्पय} = \frac{\text{त्रि} \times \text{ज्या}\ (\text{र} + \text{वि})}{\text{स्पक्रां}_1}\ \text{तब} \frac{\text{ज्यार} \times \text{स्पक्रां}_1}{\text{स्पक्रां}} = \text{ज्या}\ (\text{र} + \text{वि}),$$

चापयोरिष्टयोर्दोर्ज्ये मिथः कोटिज्यकाहते इत्यादि से ज्या (र + वि) =

$$\frac{\text{ज्यार} \times \text{कोज्यावि} + \text{कोज्यार} \times \text{ज्यावि}}{\text{त्रि}} = \frac{\text{ज्यार} \times \text{स्पक्रां}_1}{\text{स्पक्रां}} = \text{ज्यार} \times \text{गु} \quad \Big|\ \text{यहां} \frac{\text{स्पक्रां}_1}{\text{स्पक्रां}} = \text{गु}$$

दोनों पक्षों को त्रि से गुणने से

ज्यार × कोज्यावि + कोज्यार × ज्यावि = ज्यार × गु × त्रि, समशोधन करने से

ज्यार × गु × त्रि — ज्यार × कोज्यावि = ज्यार (गु × त्रि — कोज्यावि) = कोज्यार × ज्यावि, परस्पर गुणाङ्क से भाग देने से—

$$\frac{\text{ज्यार}}{\text{कोज्यार}} = \frac{\text{ज्यावि}}{\text{गु} \times \text{त्रि} - \text{कोज्यावि}} = \text{व्यक्त, दोनों पक्षों को बारह से गुणने से}\ \frac{\text{ज्यार} \times 12}{\text{कोज्यार}}$$

= १२ × व्यक्त = रतुल्याक्ष देशीय पलभा इससे जो अक्षांश होगा वही 'र' का मान होगा । अथवा उन्हीं दिनों पक्षों को यदि त्रि से गुण देते हैं तो $\frac{\text{ज्यार} \times \text{त्रि}}{\text{कोज्यार}}$ = त्रि × व्य = स्पर = रतुल्याक्षांशस्पर्शरेखा, स्पर्शरेखाखण्ड से चाप करने से 'र' का मान ही उस देश का अक्षांशमान होता है, इस पर से 'य' का मानज्ञान सुलभ ही है ।।

अब जिस क्रान्तिवृत्त के आधार पर भचक्र का चलन होता है, वही पूर्वकथित रविभ्रमण मार्ग रूप क्रान्तिवृत्त है इसका निर्णय किया जाता है—ध्रुव के स्थान में कदम्ब, याम्योत्तर वृत्त के स्थान में कदम्बप्रोतवृत्त, नाड़ीवृत्त के स्थान में क्रान्तिवृत्त और अक्षज्या के

स्थान में दृक्क्षेप लेकर आगे चन्द्रभगण की उपपत्ति में प्रदर्शित नाड़ीवृत्तधरातलान्तर ज्ञान उससे ग्रहगोलीय क्रान्ति के आनयन के लिए जो युक्ति है वही यहां भी समझनी चाहिए किन्तु यहां 'लम्बरेखा ∽ अन्तर=० उपलब्ध होता है; अत: सिद्ध हुआ।

अब रेवती में शराभाव क्यों होता है इसका निर्णय करते हैं।

गोलद्वय(वेधगोल और भगोल)के केन्द्रों से कदम्ब में और रेवती में जो रेखा लाये वे दोनों समानान्तर हैं अर्थात् कदम्बगत रेखाद्वय समानान्तर है तथा रेवतीगत रेखाद्वय भी समानान्तर है। इसलिए भूकेन्द्रलग्नकोण=स्थिरगोलीय या भगोलीय शरकोटि=दृष्टि-स्थान लग्न कोण=वेधगोलीय शरकोटि, अत: इसको नवत्यंश में घटाने से शरचाप=० यह उपलब्ध हुआ इस लिए रेवती का शराभाव सिद्ध हुआ।

अब प्रकृत विषय (अयनांश) का आनयन करते हैं।

गोलद्वय केन्द्रों (भूकेन्द्र और दृष्टिस्थान) से ध्रुव में और रेवती में रेखायें लाये तब गोलद्वय केन्द्रलग्न कोणमान द्युज्याचाप बराबर होते हैं (क्योंकि गोलद्वय केन्द्रों से ध्रुवगत रेखाद्वय समानान्तर है तथा रेवतीगत रेखाद्वय भी समानान्तर है) इसलिए ९० — रेवती द्युज्याचाप=रेवती क्रान्ति, तब $\frac{\text{त्रि} \times \text{ज्याक्रां}}{\text{ज्यां़ज}}$=ज्याभु, इसके चाप करने से रेवती का भुजांश=अयनांश, यह परम (परमायनांश)=२७° होता है।

यहां प्रसङ्गवश आये हुए दोनों गोलों के लग्न, वित्रिभदृक्क्षेपचाप, अक्षांशचाप आदि की समत्व उपपत्ति स्वयमेव समझनी चाहिए।

अब ग्रहों की पूर्वाभिमुखगति क्यों है इसका निर्णय करते हैं।

प्रथमपद में ग्रह के रहने से उनकी तात्कालिक क्रान्ति की वृद्धि, द्वितीयपद में ह्रास (क्षीणत्व) तृतीयपद में प्रथमपद की तरह और चतुर्थपद में द्वितीयपद की तरह स्थिति वेध से देखते हैं। इसलिए ग्रहों की पूर्वाभिमुख गति है यह सिद्ध हुआ। और ग्रहों की भगण-पूर्ति बहुत दिनों में होती है तथा प्रवह की भगणपूर्ति एक ही दिन में होती है इसलिए प्रवहगति की अपेक्षा ग्रहगति की अल्पता भी सिद्ध हुई।

अब ग्रहपिण्डों में गोलत्व है या नहीं और ग्रहों की स्थिति ऊर्ध्वाधर क्रम से क्यों है इनके लिए विचार करते हैं।

एक गोल को कहीं पर रखकर दृष्टिस्थान में मूल (जड़) मिलित समान यष्टित्रय को इस तरह रखना चाहिए जिस से दृष्टिसूत्र सब गोल के स्पर्शकारक (याने गोल स्पर्शरेखायें) हो और वे दृश्यवृत्ताधार समसूची कर्णगत हो। यष्टियों के अग्रों में परस्पर रेखा करने से जो त्रिभुज बनता है उसके ऊपर जो वृत्त होता है उसका धरातल आधारवृत्त धरातल के समानान्तर है और पूर्वकथित समसूची के कर्णाग्रों में जाता है।

परस्पर समयष्टित्रयाग्रगतरेखाजनितत्रिभुजोपरिगत वृत्तकेन्द्र में दृष्टिस्थान से जा दृष्टिसूत्र आवेगा उसको बढ़ाने से आधार वृत्त केन्द्रगत भी होता है ये सब गोल ही धर्म है क्योंकि ये सब बातें गोलात्मक पदार्थ ही में हो सकती हैं। आचार्य ग्रहपिण्डों में गोलत्व स्वीकार कर पूर्व-कथित गोलीय धर्म देखते हैं इसलिए ग्रहपिण्डों में गोलत्व सिद्ध हुआ। वेध से ग्रहबिम्बीय कर्णज्ञान कैसे होता है इसे इसी ग्रन्थ में मङ्गलगुरु और शनि की शीघ्रोच्चोपपत्ति स्थल में देखना चाहिए। सब ग्रहों के बिम्बीय कर्णमान अतुल्य उपलब्ध हुए इसीलिए ग्रहों के कक्षानिवेश ऊर्ध्वाधर क्रम से (जिस ग्रह का कर्णमान जिस दूसरे ग्रह के कर्णमान से अधिक उपलब्ध हुआ उसकी कक्षा उस दूसरे ग्रह की कक्षा से उपरिगत हुई इसके अनुसार) चन्द्र, बुध, शुक्र, रवि, कुज, गुरु, शनि और नक्षत्रों की कक्षायें चन्द्र से उपरिक्रम से सब आचार्यों ने अपने-अपने सिद्धान्त ग्रन्थों में लिखी हैं।

'सहग्रहैः' इसकी युक्ति।

भूगर्भ से इष्टत्रिज्या व्यासार्ध से जो गोल होता है, वह भगोल है। ध्रुवसूत्र रूप यष्टी में बन्धे हुए भचक्र और भगोल के साथ-साथ आने-जाने के कारण उनसे मिले हुए मन्दगोल और शीघ्रगोल (जो ग्रहों के आधार गोल हैं) के भी भ्रमणादि उनके साथ ही होते हैं यह सिद्ध हुआ ॥+

इन उपपत्तियों से 'ध्रुवताराप्रतिबद्धज्योतिश्चक्रं' इत्यादि आचार्योक्त सब सिद्ध हुआ।

ध्रुवसूत्रयष्टी के आधार पर पश्चिमाभिमुख भचक्र भ्रमण होता है। उस (ध्रुवयष्टी) के मध्य में ब्रह्मा ने कदम्बसूत्र इस तरह बांध दिया जिससे वह कदम्बसूत्र भचक्र के पश्चिमाभिमुख भ्रमण में विघ्न नहीं करते हुए ब्रह्मा के हाथ के आघात से उत्पन्न भ्रमण में भचक्र के पृष्ठ में कदम्ब स्थान में खचित (जड़ा हुआ) होकर स्थिर हो इसलिए ध्रुवसूत्र ध्रुवस्थान से कथितवेग (गति) की समाप्ति तक पूर्व और पश्चिम तरफ २७° अंश पर्यन्त भचक्रपृष्ठ को घिसता है अतः ध्रुवतारा स्थिर नहीं है केवल ध्रुवस्थान ही स्थिर है यह सिद्ध हुआ, इसलिए 'तदन्ततारे च तथा ध्रुवत्वे' यह भास्करोक्त 'ध्रुवतारां स्थिरां ग्रन्थे मन्यन्ते ते कुबुद्धयः' यह कमलाकरोक्त भी युक्तिसङ्गत है।

इदानीं कालेऽब्दस्य क्षेत्रस्य भगणस्य च तुल्यां विभागकल्पनां प्रदर्शयन्नाह।

प्राणैर्विनाड़िकार्क्षी षड्भिर्घटिका विनाड़िका षष्ट्या।
घटिका षष्ट्या दिवसो दिवसानां त्रिंशता भवेन्मासः ॥ ५ ॥

मासा द्वादश वर्षं विकला लिप्तांश-राशि-भगणान्तः।
क्षेत्रविभागस्तुल्यः कालेन विनाड़िकाद्येन ॥ ६ ॥

वा. भा.—प्राणैः षड्भिरार्क्षी विनाड़िका भवति। ऋक्षाणामियमृक्षाणां विषुवन्मण्डलसंबन्धिनीति यावत्। यतो विषुवन्मण्डलमेव प्राणेन कलामुदेति। नापमण्डलमथवा सर्वस्यैव च नक्षत्रस्य स्वोदयाद् यावत् षष्टिघटिका भवन्ति, अगतिमत्त्वात्। ग्रहाणां पुनर्गतिवश्याद्भिद्यते। अतः शोभनमुक्तं विनाड़िकार्क्षी षड्भिः प्राणैर्भवति इति। प्राणश्च स्वस्थेन्द्रियस्य स्वपतो जाग्रतो वा गृह्यते। न रोगाद्यपहृतस्य। तासां विनाड़िकानां षष्ट्या घटिका घटिकानां षष्ट्या दिवसो भवति। दिवसानां त्रिंशता मासो भवति।

मासैर्द्वादशभिः वर्षो भवति, एवं कालविभागो विनाडिका, नाडिका, दिवसः, मासो वर्षान्तः क्षेत्रविभागोऽप्येवम् यथा विनाडिकानां षष्ट्या घटिका। एवं विकलानां षष्ट्या लिप्ता भवति। यथा घटिकानां षष्ट्या दिवस एवं लिप्तानां षष्ट्यांशः, यथा दिवसानां त्रिंशता मास एवम्मासानां त्रिंशता राशिः, यथा मासैर्द्वादशभिः वर्षमेवं द्वादशभीराशिभिर्भगण इत्यर्थः। अत उक्तं विकलालिप्तांशराशिभगणान्तः क्षेत्रविभागतुल्यः कालेन विनाडिकाद्येन। अत्र विभागकल्पनया तुल्यत्वमुच्यते। अथवा कलया विनाड़िकास्ताः क्षेत्रे षड्लिप्ता भवन्ति विषुवन्मण्डले। एतद् गोले प्रदर्शयेदिति।

वि. भा.—षड्भिः प्राणैः (षड्भिरसुभिः) आर्क्षी विनाड़िका (नाक्षत्री विघटिका) भवति, विनाडिका षष्ट्यैका घटिका (एको दण्डः) घटिकाषष्ट्या (दण्डषष्ट्या) दिवसः (एकं दिनं) दिवसानां (दिनानां) त्रिंशता (त्रिंशत्तुल्येन) मासो भवति, द्वादशभिः मासैः वर्षं (सौरवर्षं) भवति, विनाड़िकाद्येन (पलदण्डदिनमासवर्षेण) कालेन तुल्यो विकला लिप्तांशराशिभगणान्तः (विकला-कलांशराशिभगणाः) क्षेत्रविभागो ज्ञेयोऽर्थाद्यथैकवर्षस्य मासदिनादयो विभागास्तथैव भगणस्य राश्यंशादय इत्यधो विलिख्य प्रदर्श्यते—

	एतत्सदृशा एव क्षेत्रीय (कक्षा) विभागा यथा—
६ असवः =१ पलम्	
६० पलानि =१ घटिका	६० विकलाः =१ कला
६० घटिकाः =१ दिनम्	६० कलाः =१ अंशः
३० दिनानि =१ मासः	३० अंशाः =१ राशिः
१२ मासाः =१ वर्षम्	१२ राशयः =१ भगणः

सिद्धान्तशिरोमणौ भास्कराचार्येण 'क्षेत्रे समाद्येन समा विभागाः स्युश्चक्रराश्यंशकलाविलिप्ताः' इत्यनेन सिद्धान्तशेखरे श्रीपतिना च 'एवं चक्रर्क्षांशलिप्ताविलिप्तास्तुल्याः क्षेत्रेऽनेहसाऽब्दादिकेनेत्या'दिना ब्रह्मगुप्तोक्तानुरूपमेव कथ्यते, किन्तु 'अक्ष्णोर्निमेषः कथितो निमेषस्त्रिशद्विभागोऽस्य च तत्परा स्यादि'त्यादिना श्रीपतिना, योऽक्ष्णोर्निमेषस्य खरामभागः स तत्परस्तच्छतभाग उक्त' इत्यादिना भास्करेण च ब्रह्मगुप्तोक्तादधिकं कथ्यते, वटेश्वरसिद्धान्ते निमिषादेर्या परिमितयः परिभाषितास्ततो भिन्ना एवोपर्युक्ताचार्यकथिताः। सर्वान् विलोक्य विवेचका गाणितिका विवेचयन्त्विति ॥ ५-६ ॥

अब कालमानों की विभागकल्पना को कहते हैं।

हि. भा.—छह असु की एक नाक्षत्री विघटिका (पल) होती है, साठ पल की एक घटी (दण्ड) होती है। साठ घटी का एक दिन होता है, तीस दिनों का एक मास होता है। बारह मासों का एक वर्ष होता है। पल, दण्ड, दिन, मास, और वर्ष इन्हीं के बराबर क्षेत्रीय (कक्षा) विभाग विकला, कला, अंश, राशि और भगण हैं अर्थात् जैसे एक वर्ष का विभाग मास, दिन आदि हैं वैसे ही एक भगण का विभाग राशि, अंश आदि हैं। इनके स्पष्टीकरण के लिए नीचे लिखकर दिखलाता हूँ।

इन के बराबर ही क्षेत्रीय (कक्षा) विभाग होता है। जैसे—

६ असु = १ पल	विकला —
६० पल = १ घटी	६० विकला = १ कला
६० घटी = १ दिन	६० कला = १ अंश
३० दिन = १ मास	३० अंश = १२ राशि
१२ मास = १ वर्ष	१२ राशि = १ भगण

सिद्धान्तशिरोमणि में भास्कराचार्य 'क्षेत्रे समाद्येन समा विभागाः स्युश्चक्रराश्यंशकला-विलिप्ताः' इससे तथा सिद्धान्तशेखर में श्रीपति 'एवं चक्रक्षांशलिप्ता विलिप्तास्तुल्याः क्षेत्रेऽनेह-साऽब्दादिकेन, इससे ब्रह्मगुप्तोक्त के अनुरूप ही कहते हैं लेकिन, 'अक्ष्णोर्निमेषः कथितो निमेषस्त्रिंशद्विभागोऽस्य च तत्परा स्यात्' इत्यादि से श्रीपति तथा 'योऽक्ष्णोर्निमेषस्य खरामभागः स तत्परस्तच्छतभाग उक्ता' इत्यादि से भास्कराचार्य भी ब्रह्मगुप्तोक्त से अधिक कहते हैं। वटेश्वरसिद्धान्त में वटेश्वराचार्य निमिष आदि कालप्रमाण की जो परिभाषायें करते हैं वे श्रीपत्यादिकथित उनके मानों की परिभाषाओं से भिन्न ही हैं। इन सब बातों को देखकर विवेचक ज्योतिषी लोग विचार करें इति ॥५-६॥

चतुर्युगसंख्या युगचरणमानानि च प्रदर्शयन्नामभ्यामाह।

खचतुष्टयरदवेदा ४३२०००० रविवर्षाणां चतुर्युगं भवति।
सन्ध्यासन्ध्यांशैः सह चत्वारि पृथक् कृतादीनि ॥ ७ ॥

युगदशभागो गुणितः कृतं १७२८००० चतुर्भिस्त्रिभिर्गुण १२९६००० स्त्रेता।
द्विगुणो ८६४००० द्वापरमेकेन सङ्गुणः ४३२००० कलियुगं भवति ॥८॥

वा. भा.—रविवर्षाणां खचतुष्टयरदवेदसंख्यया चतुर्युगं भवति। खचतुष्ट-यरदवेदाश्चाथ प्रदक्षिणेन स्थाप्यमानाः त्रिचत्वारिंशल्लक्षाणि विंशतिश्च सहस्राणि भवन्ति ४३२०००० संध्यासंध्यांशैः सहेति येयं चतुर्युगसंख्या मयाभिहितैषा संध्या-संध्यांशैश्च सह। संध्या च कृतादीनां स्वद्वादशभागतुल्या संध्यांशश्च तावानेव मानवे

धर्मशास्त्रे पठ्यते । चत्वारः पृथक् पृथक् । कृतत्रेताद्वापर-कलियुगानि च तत्रैव पठ्यन्ते इति चेह यथा भवन्ति तथार्यमाह।

युगशब्देन चतुर्युगमुच्यते, तेनायमर्थः युगदशभागः खत्रिरदवेदाश्चतुस्थानस्थाः क्रमेण चतुर्भिस्त्रिद्व्येकगुणाः सन्तश्चत्वारि पृथक् कृतादीनि मानानि भवन्ति। तद्यथा वसुयमनगेन्दवः, रसनवनेत्रचन्द्राः, कृतषड्वसवो: द्वित्रिवेदाः सर्वे सहस्राघ्नाः १७२८००० कृतमानम्, १२९६००० त्रेतामानम् ८६४००० द्वापरमानम्, ४३२००० कलियुगमानम् । एतावती वर्षसंख्या सौरेण मानेन कृतयुगादीनां भवति।

वि. भा.—रविवर्षाणां (सौरवर्षाणां) खचतुष्टयरदवेदाः ४३२०००० चतुर्युगं (महायुगं)भवति, सन्ध्यासन्ध्यांशैः सह कृतादीनि (सत्ययुगादीनि) पृथक् चत्वारि युगचरणमानानि भवन्ति, युगदशभागः ४३२००० चतुर्भिर्गुणितस्तदा कृतं (सत्ययुगचरणमानं) १७२८००० भवति, त्रिभिर्गुणितः १२९६००० त्रेतायुग-चरणमानम् । द्विगुणितः ८६४००० द्वापरयुगचरणमानं भवति । एक-गुणितः ४३२००० कलियुगचरणमानं भवति। अत्रैतदुक्तं भवति युगचरण-द्वादशांशसमस्तत्सन्ध्या, सा चरणादौ भवति तावानेव सन्ध्यांशः स च युगचर-णान्ते भवति, सन्ध्यासन्ध्यांशैः सह एते युगचरणाः कथिताः ।

कृतादौ सन्ध्यावर्षाणि $= \frac{\text{कृतयुगच}}{१२} = \frac{१७२८०००}{१२} =$ १४४०००, कृतान्ते-सन्ध्यांशः $=$ १४४०००, एवं त्रेतादौ सन्ध्यावर्षाणि $= \frac{१२९६०००}{१२} =$ १०८०००, त्रेतान्ते सन्ध्यांशः १०८०००, द्वापरादौ सन्ध्यावर्षाणि $= \frac{८६४०००}{१२} =$ ७२०००, द्वापरान्ते सन्ध्यांशः $=$ ७२०००, कलियुगचरणान्ते सन्ध्या $= \frac{४३२०००}{१२} =$ ३६०००, कलियुगचरणान्ते सन्ध्यांशः $=$ ३६०००, चतुर्णां युगचरणानां योगः पूर्वोक्तयुगमानं भवतीति ॥६-८॥

अब युगमान कहते हैं।

हि. भा.—४३२०००० इतने सौर वर्ष का एक युग होता है। सन्ध्या और सन्ध्यांश सहित पृथक् सत्ययुगादि चार युग चरण होते हैं। युग के दशमांश को चार से गुणने से कृतयुगचरणमान १७२८००० होता है, तीन से गुणने से त्रेतायुगचरण १२९६००० होता है। दो से गुणने से द्वापरयुगचरण ८६४००० होता है, और एक से गुणने से कलियुगचरण ४३२००० होता है।

युगचरणों का द्वादशांश अपनी-अपनी सन्ध्या और सन्ध्यांश होता है अर्थात् युगचरण के आदि में सन्ध्या और उतने ही युगचरण के अन्त में सन्ध्यांश होता है। सन्ध्या और सन्ध्यांश से सहित पूर्वकथित युगचरण मान होता है।

कृतादि में सन्ध्यावर्ष $\frac{१७२८०००}{१२} =$ १४४००० कृतान्त में सन्ध्यांश $=$ १४४०००, त्रेतादि में सन्ध्यावर्ष $= \frac{१२९६०००}{१२} =$ १०८०००, में सन्ध्यांश $=$ १०८०००, द्वापरादि में सन्ध्यावर्ष $= \frac{८६४०००}{१२} =$ ७२०००, द्वापरान्त में सन्ध्यांश $=$ ७२०००, कलियुगचरणादि

सन्ध्य ।वर्ष = $\frac{४३२००००}{१२}$ = ३६०००, कलियुगचरणान्त में सन्ध्यांश = ३६००, चारों युगचरणों का योग पूर्वकथित युगमान होता हैं। इति ।।७-८।।

इदानीमार्यभटोक्तानां कृतादीनां यानि वर्षसंख्याप्रमाणानि तेषां स्मृतिविरोधाद् दूषणमाह ।

युगपादानार्यभटश्चत्वारि समानि कृतयुगादीनि ।
यदभिहितवान् न तेषां स्मृत्युक्तसमानमेकमपि ।।९।।

वा. भा. युगपदेनात्र चतुर्युगमुच्यते । तेन युगस्य पादा युगपादाः युगचतुर्भागा इत्यर्थः । तावत एव युगपादान् आर्यभटो यदभिहितवान् चत्वारि युगानि कृतयुगादीनि तदसदुक्तं भवति । यदार्यभटेनोक्तं दश गीतिकासु 'गतास्ते च मनुयुग(ख) कल्पादेर्युगपाद' इति तदयुक्तम् । यस्मात् तेषां कृतादियुगानामार्यभटोक्तानां स्मृत्युक्तत्वादियुगेन तुल्यमेकमपि न भवत्यत्र च भगवान्मनुः "चत्वार्याहुः सहस्राणि वर्षाणि च कृतं युगम् । तस्य तावच्छती संध्या संध्यांशश्च तथाविधः ।" एतावद्दिव्येन मानेन, तद्यथा दिव्यवर्षैः कृतयुगपरिमाणम् ४००० अस्य संध्या ४०० संध्यांशैश्च ४०० एकत्र ८०० एतत्संध्यासंध्यांशैः सह कृतयुगपरिमाणम् । इतरेषां त्रेतादीनां त्रेता ३००० सन्ध्या ३०० संध्यांशः ३०० द्वापरः २००० संध्या २०० संध्यांशश्च २०० कलिः १००० संध्या १०० संध्यांशः १००, एकत्र त्रेता ३६०० । द्वापरः २४०० कलिः १२०० एतानि षष्टिशतत्रयेण गुणितानि सौरमानेन कृतादीनां वर्षाणि भवन्ति, ब्रह्मगुप्तोक्तयुगानां तुल्यानि १७२८००० । १२९६००० । ८६४००० । ४३२००० नार्यभट्टोक्तसममपि । पौलिशे दिव्येन मानेन कृतादीनां प्रमाणाब्दाः "अष्टाचत्वारिंशत्पादविहीनाः क्रमात्कृतादीनाम् । अब्दास्ते शतगुणिता ग्रहतुल्ययुगं तदेकत्वम्" इति पौलिशसिद्धान्ते द्रष्टव्यम् ।।

वि. भा.—आर्यभटः चत्वारि समानि (तुल्यानि) कृतयुगादीनि युगपादान् महायुगचतुर्थांशमितान् युगचरणान् यदभिहितवान् (यत्कथितवान्) तेषां युगपादानां (युगचरणानां) मानमध्ये एकमपि स्मृत्युक्तसमानं (स्मृतिकथितसदृशं) न, स्मृतिकथितयुगचरणमानानि समानानि न सन्ति तस्मादार्यभटकथितानि तुल्ययुगचरणमानानि स्मृतिविरुद्धानि तेनोपेक्ष्याणीत्यर्थः । युगचरणसम्बन्धे आर्यभटवाक्यम् 'युगपादाः ग ३ च'; इति । तथा—

अष्टाचत्वारिंशत् पादविहीना क्रमात्कृतादीनाम् । अब्दास्ते शतगुणिता ग्रहतुल्ययुगं तदेकत्वम् । इति पौलिशसिद्धान्तोक्तं दिव्यमानेन कृतादियुगचरण-वर्षमानं स्मृत्युक्तसमानमवलोक्यते । नहि केनापि स्मृत्युक्तवचनेन पुराणोक्तवचनेन चार्यभटमतस्य पुष्टिर्भवत्यतस्तन्मतं न शोभनम् ज्यौतिषसिद्धान्तकारेषु केवलं वटेश्वरसिद्धान्तकारः (वटेश्वरः) आर्यभटस्येदं मतं स्वीकरोत्येतदर्थं किमपि प्रबलं प्रमाणं नोपस्थापयत्यतस्तन्मतमपि न शोभनमिति ।।९।।

अब आर्यभटोक्त युगचरणमान को कहते हैं, खण्डन भी करते हैं।

हि. भा.—आर्यभट ने चार बराबर कृतादि युगचरणों (महायुग के चतुर्थांशतुल्य) को जो कहा है, उन युगचरणों में एक भी स्मृतिकथित युगचरण के बराबर नहीं है, स्मृतिकथित युगचरणमान सब बराबर नहीं हैं। इसलिए आर्यभटोक्त तुल्य युगचरण-मान स्मृति के विरुद्ध होने से उपेक्षणीय (त्याज्य) है, युगचरण के विषय में आर्यभटोक्त वाक्य है 'युगपादाः ग३च' तथा 'अष्टाचत्वारिंशत् पादविहीना क्रमात् कृतादीनाम्। अब्दास्ते शतगुणिता ग्रहतुल्ययुगं तदेकत्वम्' इस पौलिश-सिद्धान्तोक्त दिव्यमान से कृतादि युगचरणवर्षमान स्मृतिकथित वर्ष के बराबर ही देखने में आते हैं, आर्यभटमत की पुष्टि किसी स्मृतिवचन से या पुराणोक्त वचन से नहीं होती है, इसलिए उनका मत ठीक नहीं है। वटेश्वरसिद्धान्त में वटेश्वराचार्य ने आर्यभट के इस मत को स्वीकार किया है परन्तु विरोध में स्मृतिकारादियों के मत रहते हुए भी कोई प्रबल प्रमाण नहीं उपस्थापित किया है इसलिए उनका मत भी ठीक नहीं है ॥९॥

इदानीं मनुप्रमाणानि कल्पप्रमाणं चाह।

मनुरेकसप्ततियुगः कल्पो मनवश्चतुर्दश मनूनाम्।
आद्यन्तरान्तसन्धिषु कृतकालोऽस्माद्युगसहस्रम् ॥१०॥

वा. भा.—मनुस्तावदेकसप्ततियुगैः। युगग्रहणेन चतुर्युगमुच्यते। एकसप्तति-चतुर्युगैः मन्वन्तरं भवतीत्यर्थः। कल्पस्तु मनवश्चतुर्दश, यद्येवं न तर्हि चतुर्युग-सहस्रं कल्प इत्याशंक्याह, मनूनामाद्यंतरांतसंधिषु कृतकाल इति। मनूनामादि-संधिश्चांतरसन्धिश्चान्तसन्धिश्च ते भवन्त्याद्यन्तरांतसंधयः चतुर्दशानां मनूनां पञ्चदश सन्धयो भवन्तीत्यर्थः। तेषु कृतयुगतुल्यः काल एकैकस्मिन् संधौ कृतयुग-तुल्यानि वर्षाणि भवन्तीति यावत्। अस्माद्धेतोश्चतुर्युगसहस्रेण स्मृतिषु कल्पोऽभिहितः। तद्यथा मन्वतरं चतुर्युगानि एतानि चतुर्दशगुणानि वेदनवनन्दा ९९४ कृताब्दाः १७२८००० पंचदश गुणा २५९२०००० चतुर्युगप्रमाणैरेतैः ४३२०००० विभज्यावाप्तं ६। इदं पूर्वन्यस्तेषु ९९४ एषु संयोज्य जातं सहस्रम् १००० यैस्तु पुनरष्टोत्तरेण चतुर्युगसहस्रेण कल्प उक्तस्तैः स्मृतिविरोधः कृत इत्यर्थः। यतो भगवान्मनुः "दैविकानां युगानान्तु सहस्रपरिसंख्यया, ब्राह्म-मेकमहो ज्ञेयं तावती रात्रिरेव च" इति। तथा च व्यासमुनिः "सहस्रयुगपर्यन्त-महो ये ब्रह्मणो विदुः। रात्रिं युगसहस्रांतां तेऽहोरात्रविदो जनाः" इति ॥१०॥

वि. भा.—एकसप्ततियुगैः मनुरुक्तः। चतुर्दश मनवः कल्पः (अर्थाच्चतुर्दशम-नूनामेकः कल्पः) भवति, मनूनामाद्यमध्यावसानसन्धिषु कृतकालः (कृतयुगसमान-कालः) अस्मात् कारणाद्युगसहस्रं कल्प इति ॥

अत्रोपपत्तिः—युगसहस्रं कल्पः कथं भवतीति प्रदर्श्यते—

एकसप्ततियुगानामेको मनुः=७१ युगाः, परं कल्पे चतुर्दश मनवोऽतः १४ मनु=७१यु×१४=९९४ युः परं मनूनामाद्यमध्यावसानसन्धिषु कृतकाल इत्युक्तेः

सन्ध्यासध्यांशाः=कृतयुगचरण×१५	चतुर्दश मनुषु सन्धयः=१५
$=\frac{४युग\times१५}{१०}=६यु$	युगे धर्मचरणाः=१०
	ततः$=\frac{४\times युग}{१०}=$कृतयुग

ततः १४ मनु+मनुसन्ध्यासन्ध्यांश=९९४यु+६यु=१०००यु=१ कल्पः= ब्रह्मदिनम् ।

एतावता 'चतुर्युगसहस्रेण ब्रह्मणो दिनमुच्यते' इति पुराणोक्तं युगसहस्रं कल्प इति ब्रह्मगुप्तोक्त चाप्युपपद्यते । सूर्यसिद्धान्ते सूर्यसिद्धान्तकारेण 'इत्थं युगसहस्रेण भूतसंहारकारकः । कल्पो ब्राह्ममहः प्रोक्त' मित्यनेन, भास्करेणापि स्याद्युगानां सहस्रं दिनं वेधसः सोऽपि कल्पः' इत्यनेन तदेव कथ्यते इति ॥ १० ॥

अब मनुमान और कल्पमान को कहते हैं ।

हि. भा.—इकहत्तर युगों का एक मनु होता है । चौदह मनु कल्प हैं, मनुओं के आदि, मध्य और अन्त में सन्धियां कृतकाल के बराबर हैं इस कारण एक हजार युगों का कल्प होता है ।।१०।।

एक हजार युगों का कल्प क्यों होता है इसकी उपपत्ति ।

इकहत्तर युगों का एक मनु होता है परन्तु कल्प में चौदह मनु हैं अतः १४ मनु= ७१ यु×१४=९९४ यु.

लेकिन मनुओं के आदि, मध्य और अन्त में कृतयुग के बराबर सन्धि है इसलिए चौदह मनुसम्बन्धी सन्ध्यासन्ध्यांश=कृतयुग×१५ अतः चौदह मनुसम्बन्धिनी

सन्धि=१५	युग में धर्मचरण=१०, कृतयुग में धर्मचरण=४
$=\frac{४युग\times१५}{१०}=६यु$	इसलिए $\frac{४\times युग}{१०}=$कृतयुग

अतः १४मनु+मनुसन्ध्यासन्ध्यांश=९९४यु+६यु=१०००यु=१कल्प=ब्रह्मदिन,. इससे 'चतुर्युगसहस्रेण ब्रह्मणो दिनमुच्यते' यह पुराणोक्त और 'युगसहस्रम्' यह ब्रह्मगुप्तोक्त भी सिद्ध हो गया । सूर्यसिद्धान्त में सूर्यसिद्धान्तकार 'इत्थं युगसहस्रेण भूतसंहारकारकः । कल्पो ब्राह्ममहः प्रोक्तम्,' इससे सिद्धान्तशिरोमणि में भास्कराचार्य भी 'स्याद्युगानां सहस्रं दिनं वेधसः सोऽपि कल्प' इससे उसी विषय को कहते हैं ।। १० ।।

इदानीं कल्पे विशेषं प्रतिपादयति ।

आद्यन्तरान्तसन्धिषु कल्पमनूनां कृताब्दसमकालम् ।
नेच्छन्ति ये षड्नं तेषां कल्पो युगसहस्रम् ४२६४०८०००० ॥११॥

वा. भा.—कल्पे मनवः कल्पमनवः तेषामाद्यन्तरान्तसन्धिषु कृतयुगतुल्यः कालो यैर्नेप्सितस्तेषां कल्पश्चतुर्युगशतैः नवभिश्चतुर्नवत्यधिकैः भवतीति किमत्रोच्यते । प्रागार्या व्याख्यानेनैव येषामार्या गतार्थेति ।

वि. भा.—ये कल्पमनूनां (चतुर्दशमितानां) कृताब्दसमकालं (कृतयुगवर्षं) आद्यन्तरान्तेषु (आदिमध्यावसानेषु) सन्धिं नेच्छन्ति तेषां मते कल्पः षड्नं युगसहस्रं भवति ।

एकसप्ततियुगैरेको मनुर्भवति, परं कल्पे चतुर्दश मनवोऽतः १४ मनु ७१यु × १४ = ९९४यु. अत्र चतुर्दशमनुसम्बन्धिसन्ध्यासन्ध्यांशमानं योज्यते तदा वस्तुतः कल्पप्रमाणं भवति, परं ये मनुसम्बन्धिसन्ध्यासन्ध्यांशमानं न गृह्णन्ति तन्मते तु ९९४यु. = कल्पः ॥११॥

अब कल्प के सम्बन्ध में विशेष कहते हैं ।

हि. भा.—आचार्य कल्पमनु (चतुर्दश-संख्यक) सम्बन्धी आदि, मध्य और अन्त में सन्धि को कृताब्द (सत्ययुगवर्ष) के बराबर नहीं मानते हैं, उनके मत में कल्पप्रमाण छः घटा हुआ एक हजार युग(९९४ युग) होता है ॥११॥

इकहत्तर युगों का एक मनु होता है, लेकिन कल्प में चौदह मनु हैं इसलिए. १४ मनु = १४ × ७१यु = ९९४यु, इसमें मनुसम्बन्धी सन्ध्यासन्ध्यांश जोड़ने ही से वास्तवकल्प प्रमाण हो सकता है, जो उनके मान नहीं लेते हैं उनके मत में ९९४ यु = कल्प पर यह ठीक नहीं है ॥११॥

इदानीं कल्पसम्बन्धे आर्यभटमतं प्रदर्शयन्नाह

मनुसन्धि युगमिच्छत्यार्यभटस्तन्मनुर्यतः खयुगः ।
कल्पश्चतुर्युगानां सहस्रमष्टाधिकं तस्य ४३५४५६०००० ॥ १२ ॥

वा. भा.—मनोः सन्धिः मनुसंधिः । सधिमिच्छत्यार्यभटः युगतुल्यं प्रायेण । यतः तन्मनुः खयुगः तस्य मनुस्तन्मनुः स च संख्या निर्युगानि यत्र......सम...... युग......त्तदं......सुक ...मन .....नुयु......द्वास.........तस्य मन्वन्तरं भवतीत्यर्थः । एवं चतुर्युगानां सहस्रमष्टाधिकं तस्य कल्पः । तथा चाष्टशते अष्टोत्तरसहस्रं ब्राह्मो दिवसो ग्रहयुगानामिति ॥ यथा कुडव-प्रस्थ-द्रोणाद्यैः मेषो राशिः परिच्छिद्यते एवं युगमन्वन्तरकल्पैः काल इति स्मृतिषु पठ्यते । तथाचार्यश्रीषेणनिबद्धे रोमकसिद्धान्ते न पठितः ।

वि. भा.—आर्यभटो युगं (युगतुल्यं) मनुसन्धिमिच्छति, यतस्तत् (तस्याऽर्यभटस्य) मनुः खयुगोऽर्थाद् द्विसप्ततियुगैर्भवति अतस्तस्याऽर्यभटस्य मते चतुर्युगानां (महायुगानां) अष्टाधिकं सहस्रं (१००८) कल्पः (ब्रह्मदिनं) भवतीति ॥ १२ ॥

अत्रोपपत्तिः ।

वर्गाऽक्षराणि वर्गे इत्याद्यार्यभटोक्तेः श=७०, ख=२ एतयोर्योगः=७२, ब्रह्मगुप्तादिभिरेकसप्ततियुगैरेको मनुः कथ्यते, आर्यभटेन द्विसप्ततियुगैः कथ्यते । तेन तन्मते युगसम एव मनुसन्धिरिति स्पष्टं प्रतीयते । तन्मतेनापि कल्पमानम्=१४ मनु=१४×७२ युग=१००८ युग=कल्पः, एतेन 'कल्पश्चतुर्युगानां सहस्रमष्टाधिकं तस्ये'ति ब्रह्मगुप्तोक्तमुपपद्यते ।

दशगीतिकायाम् । "काहो मनवो ढ १४ मनुयुग श्ख ७२ गतास्ते च ६ मनुयुग छ्ना २७ च । कल्पादेर्युगपादा ग३च गुरुदिवसाच्च भारतात्पूर्वम्" इति ।

कालक्रियापादे च "दिव्यं वर्षसहस्रं ग्रहसामान्यं युगं द्विषट्कगुणम् । अष्टोत्तरं सहस्रं ब्राह्मो दिवसो ग्रहयुगानाम् ।।" इति च आर्यभटोक्तमस्ति । केवलमार्यभटेन ब्रह्मगुप्तमतविरोधिनाऽर्यभटमताश्रयिणा वटेश्वराचार्येण च द्विसप्ततियुगैरेकः कल्पो भवतीति कथ्यते परं तत्समर्थनमन्यैर्ज्यौतिषाचार्यैः स्मृतिकारैः पुराणैश्च न कृतं, तेन तन्मतं कथं शोभनमिति सुधियो विभावयन्त्विति ।। १२ ।।

अब आर्यभटोक्त कल्पमान को कहते हैं

हि. भा.—आर्यभट भी युगतुल्य मनुसंधि स्वीकार करते हैं क्योंकि उनके मत में एक मनु श्ख युग (७२ युग) बहत्तर युगों के होते हैं और एक हजार आठ युगों (कृतयुग त्रेता, द्वापर और कलियुगों के योग=युग) के कल्प (ब्रह्मदिन) होता है ॥ १२ ॥

उपपत्ति

ब्रह्मगुप्तादि आचार्य इकहत्तर युगों के एक मनु कहते हैं, आर्यभट बहत्तर युगों को एक मनु कहते हैं इसलिए उनके मत में युगसमान ही मनुसन्धि है यह स्पष्ट प्रतीत होता है। उनके मत में भी कल्प=१४ मनु=१४×७२युग=१००८ युग= ब्रह्मदिन, इससे 'कल्पश्चतुर्युगानां सहस्रसष्टाधिकंतस्य' यह ब्रह्मगुप्तोक्त उपपन्न होता है।

आर्यभट दशगीतिका में कहते हैं

"काहो मानवो ढ १४ मनुयुग श्ख ७२ गतास्ते च ६ मनुयुग छ्ना ७२ च। कल्पादेर्युगपादा ग३ च गुरुदिवसाच्च भारतात्पूर्वम् ।"

कालक्रियापाद में—

"दिव्यं वर्षसहस्रं ग्रहसामान्यं युगं द्विषट्कगुणम् । अष्टोत्तरं सहस्रं ब्राह्मो दिवसो ग्रहयुगानाम् ।।" केवल आर्यभट और ब्रह्मगुप्त-मत विरोधी तथा आर्यभटमताश्रयी

वटेश्वराचार्य बहत्तर युगों का कल्पमान कहते हैं, लेकिन उनके मत का समर्थन अन्य किसी ज्यौतिषाचार्य, स्मृतिकार तथा पुराणों ने नहीं किया है इसलिए उनका मत कैसे ठीक है इस बात का विवेचक लोग विचार करें ॥ १२ ॥

इदानीं रोमकसिद्धान्तमतं खण्डयति ।

युगमन्वन्तर कल्पाः कालपरिच्छेदकाः स्मृतावुक्ताः ।
यस्मान्न रोमके ते स्मृतिबाह्यो रोमकस्तस्मात् ॥ १३ ॥

वि. भा.—यस्मात् कारणात्स्मृतौ (वेदार्थप्रतिपादके ग्रन्थे) युगमन्वन्तर-कल्पाः (युगमन्वन्तरादयः) कालपरिच्छेदकाः (समयविभाजकाः) उक्ताः (कथिताः) अन्यथाऽनाद्यनन्तव्यापककालेन मानवानामेकमपि व्यवहारकार्यं न चलेत् । रोमके (रोमकसिद्धान्ते, ते (युगमन्वन्तरादयो) न सन्त्यर्थात्तेषां तेषां नामोल्लेखा न सन्ति तस्मात्कारणाद्रोमकः स्मृतिबाह्योऽतोऽत्र रोमकसिद्धान्तस्त्याज्य इति ॥ वस्तुतो ज्यौतिषसिद्धान्तग्रन्थेषु युगमन्वन्तरकल्पानां ग्रहादिसाधनार्थं कीदृशं प्राधान्यमिति तत्साधका एव ज्ञातुं शक्नुवन्ति । तान् विना सकलं ज्यौतिषशास्त्रं निरर्थकमेव भवेत् । अतो रोमकसिद्धान्ते तच्चर्चाऽकरणेन कीदृश्यस्त्रुटयः कृतास्तत्सिद्धान्तकर्त्रेति मन्दमतयोऽपि ज्ञातुं शक्ष्यन्तीति ॥ १३ ॥

अब रोमकसिद्धान्त मत का खण्डन करते हैं ।

हि. भा.—जिस कारण से वेदार्थ के प्रतिपादन करने वाले स्मृतिग्रन्थों में युग-मन्वन्तर और कल्प को काल (समय) का परिच्छेदक (विभाजक) कहा गया है अर्थात् इन्हीं युग-मन्वन्तरादियों के द्वारा विभक्त अनाद्यनन्त व्यापक काल से मानवों के सब व्यवहार चलते हैं, यदि ऐसा नहीं होता तो अविभक्त व्यापककाल से एक भी कार्य होना असम्भव है इसलिए पूर्वोक्त विषयों के उल्लेख स्मृतिकारों ने अत्यावश्यक समझ कर किये हैं। रोमकसिद्धान्त में इन सब की चर्चा भी नहीं की गई है इसलिए वह सिद्धान्त स्मृतिबाह्य है अर्थात् स्मृतिशास्त्रों से बहिर्भूत है इसलिए वह त्याज्य है। वस्तुतः ज्यौतिषसिद्धान्त में युग-मन्वन्तरादियों की ग्रहादि साधनार्थ कैसी प्रधानता है यह विषय ग्रहादि साधन करने वाले ही जान सकते हैं । बिना उनके सम्पूर्ण ज्यौतिष-शास्त्र निरर्थक है इसलिए रोमक सिद्धान्त में उनकी चर्चा न करके बहुत बड़ी त्रुटि की गई है, इस बात को अल्पज्ञ भी समझ सकते हैं ॥ १३ ॥

ख = स्वस्वस्तिकम् ।
सं = गर्भीयगोलसन्धिः ।
सं' = पृष्ठीयगोलसन्धिः ।
स्था = गर्भीयपरिणतबिम्बोपरिगतकदम्बवृत्त-
तत्रत्यक्रान्तिवृत्तसंपातबिन्दुः ।
स्थां = प्रैष्ठिकबिम्बीयकदम्बवृत्ततत्रत्यक्रान्ति-
मण्डलसंपातः ।
खस्थां = स्थां ग्रहस्य पृष्ठीयनतभागाः ।
खग्र = स्थां ग्रहस्यैव नतांशसमाना गर्भगोले
नतभागाः ।
ग्र = दार्ष्टिकगोलीयग्रहसमानो गर्भगोले दृङ्म-
ण्डलीयो ग्रहः ।
विख = गर्भीयबिम्बग्रहनतांशाः ।
वि = वित्रिभम् (पृष्ठगोले)

अत्र खविस्थां चापजात्यत्रिकोणे विख, स्थांविभुजकोटयोर्ज्ञानेन त्रिकोणमित्या खस्थां कर्णचापमानं विधातव्यम् । तदेव खग्रमानं भवेत् । दृग्मण्डलस्यैकत्वात्, तथा भूकेन्द्रात् 'ग्र' गतसूत्रदृष्टिस्थानात् स्थांगतसूत्रयोः समानान्तरत्वसिद्धेः । ततोऽनन्तरं खविग्रचापीयत्रिभुजे 'खग्र' 'खवि' भुजयोस्तदन्तर्गतकोणस्य दिगंशान्तरस्य च ज्ञानात् 'विग्र' चापमानं प्रजायते । ततो ग्रहान्तरं स्थाग्रमानं ज्ञातव्यम् । इदमेव दृग्गर्भग्रहयोरन्तरमानं भवति यदर्थं विद्वांसो निमज्जन्ति गणिताम्बुधौ । किं बहुनेति ।

अथ रविबुधशुक्रभगणोपपत्तिः ।

अथ 'रविभगणा रव्यब्दाः' इत्याचार्योक्तेः कल्पे यावन्तो रविभगणास्तावन्त्येव सौरवर्षमानानि भवन्ति, परं कल्पवर्षप्रमाणं तु विदितमेवास्ति, तत्तुल्यरविभगणमानमपि विदितं जातं, बुधशुक्रयोरुदयसत्तायां रवेरुदयास्तकाले रविबुधयोर्रविशुक्रयोश्चान्तरांशाः प्रतिदिनं यन्त्रद्वारा ज्ञातव्यास्ते च राशित्रयान्न्यूना एवागच्छन्ति । वराहमिहिराचार्येणापि बृहज्जातके पूर्वाचार्योक्तवज्रादियोगलक्षणानां खण्डनावसरे 'पूर्वशास्त्रानुसारेण मया वज्रादयः कृताः । चतुर्थे भवने सूर्याज्ज्ञसितौ भवतः कथमि'त्यादिना रविणा सह तयोरन्तरमल्पमेव भवतीति कथ्यते, तेनैव हेतुना रवेरतिनिकटस्थितत्वात्कदाचिदग्रतः कदाचित्पृष्ठतस्तस्यानुचराविव सदा तौ (बुधशुक्रौ) व्रजन्तौ दृश्येते, तेन तयोरपि कल्पभगणा रविकल्पभगणतुल्या एवाचार्यैः स्वीकृता इति ।

अथ चन्द्रभगणोपपत्तिः ।

अथ ग्रहवेधाथ समुपयुक्तस्थाने निर्मिते वेधालये नाड़ीवृत्तक्रान्तिवृत्त-कदम्बप्रोतवृत्तादिरचितं विपुलं गोलयन्त्रं कार्यं, तत्र क्रान्तिवृत्ते चक्रांशाः ३६० राश्यंशकलादयो नाड़ीवृत्ते च दण्डपलादयोऽङ्कनीयाः, तद्यन्त्र केनचिदाधार-द्वितयेन केन्द्रगतनलिकया च स्थिरीकृत्य गोलकेन्द्रे ध्रुवाभिमुखीं यष्टीं कृत्वा रात्रौ तद्गोलकेन्द्रगतदृष्ट्या रेवतीतारामवलोकयेत्। सा गोलयन्त्रीयक्रान्तिवृत्ते यत्र परिणता तत्रैव मेषादिरङ्कनीयः । तथा च गोलमध्यगतदृष्ट्यैव चन्द्रवेधकरणेन यत्र गोलयन्त्रे परिणतो भवेत्तदुपरिगतं कदम्बप्रोतवृत्तं (वेधवृत्तं) तद्गोलीय-क्रान्तिवृत्ते यत्र लगति स एव वेधागतः स्पष्टचन्द्रस्तद्राश्यादिमानं मेषादेर्यद्भवति तद्विगणय्य ग्राह्यमेवं राश्यादिकः स्पष्टश्चन्द्रो विदितो जातः, एवं द्वितीयदिनेऽपि राश्यादिस्पष्टचन्द्रो वेदितव्यः । एताभ्यां विदितस्पष्टचन्द्राभ्यां विदितचन्द्र-मन्दोच्चाच्च 'स्फुटं ग्रहं मध्यखगमि' त्यादिना दिनद्वयजौ मध्यमचन्द्रो विदितौ भवेतां, तयोरन्तरमेकदिनजा चन्द्रमध्यमगतिर्भवेत्ततोऽनुपातेन 'यद्येकेन दिनेनेयं चन्द्रमध्यमगतिर्लभ्यते तदा कल्पकुदिनैः किम्' इत्यनेन समागच्छन्ति कल्पे चन्द्र-भगणाः । परमत्रोपपत्तौ वेधद्वारा यः स्पष्टचन्द्रो गृहीतः स च वेधगोलीय (पृष्ठीय-त्रिज्यागोलीय) स्पष्टचन्द्रः, परमपेक्षितस्तु भूकैन्द्रिकत्रिज्यागोलीयः, अतस्तयोर्वेध-गोलीय (भूपृष्ठीयगोलीय) स्पष्टचन्द्रभूकैन्द्रिकत्रिज्यागोलीयस्पष्टचन्द्रयोरन्तरानयनं कृत्वा तेन संस्कृतो वेधगोलीयस्पष्टचन्द्रो भूकैन्द्रिकत्रिज्यागोलीय(भूगर्भगोलीय)स्पष्ट-चन्द्रो भवेत् । एवं वेधगोलीयद्वितीयदिनजस्पष्टचन्द्राद् भूगर्भगोलीयस्पष्टचन्द्रो वेदितव्यस्ततो विदितभूगर्भगोलीयदिनद्वयजस्पष्टचन्द्राभ्यां पृथक्-पृथक् 'स्फुटं ग्रहं मध्यखगमि' त्यादिना दिनद्वयजौ मध्यमचन्द्रौ भूगर्भगोलीयौ भवेतां, ततस्तदन्तर-(मध्यमचन्द्रान्तर)—वशात् पूर्ववत्कल्पे चन्द्रभगणा भवितुमर्हन्ति ।

अथाधुना वेधगोलीयस्पष्टचन्द्राद् भूगर्भगोलीयस्पष्टचन्द्रज्ञानार्थमुपपत्तिः । पूर्वोपपत्तौ स्पष्टचन्द्रस्य चर्चाऽस्ति । तेन गोलद्वयीययोः(वेधगोलीय भूगर्भगोलीययोः स्पष्टचन्द्रयोरन्तरानयनं क्रियते । परमेतदर्थं योपपत्तिः सैव सर्वेषां ग्रहाणां (वेधगोलीयग्रहेभ्यो भूगर्भगोलीयग्रहाणां) ज्ञानार्थं भवतीति बोध्या ।

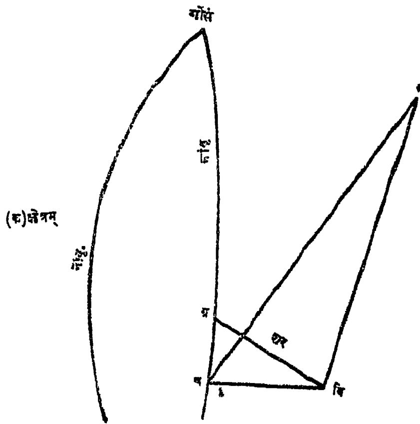
वेधगोले दृग्वशेन (दृष्ट्या) परिणतचन्द्रबिम्बस्य स्पष्टभोगचिह्नं (चन्द्रबिम्बोपरिगतकदम्बप्रोतवृत्तं क्रान्तिवृत्ते यत्र लगति स बिन्दुः) तद्गोलीय-स्पष्टचन्द्रः । एवं भूगर्भगोलेऽपि स्पष्टचन्द्रस्थानं ज्ञेयम् ।

अथ परिभाषाः

वेधगोलीयचन्द्रस्थानम् = स्थान, स्थानीयदृग्वृत्तधरातलेन च्छिन्नस्य भूगर्भगोलस्य च्छेदनं तद्गोलीयदृग्वृत्तम् । तस्य (तद्गोलीयदृग्वृत्तस्य) भूगर्भ-

गोलीय क्रान्तिवृत्तस्य च योगबिन्दुः=ष, भूगर्भात् ष-बिन्दुगता रेखा = पसंज्ञका, दृष्टितः स्थानगता रेखा च फसंज्ञका,

अथ प फ, रेखे समान्तरे (रेखागणितैकादशाध्याययुक्त्या), भूगर्भदृष्टि-स्थानाभ्यां रेवतीगते रेखे च समानान्तरे। अतो भूगर्भदृष्टिस्थानलग्नकोणयोः साम्यात् सिद्धं यद् भूगर्भगोले (भगोले) रेवतीतो ष बिन्दुपर्यन्तं वेधगोलीयस्पष्ट-चन्द्रतुल्यमर्थात् (भगोलीयरेवतीतो र बिन्दुपर्यन्तम् = वेधगोलीयरेवतीतः स्थानपर्यन्तम्) केन्द्रलग्नकोणस्य चापमानत्वात्। स्थानीयनतांशाः = ष बिन्दू-त्पन्ननतांशाः (प,फ रेखयोः समानान्तरत्वात्) स च नतांशो वेधगोले मापनेन ज्ञातः, तथा चन्द्रबिम्बीयनतांश ष-बिन्दूत्पन्ननतांशचापाभ्यां जायमानः खस्वस्तिकलग्न-कोणो यावान् वेधगोले तावानेव भूगर्भगोलेऽपि (गोलद्वये धरातलैकत्वात्) स च नतांशोत्पन्नकोणो वेधगोले मापनेन विज्ञेयः। अतो भूगर्भगोलपृष्ठे जायमान-त्रिभुजे त्रिज्यागुणाद्धरणिकोटिगुणादित्यादि विलोमेन परिणतचन्द्रबिम्ब-केन्द्र-ष-बिन्दुगतवृत्तीयाऽधारचापज्ञानं जातम्। तथा च वेधगोलीयशरक्रान्तिवृत्त-धरातलान्तरयोर्ज्ञानाद् भूगर्भगोले शरज्ञानम् (वेधगोलीयभूगर्भगोलीययोर्नाड़ी-वृत्तधरातलयोरन्तरस्य वेधगोलीयक्रान्तेश्च ज्ञानाद् भूगर्भगोलीयक्रान्तिज्ञानार्थं या युक्तिस्तादृश्येवात्र शरज्ञानार्थमस्ति) तेन चापजात्ययुक्त्या भूगर्भगोलीय-स्पष्टचन्द्र-ष-बिन्द्वोरन्तरचापस्य संस्कारसंज्ञकस्य ज्ञानम्।



अन्तरम्=संस्कारचापः

अतः वेधगोलीय स्पचन्द्र ± संस्कारचा = भूगर्भगोलीयस्पचन्द्रः। नहि दार्ष्टिक-गोलेऽपि स्थानोद्भवा नतांशा वेधेन ज्ञातुं शक्याः। स्थानस्याप्रत्यक्षत्वात्। वेधस्तु प्रत्यक्षे वस्तुनि भवति। अतस्त-त्रत्यवित्रिभग्रहान्तर दृक्षेपवशात् त्रिको-णमित्या विज्ञेयम्।

अथ संस्कारचापस्य धनर्णव्यवस्था। तत्र परिभाषाः।

वेधगोलीय-क्रान्तिवृत्तम्=इष्टक्रान्तिवृत्तम्। भूगर्भगोलीयक्रान्तिवृत्तम्= वास्तवक्रान्तिवृत्तम्। बिम्बीयकर्णगोलीयक्रान्तिवृत्तम्=वास्तवक्रान्तिवृत्तम्। परेखा वर्धिता वास्तवक्रान्तिवृत्ते यत्र लगति तत्र ष-बिन्दुः। चन्द्रबिम्ब-केन्द्रादिष्ट-क्रान्तिवृत्तधरातले या शरज्या लम्बस्तन्मूलं=क्ष। अयं बिन्दुर्वर्धितायां फ-रेखाया-मेव स्यात्। फरेखा तु स्थानीयदृग्वृत्तधरातले उत्क्रशरज्या वर्धिताऽवर्धिता वा वास्तवक्रान्तिवृत्तधरातले लम्बः स्यात्। अत्रेदमुक्तं भवति स्थानीयदृग्वृत्तधरातल-

निष्ठः क्ष बिन्दोर्वास्तवक्रान्तिवृत्तधरातले लम्बः क्रियते तन्मूलं यस्यां दिशि स्थानीय-दृग्वृत्त-वास्तवक्रान्तिवृत्त-धरातलाभ्यामुत्पन्नकोणोऽल्पः स्यात्तद्दिश्येव पतिष्यति ।

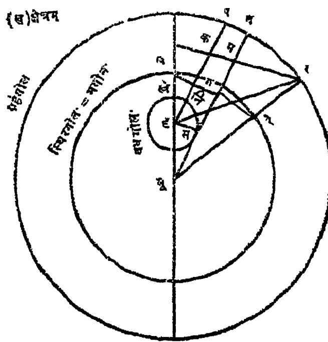
भूगर्भाद्विम्बीयकर्ण-व्यासार्धेन यो गोलस्तत्रोच्यते ।

ष-विन्दूत्थदृग्वृत्तवास्तव-क्रान्तिवृत्ताभ्यामुत्पन्नकोणो दृक्क्षेपचापाभिमुखोऽल्पः स्यात्, क्ष-बिन्दुस्तु वास्तवक्रान्तिवृत्तधरातलोर्ध्वाधरसूत्रयोर्मध्ये स्यात् फरेखाया मध्ये स्थितत्वात्, एतेन सिद्धं यद्दृक्क्षेपवृत्तात्पूर्वकपाले चन्द्रे सति रेखातः पश्चिमायां दिश्येव लम्बः पतिष्यति, प-रेखायाः स्थानीयदृग्वृत्तवास्तवक्रान्तिवृत्तधरातलयोर्योगरेखारूपत्वात् । भूगर्भलिलम्बमूलगता रेखा ष' बिन्दुतः पश्चिमायामेव दिशि क्रान्तिवृत्ते लगिष्यति, स एव बिन्दुर्भूगर्भाभिप्रायिक चन्द्रस्थानम् । त्रिज्यागोलेऽपीयमेव स्थितिः। पश्चिमकपालेऽप्येवमेव विचारणीयम् । एतावता सिद्धं यद्वित्रिभादूने चन्द्रे संस्कारचापं धनमन्यथर्णमिति ॥

अथाऽधुना पूर्वोपपत्तौ वेधगोलीयभूगर्भगोलीययोर्नाड़ीवृत्तधरातलयोरन्तरस्य वेधगोलीयक्रान्तेश्च ज्ञानाद्भूगर्भगोलीयक्रान्तिज्ञानार्थं या युक्तिस्ताद्दृश्येव वेधगोलीयशरक्रान्तिवृत्तधरातलान्तरयोर्ज्ञानाद् भूगर्भगोलीयशरज्ञानार्थं भवतीति यल्लिखितं तदर्थं विचार्यते ।

दृष्टिस्थानान्निर्मितो गोलो वेधगोलो दृश्यगोलो वा, भूगर्भान्निर्मितो गोलः स्थिरगोलो भगोलो वा, भूगर्भाद् दृष्टिस्थानाच्च भचक्रस्थध्रुवतारागते रेखे यत्र यत्र स्वस्वगोले (स्थिरगोले-वेधगोले च) लग्ने तत्र तत्र तद्गोलद्वये परिणतध्रुवे, ताभ्यां (परिणतध्रुवाभ्यां नवत्यंशेन कृते वृत्ते गोलद्वये नाड़ीवृत्ते, भूगर्भ-दृष्टिस्थानाभ्यां भचक्रस्थध्रुवगतरेखाभ्यां भूकेन्द्रदृष्टिस्थानान्तररेखया च यत्त्रिभुजं तद्धरातलच्छिन्नगोलद्वयीमार्गे च गोलद्वये याम्योत्तरवृत्ते, स्वनाड़ीवृत्तयाम्योत्तरवृत्तधरातलयोर्योगरेखा स्वनिरक्षोर्ध्वाधरसूत्रम् । वर्धितभूकेन्द्रदृष्टिस्थानगतरेखा चोर्ध्वाधरसूत्रम् । ध्रुवसूत्रस्य नाड़ीवृत्तधरातलोपरिलम्बत्वाद् ध्रुवसूत्रयोः समानान्तरत्वाच्च स्थिरगोलीय (भगोलीय) वेधगोलीयनाड़ीवृत्तधरातले समानान्तरे (रेखागणितैकादशाध्याययुक्त्या)। अथ दृष्टिस्थानाद् भगोलीय-नाड़ीवृत्तधरातलोपरिकृतो लम्बो वेधगोलीयभगोलीयनाड़ीवृत्तधरातलयोरन्तरम् । गोलद्वयेऽक्षांशयोः समत्वात्तद्धरातलान्तरज्ञानं क्रियते । भूगर्भाद् दृष्टिस्थानं यावदेको भुजः, दृष्टिस्थानाद् भगोलीयनाड़ीवृत्तधरातलोपरिकृतो लम्बो नाड़ीवृत्त-धरातलान्तरं द्वितीयो भुजः। गर्भीयनिरक्षोर्ध्वाधररेखाखण्डं तृतीयो भुज इति भुजत्रयैरुत्पन्नजातयत्रिभुजे भूगर्भलग्नकोणः=अक्षांशः, लम्बमूलबिन्दुलग्न-कोणः=९०, भूगर्भदृष्टिस्थानान्तरम्=केन्द्रान्तरसंज्ञकम् । तदाऽनुपातो यदि त्रिज्यया कोणज्यया केन्द्रान्तरं लभ्यते तदाऽक्षज्यया किमित्यनेन समागतं नाड़ीवृत्तधरातलान्तरम् $=\frac{\text{अक्षज्या}\times\text{केन्द्रान्तर}}{\text{त्रि}}$। अथ दृष्टिस्थानाद्रविगतदृष्टि-

सूत्रस्य स्वनाड़ीवृत्त-(वेधगोलीयनाडीवृत्त-) धरातलस्य चान्तरं वेधगोलेऽन्तरम्=वेधगोलीयक्रांज्या वेधगोलीयक्रान्तिज्यामापनेन विदितैव, अतो $\frac{\text{'वेधगोलीयक्रांज्या} \times \text{दृष्टिकर्ण}}{\text{वेधगालव्या}\ \frac{१}{२}}$ = ग्रहाद् वेधगोलीयनिरक्षोर्ध्वाधरसूत्रोपरि-लम्बरेखा=लम्ब,' ततो लम्ब ∽ नाड़ीवृत्तधरातलान्तर=लम्ब ∽ अन्तर= ग्रहगोलीयक्रान्तिज्या। एतज्ज्ञानेन $\frac{\text{ग्रहगोलीय क्रांज्या} \times \text{त्रि}}{\text{ग्रबिम्बीयकर्ण}}$ = भगोलीयक्रांज्या = भूगर्भगोलीयक्रांज्या = स्थिरगोक्रांज्या। अनयैव रीत्या वेधगोलीयशरज्ञानेन क्रान्तिवृत्तधरातलान्तरज्ञानेन च भूगर्भगोलीयशरज्ञानं भवेदेवेति।



र=रविः। ख=भगोलीय खस्वस्तिकम्। ख'=वेधगोले खस्वस्तिकम् दृर=रविदृष्टिकर्णः। भूर=रविकर्णः। दृस=नाड़ीवृत्तधरातलान्तरम् ± कम। रम=लम्बः। भूदृ= केन्द्रान्तरम्। भू=भूकेन्द्रम्। दृ=दृष्टिस्थानम्।
खनि=वेधगोलीयाक्षांशाः।
खनि=भगोलीयाक्षांशाः।
वेधगोलीयाक्षांश =, भगोलीयाक्षांश=ख'नि= खनिरग=भगोलीयक्रान्तिज्या।

अथ रविमन्दोच्चोपपत्तिः।

भूकेन्द्राद्रविमन्दगोलकेन्द्रगता रेखा रविमन्दप्रतिवृत्ते ऊर्ध्वभागे यत्र लगति तदेव रविमन्दोच्चम् (भूकेन्द्रात्तद्बिन्दोर्मन्दप्रतिवृत्तान्यबिन्दुभ्योऽतिदूरे स्थितत्वादुच्चमिति नाम सार्थकम्)। रविकर्णेन त्रिज्या लभ्यते तदा रविबिम्बव्यासार्धेन किमित्यनुपातेन यत्फलं तच्चापं द्विगुणितं तदा रविबिम्बकलाप्रमाणमागच्छति। प्राचीनाचार्यैरनुपातागतफलमेवं द्विगुणीकृत्य तच्चापं बिम्बकलामानं कथ्यते तन्न युक्तम्। एतस्या रविबिम्बकलायाः परमाल्पत्वे वेधागतरविरेव तत्र मन्दोच्चो भवितुमर्हति, बिम्बकलानयनप्रकारदर्शनादुच्चस्थान एव तत्कर्णस्य परमाधिकत्वात्तद्बिम्बकलायाः परमाल्पत्वात्। द्वितीयपर्ययेऽप्येवं रविमन्दोच्चज्ञानं कार्यम्। तयो रविमन्दोच्चयोरन्तरेण तद्दिनजा (प्रथमविरदितरविमन्दोच्चाद् द्वितीयपर्ययीयविमन्दोच्चज्ञानार्थं तदन्तरे यावन्ति

दिनानि) रविमन्दोच्चगतिर्भवेत् तदाऽनुपातो यद्येभिर्दिनैरियं रविमन्दोच्चगतिस्तदैकदिनेन किमित्यनुपातेनैकदिनजा तद्गतिः ततोऽनुपातो यद्येकेन दिनेनेयं रविमन्दोच्चगतिस्तदा कल्पकुदिनैः किमित्यनुपातेन कल्पे रविमन्दोच्चभगणाः समा गच्छन्तीति ।

अथवा ज्ञातरविमन्दोच्चा ७८° दष्टाद्रिमितादंशात्कुट्टकयुक्त्या तज्ज्ञानं प्रदर्श्यते ।

कल्परविमन्दोच्चभगणमानम् = य

तदा १८५३ शकान्ते कल्पादितः सौराब्दाः = १९७२९४१०३२ (नवनगशशिमुनिकृतनवेत्यादिब्राह्मस्फुटसिद्धान्तोक्त्या, गोऽद्रीन्द्वद्रिकृताङ्कदस्रनगगोचन्द्रा इत्यादिभास्करोक्त्या वा) । कल्पसौरवर्षैर्यदि कल्परविमन्दोच्चभगणा लभ्यन्ते तदा कल्पादितः शकान्तं यावत्पूर्वानीतसौरवर्षैः किमित्यनुपातेन सशेषा गतरविमन्दोच्चभगणा इष्टवर्षान्ते समागच्छन्ति, तत्स्वरूपम् =

$\frac{१९७२९४१०३२ \times य}{४३२००००००००} = ल + \frac{शे}{४३२००००००००}$ ततः १९७२९४१०३२ × य = ४३२०००००००० × ल + शे समशोधनेन,

१९७२९४१०३२ × य — ४३२०००००००० × ल = शे, एते चक्रांशैः ३६० गुणयित्वा कल्पवर्षैर्भज्यास्तदा फलं रविमन्दोच्चप्रमाणम् = ७८° ततः

$\frac{(१९७२९४१०३२ \times य — ४३२०००००००० \times ल) \times ३६०}{४३२००००००००}$ = ७८° छेदगमेन

(१९७२९४१०३२ × य — ४३२००००००००ल) × ३६० = ४३२०००००००० × ७८ पक्षौ ३६०भक्तौ तदा १९७२९४१०३२ × य — ४३२०००००००० × ल = $\frac{४३२०००००००० \times ७८}{३६०}$ = १२०००००० × ७८ = ९३६०००००० समयोजनेन १९७२९४१०३२ × य = ९३६०००००० + ४३२०००००००० × ल समशोधनेन.

१९७२९४१०३२ × य — ९३६०००००० = ४३२०००००००० × ल

∴ $\frac{१९७२९४१०३२ \times य — ९३६०००००००}{४३२००००००००}$ = ल । अत्राष्टभिरपवर्त्तनेन

$\frac{२४६६१७८७९ य — ११७००००००}{५४००००००००}$ = ल. अत्र ५५६७०१ एभिरपवर्त्तनेन

$\frac{४४३ य — २१०}{९७०}$ = ल (स्वल्पान्तरात्) तदारूपक्षेपे ऋणात्मके लब्धिगुणौ समानीयाभीप्सितक्षेपविशुद्धिनिघ्नावित्यादिना लब्धिः = २१९, गुणकः = ४८० ते भाज्यतद्भाजकवर्णमाने इति भास्करोक्त्या गुणक एव भाज्यवर्ण (य) मानं भवेत्तेन य = ४८० = कल्परविमन्दोच्चभगणाः ॥

अथ चन्द्रमन्दोच्चभगणोपपत्तिः ।

उच्चं द्विविधं मन्दशीघ्रभेदेनोच्चं भवत्यर्थान्मदोच्चं शीघ्रोच्चं च । शीघ्राख्य-तुङ्गस्य तयोरभावादित्यादिभास्करोक्ते रविचन्द्रयोः केवलं मन्दोच्चमेव भवति । चन्द्रस्य बिम्बकलायाः परमाल्पत्वं तन्मन्दोच्चस्थाने भवेत्तत्र तदा यावान् वेधागतः स्पष्टचन्द्रस्तावदेव तन्मन्दोच्चम् । एवं द्वितीयपर्ययेऽपि चन्द्रमन्दोच्चं तयोश्चन्द्रमन्दोच्चयोरन्तरं तद्दिनजा (प्रथमपर्ययीयवेधविदितचन्द्रमन्दोच्चाद् द्वितीयपर्ययीयवेधविदितचन्द्रमन्दोच्चं यावद्यावन्ति दिनानि) चन्द्रमन्दोच्च-गतिर्जाता ततोऽनुपातो यद्येभिर्दिनैरियं चन्द्रमन्दोच्चगतिस्तदैकेन दिनेन किमिति समागतैकदिनजा चन्द्रमन्दोच्चगतिस्ततो यद्येकेन दिनेनेयं चन्द्रमन्दोच्चगतिस्तदा कल्पकुदिनैः किमित्यनुपातेन कल्पे चन्द्रमन्दोच्चभगणा जायन्ते । बिम्बीयकर्ण-सम्बन्धेनापि चन्द्रमन्दोच्चभगणोपपत्तिर्भवितुमर्हति । यथा वेधेन प्रत्यहं चन्द्रस्य बिम्बीयकर्णज्ञानं कार्यम् । यदा चन्द्रस्य शराभावो भवेत्तदा चन्द्रबिम्बीयकर्णस्य परमत्वे वेधेन स्पष्टचन्द्रो बोद्धव्यस्तदेव तदा तन्मन्दोच्चं भवेत् । एवं द्वितीयपर्ययेऽपि चन्द्रमन्दोच्चं ज्ञात्वा तयोरन्तरेण तदन्तर्गतदिनप्रमाणेन च पूर्ववच्चन्द्रमन्दोच्च-भगणज्ञानं भवेदिति ॥ बिम्बकलासम्बन्धेन भगणज्ञानार्थं लम्बनावनति-दर्शनार्थमियं भूरन्यथा केवलं बिन्दुरेव भूरिति भास्कराचार्योक्तिरेवाश्रयणीया अन्यथा भगणज्ञानमतीव दुर्घटमिति ॥

अथ चन्द्रपातभगणोपपत्तिः ।

अत्र दृष्टिस्थानाभिप्रायिकगोलस्य निर्माणं कार्यं स एव वेधगोलः, दृष्टि-स्थानाद् (वेधगोलकेन्द्रात्) चन्द्रो वेध्यो यत्र वेधगोले समुपलब्धस्तदुपरि वेधगोलीयं कदम्बप्रोतवृत्तं कार्यं, तत्तद्गोलीयक्रान्तिवृत्ते यत्र लगति ततश्चन्द्रबिम्बकेन्द्रं यावत्कदम्बप्रोतवृत्ते चन्द्रशरांशाः । ततः

$$\frac{\text{वेधगोलीय शरज्या} \times \text{त्रि}}{\text{वेधगोल व्या}^{\text{२}}} = \text{चन्द्रगोले शरज्या},$$

वेधगोलीयभगोलीययोः क्रान्तिवृत्त-धरातलयोरन्तरं यत्तस्य चन्द्रगोलीयशरज्यायां संस्करणेन यद् भवति तद्वशाद् भगोलीयशरज्ञानं भवेदेव । एवं प्रतिदिनं वेधेन भगोलीयशरज्याज्ञानं कार्यम् । यस्मिन् दिने दक्षिणशराभाव उपलब्धस्तत्र वेधेन यः साधितश्चन्द्रः स भगणा-(द्वादशराशितः) च्छोधितस्तदा चन्द्रपातो भवेत्, एवमेव द्वितीयपर्ययेऽपि तज्ज्ञानं कार्यं, स च पातः पूर्वपातात्पृष्ठ एव भवति, अतः पातस्य विलोमा गतिरस्तीति सिद्धम् । एतत्पातद्वयान्तरजनितपातगत्या वेधदिनान्तरवशेन चाऽनुपातेनैकदिनजा पातगतिर्भवेत्ततः पूर्ववत्कल्पे चन्द्रपातभगणा जायन्ते, परमेतदानयनं न समीचीनं, चन्द्रकर्णस्य त्रिज्यातोऽल्पत्वादुपर्युक्तोपपत्तौ तत्त्रिज्यासमग्रहणादिति ॥

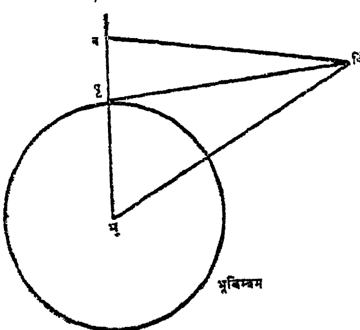
अथ बुधशुक्रयोः शीघ्रोच्चभगणोपपत्तिः

वेधगोलीयस्पष्टबुधशुक्राभ्यां भूगर्भगोलीयं तयोर्ज्ञानं (चन्द्रभगणोपपत्तौ

वेधगोलीयस्पष्टग्रहाद् भूगर्भगोलीयस्पष्टग्रहज्ञानं कथं भवेदिति यथास्थानं प्रदर्शितं तत्तत्रैव द्रष्टव्यम्) कार्यं, वेधेनान्त्यफलज्याज्ञानविधिना तयोः शीघ्रान्त्यफलज्याज्ञानं कृत्वा ग्रहगोलीयशरबिम्बीयकर्णवशेन तयोः स्पष्टकेन्द्रप्रमाणे विदिते भवतस्ततः स्वस्वस्पष्टकेन्द्राभ्यां संस्कृतौ बुधशुक्रौ तयोः शीघ्रोच्चे भवतः, एवं द्वितीयपर्ययेऽपि तयोः शीघ्रोच्चे ज्ञातव्ये । बुधशीघ्रोच्चयोरन्तरवशात्तदन्तरदिनैश्चैकदिनजां गतिमानीयाऽनुपातेन कल्पे तद्भगणाः जायन्ते । एवमेव शुक्रशीघ्रोच्चयोरन्तरवशात्तदन्तरदिनैश्च कल्पे तच्छीघ्रोच्चभगणा विदिता भवन्तीति ॥

अथ मङ्गलगुरुशनीनां शीघ्रोच्चोपपत्तिः

प्रथममेतेषां वेधेन बिम्बीयकर्णज्ञानं कार्यं, तथाशीघ्राऽन्त्यफलज्याज्ञानञ्च कार्यं, तदा भूकेन्द्राद्बिम्बगता रेखा बिम्बीयकर्ण एको भुजः । ग्रहगोलकेन्द्राद्बिम्बकेन्द्रगता त्रिज्या रेखा द्वितीयो भुजः । भूकेन्द्रग्रहगोलकेन्द्रयोरन्तरं शीघ्रान्त्यफलज्या तृतीयो भुज इति भुजत्रयैरुत्पन्नत्रिभुजे भुजत्रयज्ञानात्तत्कोणत्रयमपि विदितं भवेत् । वेधद्वारा विदितग्रहगोलीयशरात्स्थानीयकर्णस्य (भूकेन्द्राद् ग्रहस्थानगतरेखायाः) ज्ञानं सुलभं भवेत् । प्रत्यहं स्थानीयकर्णज्ञानमनयैव रीत्या कार्यं, यस्मिन् दिने तत्कर्णस्य परमत्वं भवेत्तद्दिने शीघ्रोच्चस्थाने एव ग्रहो भवेद्यत उच्चस्थाने ग्रहे तत्कर्णस्य परमत्वं भवति, तत्र यावान् स्फुटग्रहः स च पूर्ववेधविधिना विदितोऽस्ति, तेन तत्सममेव तदा शीघ्रोच्चं भवेत् । एवं द्वितीयपर्ययेऽपि शीघ्रोच्चज्ञानं कार्यं द्वयोर्विदितशीघ्रोच्चयोरन्तरं तद्दिनज-(प्रथमविदितशीघ्रोच्चदिनाद् द्वितीयशीघ्रोच्चज्ञानं यावद्भिर्दिनैर्जातं) शीघ्रोच्चगतिस्ततोऽनुपातो यद्येतावद्भिर्दिनैरियं शीघ्रोच्चगतिस्तदैकेन दिनेन किमित्यनुपातेनैकदिनजा शीघ्रोच्चगतिः, ततः पुनरप्यनुपातो यद्येकेन दिनेनेयं शीघ्रोच्चगतिस्तदा कल्पकुदिनैः किमित्यनुपातेन कल्पे शीघ्रोच्चभगणा जायन्ते। मङ्गलगुरुशनीनां शीघ्रोच्चोपपत्तिरनयैव रीत्या विधेयेति। अत्रोपपत्तौ ग्रहबिम्बीयकर्णज्ञानस्यातीवाऽवश्यकतास्ति तज्ज्ञानमन्तरेयमुपपत्तिर्निरर्थका भवेदतो वेधेन ग्रहबिम्बीय-कर्णज्ञानं क्रियते ।



विं=ग्रहबिम्बकेन्द्रम् । भू=भूकेन्द्रम् । पृ=भूपृष्टस्थानम् । च=दृष्टिस्थानम् । पृच=दृष्ट्युच्छ्रायः । पृविं=पृष्ठकर्णः । भूविं=ग्रहबिम्बीयकर्णः । चविं=दृष्टिकर्णः । भूपृ=भूव्यासार्धम् । विंपृच, विंचपृकोणौ तुरीययन्त्रद्वारा मापनेन विदितौ भवतः । तदा विंपृचत्रिभुजे $१८०-(\angle$विंपृच$+\angle$विंचपृ$)$ $=\angle$पृविंच पृच=दृष्ट्युच्छ्रायो विदित एवास्ति तदोक्तत्रिभुजेऽनुपातः ।

$\frac{\text{पृच} \times \text{ज्या} < \text{विचपृ}}{\text{ज्या} < \text{पृविच}}$ = पृवि, १८०—<विपृच = < भूपृवि अयमपि कोणो विदितो जातः, भूपृ = भूव्यासार्धं विदितमेवास्ति, तदा भूपृवि त्रिभुजे भूपृ, पृवि-भुजयोस्तदन्तर्गतकोणस्य च ज्ञानात्सरलत्रिकोणमित्या 'भूवि' इत्याधारज्ञानं भवेदयमेव ग्रहबिम्बीयकर्णः। अथ च ग्रहशीघ्रान्त्यफलज्याज्ञानं कथं भवतीति-प्रदर्श्यते। उपरिप्रदर्शितनियमेन ग्रहबिम्बीयकर्णज्ञानं कार्यं यदा ग्रहस्य शराभाव-स्तदा तस्य कर्णस्य यदा परमत्वं भवेत्तदा परमोच्चकर्णः = त्रि + शीघ्रान्त्यफलज्या। एवं परमाल्पे कर्णः = त्रि — शीघ्रान्त्यफलज्या, अतः परमोच्चकर्णः — त्रि = शीघ्रान्त्यफलज्या। त्रि — परमनीचकर्णः = शीघ्रान्त्यफलज्यानयनं कार्यमिति।

अथ मन्दोच्चोपपत्तिः

वेधेन स्पष्टग्रहं ज्ञात्वाऽस्मात् स्फुटं ग्रहं मध्यखगं प्रकल्प्येत्यादिनाऽसकृन्मन्द-स्पष्टग्रहो वेदितव्यस्तस्मान्मन्दस्पष्टग्रहान्मध्यमग्रहश्च ज्ञातव्य एतयोर्मन्द-स्पष्टमध्यमग्रहयोरन्तरं मन्दफलम् भवेत्। यस्मिन् दिने तन्मन्दफला-भावो भवेत्तदा तत्र मन्दस्पष्टमध्यमग्रहयोः साम्यं भवेत्तदेव मन्दोच्चम्। एवं द्वितीयपर्ययेऽपि मन्दोच्चज्ञानं कार्यं तयोरन्तरं प्रथमविदितमन्दोच्चदिनाद् द्वितीयपर्यये विदितद्वितीयमन्दोच्चदिनं यावद्यावन्ति दिनानि तद्दिनजा मन्दोच्चगतिर्भवेत्ततोऽनुपातो यद्येभिर्दिनैरियं मन्दोच्चगतिस्तदैकदिने किं जातंक-दिनजा तद्गतिस्ततो यद्येकेन दिनेनेयं मन्दोच्चगतिस्तदा कल्पकुदिनैः किमित्य-नुपातेन कल्पे मन्दोच्चभगणा जायन्ते इति।

अथवा

भूकेन्द्राद् ग्रहबिम्बस्य स्पर्शरेखा कार्या तथा ग्रहबिम्बकेन्द्रात् स्पर्शबिन्दुगता रेखा कार्या तद्ग्रहबिम्बव्यासार्धम्। भूकेन्द्राद् ग्रहबिम्ब-केन्द्रगता रेखा ग्रहकर्णस्तदा ग्रहकर्णबिम्बव्यासार्धस्पर्शरेखाभिर्जाय-मानत्रिभुजेऽनुपातो यदि ग्रहकर्णेन त्रिज्या लभ्यते तदा ग्रहबिम्बव्यासार्धेन किमित्यनुपातेन दृष्टिस्थानलग्नकोणार्धज्या बिम्बकलार्धज्या समागच्छति तत्स्वरूपम् = $\frac{\text{त्रि} \times \text{ग्रविव्या}\frac{1}{2}}{\text{ग्रकर्ण}}$ अत्र भाज्यस्य स्थिरत्वाद्यदा ग्रहकर्णमानं पर-माधिकं भवेत्तदा फलं परमाल्पं भवेदर्थादुच्चस्थाने ग्रहे तत्कर्णस्य परमाधि-कत्वाद् बिम्बाकलार्धज्यामानं परमाल्पं भवेत्तच्चापं द्विगुणितं तदा परमाल्पं ग्रह-बिम्बकलामानं भवेदतो बिम्बकलायाः परमाल्पत्वे उच्चस्थो ग्रहो भवति तत्र यावान् वेधागतस्फुटग्रहस्तावदेव तन्मन्दोच्चमपि एवं द्वितीयपर्ययेऽपि ज्ञेयं तयोरन्तरं तद्दिनजा मन्दोच्चगतिस्ततो विदितमन्दोच्चान्तरदिनैस्त-

द्दिनजमन्दोच्चगत्या चानुपातेन कल्पे मन्दोच्चभगणाः समागच्छन्तीति । अत्र बिम्बकलामानं भूकेन्द्रलग्नकोणमानमस्ति तज्ज्ञानं मापनेन कार्यं लम्बनावनतिदर्शनार्थमियं भूरन्यथा केवलं बिन्दुरेव भूरित्याचार्योक्तादत्र बिन्दुरूपभुवः कल्पने बिम्बकलाकोणमापने न काचिद्धानिरिति ।

अथैषां पातभगणोपपत्तिः

अथैषां वेधगोलीयशरज्ञानतो भगोलीयशरान् ज्ञात्वा तदभावो यत्र भवेत्तत्र गणितागतान् तान् मन्दस्पष्टग्रहान् द्वादशराशिभ्यः शुद्धान् कृत्वा पातो ज्ञेयः । द्वितीयपर्ययेऽप्येवं तत्पातो ज्ञेयस्तदन्तरैस्तद्दिनान्तरैश्च पूर्ववत्तत्पातभगणा भवन्तीति ॥१३॥

रवि, बुध और शुक्र की भगणोपपत्ति

'रविभगणा रव्यब्दाः' इस आचार्योक्ति से कल्प में जितने रविभगण होते हैं उतने ही सौर वर्षमान होते हैं, लेकिन कल्पवर्षप्रमाण विदित है इसलिए तत्तुल्य कल्परविभगण मान भी विदित हो गया, बुध और शुक्र के उदयलक्षण में रवि के उदयकाल और अस्तकाल में रवि और बुध के अन्तरांश तथा रवि और शुक्र के अन्तरांश भी प्रत्येक दिन यन्त्रद्वारा जानने चाहिएँ। वे अन्तरांश तीन राशि से अल्प ही आता है। वराहमिहिराचार्य भी 'बृहज्जातक में पूर्वाचार्योक्त वज्रादि योगों के खण्डन में 'पूर्वशास्त्रानुसारेण मया वज्रादयः कृताः । चतुर्थे भवने सूर्याज्ज्ञसितौ भवतः कथम् ।'' इत्यादि से रवि के साथ बुध और शुक्र का अन्तर अल्प ही होता है, ऐसा कहते हैं। इसलिए रवि के अतिनिकट (समीप) रहने के कारण कभी आगे कभी पीछे उनके नौकर की तरह बुध और शुक्र जाते हुए देखे जाते हैं। इसी कारण से बुध और शुक्र के कल्पभगण कल्परविभगण के बराबर ही आचार्यों ने स्वीकार किये हैं ॥

चन्द्रभगण की उपपत्ति

ग्रहवेध के लिए हर तरह से उपयुक्त स्थान में वेधालय बनाना चाहिए। उसमें नाड़ीवृत्त, क्रान्तिवृत्त, कदम्बप्रोतवृत्त आदि वृत्तों से युक्त एक गोल यन्त्र बनाना चाहिए । क्रान्तिवृत्त में भगणांश ३६० और राशि-अंश-कला आदि अङ्कित करना तथा नाड़ीवृत्त में दण्ड, पल आदि चिह्नित करना, किन्हीं दो आधारों पर तथा केन्द्रगत नलिका से उस गोलयन्त्र को खूब दृढ़ कर गोलकेन्द्र में ध्रुवाभिमुख (ध्रुव की तरफ) यष्टि को करके रात्रि में उस गोलकेन्द्रगत दृष्टि के द्वारा रेवती तारा को देखने से गोलयन्त्रीय क्रान्ति वृत्त में जहाँ पर परिणत हुई वहीं पर मेषादि चिह्नित करना । तथा गोल केन्द्रगत दृष्टि ही से चन्द्र के वेध करने से गोलयन्त्र में जहाँ परिणत हुए उनके ऊपर गोलयन्त्रीय कदम्ब प्रोतवृत्त (वेधवृत्त) करने से वह वृत्त (वेधवृत्त) गोलयन्त्रीय क्रान्तिवृत्त में जहाँ पर लगता है वही वेधागत स्पष्ट चन्द्र है। मेषादि से उनके जितने राश्यादिमान हैं वही राश्यादि स्पष्टचन्द्र है। इस तरह स्पष्टचन्द्र का ज्ञान हो गया, इसी तरह द्वितीय दिन में भी स्पष्टचन्द्र का ज्ञान करना,

इन विदित स्पष्टचन्द्रद्वय से तथा विदित चन्द्रमन्दोच्च से 'स्फुटं ग्रहं मध्यखगं प्रकल्प्य कृत्वा फले मन्दचले यथोक्ते' इत्यादि से दोनों दिनों के मध्यम चन्द्र जान कर दोनों मध्यम चन्द्रों के अन्तर (चन्द्रमध्यमगति) जान लेना. इससे अनुपात करते हैं यदि एक दिन में यह चन्द्रमध्यम गति पाते हैं तो कल्प कुदिन में क्या इससे कल्प चन्द्रभगण मान आते हैं । लेकिन इस उपपत्ति में वेध द्वारा जो स्पष्टचन्द्र लिये गये हैं वे वेधगोलीय (दृग्गोलीय या भूपृष्ठस्थान में दृष्टिस्थान रखने से पृष्ठीय त्रिज्यागोलीय) हैं, लेकिन भूकेन्द्रिक त्रिज्यागोलीय स्पष्टचन्द्र अपेक्षित है, इसलिए वेधगोलीय स्पष्टचन्द्र और भूकेन्द्रिक त्रिज्यागोलीय (भूगर्भगोलीय) स्पष्टचन्द्र का अन्तरानयन करके वेधगोलीय स्पष्टचन्द्र में उस अन्तर को संस्कार करना तब भूगर्भगोलीय स्पष्टचन्द्र होते हैं । इसी तरह वेधगोलीय द्वितीय दिन के स्पष्ट चन्द्र से गर्भगोलीय स्पष्ट चन्द्र ज्ञात करना, तब इन विदित भूगर्भगोलीय स्पष्टचन्द्रद्वय से 'स्फुटं ग्रहं मध्यखगं प्रकल्प्य' इत्यादि से दोनों दिनों के मध्यम चन्द्र ज्ञात कर अन्तर करने से एक-दिन-सम्बन्धिनी चन्द्र-मध्यमगति होती है इससे पूर्ववत् कल्पचन्द्रभगण ज्ञात करना ।

उपर्युक्त उपपत्ति में वेधगोलीय स्पष्टचन्द्र से भूगर्भगोलीय स्पष्टचन्द्र ज्ञान का उल्लेख किया गया है परन्तु वह अवतरण रूप में कहा गया। अब यहां उस का साधनप्रकार लिखते हैं । यहां स्पष्टचन्द्र का प्रसङ्ग है इसलिए दोनों गोलीय (वेधगोलीय और भूगर्भगोलीय) स्पष्टचन्द्रों का अन्तरानयन करते हैं परन्तु जिस किसी वेधगोलीय स्पष्टग्रह से भूगर्भगोलीय स्पष्टग्रहज्ञान करना हो तो यही अधोलिखित उपपत्ति समझनी चाहिए । वेधगोल में दृष्टिवश परिणत चन्द्रबिम्ब के स्पष्टभोग चिह्न (परिणतचन्द्रबिम्बोपरिगतकदम्बप्रोतवृत्त क्रान्तिवृत्त में जहां लगता है वह बिन्दु) तद्गोलीय स्पष्टचन्द्र है । इस तरह भूगर्भगोल में भी स्पष्टचन्द्र स्थान समझना ।

उपपत्ति के लिए परिभाषाएँ

वेधगोलीय चन्द्रस्थान=स्थान स्थानीय दृग्वृत्त धरातल से कटित भूगर्भगोल का प्रदेश उस गोल का दृग्वृत्त होता है। भूगर्भगोलीय दृग्वृत्त और भूगर्भगोलीय क्रान्तिवृत्त के योग बिन्दु =ष, भूगर्भ से ष बिन्दुगत रेखा=प संज्ञक । दृष्टिस्थान से स्थानगत रेखा=फ संज्ञक। प और फ रेखा समानान्तर हैं (रेखागणित एकादशाध्याय युक्ति से), भूगर्भ से तथा दृष्टिस्थान से रेवतीगत रेखाद्वय समानान्तर है अतः भूगर्भलग्न कोणमान और दृष्टिस्थानलग्न कोणमान समान हुआ अर्थात् भूगर्भगोल (भगोल) में रेवती से ष बिन्दुपर्यन्त चाप वेधगोलीय स्पष्टचन्द्र के बराबर हुआ, अर्थात्

भगोलीय रेवती से र बिन्दुपर्यन्त= वेधगोलीय रेवती से स्थान पर्यन्त; क्योंकि केन्द्रलग्न कोण का मान तत्संमुखचाप होता है । स्थानीयनतांश= ष बिन्दूत्पन्न नतांश क्योंकि प, और फ रेखा समानान्तर हैं । वह नतांश वेधगोल में मापन

करने से विदित हुआ। तथा चन्द्रविम्बीयनतांश और ष-बिन्दूत्पन्न नतांश चापों से उत्पन्न खस्वस्तिक लग्नकोण जितने वेधगोल में होते हैं उतने ही भूगर्भगोल में भी, क्योंकि दोनों गोलों में धरातल एक ही है। अतः ग्रहों के दिगंशवश वह कोण का मान निकालना होगा तब भूगर्भगोल पृष्ठ पर जो त्रिभुज बना है उसमें 'त्रिज्या-गुणाद्धरणिकोटिगुणात्' इत्यादि के विलोम से पश्चिमत चन्द्रबिम्ब केन्द्र ष बिन्दु-गतवृत्तीयाधार चापज्ञान हुआ। तथा वेधगोलीयशर, क्रान्तिवृत्तधरातलान्तर के ज्ञान से भूगर्भगोल में शरज्ञान (वेधगोलीय और भूगर्भगोलीय नाड़ीवृत्तधरातलान्तर और वेधगोलीय क्रान्तिज्ञान से भूगर्भगोलीय क्रान्तिज्ञान के लिए जो युक्ति है उसी तरह की युक्ति शरज्ञान के लिए है), इस लिए चापजात्य युक्ति से भूगर्भगोलीय स्पष्टचन्द्र और ष बिन्दु के अन्तर संस्कारसंज्ञक चाप का ज्ञान हो जायगा। अन्तर=संस्कारचाप।

अतः वेधगोलीयस्प चन्द्र ± संस्कारचाप = भूगर्भगोलीय स्प चन्द्र।

अब संस्कार चाप की धन और ऋण की व्यवस्था दिखलाते हैं।

परिभाषाएँ

वेधगोलीयक्रान्तिवृत्त = इष्टक्रान्तिवृत्त । भूगर्भगोलीयक्रान्तिवृत्त = वास्तव-क्रान्तिवृत्त। बिम्बीय कर्णगोलीय क्रान्तिवृत्त = वास्तवक्रान्तिवृत्त। 'प' रेखा बढ़कर वास्तव क्रान्तिवृत्त में जहां लगती है वहां ष' बिन्दु है, चन्द्रबिम्ब केन्द्र से इष्ट क्रान्तिवृत्त धरातल का जो शरज्यालम्ब है उसका मूल बिन्दु = क्ष, यह बिन्दु वर्धित फ रेखा ही में होता है। फ-रेखा स्थानीय दृग्वृत्त धरातल में है। पूर्वकथित शरज्या बढ़कर या नहीं बढ़कर वास्तव क्रान्तिवृत्त धरातल के ऊपर लम्ब है। स्थानीय दृग्वृत्तधरा-तलनिष्ठ 'क्ष' बिन्दु से वास्तव क्रान्तिवृत्त धरातल के ऊपर लम्ब करते हैं, उसका मूल बिन्दु स्थानीय दृग्वृत्त धरातल और वास्तव क्रान्तिवृत्त धरातल से उत्पन्न कोण जिस दिशा में अल्प है उसी दिशा में पतित होगा।

अब भूगर्भ से बिम्बीय कर्णव्यासार्ध से जो गोल होता है उस पर विचार करते हैं।

ष बिन्दुजनित दृग्वृत्त और वास्तवक्रान्तिवृत्त से उत्पन्न दृक्षेप चापाभिमुख कोण अल्प है, क्ष बिन्दु तो वास्तव कान्तिवृत्त धरातल और ऊर्ध्वाधर सूत्र के मध्य (बीच) में है क्योंकि फरेखा मध्य में है। इससे सिद्ध होता है कि दृक्षेप वृत्त से पूर्वकपाल में चन्द्र के रहने से रेखा से पश्चिम दिशा ही में लम्बमूल गिरेगा, क्योंकि स्थानीय दृग्वृत्त धरातल और क्रान्तिवृत्त धरातल की योगरेखा प-रेखा है। भूगर्भ से लम्बमूलगतरेखा ष' बिन्दु से पश्चिम दिशा ही में क्रान्तिवृत्त में लगेगी वही बिन्दु भूगर्भाभिप्रायिक चन्द्र-स्थान है। त्रिज्यागोल में भी यही स्थिति है। पश्चिम कपाल में भी इसी तरह विचार करना। इससे सिद्ध होता है कि वित्रिभ से चन्द्र के अल्प रहने से संस्कारचाप धन होता है अन्यथा ऋण होता है इति॥

अब पूर्वोपपत्ति में वेधगोलीय नाड़ीवृत्त धरातल और भूगर्भगोलीय नाडीवृत्त धरातलान्तर ज्ञान से तथा वेधगोलीय क्रान्तिज्ञान से भूगर्भगोलीय क्रान्तिज्ञान के लिए जो युक्ति है उसी तरह की युक्ति वेधगोलीय शर और क्रान्तिवृत्तधरातलान्तर ज्ञान से भूगर्भगोलीय शरज्ञान के लिए होती है यह हमने जो लिखा है उसके लिए विचार करते हैं। दृष्टिस्थान से जो गोल बनाया जाता है उसको वेधगोल या दृश्यगोल कहते हैं। और भूगर्भ से जो गोल बनता है उसे स्थिरगोल या भगोल कहते हैं। भूगर्भ से और दृष्टिस्थान से भचक्रस्थ ध्रुवतारागत रेखाद्वय अपने अपने गोल (भूगर्भगोल और वेधगोल) में जहां जहां लगता है वहां वहां दोनों गोलों में परिणत ध्रुव होता है। इन दोनों (परिणत ध्रुवबिन्दुओं से नवत्यंश जो वृत्त बनते हैं वे दोनों गोल में नाड़ीवृत्त होते हैं, भूगर्भ से और दृष्टिस्थान से ध्रुवगत रेखाद्वय और भूगर्भदृष्टिस्थान से जो त्रिभुज बनता है उस त्रिभुजरूपी धरातल से कटित गोलद्वय का प्रदेश गोलद्वय में याम्योत्तरवृत्त होता है, स्वनाड़ीवृत्त धरातल और याम्योत्तर वृत्त धरातल की योगरेखा स्वनिरक्षोर्ध्वाधरसूत्र है, वर्धित भूकेन्द्रदृष्टिस्थानान्तररेखा ऊर्ध्वाधर सूत्र है। नाड़ीवृत्त धरातल के ऊपर ध्रुवसूत्र लम्ब है परन्तु दोनों गोलों के ध्रुवसूत्र समानान्तर हैं इसलिए दोनों गोलों के नाड़ीवृत्त धरातल समानान्तर हुए (रेखागणित की एकादशाध्याययुक्ति से), दृष्टिस्थान से भगोलीय नाड़ीवृत्त धरातल के ऊपर जो लम्ब होता है वही वेधगोलीय और भगोलीय नाड़ीवृत्त धरातलान्तर है, दोनों गोलों में अक्षांश समान होने से नाड़ीवृत्त धरातलान्तर ज्ञान करते हैं।

भूगर्भ से दृष्टिस्थान पर्यन्त (केन्द्रान्तर) एकभुज। दृष्टिस्थान से भगोलीय नाड़ीवृत्तधरातल के ऊपर लम्ब (नाड़ीवृत्तधरातलान्तर) द्वितीय भुज, गर्भीय निरक्षोर्ध्वाधररेखाखण्ड तृतीय भुज, इन तीनों भुजों से उत्पन्न जात्यत्रिभुज में भूगर्भलग्न कोण=अक्षांश, लम्बमूल बिन्दुलग्नकोण=९०, अतः अनुपात करते हैं यदि त्रिज्या कोणज्या में केन्द्रान्तर पाते हैं तो अक्षज्या कोणज्या में क्या इस अनुपात से नाड़ीवृत्त धरातलान्तर प्रमाण आता है; $\frac{\text{अज्या} \times \text{केन्द्रान्तर}}{\text{त्रि}}$ = नाडीवृत्तधरातलान्तर। दृष्टिस्थान से स्वगोलस्थ रविगतरेखा और स्वनाड़ीवृत्त (वेधगोलीयनाड़ीवृत्त) धरातल के अन्तर वेधगोल में वेधगोलीय क्रान्तिज्या है। वेधगोलीय क्रान्तिज्या मापनद्वारा विदित है इसलिए $\frac{\text{वेधगोलीय क्रांज्या} \times \text{दृष्टिकर्ण}}{\text{वेधगोल व्या}\frac{1}{2}}$ =ग्रह से निरक्षोर्ध्वाधर सूत्र के ऊपर लम्बरेखा= लम्ब। अतः लम्ब $\pm$ नाड़ीवृत्त धरातलान्तर = लम्ब $\pm$ अन्तर=ग्रहगोलीय क्रान्तिज्या। इसके ज्ञानसे $\frac{\text{ग्रहगो कांज्या} \times \text{त्रि}}{\text{ग्रविकर्ण}}$ = भगोलीय क्रांज्या=भूगर्भगोलीय क्रांज्या=स्थिरगोलीय क्रांज्या, इस रीति से वेधगोलीय शरज्ञान मे क्रान्तिवृत्त धरातलान्तरज्ञान से भूगर्भगोलीय शरज्ञान होता है।

यहां (B) क्षेत्र देखिये।

र = रवि । ख = भगोलीय खस्वस्तिक । ख' = वेधगोलीय खस्वस्तिक, दृर = रविदृष्टि कर्ण, भूर = रविकर्ण, दृस = नाड़ीवृत्त धरातलान्तरम् = कम, रम = लम्ब भूदृ = केन्द्रान्तर, भू = भूकेन्द्र, दृ = दृष्टिस्थान । ख'नि = वेधगोलीयाक्षांश ख'नि- = भगोलीयाक्षांश वेधगोलीयाक्षांश = भगोलीयाक्षांश = ख'नि = खनि' । रग = भगोलीय क्रान्तिज्या ।

रविमन्दोच्चोपपत्ति

भूकेन्द्र से रविमन्दगोल केन्द्रगतरेखा रविमन्दप्रतिवृत्त में जहां लगती है वही रवि के मन्दोच्च है । (भूकेन्द्र से मन्दप्रतिवृत्तीय अन्य विन्दुओं से वह बिन्दु अधिक उच्च में है इसलिए उसका उच्चनाम अनुगतार्थ है, रविकर्ण में यदि त्रिज्या पाते हैं तो रवि बिम्ब व्यासार्घ में क्या—इस अनुपात से फल आता है उसके चाप को द्विगुणित करने से रवि के बिम्बकला प्रमाण होता है । प्राचीनाचार्य लोग अनुपात से जो फल आता है उसीको द्विगुणित कर चाप करते हैं उसीको बिम्बकलामान कहते हैं यह ठीक नहीं है, बिम्बकलानयन प्रकार के देखने से उच्चस्थान में रविकर्ण के परमत्व के कारण रविबिम्बकलाप्रमाण परमाल्प सिद्ध होता है । 'लम्बनावनतिदर्शनार्थमियं भूरन्यथा केवलं बिन्दुरेव भूः' इस भास्करोक्ति से यहां भूगर्भ और भूपृष्ठ में अभेद मानकर भूकेन्द्रलग्न कोण (रविबिम्बकला) को मापन कर जान लिया जाय तब रवि बिम्बकला के परमाल्पत्व वेधागत स्पष्ट रवि ही रविमन्दोच्च होंगे । द्वितीय पर्यय में भी इस तरह रविमन्दोच्च ज्ञान कर दोनों रविमन्दोच्चों के अन्तर करने से वेधदिनान्तरजनित रविमन्दोच्च गति होगी । तब अनुपात करते हैं यदि इन वेधदिनान्तर में यह रविमन्दोच्च गति पाते हैं तो एक दिन में क्या इस अनुपात से एकदिनसम्बन्धिनी रविमन्दोच्च गति आई । फिर अनुपात करते हैं यदि एक दिन में यह रविमन्दोच्च गति पाते हैं तो कल्पकुदिन में क्या इससे कल्परविमन्दोच्च भगण आया ।

अथवा विदित रविमन्दोच्च ७८° से कुट्टकयुक्ति से उसका (रविमन्दोच्च) आनयन करते हैं ।

कल्पना करते हैं कल्परविमन्दोच्चभगणमान = य

तब १८५३ शकान्त में कल्पादि से सौर वर्ष = १९७२९४१०३२ (नवनगशशिमुनिकृतनव इत्यादि ब्राह्मस्फुटसिद्धान्तोक्ति से या गोऽद्रीन्द्वद्रिकृताङ्कदस्रनगगोचन्द्रा इत्यादि भास्करोक्ति से) तब अनुपात करते हैं यदि कल्प सौर वर्ष में कल्परविमन्दोच्च भगण पाते हैं तो कल्पादि से शकान्त तक पूर्वानीत सौर वर्ष में क्या—इससे शेषसहित रविमन्दोच्चभगण इष्टवर्षान्त में आया ।

$$\frac{१९७२९४१०३२ \times \text{य}}{४३२०००००००} = \text{ल} + \frac{\text{शे}}{४३२०००००००} \therefore १९७२९४१०३२ \times \text{य} =$$

$४३२००००००० \times \text{ल} + \text{शे}$ समशोधन करने से $१९७२९४१०३२ \times \text{य} - ४३२०००००००$

$\times$ल=शे इसको चक्रांश (३६०) से गुणाकर कल्प वर्ष से भाग देना तब फल रविमन्दोच्च प्रमाण = ७८ $\therefore \frac{(१९७२९४१०३२\times य-४३२००००००० \times ल) \times ३६०}{४३२०००००००}$

=७८° छेदगम से

$(१९७२९४१०३२\times य-४३२००००००० \times ल) \times ३६० = ४३२००००००० \times ७८$-

दोनों पक्षों को ३६० इस से भाग देने से

$१९७२९४१०३२\times य-४३२००००००० \times ल = \frac{४३२००००००० \times ७८}{३६०} = १२००००००\times ७८ = ९३६००००००$ दोनों पक्षों में समान जोड़ने से $१९७२९४१०३२ \times य =$ $४३२००००००० \times ल + ९३६०००००० \therefore \frac{१९७२९४१०३२ \times य - ९३६००००००}{४३२०००००००} = ल$।

आठ से भाग देने से $\frac{२४६६१८६२९\times य-११७००००००}{५४००००००} = ल$, यहां ५५६७०१ इन से अपवर्त्तन देने से $\frac{४४३य-२१०}{९७०} = ल$ (स्वल्पान्तर से) ऋणात्मक रूपक्षेप में लब्धि और गुण लाकर 'अभीप्सितक्षेपविशुद्धिनिघ्नौ' इत्यादि से लब्धि=२१९, गुणक =४८० 'ते भाज्यतद्भाजकवर्णमाने' इस भास्करोक्ति से गुणक ही भाज्यवर्ण (य) का मान होता है इसलिए य=४८०=कल्परविमन्दोच्च भगण।

चन्द्रमन्दोच्चोपपत्ति

दो तरह के मन्द और शीघ्र भेद से मन्दोच्च और शीघ्रोच्च होता है। 'शीघ्राख्यतुङ्गस्य तयोरभावात्' इत्यादि भास्करोक्ति से रवि और चन्द्र का केवल मन्दोच्च ही होता है। चन्द्रबिम्ब कला की परमाल्पता चन्द्रमन्दोच्च स्थान में होती है वहां उस समय में जितने वेधागत स्पष्ट चन्द्र होते हैं उतने ही चन्द्रमन्दोच्च होते हैं। परमाल्पचन्द्रबिम्बकलाप्रमाण को मापन कर समझ लेना चाहिए इसके लिए भूगर्भ और भूपृष्ठ को अभेद मानना पड़ेगा, द्वितीय पर्यय में भी पूर्वोक्त युक्ति से चन्द्रमन्दोच्च जानकर दोनों चन्द्रमन्दोच्च के अन्तर करने से वेधकालान्तर दिन-सम्बन्धी चन्द्रगति होती है तब अनुपात करते हैं यदि वेधकालान्तर में चन्द्रगति पाते हैं तो एक दिन में इससे एकदिनसम्बन्धिनी चन्द्रमन्दोच्च गति आई, इससे पूर्ववत् कल्प चन्द्रभगण ले आना। बिम्बीय कर्णसम्बन्ध से भी चन्द्रमन्दोच्च भगणोपपत्ति हो सकती है। यथा

प्रत्येक दिन वेध से चन्द्रबिम्बीय कर्ण साधन करना, जब चन्द्र शराभाव होगा उस दिन में चन्द्रबिम्बीय कर्ण के परमत्व में वेधागत स्पष्ट चन्द्र ही मन्दोच्च होंगे। द्वितीय पर्यय में भी इसी तरह चन्द्रमन्दोच्चों के अन्तर पर से पूर्ववत् कल्पचन्द्र मन्दोच्च भगण आ जाएंगे।

चन्द्रपातभगणोपपत्ति

दृष्टिस्थानाभिप्रायिक गोल का निर्माण करना ही वेधगोल है। दृष्टिस्थान (वेध-

गोल केन्द्र) से चन्द्र को वेध करने से वेधगोल में जहाँ उपलब्ध होते हैं उनके ऊपर वेध-गोलीय कदम्ब प्रोतवृत्त करने से वह कदम्ब प्रोतवृत्त वेधगोलीय क्रान्तिवृत्त में जहां लगता है वहां से चन्द्रविम्बकेन्द्र तक कदम्ब प्रोतवृत्त में चन्द्र का शरांश है, तब

$\frac{\text{वेधगोलीय शरज्या} \times \text{त्रि}}{\text{वेधगोलव्या} \frac{1}{2}}$ —चन्द्रगोलीयशरज्या । इसमें क्रान्तिवृत्त धरातलान्तर संस्कार करने से जो होता है उसके वश से भगोलीय शरज्ञान होगा ही, इस तरह प्रत्येक दिन वेध से भगोलीय शरज्या का ज्ञान करना ॥१३॥

इदानीं ग्रहयुगस्य परिभाषां करोति

कालर्क्षदेशयोगाद् भूयो ग्रहमन्दशीघ्रपातानाम् ।
कल्पेन यतो योगस्ततः स्फुटं ग्रहयुगं कल्पः ॥१४॥

वा. भा.—कालयोगः चैत्रसितादेरुदयाद् भानोः । ऋक्षयोगः पौष्णाश्विनांतरस्थैः सह ग्रहैः । देशयोगो लङ्कायामिति । तेनायमर्थः, कालर्क्षदेशयोगाद् भूय एतावत्या सामग्र्या पुनरपि ग्रहशीघ्रमन्दपातानां यतो यस्मात्कल्पे योगो भवति तस्मात् कल्प एव ग्रहयुगं स्फुटम् ॥

वि. भा.—ग्रहमन्दशीघ्रपातानां (ग्रहाणां मन्दोच्चानां शीघ्रोच्चानां पातानां च) कालर्क्षदेशयोगात् (कालयोगश्चैत्रसितादेरुदयाद्भानोः) ऋक्ष (नक्षत्र)योगः पूर्वकथितैः पौष्णाश्विन्यन्तस्थैः सह ग्रहैः देशयोगः(लङ्कायाम्) एतस्मात्कालर्क्षदेश-योगाद्, भूयः (वारं वारं) यतः (यस्मात्कारणात्) कल्पेन (कल्पवर्षप्रमाणेन)योगो भवेन्नहि तत्पूर्वं पश्चाद्वा ततः(तस्मात्कारणात्)कल्पो ग्रहयुगमिति स्फुटमर्थाद्यदैकदा सृष्ट्यारम्भे कल्पादौ ग्रहमन्दशीघ्रपातानां कालदेशयोगो भवति ततोऽनन्तरं पुनः कल्पान्ते (द्वितीयसृष्ट्यारम्भे) तादृशयोगः कल्पवर्षैर्भवत्यतः कल्प एव ग्रहयुगमिति ॥१४॥

अब ग्रहयुग की परिभाषा करते हैं ।

हि. भा.—ग्रहों, मन्दोच्चों, शीघ्रोच्चों और पातों के कालसम्बन्ध से योग हो (पहले सृष्ट्यारम्भ में जो कहा गया है चैत्रसितादेरुदयाद्भानोः) ऋक्ष (नक्षत्र) योग (पूर्वकथित भचक्रचलनसूत्रक श्लोक में पौषणाश्विन्यन्तस्थैः सह ग्रहैः) देशयोग (पूर्वकथित काल प्रवृत्ति-सूचक श्लोक में) 'लङ्कायाम्' इस तरह की स्थिति जब (कल्पादि में) हो उसके बाद फिर उन सब ग्रहमन्दशीघ्रपातों) के वह योग कल्पवर्ष में होता है इसलिए कल्प ही स्फुट ग्रह युग होता हैं। अर्थात् ग्रहादि के कालयोग, ऋक्षयोग और देशयोग, एकबार जब (कल्पारम्भ में) होता है फिर उन सब के उस तरह के योग कल्पवर्ष में (कल्पान्त में) होता है उससे पहले या पीछे नहीं होता है इसलिए कल्पादि से कल्पान्त पर्यन्त एक कल्पवर्ष ही ग्रहयुग होता है । इति ॥१४॥

इदानीं रविबुधसितानां कुजगुरुशनिशीघ्रोच्चानां च प्राग्व्रजतां कल्पभगणानाह।

कल्पेऽर्कबुधसितानां भगणाः शून्यानि सप्तरदवेदाः ४३२०००००० ।
प्राग्व्रजतां कुजगुरुशनिशीघ्रोच्चानां स्वकक्षासु ॥१५॥

वा. भा.—कल्पाख्ये कालप्रमाणे, भगणाश्चक्रपरिवर्त्ताः, केषामर्क-बुधसितानां, कियन्तस्ते इत्याह शून्यानि सप्त रदवेदाः ४३२०००००००० प्राग्व्रजतां पूर्वाभिमुख गच्छतां स्वगत्येत्यर्थः, स्वकक्षासु स्वेषु भ्रमणप्रदेशेषु । न केवलमर्कादीनामेते भगणाः स्युः कुजगुरुशनिशीघ्रोच्चानाञ्च, यतो रविकक्षायामेव तेषां शीघ्रप्रतिमण्डलमध्यभ्रमणम्। (सर्वमेतद्गोले छेदके वा प्रतिपादयेत्) भयञ्जर-तुल्यया परगत्या, यतोऽहोरात्रेणैव स्वकक्षायां पूरयन्तो दृश्यन्ते। अतएवोक्तं प्राग्व्रजतामिति, एवं सर्वेषां वक्ष्यमाणानामपि योज्यम्। भगणाश्च खेरविभूयोगभगणभोगोपलब्धासकृद्रविचन्द्रयोगोपलब्धा चन्द्रभगणाःशेष ग्रहाणाम्। चन्द्रयोगोपलब्धा शीघ्रमंदानां परमफलोत्पत्त्यनुत्पत्तिभ्याम्। पातानां परमविक्षेपा विक्षिप्त्युपलब्ध्यभियोगाशयेन च ज्ञेयाः। सूक्ष्मावयवोपलब्धा च। अथवा भगणादिष्वस्माकमागम एव प्रमाणमिति।

पञ्चाम्बराणि गुणगुण-पञ्चमुनिस्वर-शरैर्मिताः शशिनः ५७७५३३०००००।
भौमस्य द्वियमशराष्टपक्षवसुरसनवद्वियमाः २२९६८२८५२२ ॥१६॥

चन्द्रभगणाः५७७५३३०००.०० ।

कुजभगणाः२२९६८२८५२२ एतेन चन्द्रभौमयोः कल्पे भगणसंख्या प्रतिपादिता ।

कृतवसुनवाष्टनवनवषट्त्रिनवनगेन्दवोऽज्ञ शीघ्रस्य १७९३६९९८९८४ ।
जीवस्य शरेषूदधिषट्पक्षद्विकृतरसरामाः ३६४२२६४५५ ॥१७॥

बुधशीघ्रभगणाः १६९३६९९८९८४ ।
बृहस्पतिभगणाः ३६४२२६४५५ ।

इदानीं शुक्र शीघ्र शनैश्चरयोः कल्पभगणानाह

सितशीघ्रस्य यमलगोवेदनवाष्टाग्निपक्षयमखनगाः ७०२२३८९४९२ ।
अष्टनवपक्षमुनिरसशररसमनवोऽर्कपुत्रस्य १४६५६७२९८ ॥१८ ॥

शुक्र शीघ्रभगणाः ७०२२३=८९४९२ ।
शनैश्चरभगणाः १४६५६७२९८।

इदानीं रव्यादिमन्दानां चन्द्रादिपातानां च कल्पभगणानाह ॥

खाष्टाब्धयो ४८० वसुशरवसुपञ्चखचन्द्रवसुवसुसमुद्राः ४८८१०५८५८।
द्विनवयमा २९२ द्वित्रिगुणाः ३३२ शरेषु वसव ८५५ स्त्रिपञ्चरसाः ६५३ ॥१९॥

खाष्टोदधयोर्कमन्दस्य ४८० । वसुशरपंचखचन्द्रवसुवसु-समुद्राः ४८८१०-५८५८ चन्द्रमन्दस्य ।

भौममन्दस्य द्विनवयमाः २९२ । बुधमन्दस्य द्वित्रिगुणाः ३३२ । जीवमन्दस्य शरेषुवसवः ८५८ । शुक्रमन्दस्य ६५३ त्रिपञ्चरसाः कल्पे भगणाः भवन्ति ।

शशिवेदा ४१ मन्दानामार्कादीनां विलोमपातानाम्. ।
वसुरसरुद्रेन्दु-गुण द्वित्रियमाः २३२३१११६८ सप्तरसपक्षाः २६७ ॥२०॥

शशिवेदा ४१ इति शनिमन्दस्य कल्प भगणाः भवन्ति । विलोमपातानामिदानीं लिख्यते ।

वसुरसरुद्रेन्दु गुणाद्वित्रियमा इति चन्द्रपातस्य २३२३१११६८ । सप्तरसपक्षा २६७ इति भौमपातस्य भगणाः भवन्ति !

शशियमशरा ५२१ गुणरसा ६३ स्त्रिनववसवः ८९३ समुद्रवसुविषयाः ५८४ ।
चन्द्रादीनां पश्चाद् व्रजतोऽश्विन्यादिभगणस्य ॥२१॥

शशियमशरा ५२१ इति बुधपातस्य । गुणरसा ६३ इति गुरुपातस्य, त्रिनन्दवसवः ८९३ इति शुक्रपातस्य । समुद्रवसुविषयाः ५८४ इति शनिपातस्य ।

एते यथाक्रमेण कल्पभगणा विलोमपातानामित्यर्थः । यतः सर्वे एव पाताः मेषान्मीनं मीनात्कुम्भमित्याद्युत्क्रमेण भगणपरिवर्त्तं कुर्वंते इति । पश्चाद् व्रजतोश्विन्यादिभगणस्य इत्युत्तरसंबन्धो भविष्यतीति ॥

वि. भा.—कल्पे (ब्राह्मदिने) अर्कबुधसितानां (रविबुधशुक्राणां) शून्यानि सप्तरदवेदाः (सप्तशून्यानि-रदा द्वात्रिंशत् वेदाश्चत्वारोऽर्थात् ४३२०००००० एतावन्तः) भगणा भवन्ति। किं विशिष्टानां कुजगुरुशनिशीघ्रोच्चानाम् (मङ्गलगुरुशनीनां शीघ्रोच्चरूपा ये तेषां) स्वकक्षासु (स्वभ्रमणवृत्तेषु) प्राग्व्रजतां (पूर्वाभिमुखं गच्छतां) शशिनश्चन्द्रस्य पञ्चाम्बराग्नि गुणगुणपञ्चमुनिस्वरशरैर्मिताः (पञ्चशून्यानि त्रित्रिपञ्चसप्तसप्तपञ्च ५७७५३३००००० तुल्याः) कल्पभगणा भवन्ति । द्वियमशराष्टपक्षवसुरसनवद्वियमाः (द्विद्विपञ्चाष्टद्व्यष्टषड्नवद्वियमाः २२९६८२८५२२) भौमस्य (मङ्गलस्य) कल्पभगणाः । कृतवसुनवाष्टनवनवषट्त्रिनवागेन्दवः । (चतुरष्टनवाष्टनवनवषट् त्रिनव सप्तचन्द्राः १७९३६९९८९८४ (ज्ञशीघ्रस्य) बुधशीघ्रोच्चस्य) कल्पे भगणा भवन्ति शरेषूदधिषट्पक्षद्विकृतरसरामाः (पञ्चपञ्चचतुःषट्द्विद्विवेदषड्गनयः ३६४२२६४५५) जीवस्य (गुरोः) कल्पभगणा भवन्ति । यमलगोवेदनवाष्टाग्निपक्षयमखनगाः (द्विनवचतुर्नवाष्टत्रिद्विद्वशून्यसप्त (७०२२३८९४९२) सितशीघ्रस्य (शुक्रशीघ्रोच्चस्य,) अष्टनवपक्षमुनिररसशरसमनवः (अष्टनवद्विसप्तषट्पञ्चषट्चतुर्दश (१४६५६७२९८) अर्कपुत्रस्य (शनैश्चरस्य), खाष्टाब्धयः (शून्याष्टचत्वारः

४८०)वसुशरवसुपञ्चखचन्द्रवसुवसुसमुद्रा:(अष्टपञ्चाष्टपञ्चशून्यैकाष्टाष्टचत्वार:४८८१०-५८५८), द्विनवयमा: (२९२), द्वित्रिगुणा: (३३२), शरेषुवसव: (पञ्चपञ्चाष्टौ ८५५) त्रिपञ्चरसा:(त्रिपञ्चषट्का:६५३), शशिवेदा: (एकचत्वारिंशत् (४१) एते क्रमशोऽर्कादीनां (रव्यादिग्रहाणां) मन्दानां (मन्दोच्चानां) कल्पभगणा भवन्ति, वसुरसरुद्रेन्दुगुणद्वित्रियमा: । अष्टषडेकादशैकत्रिद्वित्रियमा:२३२३१११६८), सप्तरसपक्षा: (सप्तषट्दस्रा: २६७), शशियमशरा: (एकद्विपञ्च ५२१), गुणरसा: (त्रिषष्टि:), त्रिनववसव: (त्रिनवाष्टौ (८९३), समुद्रवसुविषया: चतुरष्टपञ्च (५८४) इति चन्द्रादीनां ग्रहाणां विलोमपातानां (विपरीतगतिकपातसंज्ञकानां), अश्विन्यादिभगणस्य पश्चात् व्रजत: कल्पे भगणा भवन्तीति ॥१५-२१॥

इदानीं भभ्रमान् कुदिनानि चाह

भपरिवर्त्ता: खचतुष्टय-शराब्धिरसगुणयमद्विवसुतिथय: १५८२२३६४५००००।
रविभगणोना भानो: सावनदिवसा: कुदिवसास्ते ॥२२॥

वा. भा.—पश्चाद् व्रजत: पश्चिमाभिमुखं भ्रमत: अश्विन्यादिभगणस्य कल्पे परिवर्त्ता: कियन्त इत्याह ।

खचतुष्टयशराब्धिरसगुण-यम-द्विवसुतिथय: १५८२२३६४५०००० एत एव रविभगणैरूना: सन्तो भानोस्संबन्धिन: सावनदिवसा: भवन्ति । कल्पे एतावन्तोऽर्कोदया भवन्ति । कुदिवसा: भूमे: संबन्धिनो दिवसा वा एते । अयमभिप्रायो भूर्वा भ्रमति प्राङ्मुखा सा चावर्त्तवत्यैतावतो वारान् क्षितिजे रविणा सह युज्यते । तथाप्यर्कोदय: समो भवति, रविग्रणमत्र ग्रहोपलक्षणार्थम् । तेन यस्यैव ग्रहस्य भगणैरूना नक्षत्रपरिवर्त्ता: क्रियन्ते तस्यैव सावनदिवसा भवन्ति । कल्पे तावन्त उदयास्तस्य, अर्थादेव नक्षत्रस्य परिवर्ततुल्या उदया:, यतो नक्षत्रमगतिमतो ग्रहस्य स्वभुक्तितुल्यमन्तर-प्रतिदिनं नक्षत्रेण सह भवत्यत: कल्पेन स्वभगण-तुल्यमन्तरं भवतीति कृत्वा नक्षत्रपरिवर्त्तेभ्यो भगणान्संशोध्य तदुदया: भवन्ति । सावनमुदयादुदय इति लक्षणेन सावनदिवसा उच्यन्ते, तद्यथा—नक्षत्रपरिवर्त्ता १५८२२३६४५०००० रविभगणैरमीभि; ४३२०००००० ऊना जाता: १५७७९ १६४५०००० खचतुष्टयशराब्धिरसचन्द्रनवागमुनितिथय: । तथा च बलभद्र: 'खचतुष्टयशराब्ध्यष्टिनवागागशरेन्दव: । कल्पे सूर्योदया ज्ञेयास्त एव च कुवासरा:' ।। इति ।।

वि. भा.—कल्पे १५८२२३६४५०००० एतावन्तो भभ्रमा भवन्ति । ते भभ्रमा रविभगणोना: (रविभगणरहिता:) तदा भानो: (सूर्यस्य) सावनदिवसा: स्यु: । ते कुदिवसा: (कुदिनानि) स्यु:, कल्पे यावन्ति सूर्यसावनदिनानि तान्येव कुदिनसंज्ञकानि ।।२२।।

अत्रोपपत्तिः ।

एकस्मिन् दिने उदयकाले केनापि नक्षत्रेण सह रविरुदितो दृष्टो द्वितीयदिने नक्षत्रस्यगत्यभावात्प्रथमं तदुदयस्तदनन्तरं रविगतिकलोत्पन्नासुभिस्तदुदयोऽत एकस्मिन् नाक्षत्रदिने रविगति-कलोत्पन्नासुयुक्ते एक सावनदिनान्तःपातिनाक्षत्र-कालः । द्वितीयदिने नाक्षत्रदिनद्वये रविदिनद्वयगतियोगोत्पन्नासुयुक्ते सावनदिन-द्वयान्तःपातिनाक्षत्रकाल एवमग्रेऽपि अर्थाद्यस्मिन्निष्टदिने नाक्षत्रकालोऽपेक्षितस्तद्दिन-संख्यक-नाक्षत्रदिने इष्टदिनरविगतियोगासुयुक्ते सतोष्टदिनान्तःपातिनाक्षत्र-कालो भवेदेतेनैव नियमेन एकवर्षान्तःपातिसावनसंख्यातुल्ये नाक्षत्रदिने एकवर्ष-सम्बन्धिरविगतियोगा (क्रान्तिवृत्त) सु (नाक्षत्रदिनमेकं) युक्ते वर्षान्तःपाति नाक्षत्रदिनमर्थाद् वर्षान्तःपातिभभ्रमो भवेदतो वर्षान्तःपातिभभ्रम=वर्षान्तः पातिरविसावन सं+१ नाक्षत्रदिनम् । ततोऽनुपातेन, यद्येकेन वर्षेण वर्षान्तःपाति-भभ्रमा लभ्यन्ते तदा कल्पवर्षैः किमिति । कल्पे भभ्रमाः=(वर्षान्तःपातिरवि-सावन सं+१) क वर्ष=वर्षान्तःपातिरविसावनसं×कवर्ष+कवर्ष=कल्परवि-सावनदिन+कवर्ष=कल्पकुदिन+करविभगण=पठिताङ्काः, तथा कल्पभभ्रम—करविभगण=कल्पकुदिन कल्परविसावनदिन+कवर्ष=कल्पकुदिनम् भास्करा चार्येणापि खखेषुवेदषड्गुणाकृतीभभूतभूमयः शताहता भपश्चिमभ्रमा भवन्ति काहनी'त्यनेनेदमेव कथ्यत इति ॥२२॥

अब भभ्रम को और कुदिनों को कहते हैं ।

हि. भा.—कल्प में १५८२२३६४५०००० इतने भभ्रम होते हैं, भभ्रम में रविभगण को घटाने से रवि के सावन दिन होते हैं वह कुदिनसंज्ञक हैं अर्थात् कल्प या युग में जो सूर्यसावन दिन होते हैं उन्ही को कल्प या युग में कुदिन कहते हैं ॥२२॥

उपपत्ति

एक दिन में उदय काल में किसी नक्षत्र के साथ रवि उदित हुए, दूसरे दिन में नक्षत्र की गति नहीं रहने के कारण पहले नक्षत्र का उदय होता है उसके बाद रविगति-कलोत्पन्नासु करके रवि का उदय होता है इसलिए एक नाक्षत्र दिन में रविगतिकलोत्पन्नासु जोड़ने में एक सावन दिनान्तःपाती नाक्षत्र काल होगा । एवं दूसरे दिन में दो नाक्षत्र दिन में दो दिनों के रविगतियोगकालोत्पन्नासु से दो सावन दिनान्तःपाति नाक्षत्र काल होगा । इसी तरह तीसरे, चौथे आदि दिनों में भी विचार करना । इससे यह देखने में आता है कि जिस इष्टदिन में नाक्षत्र काल अपेक्षित हो उस दिन के संख्यातुल्य नाक्षत्र दिन में एक वर्ष सम्बन्धित रविगतियोगा (क्रान्तिवृत्त) सु (एक नाक्षत्र दिन) जोड़ने से एक वर्षान्तःपाति नाक्षत्र दिन अर्थात् एक वर्षान्तःपाति भभ्रम होता है । इसलिए वर्षान्तः-

पतिभभ्रम=वर्षान्तःपाति रविसावनसं+१ नाक्षत्र दिन तब अनुपात यदि एक वर्ष में यह वर्षान्तःपाति भभ्रम पाते हैं तो कल्पवर्ष में क्या, इससे कल्प में भभ्रम=(वर्षान्तःपाति रसावन सं+१)×कवर्ष=वर्षान्तःपाति र सावन सं×कवर्ष=कल्परविसावनदि+कवर्ष=कल्पकुदिन+करविभगण=पठिताङ्क तथा कल्पभभ्रम—कल्परविभगण=ककुदिन (भास्कराचार्य भी खखेषुवेदषड्गुणा कृतीभभूतभूमयः। शताहता भपश्चिमभ्रमा भवन्ति काहनि' इससे वही कहते हैं इति ॥ २२ ॥

इदानीं कल्पे रविवर्षमासशशिमास-दिनाधिमासोनरात्राणां प्रतिपादनायार्याद्वयमाह—

रविभगणा रव्यब्दा द्वादशगुणिता भवन्ति रविमासाः=५१८४००००००।
भगणान्तरं रवीन्द्वोः शशिमासाः ५३४३३३००००० सूर्यमासोनाः ॥२३॥

अधिमासाः१५९३३००००० शशिमासास्त्रिंशद्गुणिता १६०२९९९०००००० भवन्ति शशिदिवसाः।
शशिसावनदिवसान्तरमवमानि तिथिः शशाङ्कदिनम् ॥२४॥

वा. भा.—रवेर्भगणाः एव रव्यब्दा भवन्ति, यतः स्वभगणभोगेनैव तस्य वर्षं भवति। त एव भगणा द्वादशगुणिताः सन्तो रविमासा भवन्ति। वर्षद्वादशगुणं मासत्वमापद्यते। सर्वस्यैवमतः। तद्यथा रविभगणाः ४३२०००००० एते द्वादशहताः कृतवसुचन्द्रशराः शून्यसप्तकेनाहताः ५१८४०००००० तथा सप्त शून्यानि वेदाष्टनिशाकर शिलीमुखा भवन्ति, 'मासाः सावित्राब्राह्मेणाह्ना सदैव तु। भगणान्तरं रवीन्द्वोः शशिमासा' इति शशिमासाः। पुनर्भगणांतरं रवीन्द्वोः कृत्वा शशिमासा भवन्ति, यस्माद्रविचन्द्रयोः यावन्तः कल्पे योगाःतावन्त एव शशिमासास्तावन्त्य एव कल्पेऽमावास्या इत्यर्थः। वक्ष्यति यतः तिथिशशांकदिनमिति। तद्यथा रविभगण ४३२०००००० शशिभगणाश्च ५७७५३३-०००००० एतेषामन्तरं ५३४३३३००००० पञ्चशून्यानि गुणरामाग्निवेदलोकशराः एते कल्पे शशिमासा एत एव सूर्यमासैरमीभिः १५९३००००० ऊना जाता कलाधिमासकाः त्रिगुणनवतिथयः पंचशून्येनाहताः १५९३३००००० तथा च पंचशून्यानि रामाग्नि-नवपञ्चनिशाकरकल्पाधिमासका ज्ञेया नित्यमेव विचक्षणैः॥

शशिमासाश्च त्रिंशद्गुणिताः शशिदिवसाः भवन्ति। न केवलं चन्द्रस्यान्यस्यापि मासाः त्रिंशद् गुणिताः दिवसत्वमापद्यन्ते। तद्यथा शशिमासास्त्रिंशद् गुणिता जाता नवनन्दनवखखरसचन्द्राः शून्यषट्काहता १६०२९९९०००००० एते कल्पे चन्द्रदिवसाः। तथाच 'शून्यषट्कं च गोनन्दनवाश्विखरसेन्दवः। कल्पे चन्द्रदिनान्याहुर्नित्यं गणितपारगाः।' शशिसावनदिवसान्तरमवमानीति। शशिदिनानां सावनानां च यावत्यन्तरे दिनानि तावन्त्यवमानि, तावन्तः कल्पे तिथिलोपाः। तद्यथा कल्पे शशिदिनानि १६०२९९९००००००अर्कसावनदिनानि च १५७७९१६४५

००००एतयोरन्तरं शरेषुयमवसु-ख-शराश्विनः खचतुष्टयैकाहताः—
२५०८२५५०००० तथा च बलभद्रः "खचतुष्कं शरार्थाश्विवसु-शून्यशराश्विनः। कल्पोनरात्रा विज्ञेया नित्यमेव मनीषिभिः"। तिथिशशाङ्कदिनमित्युक्तरत्र संबद्धं भवतीति ।

वि. भा.—रविभगणाः (कल्पपठितरविभगणाः ४३२००००००) रव्यब्दा (कल्पसौरवर्षाणि) भवन्त्यर्थात्कल्पे यावन्तो रविभगणास्तावन्त्येव कल्पसौर-वर्षाणि भवन्ति। ते (रव्यब्दाः) द्वादशगुणितास्तदा रविमासा (सौरमासाः) भवन्ति । रवीन्द्वोर्भगणान्तरं (कल्पचन्द्रभगणरविभगणयोरन्तरं) शशिमासाः कल्पचान्द्रमासाः)भवन्ति, चान्द्रमासाः सूर्यमासोनाः(कल्पचान्द्रमासाः कल्पसौरमास-रहिताः) तदाऽधिमासाः (कल्पाधिमासा.) भवन्ति। शशिमासाः(कल्पचान्द्रमासाः) त्रिंशद्गुणितास्तदा शशिदिवसाः(कल्पचान्द्रदिनानि)भवन्ति,शशिसावनदिवसान्तरं कल्पचांद्रदिनकल्पकुदिनयोरन्तरं कल्पावमानि भवन्ति) तिथिः शशाङ्कदिनं (तिथि-श्चान्द्रदिनं) भवतीति ॥२३-२४॥

अत्रोपपत्तयः

सृष्ट्यादिकाले नाडीक्रान्तिवृत्तयोः सम्पाते (स्थिरमेषादौ) एव रविस्ततोऽनन्तर रवेर्भ्रमणेन पुनर्यदा तद्बिन्दौ (स्थिरमेषादौ) रविरागच्छति तदा तद्भगणपूर्तिर्भ-वति परमेतावति (द्वादशराशिभोग) काले तत्सम्पातस्यापि तु किमपि चलनं भवेत्तेन पूर्वोक्तरविभगणे (सौरवर्षे) सम्पातस्य यच्चलनं भवेत्तद्योज्यं तदा सम्पातात् सम्पातं यावत्सायनसौरवर्षमेकरविभगणभोगकालो वा भवति परमत्राचार्येण निरयणसौरवर्षमेव कथ्यते, कल्पेऽपि रविभगणतुल्यानि निरयणसौरवर्षाण्येव भवितुमर्हन्ति, आचार्येण तथैव कथ्यन्ते । कल्पसौरवर्ष × १२ = कल्पसौरमासाः एतावता 'रविभगणा रव्यब्दाः' इत्याचार्यकथनं निरयणसौरवर्षपरं बोध्यं, भास्कराचार्येणापि 'रवेश्चक्रभोगोऽर्कवर्षप्रदिष्टमि'त्यनेन निरयणसौरवर्षमेव कथ्यते, सर्वैरेवाचार्यैरयनगतिरत्र विषये शून्या कल्पितेति ॥

अथ चान्द्रमासोपपत्तिः

अमान्तकाले रविचन्द्रावेकत्रैव भवतः एव (दर्शः सूर्येन्दुसङ्गम इत्यमरोक्तेः) ततोऽनन्तरं स्वस्वगत्या तौ चलितौ तयोश्चन्द्रस्याधिकगतित्वाच्चन्द्रः पूर्वस्थानं (अमान्तबिन्दुं) गत्वा रविणा सह पुनरपि मिलितस्तदैकचान्द्रमासपूर्त्तिर्जाता। तत्र चन्द्रगतिः = १चन्द्रभगण + रविगतिः। अतः चन्द्रगति — रविगति = १चन्द्रभगणः, ततोऽनुपातो यदा रविचन्द्रयोर्गत्यन्तरमेकभगणतुल्यं तदैकश्चान्द्रमासस्तदा कल्पीयगत्यन्तरेण (कल्पीय-रविचन्द्रभगणान्तरेण) कियन्तो लब्धा कल्परविचन्द्र-भगणान्तरतुल्याश्चान्द्रमासा एतावता 'भगणान्तरं रवीन्द्वोः शशिमासाः' इति आचार्योक्तमुपपद्यते। वटेश्वरश्रीपतिभास्करप्रभृतिभिराचार्यैरेतदनुरूपमेव कथ्यते। सूर्यसिद्धान्तेऽपि 'भवन्ति शशिनो मासाः सूर्येन्द्रभगणान्तरमि' त्यनेन तदेव कथ्यते सूर्यांशदेवेनेति ॥

अथाऽधिमासोपपत्तिः

अथैकसावनदिने $\left\{ \begin{array}{l} \text{चान्द्रमध्यगतिः} = ७९०'।३५'' \\ \text{रविमध्यग} = ५९'।८'' \end{array} \right\}$ अनयोरन्तरम् $= ७३१'।२७''$ $= १२°।११'।२७''$

अथ यतः चंग — रग $= १२° = १$ तिथिस्तस्मात्सावनदिनपूर्तिकालात् पूर्वमेव चान्द्रदिनपूर्तिः सिद्धाऽतः चान्द्रदि < सावनदि < सौरदिन यतः सौरदि $= ६०'$, यदा रविगतिः षष्टिकला भवेत्तदा सौरदिनपूर्तिः, सावन-दिन-पूर्त्तिरस्ति ५९'।८'' एतत्तुल्यरविगतावेवातो दिनसंख्यया सौरदिसं < चान्द्र दिवसम्

ततः कचान्द्रमास — कसौरमास = कल्पाधिमास, कचांदिन — कसावनदि = कक्षयदिन = कल्पात्रमदिन एतेन 'शशिमासाः सूर्यमासोना' इत्यारभ्य 'शशिसावन-दिवसान्तरमवमानीत्यन्तमुपपद्यते । भास्कराचार्येणापि 'सौरान्मासादैन्दवः स्याल्लघीयान् यस्मात्तस्मात्संख्यया तेऽधिकाः स्युरि'त्यादिना तदेव कथ्यत इति ।।२४।।

अब सौरमास चान्द्रमास अधिमास और अवमदिन को कहते हैं

हि.भा.—कल्प पठित रविभगण ४३२०००००० कल्पसौरवर्ष होते हैं अर्थात् कल्प में जितने रविभगण हैं उतने ही कल्पसौरवर्ष होते हैं, कल्पसौरवर्ष को बारह से गुणने से कल्पसौरमास होते हैं, कल्पचन्द्रभगण और कल्परविभगण का अन्तर कल्प चान्द्रमास होते हैं। कल्पचान्द्रमास में कल्प सौरमास को घटाने से कल्पाधिमास होता है। कल्पचान्द्रमास को तीस से गुणने से कल्पचान्द्रदिन होते हैं, कल्पचान्द्रदिन और कल्पकुदिन का अन्तर कल्पावमदिन होते हैं। एक तिथि एकचान्द्रदिन है ।।२३-२४।।

इन सब की उपपत्ति

सृष्ट्यादि काल में नाड़ीवृत्त और क्रान्तिवृत्त के सम्पात (स्थिरमेषादि) में रवि थे। उसके बाद रवि भ्रमण करते हुए फिर जब उसी बिन्दु में आते हैं तब उनकी एक भगण (द्वादशराशिभोग) पूर्त्ति होती है लेकिन इतने समय में वह सम्पात भी कुछ पूर्व स्थान से चलेगा, इसलिए पूर्वकथित रवि के एकभगणभोग कालतुल्य सौरवर्ष में सम्पात चलन (अयनगति) जोड़ने से वास्तव सायन सौरवर्ष होगा. परन्तु यहां आचार्य निरयण सौरवर्ष ही लेते हैं, कल्पसौरवर्ष भी निरयण ही कहते हैं।

कल्पसौरवर्ष × १२ = कल्पसौरमास 'इससे (रविभगणरव्यब्दाः) यह आचार्यकथन निरयणसौरवर्षपरक समझना चाहिए, भास्कराचार्य भी 'रवेश्चक्रभोगोऽर्कवर्ष-प्रदिष्टम्' इससे जो एक रविभगण भोगकाल को एक सौरवर्ष कहते हैं वह भी निरयण सौरवर्ष ही सिद्ध होता है, सब आचार्य यहां अयनगति को शून्य मानते हैं जो ठीक नहीं है ।।

चान्द्रमास की उपपत्ति

अमान्तकाल में रवि और चन्द्र एक ही स्थान में रहते हैं, उसी का नाम दर्शान्त

(अमान्त) है उसके बाद रवि और चन्द्र अपनी-अपनी गति से चलने लगे, चन्द्र गति की अधिकता के कारण जिस स्थान (अमान्त बिन्दु) से चले थे वहां जाकर फिर रवि के साथ योग करते हैं तब एक चान्द्रमास (प्रथमामान्त से द्वितीयामान्त तक) भी पूरा हो जाता है यहाँ पर चन्द्रगति = १ चन्द्रभगण + रविगति हुई क्योंकि जिस स्थान से (प्रथमामान्तबिन्दु) चले थे वहाँ फिर जाने से चन्द्र की एक भगण पूर्ति होती है इसलिए चन्द्रगति — रविगति = चन्द्रभगण, तब अनुपात करते हैं यदि एक चन्द्रभगणतुल्य रविचन्द्र गत्यन्तर में एक चान्द्रमास पाते हैं तो कल्पीय रविचन्द्रगत्यन्तर (कल्पीय रविचन्द्रभगणान्तर) में क्या इस अनुपात से कल्पचन्द्र भगण और कल्परविभगण के अन्तर तुल्य ही कल्पचान्द्रमास सिद्ध हुआ इससे 'भगणान्तरं रवीन्द्वोः शशिमासाः' यह उपपन्न हुआ ॥

अधिमास की उपपत्ति

कल्पचान्द्रमास में कल्प सौरमास को घटाने से कल्पाधिमास क्यों होता है इसके लिए विचार करते हैं।

एक सावन दिन में चन्द्र मध्यमगति = ७९०'।३५''
रविमध्यमगति = ५९'।८'' दोनों के अन्तर = ७३१'।२७'' =
१२°११'।२७'' = चंमग — रमग तथा चंमग — रमग = १२° = १ तिथि इसलिए सावन दिन पूर्ति (पूरा) काल से पहले ही चान्द्रदिन पूर्ति सिद्ध हुई।

अतः चान्द्रदिन < सावनदि < सौरदिन, क्योंकि जब रवि की मध्यमगति साठ कला के बराबर होती है तब सौर दिन पूर्ति होती है और ५९'।८'' इतनी रवि मध्यमगति में सावन दिन पूर्ति होती है इसलिए दिन संख्या से सौदिसं < चांदिसं अतः कल्पचान्द्रमास — कल्पसौर मास = कल्पाधिमास, तथा कल्पचांदि — कसावनदि = कक्षयदि = कल्पावमदि इससे शशिमासा रविमासोना — यहाँ से 'शशिसावनदिवशान्तरमवमानि' यहाँ तक उपपन्न हुआ ॥ २४ ॥

इदानीं सावनदिननाक्षत्रदिनमानववर्षपितृदिनदिव्यदिनान्याह

सावनमुदयादुदयं भानां चार्क्षं नृवत्सरोऽर्काब्दः ।
पितृदिवसाः शशिमासा दिव्यानि दिनानि रविभगणाः ॥२५॥

वा. भा.—शशिमासा दिव्यानि दिनानि रविभगणाः। तिथिः शशांकदिनं तिथिरेव चन्द्रदिनम्। दिनग्रहणेनाहोरात्रोगृह्यते सर्वेष्वेव मानेषु, तेन यावदेव तिथिभोगप्रमाणं तावदेव चन्द्रमाससमानेन दिनप्रमाणं भवतीति, तैस्त्रिशता शशिमासा इत्यादि योज्यम्। एतच्च भगणान्तरं रवीन्द्वोः शशिमासा इत्येनेनैव सिद्धेः स्पष्टीकरणायोच्यते। सावनमुदयादुदयमित्यनेनैव सिद्धेः चन्द्रनक्षत्रभागावधिजस्य नाक्षत्रमानस्य व्युदासार्थमाचार्येणोक्तम्। भानां चार्क्षमिति। तथा नक्षत्रसावन-

मपि नाक्षत्रमुच्यते यतोर्कसावनमेवमेवोपयोगि-ग्रहगत्यानयनेऽन्यत्सावनेन नृवत्सरो-र्काऽब्दः मानुषवर्षमित्यर्थः, तस्य द्वादशभागः मध्यरविसंक्रान्त्यवधिजो रविमासः तस्यैव त्रिशद्भागो रविदिवसः स च शशिभोगावधिज इत्यादि सौरमानमुक्तम्, पितृदिवसाः शशिमासाः इत्थं त एव शशिनो मासास्त-पितृमानेन एव दिवसाश्चन्द्र-मासेनैकेन पितृणामहोरात्रो भवतीत्यर्थः । अत्र वासना पूर्वमेव गोलाध्याये प्रदर्शि-तेति । दिव्यानि तु पुनर्दिनानि रविभगणा; मेरुवासिनां रविभगणभोगकालेना-होरात्रं भवति । वडवामुखवासिनामप्यसुराणां रविभगणभोगकालेनैव त्वहोरात्रं भवति, रविमासैः षड्भिः तेषां दिनम् षड्भो रात्रिर्भवति एतत् गोलाध्याये सर्वं-व्याख्यातम् । सवासनिको ब्राह्मो दिवसः कल्पः । एवं मानेश्च यत्प्रयोजनम् तन्मानाध्याये वक्ष्यत्याचार्यः । वयमपि तत्रैव व्याख्यास्याम इति ॥

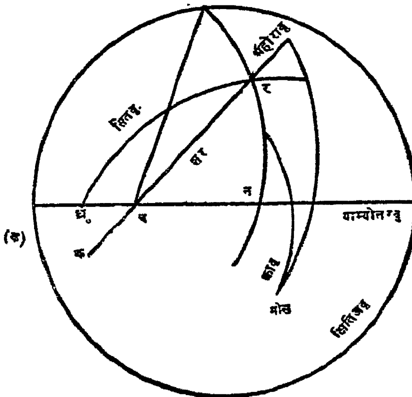
वि. भा.—रवेरुदयादुदयं सावनं (रविसावनं) भानां च (उदयादुदयं) आर्क्षं सावनं (नाक्षत्रसावनं दिनं) भवति । अर्काऽब्दः (सौरवर्षम्) नृवत्सरो (मानववर्षं) अर्थादेकसौरतुल्यं मानववर्षं भवति, पितृदिवसाः (पितृदिनानि) शशिमासाः (चान्द्र-मासाः) भवन्त्यर्थाच्चान्द्रमासतुल्यानि पितृणां दिनानि भवन्ति, रविभगणाः दिव्यानि दिनानि (दैवदिनानि) भवन्त्यर्थादेकरविभगणतुल्यानि दैवदिनानि भवन्तीति ॥२५॥

अत्रोपपत्तयः

रवेरुदयादुदयं यावद्रविसावनं कुदिनसंज्ञकम् । नक्षत्रोदयात्पुनस्त-दुदयं यावन्नाक्षत्रदिनं, सौरवर्षतुल्यं मानवबर्षमिति परिभाषारूपाः कथ्यन्ते । अथाधुना चान्द्रमासतुल्यं पितृदिनं कथं भवतीत्येतदर्थं विचार्यते ।

विधूर्ध्वभागे पितरो वसन्तीति पुराणादिकथितमवलम्ब्य विचारः । तत्र विधूर्ध्वभाग (चन्द्रोर्ध्वभाग) शब्देन चन्द्रस्य कियान् भागो ग्रहीतव्य इति । दृष्टिस्थानात् (भूकेन्द्रात्) चन्द्रबिम्बस्यानेकाः स्पर्शरेखा कार्यास्तदा प्रतिस्पर्श-बिन्दुजनितचन्द्रबिम्बप्रदेशो वृत्ताकारो भवति, चन्द्रबिम्बे एतस्य शोधनेन यच्छेषं स एव चन्द्रोर्ध्वभागस्तत्र पितरो निवसन्तीति पुरातनानां कथनेन ज्ञायते। अथ भूकेन्द्राच्चन्द्रकेन्द्रगता रेखा यत्र पितृत्रिज्यागोलीययाम्योत्तरवृत्ते लगति तत्रैव परिणतश्चन्द्रस्तदेव पितृ-ख-स्वस्तिकमप्यस्ति, तत्र यदा रविर्भवेत्तदा दर्शः सूर्येन्दुसङ्गम इत्युक्तेरमान्तो भवेत्तथा परिणतचन्द्ररूपपितरूर्ध्वखस्वस्तिक बिन्दौ रवेर्गमनात्तन्मध्याह्नकालोऽतः सिद्धं यदमान्तकाले पितृणां मध्याह्न-कालो (दिनार्धं) भवति, पुनर्यदा तद् द्वितीयामान्तो भवेत्तदा पितृणा द्वितीयदिनार्धं भविष्यति तेन प्रथमामान्ताद् द्वितीयामान्तं यावच्चान्द्रमासतुल्यं पितृप्रथमद्वितीय-मध्याह्नकालयोरन्तरं जातं परन्तु प्रथमद्वितीयमध्याह्नकालयोरन्तरं प्रथमद्वितीय-

सूर्योदययोः कालयोरन्तरं समं, प्रथमद्वितीयसूर्योदयकालयोरन्तरं सावनदिनम्, अतः पितॄणां दिन (अहोरात्र) चान्द्रमासतुल्यं सिद्धम् । परमत्रोपपत्तावमान्तकाले पितृमध्याह्नकालं स्वीकृत्य विचारः कृतः, सिद्धान्तशिरोमणौ भास्करेणापि, 'दर्शे यतोऽस्माद् द्युदलं तदैषामि'त्यादिनाऽमान्तकाल एव पितृदिनार्धकालः स्वीकृतः स च न समीचीनः । पितृयाम्योत्तरेऽर्थाच्चन्द्रोपरिगतध्रुवप्रोतवृत्ते यदा रविरागच्छेत्तदैव तन्मध्याह्नकालः, चन्द्रोपरिगतकदम्बप्रोतवृत्तमेव यदि पितृयाम्योत्तरवृत्तं भवेत्तदैवामान्तकालपितृमध्याह्नकालयोरभेदत्वं भवेत्परमेवं चन्द्रशराभावस्थले, शरसत्तायामपि मिथुनान्ते चन्द्रे सति भवद्यया (चन्द्रकेन्द्रोपरि ध्रुवप्रोतकदम्बप्रोतयोरभेदे सतीय स्थितिः स्याच्छरसत्त्वेऽपि । तत्तु मिथुनान्ते धनुरन्ते वा भवतीति ।) भूकेन्द्राच्चन्द्रकेन्द्रगता रेखा पितृगोले यत्र लगेत्तत्रैव यदि रविकेन्द्रं स्यात्तदा तस्मिन्नेवामान्तविन्दौ चन्द्रशराभावत्वान्मध्याह्नकालामान्तयोरभेदत्वं भवेत् । तथा च मिथुनान्ते विमण्डले चन्द्रे सति तस्मिन्नेवायनप्रोतवृत्त-क्रान्तिवृत्तयोर्योगविन्दौ यदा रविः स्यात्तदैवामान्तकालमध्याह्नकालयोरभेदत्वं स्यादेतत्कथितस्थानद्वयातिरिक्तस्थले सर्वदैवामान्तकालमध्याह्नकालयोर्भेदो भवेद्यया, यदारविः पितृयाम्योत्तरे समागच्छेत्तदैव मध्याह्नकालः । चन्द्रोपरिगतकदम्बप्रोतवृत्तक्रान्तिवृत्तयोर्योगबिन्दौ (चन्द्रस्थाने) यदा रविरागच्छेत्तदाऽमान्तकालो भवेदमान्तबिन्दुतोऽर्थाच्चन्द्रोपरिगतकदम्बप्रोतवृत्त-क्रान्तिवृत्तयोर्योगबिन्दुस्थरविबिन्दुतः पितृयाम्योत्तरवृत्तं प्राक् पश्चिमे वा भवेत्तत्रामान्तकालाद्यावता कालेन पितृयाम्योत्तरे रविरागच्छेत्त कालमानमायनदृक्कर्मासुतुल्यं तेन कालेन (आयनदृक्कर्मासुना) अमान्तकालो यदि संस्कृतो भवेत्तदा पितृयाम्योत्तरे रविर्भवेत् स एव वास्तवपितृमध्याह्नकालः ।



रन=आयनदृक्कर्मकलामव:
∴ अमान्तकाल±आयन दृक्कर्मकलासु
=वास्तवपितृदिनार्धं एतद्वशेनैव रात्र्यर्धमपि बोध्यम् । पितॄणामूर्ध्वखस्वस्तिके (परिणतचन्द्रबिन्दौ) रवावमान्तकाले तद्दिनार्धम्, परिणतचन्द्रात्षड्भान्तरेऽधःखस्वस्तिके रवौ पूर्णान्ते तद्रात्र्यर्धं भवतीति ।

अमान्तकाले पितृदिनार्धं पूर्णान्तकाले च रात्र्यर्धं सिद्धं परं तदुदयास्तौ कदा कुत्र भवेतां तदर्थं विचार्यते ।

भूकेन्द्राच्चन्द्रकेन्द्रगता रेखा पितृत्रिज्यागोले याम्योत्तरवृत्ते यत्र लगति तत्र परिणतचन्द्रः पितृखस्वस्तिकञ्च. । पितृखस्वस्तिकान्नवत्यंशवृत्तं तत्क्षितिज-

वृत्तम्। तत्स्थरवौ परिणतचन्द्रतद्रविगतमिष्टवृत्तं (सितवृत्तं कार्यम्) तथा परिणतचन्द्रोपरिगतं कदम्बप्रोतवृत्तं च कार्यं, सितवृत्त-कदम्बप्रोतवृत्त-क्रान्तिवृत्तजचापैः कर्णभुजकोटिभिरुत्पन्नचापीयजात्ये सितवृत्तीयचापं सितवृत्तीय-रविचन्द्रान्तरं वा=९०, अतो गोलीयरेखागणितयुक्त्या क्रान्ति-वृत्तीयचापं क्रान्तिवृत्तीयरविचन्द्रान्तरं वा =९० ततस्तदुदयास्तयोः सर्वदैव रविचन्द्रान्तरं नवत्यंशसमं भवितुमर्हति। परिणतचन्द्रोपरिगतकदम्बप्रोतवृत्त-क्रान्तिवृत्तयोः सम्पातबिन्दोश्चन्द्रत्वात्. । तेन कृष्णपक्षसार्धसप्तम्यां तदुदयः शुक्लपक्षसार्धसप्तम्यां चास्तो ज्ञेयः। सिद्धान्तशिरोमणौ भास्करेण 'कृष्णो रविः पक्षदलेऽभ्युदेति शुक्लेऽस्तमेत्यर्थत एव सिद्धमि'त्यनेनैवमेव कथ्यते। परमेतत्कथितयोरुदयास्तकालयोः खण्डनं म० म० पण्डितसुधाकरद्विवेदिभिः क्रियते। यथा—

भूकेन्द्राच्चन्द्रकेन्द्रगता रेखा चन्द्रपृष्ठे यत्र लगति तद्बिन्दुतश्चन्द्रगर्भक्षितिज-धरातलस्य समानान्तरधरातलं कार्यं तदैकं त्रिभुजमुत्पद्यते। भूकेन्द्राच्चन्द्रपृष्ठं यावच्चन्द्रव्यासार्धयुतश्चन्द्रकर्णः कोटिरेको भुजः। रविकेन्द्रमुदयास्तकाले सर्वदा पृष्ठक्षितिज एव भवेत्तत्रत्यो रविकर्णःकर्णो द्वितीयो भुजः। पृष्ठक्षितिजधरातले भुजस्तृतीयो भुजोऽत्र कोटिकर्णभुजैरुत्पन्नत्रिभुजेऽनुपातः क्रियते यदि रविकर्णेन त्रिज्या लभ्यते तदा चन्द्रव्यासार्धयुतचन्द्रकर्णेन किमित्यनुपातेन रविलग्नकोणज्या समागच्छति तत्स्वरूपम् $=\frac{\text{त्रि}\times(\text{चंक}+\text{चंव्या}\frac{1}{2})}{\text{रविक.}}$ अस्याश्चापम् =चा, नवत्यंशे विशोधितं तदा भूकेन्द्रलग्नकोणमान रविचन्द्रयोः सितवृत्तीयमन्तरं भवेत्, ९०—चा=सितवृत्तीयान्तरम्, ततो भक्ताव्यर्कविधोर्लवा यमकुभिरित्यादिना पितॄणामुदयकालिकगततिथिः $=\frac{\text{९०—चा}}{\text{१२}}=७\frac{1}{2}-\frac{\text{चा}}{\text{१२}}$ एतद्दर्शनेन स्पष्टमव-मीयते यत्कृष्णपक्षसार्धसप्तम्यां यत्तदुदयकालो भास्करेण कथितः स च न समीचीनः, सार्धसप्तम्यां चापस्य द्वादशांशप्रमाणं यदि शोध्यते तदोदय कालिकतिथिः समागच्छति पूर्वं पितॄणामुदयकालं मत्वा तत्कालीनतिथि-प्रमाणमानीतं तद् भास्करोक्तं नागच्छति. एवं पितॄणामस्तकालोऽपि शुक्ल-पक्ष-सार्धसप्तम्यां न भवत्यतो भास्करोक्तं 'कृष्णोरविःपक्षदलेऽभ्युदेतीत्या'दि न समीचीनमिति । परं म० म० सुधाकरद्विवेदिकृतखण्डनमपि समीचीनं नास्ति। भक्ताव्यर्कविधोर्लवा इत्यादिना क्रान्तिवृत्तीयरविचन्द्रान्तरांशवशेन तिथ्यानयनं भवति, सितवृत्तीयरविचन्द्रान्तरवशेन नहि, परं पूर्वोपपत्तौ सितवृत्तीयान्तरवशे-नैव तिथ्यानयनं कृतमतस्तन्न तथ्यम्। अत्र वास्तवानयनं क्रियते। पूर्वोपपत्तिबलेन सितवृत्तीयान्तरं विदितमस्ति, चन्द्रशरोऽपिविदितोऽस्ति तदोपरिप्रदर्शितचापीय जात्ये (सितवृत्तीयान्तरं कर्णः, क्रान्तिवृत्तीयरविचन्द्रान्तरं कोटिः, चन्द्रशरो भुज इति कर्णकोटिभुजैरुत्पन्ने) भुजकोटिज्याकोटिकोटिज्ययोर्घातस्य त्रिज्याकर्णको-टिज्ययोर्घातसमत्वात् ।

सितवृत्तीयान्तरकोटिज्या × त्रि = क्रान्तिवृत्तीयान्तरकोज्या × शरकोज्या, पक्षौ (शरकोज्या) भक्तौ तदा

$$\frac{\text{सितवृत्तीयान्तरकोज्या} \times \text{त्रि}}{\text{शरकोज्या}} = \text{क्रान्तिवृत्तीयान्तरकोज्या}$$ अस्याश्चापं नवतेर्विशोध्यं तदा क्रान्तिवृत्तीयान्तरांशा भवेयुस्तदैतद्वशेन पितृणामुदयास्तकालिकतिथी साध्येते वास्तविके भवेतामिति ॥

वस्तुतस्तु पितृणां दिनार्धरात्र्यर्धकालौ दृक्कर्मासुभिर्विभिद्येते इति गोलयुक्त्या स्फुटमेव । तेन तदीयोदयास्तकालावपि विभिन्नावेव । किं तत्र वैचित्र्यम् । अत्र बहवो विशेषाः प्रतिपादयितुं शक्यन्ते । किमत्र ग्रन्थविस्तरेण ।

दिव्यानि दिनानि रविभगणा इत्यादेरुपपत्तिः

उत्तरध्रुवो देवानामूर्ध्वखस्वस्तिकं, दक्षिणध्रुवश्च राक्षसानाम् । खस्वस्तिकात् (ध्रुवात्) नवत्यंशेन यद्वृत्तं तन्नाडीवृत्तं तत्क्षितिजवृत्तम् । नाड़ीवृत्तादुत्तरे (मेषादितः कन्यान्तं यावत्) स्थिते रवौ षण्मासं देवदिनं राक्षसरात्रिश्च, तथा नाडीवृत्ताद्दक्षिणे (तुलादेर्मीनान्तं यावत्) स्थिते रवौ षण्मासं देवरात्रिः, राक्षसदिनञ्च (क्षितिजादूर्ध्वस्थे रवौ दिनं तदधःस्थे रवौ रात्रिरिति नियमात्) तेन मेषादितो द्वादशराशिभोगकालः (रवेरेकभगणभोगः) सौरवर्षमेकं देवराक्षसयोरहोरात्रं (दिनं) सिद्धम् । वस्तुतस्तु मेषादितो मीनान्तं यावद्रविर्गमिष्यति तावति काले सम्पातस्याऽपि किमपि चलनं भवेत्तदैकरविभगणभोगकाले देवराक्षसयोरहोरात्रान्तकालिकायनगत्युत्पन्नकालस्य संस्करणेन वास्तवं तदहोरात्रमानं भवेत् । सम्पातचलनमेवायनगतिः । आचार्येणात्रायनगतिर्न स्वीकृता तेन तज्जन्यात्र त्रुटिरस्ति, भास्करेणापि 'रवेश्चक्रभोगोऽर्कवर्षं प्रदिष्टमित्यादिनैतदेव कथ्यते भास्करोक्तावपि सैव त्रुटिरस्ति । ब्रह्मगुप्तेन केवलं दिव्यानि दिनानि रविभगणतुल्यानि कथ्यन्ते, राक्षसदिनानां चर्चा न क्रियते, यदा देवानां दिनं भवति तदा राक्षसानां रात्रिः, यदा च देवानां रात्रिस्तदा राक्षसानां दिनं भवति, द्वयोः सहैव विलोमेन रात्रिदिने भवतोऽतो मया दैवदिनेन सार्कं राक्षसदिनमपि प्रदर्शितमिति ॥ २५ ॥

अब सावन दिन नाक्षत्र दिन मानव वर्ष पितृदिन और दिव्य दिनों को कहते हैं

हि. भा.—रवि के उदय से द्वितीय उदय पर्यन्त रविसावन दिन है, नक्षत्रोदय से नक्षत्रोदय तक नाक्षत्रसावन दिन होता है; एवं किसी ग्रह के उदय से उदय तक उस ग्रह का दिन सावन होता है । मानव वर्ष सौरवर्ष के बराबर होता है । पितरों का दिन चान्द्रमास के बराबर होता है, रविभगण के बराबर दिव्य (देवताओं के) दिन होते हैं ॥ २५ ॥

इन सब की उपपत्तियाँ

सावनदिन, मानववर्ष ये परिभाषा रूप में कहे जाते हैं, अब पितरों का दिन (अहोरात्र) एक चान्द्रमास के बराबर क्यों होता है इसके लिए विचार करते हैं । चन्द्र के ऊर्ध्वपृष्ठ पर

पितर लोग बसते हैं ऐसा पुराणादियों में कहा गया है, इसी के अवलम्बन से विचार करते हैं। चन्द्र के ऊर्ध्वपृष्ठ (ऊर्ध्वभाग) से कितना भाग ग्रहण करना चाहिए। दृष्टिस्थान (भूकेन्द्र) से चन्द्रबिम्ब की अनेक स्पर्शरेखा करने से प्रत्येक स्पर्शबिन्दुजनित चन्द्रबिम्बप्रदेश वृत्ताकार होता है; चन्द्रबिम्ब में इसको घटाने से जो शेष रहता है वही चन्द्र का ऊर्ध्व भाग है। वहां पितर लोग वास करते हैं, यह पुराणादि वचनों से विदित होता है। भूकेन्द्र से चन्द्रकेन्द्रगत रेखा पितरों के त्रिज्यागोलीय याम्योत्तरवृत्त में जहां लगती है वही पितरों के त्रिज्यागोल में परिणत चन्द्र है और पितरों का ऊर्ध्व खस्वस्तिक भी है। वहां जब रवि आयेंगे तो रवि और चन्द्र के एक स्थान में रहने के कारण अमान्तकाल होगा और वहीं परिणत चन्द्र पितरों का ऊर्ध्व खस्वस्तिक है और वहीं रवि भी है इसलिए ऊर्ध्व खस्वस्तिक में रवि के जाने से दो प्रहर (दिनार्ध वा मध्याह्न) होता है अतः सिद्ध हुआ कि अमान्तकाल में पितरों का दिनार्धकाल होता है। फिर दूसरा अमान्तकाल जब होगा तो पितरों के वहां दूसरा दिनार्धकाल होगा, अतः प्रथम अमान्त से द्वितीय अमान्त तक (एक चान्द्रमास) प्रथम दिनार्ध से द्वितीय दिनार्ध तक काल के बराबर हुआ। परन्तु प्रथम दिनार्ध से द्वितीय दिनार्ध तक काल प्रथम सूर्योदय स द्वितीय सूर्योदय तक काल (अहोरात्र) के बराबर होता है इसलिए पितरों का अहोरात्र एक चान्द्र मास के बराबर सिद्ध हुआ। परन्तु यहां अमान्तकाल में पितरों का मध्याह्नकाल स्वीकार कर विचार किया गया है, यह ठीक नहीं है। सिद्धान्त शिरोमणि में भास्कराचार्य ने भी 'दर्शे यतोऽस्माद् द्युदलं तदेषाम्' इससे अमान्तकाल ही में पितरों का दिनार्धकाल स्वीकार किया है, पितरों के याम्योत्तरवृत्त में अर्थाच्चन्द्रोपरिगत ध्रुवप्रोतवृत्त में जब रवि आते हैं तभी उनका दिनार्धकाल होता है, चन्द्रोपरिगतकदम्बप्रोतवृत्त ही यदि पितरों का याम्योत्तरवृत्त हो तभी अमान्तकाल और पितृमध्याह्नकाल में अभेदत्व होगा। लेकिन ऐसी स्थिति चन्द्रशराभाव स्थान में और चन्द्र की सत्ता में भी चन्द्र के मिथुनान्त में रहने से होती है। यथा भूकेन्द्र से चन्द्रकेन्द्रगत रेखा पितृगोल में जहां लगती है वहीं यदि रविकेन्द्र होगा तभी उसी अमान्त बिन्दु में चन्द्र के शराभाव के कारण मध्याह्नकाल और अमान्तकाल में अभेदत्व होगा। और मिथुनान्त में विमण्डल में चन्द्र के रहने से उसी अयन प्रोतवृत्त और क्रान्तिवृत्त के योगबिन्दु में जब रवि होंगे तभी अमान्तकाल और पितृमध्याह्नकाल में अभेदत्व होता है। इन दोनों स्थानों से भिन्न स्थल में अमान्तबिन्दु से अर्थात् चन्द्रोपरिगतकदम्बप्रोतवृत्त और क्रान्तिवृत्त के योगबिन्दुस्थ रविबिन्दु से पितरों के याम्योत्तरवृत्त पूर्व या पश्चिम में होता है। वहां अमान्तकाल से जितने काल में पितृयाम्योत्तरवृत्त में रवि होता है वह काल आयनदृक्कर्मासुतुल्य है, उस काल (आयनदृक्कर्मासु) करके यदि अमान्तकाल का संस्कार करते हैं तब पितृयाम्योत्तरवृत्त में रवि होता है वही वास्तव पितृमध्यान्हकाल है।

यहां (क) क्षेत्र देखिए। रन = आयनदृक्कर्मकलासु। अतः अमान्तकाल ± आयनदृक्कर्मासु = वास्तव पितृदिनार्ध, इसी के वश से रात्र्यर्ध भी समझना चाहिए।

पितरों के ऊर्ध्व खस्वस्तिक में (परिणत चन्द्रबिन्दु में) रवि के रहने से अमान्तकाल में उनका दिनार्ध होता है। परिणत चन्द्र से छह राशि अन्तर पर अधः खस्वस्तिक में रवि

के रहने से पूर्णान्त काल में पितरों का रात्र्यर्ध सिद्ध होता है। अब पितरों का उदयकाल और अस्तकाल कहां कहां होता है इसके लिए विचार करते हैं। भूकेन्द्र से चन्द्रकेन्द्रगत रेखा चन्द्रपृष्ठ में जहां लगती है उस बिन्दु में परिणत चन्द्र है और वही पितरों का ऊर्ध्व खस्वस्तिक भी है। पितृखस्वस्तिक से नवत्यंश व्यासार्ध से जो वृत्त होता है वह पितरों का क्षितिजवृत्त है, उसमें रवि के रहने पर परिणत चन्द्र और उस रवि में गये हुए वृत्त करते हैं उसका नाम सितवृत्त है। परिणत चन्द्रोपरिगत कदम्बप्रोतवृत्त करने से सितवृत्त कदम्बप्रोतवृत्त और क्रान्तिवृत्त के चापों से एक चापीय जात्य त्रिभुज बनता है, जिस में सितवृत्तीयचाप (सितवृत्तीय रविचन्द्रान्तरांश) कर्ण है, क्रान्तिवृत्तीयचाप (स्थानीय रवि चन्द्रान्तरांश) कोटि है, कदम्बप्रोतवृत्तीय चाप शर भुज है, इस चापीयजात्य त्रिभुज में सितवृत्तीय रवि-चन्द्रान्तरांश कर्णचाप=९० इसलिए गोलीयरेखागणित की युक्ति से क्रान्तिवृत्तीय रवि-चन्द्रान्तरांश कोटिचाप भी नवत्यंश के बराबर होगा, अतः पितरों के उदय और अस्त समय में सर्वदा रवि और चन्द्र का अन्तर नवत्यंश के बराबर होगा. क्योंकि परिणत चन्द्रोपरिगत कदम्बप्रोतवृत्त और क्रान्तिवृत्त का सम्पात बिन्दु चन्द्रस्थान है। इसलिए कृष्ण पक्ष के साढ़े सप्तमी में पितरों के उदय और शुक्ल पक्ष के साढ़े सप्तमी में अस्त समझना चाहिए। सिद्धान्तशिरोमणि में भास्कराचार्य 'कृष्णे रविः पक्षदलेऽभ्युदेति शुक्लेऽस्तमेत्यर्थत एव सिद्धम्' इससे यही बात कहते हैं, परन्तु भास्करकथित पितरों के उदयकाल और अस्तकाल का खण्डन म० म० पण्डित सुधाकर द्विवेदी ने किया है। जैसे—

भूकेन्द्र से चन्द्रकेन्द्रगत रेखा चन्द्रपृष्ठ में जहां लगती है उस बिन्दु से चन्द्रगर्भक्षितिज धरातल के समानान्तर करने से एक त्रिभुज बनता है. भूकेन्द्र से चन्द्रपृष्ठपर्यन्त चन्द्र-व्यासार्धयुत चन्द्रकर्ण कोटि प्रथमभुज। उदय और अस्तसमय में रविकेन्द्र सर्वदा पृष्ठ क्षितिज ही में रहते हैं इसलिए वहां के रविकर्ण कर्ण द्वितीयभुज, पृष्ठक्षितिज धरातल में तृतीयभुज, इन कोटि-कर्ण भुजों से उत्पन्न जात्यत्रिभुज में अनुपात करते हैं यदि रविकर्ण मे त्रिज्या पाते हैं तो चन्द्रव्यासार्धयुत चन्द्रकर्ण में क्या आजायगी रविकेन्द्रलग्न कोणज्या $=\frac{\text{त्रि}\times(\text{चन्द्रकर्ण}+\text{चन्द्रव्या}\frac{१}{२})}{\text{रविक}}$ इसके चाप=चा, नवत्यंश में घटाने से भूकेन्द्र-लग्न कोणप्रमाण अर्थात् सितवृत्तीय रवि चन्द्रान्तरांश=९०—चा, हुआ तब 'भक्ताव्यर्कविधोर्लवा यमकुभिः' इत्यादि से पितरों के उदयकालिक गत तिथिप्रमाण $=\frac{९०-\text{चा}}{१२}=७\frac{१}{२}-\frac{\text{चा}}{१२}$ इसको देखने से स्पष्ट है कि कृष्ण पक्ष की साढ़े सप्तमी में पितरों का उदयकाल नहीं होता है किन्तु साढ़े सप्तमी में $\frac{\text{चा}}{१२}$ इतना घटाने से जो होता है उसमें उदयकाल सिद्ध हुआ, इसी तरह शुक्ल पक्ष की साढ़े सप्तमी में उनका अस्तकाल भी नहीं होता है अतः भास्करोक्त 'कृष्णे रविः पक्षदलेऽभ्युदेति' इत्यादि ठीक नहीं है; परन्तु म० म० पण्डित सुधाकर द्विवेदीकृत खण्डन में भी त्रुटि है; उपलिखित खण्डनोपपत्ति में सितवृत्तीय रविचन्द्रान्तर परसे 'भक्ताव्यर्कविधोर्लवाः' इत्यादि से जो तिथिप्रमाण लाया गया है सो ठीक नहीं है। क्रान्तिवृत्तीय रविचन्द्रान्तर से तिथ्यानयन करना उचित है, इसलिए उक्त खण्डन भी दोषयुक्त है। अतः अब इसका वास्तवानयन प्रकार

दिखलाया जाता है । सितवृत्तीय रविचन्द्रान्तर कर्ण, क्रान्तिवृत्तीय रविचन्द्रान्तर कोटि, चन्द्रशरभुज इस त्रिभुज में पूर्वोक्त नियम से सितवृत्तीय रविचन्द्रान्तरांश विदित है, और चन्द्रशर भी विदित है तब भुजकोटिज्या और कोटिकोटिज्या के घात त्रिज्या और कर्णकोटिज्या के घात के बराबर होता है इस नियम से सितवृत्तीयान्तर कोटिज्या × त्रि = क्रान्तिवृत्तीयान्तर कोज्या × शरकोज्या. दोनों पक्षों को (शरकोज्या) इस से भाग देने से—

$\frac{\text{सितवृत्तीयान्तर कोज्या} \times \text{त्रि}}{\text{शरकोज्या}}$ = क्रान्तिवृत्तीयान्तर कोज्या, इसके चाप को नवत्यंश में घटाने से क्रान्तिवृत्तीय रविचन्द्रान्तरांश होंगे, इसके वश से पितरों की उदयकालिक तिथि और अस्तकालिक तिथि साधन करना वह वास्तविक तिथि होगी । इति ।

अब दिव्य दिन रविभगण के बराबर होता है इसकी उपपत्ति दिखलाते हैं

देवों का ऊर्ध्व खस्वस्तिक उत्तर ध्रुव है, राक्षसों का ऊर्ध्व खस्वस्तिक दक्षिण ध्रुव है। खस्वस्तिक (ध्रुव) से नवत्यंश चाप व्यासार्ध से जो वृत्त (नाड़ीवृत्त) होता है वही उनका क्षितिज वृत्त है । नाड़ीवृत्त से उत्तर (मेषादि से कन्यान्त तक) जब रवि रहते हैं तब देवों का छः महीने का दिन होता है और राक्षसों की छः महीने की रात्रि होती है तथा नाड़ीवृत्त से दक्षिण (तुलादि से मीनान्त तक) रवि के रहने से देवों के छः महीने की रात्रि होती है और राक्षसों के छः महीने के दिन होते हैं। (क्षितिज से ऊपर रवि के रहने से दिन और उससे नीचे रहने से रात्रि होती है इस नियम से) इसलिए मेषादि से रवि के बारह राशि भोगकाल (एक रविभगण भोग) याने एक सौरवर्ष देव और राक्षस का अहोरात्र (दिन) सिद्ध हुआ । लेकिन रवि के एक भगण भोगकाल में सम्पात का भी कुछ चलन होगा उसी को अयन गति कहते हैं; इसलिए रवि के एकभगण भोगकाल में देव और राक्षसों के अहोरात्रान्त कालिक अयनगत्युत्पन्न काल का संस्कार करने से उन दोनों का वास्तव अहोरात्रमान होता है, यहां आचार्य ने अयनगति का ग्रहण नहीं किया है इसलिए उतनी त्रुटि है । भास्कराचार्य भी 'रवेश्चक्रभोगोऽर्कवर्षं प्रदिष्टम्' इत्यादि से वही बात कहते हैं इनमें भी वही त्रुटि है । यहां आचार्य 'दिव्यानि दिनानि 'रविभगणाः' इससे देव-सम्बन्धी दिन के विषय में कहते हैं, राक्षसों की चर्चा नहीं की है, देव और राक्षस का विलोम (उल्टा) करके रात्रि और दिन होते हैं लेकिन दिन और रात्रि दोनों की बराबर होती है. इसलिए देव अहोरात्र (दिन) के साथ ही राक्षस अहोरात्र भी दिखला दिये हैं । यदि दिव्य दिन से (राक्षस सम्बन्धी दिन भी) कहा जाय तब तो कोई बात कहने की जरूरत ही नहीं होगी । इति ।। २५ ।।

इदानीं तत्सर्वस्यैव कोत्पत्तेरारभ्य गतकालस्य शककालस्य ग्रहगणितेऽहर्गणादयः प्राप्ता इत्येतदाशङ्क्य सयुक्तिकं परिहारमाह

कल्पपरार्धे मनवः षट्कस्य गताश्चतुर्युगत्रिघनाः ।
त्रीणि कृतादीनि कलेर्गोऽगैकगुणाः ३१७९ शकान्तेऽब्दाः ।। २६ ।।

नवनगशशिमुनिकृतनवयमनगनन्देन्दवः १९७२९४७१७९ शकनृपान्ते ।
सार्धमतीतमनूनां सन्धिभिराद्यन्तरान्तगतैः ॥ २७ ॥

वा. भा.—कशब्देन ब्रह्मोच्यते, तस्य कस्य कल्पानां परार्द्धं गतम् । वर्त्तमाने च कल्पे मनवः षट् गताः । चतुर्युगानां त्रिघनाः सप्तविंशतिश्चतुर्युगानां गता । त्रीणि कृतादीनि कृतत्रेताद्वापराणि, कलेः कलियुगस्य गोगैकगुणाः ३१७९ एतावन्तोऽब्दाः, शकान्ते शककालकालात् प्राग्गताः इत्यर्थः । तद्यथा कल्पाब्दाः ४३२००००००० एतैः परार्धसंख्ययाष्टादशस्थानात्मिकया हता जाताः द्वित्रिवेदाः खचतुर्विंशत्येकहता जाता :—४३२००००००००००००००००००००००० वर्त्तमान-कल्पात्षण्मनवो गताः, चतुर्युगत्रिघनाः त्रीणि कृतादीनि सर्वेषां वर्षाणि कृत्वा कलिगतवर्षैः पूर्वस्थापितैश्च सह शकान्ते के जन्मनोतीतानि वर्षाणि नवनग-शशिमुनिकृतनवयमा नगनवेन्दुखचतुर्दशकद्विगुणाब्धयोमी ४३२०००००००००-००००१९७२९४७१७९ एतावन्तोऽब्दाः सौरमानेन कस्य गताः, सोपि कलिनियता-युरिति अन्यैः पुनरेवं व्याख्यातं कल्पपरार्धं कस्य दिनम्, कशब्देन परः पुरुष उच्यते । तस्य कल्पानां परार्धेनाहोरात्रो भवति यस्मान्मानाधिकारे एतत् पठितमाचार्येण । वर्त्तमाने च कल्पे षण्मनवो गता इत्यादौ तुल्यव्याख्यानं तथा च पुराणकारःपरार्धसंख्यैः कल्पैस्त्रिदिवसाः पौरुषः स्मृता इति यद्येवम् ।।२६-२७।।

वि. भा.—कस्य(ब्रह्मणः) कल्पपरार्धे षट् मनवो गताः (व्यतीताः), चतुर्युगत्रि-घनाः(चतुर्युगानां महायुगानां सप्तविंशतिः)गता अर्थात्सप्तविंशतिमितानि महायुगानि व्यतीतानि; कृतादीनि त्रीणि (सत्ययुगादीनि त्रीणि युगचरणमानानि) गतानि शकान्ते (शकनृपस्यान्ते) कलेः (कलियुगादितः) गोऽगैकगुणाः ३१७९ अब्दाः (वर्षाणि) गताः, अतीतमनूनां (गतमनूनां षड्मितानां) आद्यन्तरान्तगतैः (आदिमध्यावसानस्थितैः) सन्धिभिः सार्धं, शकनृपान्ते नवनगशशिमुनि-कृतनवयमनगनन्देन्दवः १९७२९४७१७९ एतावन्तोऽब्दा गता इति । ब्रह्मणो द्वितीयार्धे षड् मनवो व्यतीताः, वर्त्तमानसप्तममनोः सप्तविंशतिसंख्यकानि युगानि व्यतीतानि, अष्टाविंशतितमयुगस्य सत्ययुगादयस्त्रयो युगचरणा व्यतीताः, कलेः शकान्तं यावत् ३१७९ अब्दाः (सौरवर्षाणि) व्यतीताः । एतेषां योगः कियान् भवेदित्यानीयते ।

श्लोकोक्त्या ६ मनु + ७ मनुसन्धि + २७ युग + युगचरणत्रय + ३१७९
= ६ मनु + ७ मनुसं + २७ युग + (युग-कलिच) + ३१७९
= ६ × ७१ यु + ७ × ४ × ४३२००० + २७ युग + (युग-कलिच) + ३१७९
= ६ × ७१ × ४३२०००० + ७ × ४ × ४३२००० + २७ × ४३२००००
(४३२००००−४३२०००) + ३१७९
= ४२६ × ४३२०००० + २८ × ४३२००० + २७ × ४३२००००
+ (४३२००००−४३२०००) + ३१७९

=१८४०३२०००००+१२०६६०००+११६६४००००+३८८८०००+३१७९
=१९७२९४७१७९=आचार्यपठिताङ्काः

एतत्कथनस्येदं तात्पर्यं ग्रहादिचारसाधनं शकादेवार्यभटवटेश्वराचार्यौ विहाय सर्वे प्राचीना नवीनाश्चात्रत्याः (भारतीयाः) आचार्याः कृतवन्तः । कलियुगादित ३१७९ एतन्मितवर्षान्ते शकाब्दारम्भ इति गणकसमाजे जनश्रुत्या प्रसिद्धिरस्ति, तेन कल्पादितः शकान्तं यावत्कियन्ति सौरवर्षाणि गतान्येतत्प्रयोजनमत्यावश्यकमतः पूर्वोक्तानां 'कल्पपरार्धेमनव इत्यादीनां योगकरणेन पूर्वोक्ता अङ्का जायन्त एतद्वशेनैवाहर्गणादीनां साधनं भवत्यत एतत्पाठकरणमतीवावश्यकत्वादाचार्येण तेऽङ्काः पठिता इति । भास्कराचार्येणापि 'याताः षड् मनवो युगानि' भमितानीत्यादिनैतदनुरूपमेव कथ्यते ॥ २६-२७ ॥

अब कल्पगत कहते हैं ।

हि. भा.—ब्रह्मा के कल्प के द्वितीयार्ध (परार्ध) में छः मनु गत हो गये । वर्त्तमान मनु के सत्ताइस महायुग बीत गये, अठाइसवें युग के सत्य युगादि तीन युग चरण बीत गये, शकान्त में कलियुगादि से ३१७९ इतने वर्ष बीत गये, गत छः मनुओं के आदि में मध्य में और अन्त में जो मनु सन्धि है उनके साथ, शकान्त में १९७२९४७१७९ इतने सौरवर्ष बीत गये, पूर्व कथित गतमनु-गतमहायुगादियों के योग करने से आचार्य पठिताङ्क आता है या नहीं इसके लिए गणित दिखलाते हैं ।

श्लोकोक्ति के अनुसार ६ मनु+७मनुसन्धि+२७ युग+कृतादि युगचरणत्रय+
३१७९=६मनु+७मनुसं+२७युग+(युग--कलिचरण)+३१७९
=७×७१यु+७×४×४३२०००+२७×४३२००००+(४३२००००—
४३२०००)+३१७९
=४२६यु×२८×४३२०००+२७×४३२००००+(४३२००००—
४३२०००)+३१७९
=४२६×४३२००००+१२०९६०००+११६६४००००+३८८८०००+
३१७९
=१८४०३२०००००+१२०९६०००+११६६४००००+३८८८०००+३१७९
=१९७२९४७१७९=आचार्य पठिताङ्क ।

यहाँ कहने का अभिप्राय यह है कि आर्यभट और वटेश्वराचार्य को छोड़कर जितने भारतीय ज्योतिषाचार्य हुए हैं उन्होंने ग्रहादि चार साधन शक ही से किये हैं, कलियुगादि से ३१७९ एतन्मितवर्षान्त में शक वर्षारम्भ हुआ यह बात भारतीय गणक समाज में प्रसिद्ध है, इसलिए कल्पादि से शकान्त तक कितने सौरवर्ष बीते हैं इसकी बहुत आवश्यकता प्रतीत हुई अतः उपर्युक्त गतमनु, मनुसन्धि आदि का योग कर आचार्य ने उपरिलिखित अङ्क पठित

किये हैं, इसके बिना अहर्गणादि. का साधन हो ही नहीं सकता। भास्कराचार्य भी 'याताः षड्मनवो युगादि भनितानि' इत्यादि से ब्रह्मगुप्तोक्त के अनुरूप ही कहते हैं। इति ॥२६-२७॥

ग्रहनक्षत्रोत्पत्तिर्ब्रह्मदिनादौ दिनक्षये प्रलयः ।
यस्मात्कल्पस्तस्माद् ग्रहगणिते कल्पयाताब्दाः ॥ २८ ॥

वा. भा.—ग्रहाणां नक्षत्राणां च सृष्टिः ब्रह्मदिनादौ कल्पादौ, दिनक्षये प्रलयः कल्पान्ते ग्रहनक्षत्राणां पुनरपि विनाशः, यस्मादेवं तस्मात्कल्प एव ग्रहगणिते उपयुज्यते । न ततोर्वाक् नवाग्रतो ग्रहगणयितुरभावादित्यर्थः । द्वितीयार्धे पाठोऽन्येषां यस्मात्कल्पस्तस्माद् ग्रहगणितं यत एव कालात्कल्पः प्रवृत्तस्तत एव कालात् ग्रहगणितमपि प्रवृत्तमित्यर्थः । कल्पयाताब्दाः इत्युत्तरत्र संबद्धं भविष्यतीति यदुक्तं प्राक्कल्पयाताब्दास्तानाह ॥

वि. भा.—ग्रहाश्च नक्षत्राणि च ग्रहनक्षत्रं तस्योत्पत्तिः सृष्टिः ब्रह्मदिनादौ कल्पादौ भवति । तथा दिनक्षये ब्रह्मदिनावसाने कल्पान्त इत्यर्थः । तेषां ग्रहनक्षत्राणां प्रलयः नाशो भवति । अर्थादेतदुक्त भवति । कल्पप्रमाणं ब्रह्मणो दिनं भवति । "कल्पो ब्राह्ममहः प्रोक्त"मिति सूर्यसिद्धान्तोक्तेः । तत्प्रमाणा तस्य रात्रिः स्यात् । "सर्वान् पदार्थान् संहृत्य ब्रह्मा शेते" इत्याप्तवचसा ब्रह्मा स्वदिनादौ कल्पादौ सृष्टिं रचयति । कल्पावसानेऽर्थाद्वि विकल्पे सर्वान् संगृह्य शेते । अतः सृष्टिकल्प एव ग्रहनक्षत्रादयो वर्तन्ते । कल्पावसाने च सर्वाणि तानि ग्रहनक्षत्राणि तस्मिन् विलीयन्ते । "अव्यक्ताद्व्यक्तयः सर्वाः प्रभवन्त्यहरागमे । रात्र्यागमे विलीयन्ते तत्रैवाव्यक्तसञ्ज्ञके" इति भगवद्वाक्यम् ।

अथ यस्मात्कारणात् कल्पोऽस्त्यत्र कल्पशब्देन दिनकल्प एव विवक्षितः । अस्मिन्नेव ग्रहादीनां सद्भावात् । विद्यमानेषु तेषु ग्रहादिषु तेषां गत्यावगमो भवितुमर्हति । अतएव भास्कराचार्या अपि "यतः सृष्टिरेषां दिनादौ दिनान्ते लयस्तेषु सत्स्वेव तच्चारचिन्ता" इति निजे सिद्धान्तशिरोमणौ प्रोचुः । तस्मात् कारणात् ग्रहगणिते ग्रहादीनां गत्यावगमे कल्पयाताब्दाः साध्यन्त इत्यर्थः । नेयमार्या म० म० सुधाकरद्विवेदिसङ्कलितपुस्तके समुपलभ्यत इति म० म० मुरलीधरझा लेखादवगम्यते । किन्तु मुनीश्वरेण मरीचभिधायां शिरोमणेर्निजटीकायां बह्वादरेण सन्निवेशिता समादृता च । अतएव अस्यैव दिनकल्पस्य प्रयोजनं भवति नान्यस्येति । ग्रन्थकाराशयः ॥२८॥

हि. भा.—एक कल्प के बराबर ब्रह्मा का एक दिन होता है। ऐसा आगमशास्त्र का मत है। सूर्यसिद्धान्त का वचन है कि "कल्पो ब्राह्ममहः प्रोक्तम्" एक कल्प ब्रह्मा का दिन कहा

जाता है उतनी ही उनकी रात्रि होती है। अपने दिनादि में ब्रह्मा सब ग्रहनक्षत्रों की रचना करते हैं और दिनावसान में अपने सब को संहार करके सोते हैं। ऐसा ही भगवान् का वाक्य है। "अव्यक्ताद्व्यक्तय: सर्वा: प्रभवन्त्यहरागमे। रात्र्यागमे प्रलीयन्ते तत्रैवाव्यक्तसंज्ञके ॥" दिन के आरम्भ में अव्यक्तरूप ब्रह्म से यह सब व्यक्त (जगतरूप में) निकलते हैं और रात्र्यारंभ में सब उसी अव्यक्त ब्रह्म में लीन हो जाते हैं। इसलिए यहां आचार्य का कथन है कि दिनकल्प मे ही ग्रहों के रहने का कारण उनकी गति होती है और उसके साधन के लिये यही दिनकल्प से वर्षमान की आवश्यकता है, अन्यकल्पवर्ष की आवश्यकता नहीं है। यह ग्रन्थकार का आशय है ॥ २८ ॥

इदानीं कल्पगतसम्बन्धे आर्यभटमतं कथयति

अधिकः स्मृत्युक्तमनोरार्यभटोक्तश्चतुर्युगेन मनुः।
अधिकं विंशांशयुतैस्त्रिभिर्युगैस्तस्य कल्पगतम् ॥ २९ ॥

वा.भा.—स्मृत्युक्तश्चासौ मनुश्च स्मृत्युक्तमनुः तस्मात् स्मृत्युक्तमनोः सकाशादार्यभटोक्तो मनुरधिकः, क्रियते इत्याह—चतुर्युगेन। यत एवमतः त्रिगुणयुगैः विंशांशसंयुतैः तस्याधिकं कल्पे गतं कल्पगतम्। तद्यथा मनवः षट् द्वासप्तत्या गुणिता ४३२ षण्णां मनूनामेतावन्ति चतुर्युगानि, चतुर्युगसप्तविंशत्या युतानि ४५, एतानि चतुर्युगगुणितानि १९८२८८०००० एतेषु युगपादेषु २०८०००० त्रिगुणः क्षिप्तोऽम्बर-चतुष्क-वेद-यम-रस-संख्या ६२४०००० कलियुगाब्दांश्च गोगैकगुण-संख्यानि क्षित्वा जातोऽब्दराशिःशककालावधिजः कल्पादेरार्यभटमतेन नवनगशशि-गुणद्विचन्द्ररसवसुनन्दशीतकराः १९८६१२३१७९ यत उक्तं दशगीतिकासु गतास्ते च मनुयुगछ्नाच" कल्पादेर्युगपादा च गुरुदिवसाश्च भारतात्पूर्वमिति। तस्य राशेः ब्रह्मोक्तकल्पगतकालस्य नवनगशशिमुनिकृतनवयमागनन्देन्दुसंख्यस्य चान्तरे च कृते, जाता अधिका अब्दाः खत्रयरसमुनिरूपगुणचन्द्राः १३१७६००० एतावन्तोब्दाः आर्यभटमतेनाधिका गताश्चतुर्युगत्रयं चतुर्युगविंशांशयुतमेतावानेव कालो भवति, तद्यथा चतुर्युगाब्दा ४३२०००० त्रिगुणाः १२९६०००० चतुर्युगविंशांशः २१६००० चानेन युता जाता १३१७६००० एतेऽब्दा अधिककालसमाः अत उक्तं अधिकं विंशांशयुतैस्त्रिभिस्तस्य युगैः कल्पगतम्।

वि. भा.—आर्यभटोक्तो मनुः (आर्यभटकथितो मनुः) स्मृत्युक्तमनोः (स्मृतिकथितमनुमानात्) चतुर्युगेन (एकेन महायुगेन) अधिकोऽस्ति, मनुस्मृत्यादिकथितो मनुरेकसप्ततियुगसमः। आर्यभटोक्तमनुर्द्विसप्ततियुगैः समोऽतोऽनयोरन्तरमेकयुगसमोऽधिकः। तस्यार्यभटस्य मते कल्पादौ विंशांशयुतैः त्रिभिर्युगैरधिकं कल्पगतं भवति, द्वयोराचार्ययोः (ब्रह्मगुप्तार्यभटयोः) मतेन यत्कल्पगतं तदन्तरमेकयुगस्य विंशाधिकं युगत्रयं भवतीति ॥ २९ ॥

अत्रोपपत्तिः

आचार्य मतेन सत्ययुगे युगमानम्$=\frac{१०}{४}$ गतषड्मनूनामादिमध्यावसानेषु सप्तसन्धिषु युगमानम्$=\frac{७\times४}{१०}=\frac{२८}{१०}$ ।

हि. भा.—आर्यभट्ट तथा मनुस्मृति के महायुगों में एक महायुग का अन्तर है। मनुस्मृत्यनुसार ७१ महायुग और आर्यभट्ट के मतानुसार ७२ महायुग होते हैं। दोनों में कल्पादि मानने के दृष्टिकोण का ही अन्तर है ॥२९॥

इदानीं कल्पगतार्कसावनाहर्गणार्धमार्याद्वयमाह

कल्पगताब्दद्वादशघातश्चैत्रादिमासयुक्तोऽधः ।
गुणितो युगाधिमासै रविमासाप्ताधिमासयुतः ॥३०॥
त्रिंशद्गुणस्तिथियुतः पृथग्युगावमगुणो युगेन्दुदिनैः ।
भक्तः फलावमोनोऽर्कसावनाहर्गणोऽर्कादिः ॥३१॥

वा. भा.—अत्र युगग्रहणेन कल्पो गृह्यते। तेन कल्पादेरारभ्य गता ये रव्याब्दास्तेषां द्वादशानां च घातः परस्परगुणनं ततः स घातश्चैत्रादिमासैर्युतः। वर्तमानकल्पे येऽब्दाः गता नवनगशशिमुनिकृतनवयमागनन्देन्दवः तेऽतीत शककालाब्दाः द्वादशहताः। चैत्रसितादिगतचान्द्रैः मासैर्युताः गतरविमासगणः कल्प्यते कल्पादेरारभ्येत्यर्थः। यद्यपि संक्रान्त्यवधिजो रविमासः, तथापि न कश्चिद्दोषो यस्मादधिमासकावयवा गृह्यन्ते। यद्यपि संक्रान्त्यवधिजो रविः। अहर्गणानयनोऽन्यश्च यद्यधिमासपातकालो दूरे, तन्मासैरप्यन्तरं न भवति। निकटश्चेत्तदामावास्योद्देश एवार्कसंक्रान्तिः तथापि न दोषो यतो मासद्वयात्मक एव समासः तथा चान्द्रमासाः सर्व एवाऽचार्येण कर्त्तुमारब्धाः तन्मासांतावधित्वेनाधिमासोपलब्धये रवेर्मासगणः परिकल्पितोप्यतो रविमासाश्चान्द्रैर्मासैर्नीयमाना अधिका भवन्ति चन्द्रमासस्याल्पत्वात्। ततो रविमासगणोऽधः पृथक् कार्यः। ततो गुणितो युगाधिमासै रविमासाप्ताधिमासयुत इति त्रैराशिकमत्र यदि कल्परविमासैः कल्परविमासानां संबंधिनोऽधिकमासाः लभ्यन्ते तदैभीरविमासैः तांश्च गतरविमासेषु संयोज्य कल्पादेरारभ्यगतश्चांद्रमासगणो भवति। तन्मासान्तनिरोधेनाधिमासशेषाश्चातीता। नागतयोरधिमासपातकालयोः परिज्ञानं तद्यथा यदि—कल्परविमासैः कल्पाधिमासाः लभ्यन्ते तदेकेन रविमासेन किमिति कल्पाधिमासतुल्यं, अधिमासशेषं भवति। ततो द्वितीयं यद्येतदेकस्य शशिमासस्याधिमासशेषं तत्कियन्तस्ते शशिमासा येषामिदमभीष्टमधिमासशेषमित्यत्र भागहारगुणकारयोः कल्परविमासाश्छेदोतस्तुल्यत्वान्नष्टेषु कल्परविमासेषु कल्पाधिमासका भागहारः। एकको गुणकारोऽभीष्टाधिमासशेषस्यफलम्। शशिमासाश्चान्द्रमासान्तावधित्वेन गतस्याधिकपातकालस्य यतोऽनंतरानीताधिमासपातका-

लादारभ्य सर्वं एव मासाश्चान्द्राः प्रदत्ता। सौम्कलाना च तेषामधिमासानय-नत्रैराशिकसिध्यर्थं प्रागस्माभिः कृता तस्मादुत्पन्नं फलं चन्द्रमासा इति, तथाविधमासशेषं कलारविमासेभ्यो विशोध्य रविशेषमधिमासशेषं परिकल्प्यमेत। एषः कालोऽधिमासपातस्य वाच्यः अथवा रविमासान्दिनीकृत्यैतत्कर्मक्रियते, तदभीष्टचन्द्रादिनान्तनिरोधेन, गतगम्यकालयोः परिज्ञानं भवति,

वा. भा.—ततो गतचन्द्रमासगणः त्रिंशद्गुणितः तिथियुतः कार्यः तिथिरेव चन्द्रदिनं यस्मादतः कल्पादारभ्य गतातीथगणोऽभीष्ट तिथ्यन्ते मध्यमे भवन्ति। चान्द्रो दिनगणः स एव भवति। स च पृथक् कार्यः ततो युगावम-गुणैर्गुणितो युगेन्दुदिनैः भक्तः फलावमोनोऽकसावनोऽहर्गणोऽर्कादिरति, अत्र त्रैराशिकं यदि कलाचन्द्रदिनानां सावनीक्रियमाणानां कलावमतुल्यानि दिनानि पूर्यन्ते। तद्गत चन्द्रदिनानां कियन्तीति फलं गतचन्द्रदिनानां सम्बन्धीन्यत्रमदिनानि चागतचन्द्रदिनगणात् संशोध्य कलगतरविसावनदिवसगणो भवति। लंकाम-ध्यार्के कालावधौ यस्मात्सावनचान्द्रमानयोरन्तरमवमानि स चाहर्गणोऽर्कादिरिति। यतोर्कवारे कलारम्भः। अवमशेषाच्च गतानागतोन रात्रपातकालयो परिज्ञानं "तद्यथा" यदि कल्पचन्द्रदिनैः कलावमानि लभ्यन्ते, तदेकेन चन्द्रदिनेन किमिति......(कलोन) योन रात्रि तुल्यं.. (अव) मशेषं लभ्यते, द्वितीय-त्रैराशिकं यद्येतत् सावनमवमशेष...दिनस्य कि...ति तानि चन्द्रदिनानि येषामि-दमभीष्टदैवसिकमवमशेषं सावनमित्यत्र भगहारगुणकारयोः तुल्यच्छेदः। कलादिनचन्द्रप्रमाणकः तस्मिन्नष्टोऽभीष्टावमशेषस्यैककागुणकारः कलोनरात्राणि भागहारः फलं चन्द्रदिनान्यतीतस्योनरात्रपातस्य, तदवमशेषं कलाचन्द्रदिनेभ्यो विशोध्यावशेषमवमावशेषं परिकल्प्योक्तवदेष्य कालः साध्य इति, अधिमास-पातकाले मासद्वयेऽपि दत्ते एक एव मासो भवति। तिथिद्वयेऽपि दत्ते एक एव वारो लभ्यते इति। अथैवं ज्ञातुमिच्छति। कियद्भिर्दिनैरधिमासः पततीति। तद्यथा कलाधिमासैः कलारविदिनानि भवन्ति तदेकेनाधिमासेन कियन्तीति फलं रविदि-नानि भवन्ति। तदेकेनाधिमासेन कियन्तीति फलं रविमासाः षड्गनन्दरव्या स्तदश श्च पंचशून्याश्विनवगुणचन्द्राः कलाधिमासच्छेदः $\frac{१३६३००००}{१५९३३००००}$ अथवा यदि कलाधिमासैः कला चन्द्रदिनानि भवन्ति, तदेकेनाधिमासकेन किमिति फलं चन्द्रदिवसाः रसशून्यखचन्द्राः तदंशास्तुल्या एव १००६ $\frac{१३६३००००}{१५९३३००००}$ अथवा यदि कलाधिमासैः कलसावनदिवसा भवन्ति तदैकेनाधिमासेन कियन्तः फलं सावनदिवसाः खनन्दानवसख्यास्तदंशाश्च खचतुष्टयशरचेदनवकृतेषवः छेदः स एव $\frac{५४९४५००००}{१५९३३००००}$ एतेषु प्रकारेष्वधिमासोन्तर्गतस्तिष्ठतीति। अथवाऽवमशेषे-तद्यथा—यदि कलोनरात्रैः कलाचन्द्रदिनानि भवन्ति, तदेकेनोनरात्रेण कियन्तीति फलं चन्द्रदिनानि त्रिरससंख्यानि तदंशाश्च खचतुष्टयशरगुणवसुनन्दगद्वियमाः $\frac{२२७९८३५००००}{२५०८२५५००००}$ अत्र छेदस्यांशानां चापवर्त्तनं वसुचन्द्राष्टेन्दुगुणयमखवसुद्वियमैः कृत्वा जातौ राशी उपरि दशाधः एकादशत्रिषष्टेरधः कृत्वा $\frac{६३}{१०}$ दर्शनम्। अत्र

सावर्णित जातमुपरि त्रिखमुनयोऽधः एकादश । अत्रेतज्जातं त्रिखमुनिसंख्यं श्चान्द्रदिनैरेकादशावमानि । भवन्तीति यच्चापवर्तने क्रियमाणेतरमत्र सूक्ष्मं तदर्थमाचार्येण खण्डखाद्यवमुपनिबद्धम् । अग्रतिथिरुद्रैरवाप्तेन फलेनैकादशगुणश्चान्द्रदिनगणः ऊनः क्रियते इति. अथवा यदि कल्पोनगात्रैः कल्पावनदिनानि भवन्ति तदेकेनोनरात्रेण किमिति फलं सावनदिवसा द्विरससंख्या । तदंशाश्च खतुष्टयशरगुणवसुनन्दागद्विसमाः $\frac{३२७६८५४००००}{२५०८२५५००००}$ अत्रापि तेनैवापवर्तनापवर्त्तच्छेदांशान् द्विषष्ट्या सहस्त्रवर्णने कृत जातम्, द्विनवरससख्यैः सावनैरेकादशावमानि भवन्तीति ।

वि. भा.—कल्पाद्यो गताब्दः शकनृपान्ते नवनगशशिमुनिकृत नवयमनगनन्देन्दु १९७२९४७१७९ संख्यकस्तस्य द्वादशस्य च घातो गतचैत्रादिमासैर्युतः; पृथक् स्थापितः, अधः स्थो राशिर्युगपठिताधिमासैर्गुणितोयुगपठितरविमासै (सौरमासैः) र्भक्तो लब्धाधिमासैः पृथक् स्थापितो युनः स त्रिंशद् गुणितः (शुक्लप्रतिपदादिगततिथिभि)र्युतः स पृथक् स्थापितः । अधः स्थो राशिर्युगपठितावमदिनैर्गुणितो युगपठितचान्द्रदिनैर्भक्तो लब्धावमैरुपरिस्थोराशिरूनः (वर्जितः) तदा रविसावनाहर्गणो भवेत् । तस्याहर्गणस्यार्कनारभ्य प्रवृत्तिर्भवत्यत एवार्कादिः कथ्यतेऽऽचार्येणेति ॥३०-३१॥

अत्रोपपत्तिः

अथ मध्यम ग्रहानयनं विवक्षुस्तत्रादौ तावत्तदुपयुक्तं कल्पादितः सावनाहर्गणं साधयत्याचार्य. ।

प्रागानीतेन प्रकारेणेष्टशकान्तं यावत्सौरवर्षमानान्यानोय द्वादशगुणानि-अभीष्टशकान्ते सौरा मासा भवन्ति । तत्र चैत्रामान्ततोऽभीष्टामान्तावधि ये चान्द्रा मासास्तत्समाः सौरा मासा एव क्षेप्यास्तदेष्टमासीयसंक्रान्ति यावत्कल्पादितः सौरमासाः स्युः । अत्र मध्यममेषसंक्रान्तिज्ञानाभावत् चैत्रामान्ततो मासग्रहणं विहितम् । अन्यविधानस्य प्रापकाभावात् । अयमेव कल्पादितोऽभीष्टमासीय संक्रान्तिपर्यन्तमभोष्टः सौरमासगणः स्यात् ततस्त्रैराशिकेनैतत्सम्बन्धोयाधिमासमानं सशेषं साध्यते ।

$$\text{तथाहि} \quad \frac{\text{कल्प अधिमास} \times \text{इष्टसौरमास}}{\text{कल्पसौरमास}} = \text{इष्टाधिमास} + \frac{\text{अशे}}{\text{कसौमा}}.$$

$$\therefore \text{अतोऽभीष्टसंक्रान्तिकाले चान्द्रमासाः सावयवाः} = \text{इसौ} + \text{इअमा} + \frac{\text{अशे}}{\text{कसौ}}$$

अत्रा $\frac{\text{अशे}}{\text{कस}}$ मं चान्द्रात्मकोऽधिशेपः । स चामान्तसंक्रान्त्यन्तरं स्यात् ।

"दर्शाग्रतः संक्रमकालतः प्राक् सदैव तिष्ठत्यधिमासशेष" मिति भास्करोक्तेः । अत्राधिशेषखण्डस्य विशोधनेन तिथ्यन्तकालिकः स्यात् अतोऽभीष्टामान्तीयचांद्रमासगणः इसौ + इअमा अयं त्रिंशद्गुणोऽभीष्टतिथियुतः कार्यस्तदा तिथ्यन्ते चान्द्राहर्गणः स्यात् । अतोऽनुपातेनैतच्चान्द्रसम्बन्धीन्यवमान्यानीयात्रविशोधनेन तिथ्यन्ते सावयवः सावनाहर्गणः स्यात् ।

$$\therefore \frac{\text{कअवम} \times \text{इचा}}{\text{कचा}} = \text{अवम} + \frac{\text{अशे}}{\text{कचा}}$$

$$\therefore \text{तिथ्यन्ते सावनाहर्गणः सावयवः} = \text{इचा} - \text{अवम} - \frac{\text{अवशे}}{\text{कचा}}$$ अत्रावमशेषस्य

तिथ्यन्तोदयान्तरे वर्तमानत्वात् अवमशेषं योज्यते चेत्तदौदयिकः सावनाहर्गणो निरवयवः । अहर्गणः = इचा — अवम ।

अत्र परिदर्शित समीकरण दर्शनेन विज्ञायते यत्केवलाधिमासैः सहितोऽभीष्टसंक्रान्तिकालिकः सौरमासगणस्तिथ्यन्ते चान्द्रमासगणः स्यात् । एवं च भवेलावमदिनरहितस्तिथ्यन्तकालिकश्चान्द्राहर्गणस्तिथ्यन्ताव्यवहितोत्तरौदयिकः सावनाहर्गणो जातः । अत एवाधिशेषावमशेषे त्यक्ते ।

अथैतत्प्रतीत्यर्थं विचार्यते

क	द	च	व	अ	ति	उ	सं	उ

क = कल्पादिः ।
च = चैत्रामान्तः ।
व = मध्यमः सौरवर्षान्तः ।
ति = तिथ्यन्तोऽभीष्टमासीयः ।
उ = उदयकालः ।
सं = अभीष्टसंक्रान्तिः ।
अ = अभीष्टमासीयामान्तः ।

क स्थानात् व स्थानपर्यन्तं सौरवर्षगणं समाननीय द्वादशगुणेन तत्रत्यः सौरमासगणः स्यात् । अत्र चैत्रामान्ततो अ अमान्तावधि यावन्तश्चान्द्रमासास्तान् सौरान् प्रकल्प्य प्रागानीतसौरमासगणे क्षेप्याः । तथा कृते सति अभीष्टसंक्रान्तिबिन्दौ सौरमासगणः सिद्धचति । अत्र अ अमान्तकालिक चान्द्रमाससाधनार्थं तत्र तावत् क स्थानमारभ्य प्रतिसौरमाससंख्याकसमचान्द्रमासदानेन पूर्वमेव कुत्राप्यमान्ते तत्पर्यवसान भवेत् । संख्यया सौरमासगणस्याल्पत्वात् । कल्प्यते द बिन्दौ तत्पूर्त्तिर्जाता । अत्र द, अ बिन्द्वोरन्तर्गताश्चान्द्रात्मका अधिमासा निरवयवाः । अ, स, बिन्द्वोरन्तरे तदधिशेषमानम् । अतः क, द, बिन्द्वोरन्तर्गते सौरमासग-

णसंख्याकसमे चान्द्रमासगणे अ, द, बिन्द्वोरन्तर्गतचान्द्राधिमासगणस्य योगेन अ बिन्दौ चान्द्रमासगणो भवतीति स्फुटमेव। ततो दिनीकरणेन अ बिन्दौ चान्द्राहर्गणः स्यात्। अत्र तिथिसंख्याया योगेन ति बिन्दौ चान्द्राहर्गणः। अत्रापि ति स्थानीयचान्द्रदिनसंख्याक समं सावनमानं प्रकल्प्य क स्थानात् तादृश-प्रतिसावनानां समायोगेन उ स्थानात् क्वचिदग्रगतो भवेत्। सावनसंख्यापेक्षया चान्द्रदिनसंख्याया अधिकत्वात्। स च दानाग्रबिन्दुः उ कल्पितः। अत्र उ उ बिन्द्वन्तर्गतानि दिनानि सावनात्मकानीति स्वरूपेणैव स्फुटम्। तैः केवलदिनैः सावनसंख्यासमैश्चान्द्रैर्विशोध्यते तदा उ बिन्दौ सावनाहर्गणः स्यात्। अत्राधिशेषावमशेषे न गृहीते। अतो भास्करेण "द्युघटिकादिकमत्र न गृह्यते" इत्युक्तम्।

एवं च सौराच्चान्द्रावगमेऽधिमासाश्चान्द्रात्मकास्तथाधिशेषं च चान्द्रात्मकमिति। तथैव चान्द्रात्सावनागमेऽवमानि सावनात्मकानि। तथा तच्छेषं च सावनात्मकमित्यपि सिद्ध्यति।

एवमहर्गणात्कल्पगताब्दावगमे सावनदिनगणादनुपातेन यान्यवमदिनानि तानि चान्द्रजातीयानि भवन्ति। शेषं च तज्जातीयमेव। तत्तु प्रागानीतसावनात्मकावमशेषस्य सममेव स्यात्। एवमेव चान्द्रात्सौरावगमे येऽधिमासास्ते सौरजातीयास्तच्छेषमपि तथैव। तदपि प्रागानीतचान्द्राधिशेषेण समसवैत्यनन्तरप्रदर्शितोपपत्त्या स्पष्टमेव गणितपटूनाम्। अतएवाधिमासस्य चान्द्रत्वे सौरत्वे चाधिशेषं तुल्यमेव स्यात्। किन्त्वत्र सौरदिनानि हारः अन्यत्र चान्द्रदिनानीति सर्वं 'सौरेभ्यः साधितास्ते चे"दित्यादिगोलीय ग्रन्थेन प्रपञ्चितं भास्कराचार्यैः।

अब अहर्गणानयन कहते हैं

हि॰ भा.—कल्पादि से जो गत वर्ष संख्या १९७२९४७१७९ है उसको बारह से गुणा देना, गत चैत्रादि मास संख्या जोड़कर जो हो उसको दो स्थान में स्थापित करना। एक स्थान में युग पठित अधिमास संख्या से गुणाकर युग पठित सौर मास संख्या से भाग देने से जो लब्धाधिमास हो उसको द्वितीय स्थान में स्थापित फल में जोड़कर जो हो उसको तीस से गुणा कर शुक्ल प्रतिपदादि से गत तिथि संख्या जोड़कर जो फल हो उसको दो स्थान में स्थापित करना, एक स्थान में उसको युगपठित अवमदिनों से गुणा कर युगपठित चान्द्र दिनों से भाग देने से जो लब्धि हो उसको (गतावमदिन) द्वितीय स्थान स्थित पूर्व फल में घटाने से रविसावनाहर्गण होता है; रवि से आरम्भ कर अहर्गण की प्रवृत्ति होती है। इसीलिये आचार्य पद्य में 'अर्कादिः' कहते हैं॥ ३०-३१॥

उपपत्ति

शाकवर्ष-स्पष्टमास तिथि इन सबों के ज्ञान से अहर्गण का आनयन करते हैं। 'कल्प-परार्धे मनवः षट्कस्य गताः' इत्यादि आचार्योक्त श्लोक से सृष्ट्यादि से गतवर्षान्त तक गत वर्ष संख्या विदित है, सृष्ट्यादि से चान्द्रवर्षतुल्य दान देने से जो दानान्त बिन्दु होता है वह किसी चैत्रामान्त बिन्दु ही पर होता है; फिर गत चैत्रामान्त से इष्टतिथ्यन्त पर्यन्त जो चान्द्रदिन संख्या है तत्संख्यक सौर दिन सख्या (इष्ट तिथि संख्यक सौर दिन सख्या) गत मेषादि से दान दिया वह सौरदानान्तबिन्दु इष्ट तिथ्यन्त से आगे होता है क्योंकि गतमेषादि बिन्दु गतचैत्रामान्त से आगे है फिर दानान्त बिन्दु का चान्द्रवर्षान्त से (दानान्त चैत्रामान्त से) इष्ट तिथि तुल्य चान्द्र दिन दिया तब वह दानान्तबिन्दु गतवर्षान्त से पहले ही कहीं इष्ट तिथ्यन्तसमबिन्दु ही में होता है. क्योंकि. चान्द्रदिन < सौरदि. तब सृष्ट्यादि से सौरवर्षादि संख्या और चान्द्रवर्षादि संख्या-समान ही दान दिया क्योंकि सृष्ट्यादि से गतवर्षान्त- पर्यन्त सौर वर्ष संख्या जो है तत्संख्यक ही सृष्ट्यादि से चान्द्रवर्ष दिये उससे आगे फिर गत मेषादि से सौरान्तपर्यन्त इष्टतिथितुल्य सौर संख्या जो है उतने ही दानान्त चान्द्रवर्षान्त से इष्ट तिथि तुल्य चान्द्र दिन दिया, अतः इन दोनों (सृष्ट्यादि से सौरदानान्त बिन्दुपर्यन्त चान्द्रवर्षादि संख्या जो है तत्सख्यक ही सृष्ट्यादि से इष्टतिथ्यन्त सम दानान्त बिन्दु पर्यन्त चान्द्रवर्षादि संख्या) के अन्तर (इष्टतिथ्यन्तसमदानान्तबिन्दु से सौरान्तबिन्दुपर्यन्त) चान्द्रजातीय सावयवाधिमास है, उनमें इष्टतिथ्यन्तसमदानान्त बिन्दु से इष्टतिथ्यन्त पर्यन्त पूरा अधिमास है उसके बाद. (इष्टतिथ्यन्त से सौरान्त तक) अधिशेष है। सौरान्त में जो चान्द्र है उनका और सौरसंख्यक चान्द्र का अन्तर सावयवाधिमास जो है वही सौरान्त में जो सौर है उनका और उस सौरान्तःपाति चान्द्रसंख्यक सौर का अन्तर है, दोनों में संख्या की तुलयता ही है किन्तु चान्द्रात्मक अधिमास सौरान्त से पहले और सौरात्मक अधिमास आगे होता है। इन दोनों में यहाँ पहला ही अधिमास लेना चाहिये। इसलिए उसका आनयन करते हैं।

$\frac{\text{कल्पाधिमास} \times \text{इष्टसौर}}{\text{कल्पसौर}} = \text{गताधिमास} + \frac{\text{अधिशेष}}{\text{कसौ}}$ इस तरह करके यहां अधिशेष को त्याग देना क्योंकि इष्ट तिथ्यन्त से सौरान्त तक अधिशेष ही है, इष्टाधिमाससंख्या (गताधिमाससंख्या) को तीस से गुणकर जो हो गताधिदिन उसमें इष्टसौर दिन संख्या जोड़ने से जो इष्ट तिथ्यन्त में चान्द्राहर्गण होता है। तब कल्पचान्द्रदिन में कल्पावमदिन पाते हैं तो इष्टचान्द्रदिन (आनीतचान्द्राहर्गण) में क्या इस अनुपात से अवमशेष सहित गतावमदिन आता है $\frac{\text{कल्पावम} \times \text{इष्टचान्द्रदिन}}{\text{कल्पचान्द्रदिन}} = \text{गतावमदिन} + \frac{\text{अवमशेष}}{\text{कल्पचान्द्रदिन}}$ इन अवमशेष सहित गतावमदिन को चान्द्राहर्गण में घटाने से तिथ्यन्त में सावनाहर्गण होता है चान्द्रा-हर्गण-गतावमदिन $- \frac{\text{अवमशेष}}{\text{कल्पचान्द्रदिन}}$ परन्तु तिथ्यन्त और सूर्योदय के मध्य में अवमशेष है इसलिए तिथ्यन्त कालिक सावनाहर्गण में अवमशेष को जोड़ने से सूर्योदयकालिक सावनाहर्गण होता है, चान्द्राहर्गण $-$ गतावमदिन $- \frac{\text{अवमशेष}}{\text{कल्पचान्द्रदिन}} + \frac{\text{अवमशेष}}{\text{कल्पचान्द्रदिन}} =$ चान्द्राहर्गण$-$

गतावमदि = तिथ्यन्तकालिक सावनाहर्गण + $\frac{\text{अवमशे}}{\text{कल्पचांदि}}$ = सूर्योदयकालिक सावनाहर्गण।

अहर्गण के दिन निश्चित रहने के कारण अहर्गण में सात से भाग देने से जो शेष रहता है तत्तुल्य रव्यादि दिन होता है क्योंकि कल्पादि में रविवार दिन था इसलिए रवि ही से गणना करनी चाहिये, इससे आचार्योक्त उपपन्न हुआ। आनीत अहर्गण मध्यम सावनाहर्गण है, क्योंकि इसके आनयन में अनुपात से काम लिया गया है, सिद्धान्तशिरोमणि में भास्कराचार्य ने भी "कथितकल्पगतोऽर्कसमागणः" इत्यादि से इसी तरह आनयन किये हैं, इति ॥३०-३१॥

इदानीं ग्रहमन्दशीघ्रपातानां मध्यमानां मध्यमानयनमाह

इष्टग्रहभगणगुणादहर्गणात्कल्पसावनद्युहृतात् ।
भगणादिफलं मध्यो लङ्कायां भास्करौदयिकः ॥३२॥

वा. भा.—ग्रहग्रहणेन ग्रहमन्दशीघ्रपाताः गृह्यन्ते। तेनायमर्थः इष्टस्य ग्रहादेः भगणैरिष्टाहर्गणं सुगणय्य कल्परविसावनदिवसैर्विभजेत्। लब्धं भगणादिरिष्टो ग्रहादिरत्र त्रैराशिकं यदि कल्पाहर्गणेनेष्टकल्पानां भगणाः लभ्यन्ते तदिष्टाहर्गणेन किमिति भगणादि स एव लभ्यते। तत्र भगणांस्त्यक्त्वा राश्यादिकः स्थाप्यते स्फुटीकरणादिषु प्रश्नेषु पुनः सभगणश्च स्थाप्यते। शेषमतिप्रसिद्धत्वात् नोदाहृतं स च भगणादिको मध्यो भवति। कक्षामण्डलग इत्यर्थः। लंकायां भास्करौदयिकश्च भवति। अन्यत्र देशे यतो देशान्तरकर्मणा स्वौदयिको भविष्यतीति। स्वमध्यभुक्तिश्च ग्रहवदेकाहर्गणेन स्वभगणैश्च साध्या, मया च रव्यादिनां सिद्धा एव भुक्तयो लिख्यन्ते। तत्पराशेषैः सह बलभद्रकृतैः श्लोकैः तद्यथा—

एकोनषष्टिरष्टौ च दश चेति रवेर्गतिः।
खाष्टगोनन्दनन्दर्त्तुसंख्यं शेषश्च तत्परः॥
चन्द्ररामारसयमावसुपक्षाः कुजस्य तु।
द्विपञ्चरसशून्याश्विपक्षाः शेषश्च तत्परः॥
अर्थाश्विपक्षादशनाक्षशीघ्रस्याष्टा रात्रियाः।
वेदतत्वेन्दुखनवसंख्यशेषश्च तत्परः॥
वेदा नवार्थं नव च गतिजीवस्य कीर्तिता।
पञ्चागगोनवागाश्विसंखशेषश्च तत्परः॥
सितशीघ्रस्य षट् नन्दाः पर्वता कृतसागरा।
पक्षार्थाग्निरसाब्धीश संख्याशेषश्च तत्परः।
रसाखवेदा रामार्थाश्चन्द्रस्योच्चगतिः स्मृता।
गुणाष्टगोर्थाग्निवसुचन्द्राः शेषश्च तत्परः॥
चन्द्रपातस्य दहना दिशश्चाष्टार्णवास्तथा।
अष्टर्त्तुनवपक्षार्थरसाः शेषश्च तत्परः॥
शेषाणां तत्पराः शेषाः क्रमशश्चार्कमन्दतः।

खाष्टखर्त्तुकृताः शेषाः सूर्योच्चस्य तु तत्पराः ॥
भौमोच्चस्याश्विदहनाः शून्यवस्वश्विनः स्मृताः ।
बुधोच्चस्याश्विशैलाष्टपंचरामाः प्रकीर्त्तिताः ॥
खाष्टशून्याष्टवसवो जीवोच्चस्य प्रकीर्त्तिताः ।
शुक्रोच्चस्य तु वस्वष्टरसपक्षरसाः स्मृताः ।
ऋत्वग्निनन्ददहनाः सौरोच्चस्य प्रकीर्त्तिताः ॥
भौमपातस्य च तथा दशनर्तुशराश्विनः ।
बुधपातस्य षट् चन्द्रशून्यशून्यषवः स्मृताः ॥
जीवपातस्य वस्वश्विशून्यषट्काः प्रकीर्त्तिताः ।
शुक्रपातस्य वस्वश्विसप्तार्थवसवः स्मृताः ॥
सौरपातस्य वेदर्त्तुशून्यषट्पंचकाः स्मृताः ।
छेदस्तुतत्पराशेषे सर्वेषाञ्च निगद्यते ।
पंचदेवखवस्वब्धिनवप्रालेयरश्मयः ।
सर्वेषां तत्पराशेषाणां भूदिनानां चापवर्त्तकः ॥ ८१०००

वि. भा.—इष्टग्रहकल्पपठितभगणगुणितादहर्गणात्कल्पपठितसावनद्यु (कल्पकुदिनं) भक्तात्फलं भगणादि मध्यमो ग्रहो लङ्कासूर्योदयकालिको भवतीति ॥ ३२ ॥

अत्रोपपत्तिः

$\frac{\text{कल्पग्रहभगण} \times \text{अहर्गण}}{\text{कल्पकुदिन}} = \text{ग्रहभ} + \frac{\text{भगणशे}}{\text{कनु.}}$ प्रतिदिनजगतिकलोत्पन्नासु वैषम्यमूलकप्रतिकुदिनवैषम्येनैताहशानुपाताभावादेकवर्षान्तःपातिस्पष्टकुदिनानामेकत्रितानां कृतस्वसंख्यकसमखण्डानां मध्यसावनमेवं स्पष्टगतिकलाभ्यो मध्यगतिकलेति च कृत्वैकस्ताहशो ग्रहश्चेत्कल्पितो भवेद्यस्य कुदिनं मध्यमसावनं तद्गतिकला च मध्यमगतिकला भवेत्तदा तत्कुदिनेनैवमनुपातः स्यात् । परं नायं क्रान्तिवृत्ते चालितो भवेत्तत्र समचापजासूनामप्यसमत्वात् $\frac{\text{अथ वर्षान्तःपातिस्पष्टसावनयोग}}{\text{वर्षान्तःपातिस्पष्टसावनसं}} =$ मध्यमसावन, वर्षान्तःपातिस्पष्टसावनयोगसम्बन्धि नाक्षत्रम् = वर्षान्तः पातिस्पष्टसावनसंख्या + १ नाक्षत्र

अतः मध्यमसावन $= \frac{\text{वर्षान्तःपातिस्पष्ट सावनसं ना} + \text{१ ना}}{\text{वर्षान्तःपातिस्पष्टसावनसं}}$

$= \text{१ ना} + \frac{\text{१ ना}}{\text{वर्षान्तः पातिस्पसा}} = \text{१ ना} + \frac{\text{२१६०० असु}}{\text{वर्षान्तःपातिस्पष्टसावनसं}}$

परञ्च $\frac{\text{२१६०० कला}}{\text{वर्षान्तः पातिस्पष्टसावनसं}} =$ मध्यगतिक; अतः मध्यमगतिकलासमासु

$= \frac{\text{२१६०० असु}}{\text{वर्षान्तः पातिस्पष्टसावनसं}}$ अतः मध्यसा = १ ना + मध्यमगतिकलासमासु, परञ्च कलातुल्या असवो नाडीमण्डल एवातो नाडीमण्डल एवोक्तग्रहश्चालनीय इति सिद्धः। अतः स्वस्वभगणात्पूर्वोक्तानुपातेन नाडीमण्डलीय मध्यमार्कस्य काल्पनिकत्वात्कल्पिते क्रान्तिवृत्तीयमध्यमार्कं आगतोऽयं मध्यमग्रह इत्यत्र 'दशशिरः पुरि मध्यमभास्करे क्षितिजसन्निधिगे इति वदति भास्करः' गोलसन्धेः प्रागाशाभिमुखं चालितयोः समगतिवेगवतोरुभयवृत्तीयमध्यमार्कयोर्यदा नाडीवृत्तीयमध्यमार्को लङ्काक्षितिजस्थस्तदा क्रान्तिवृत्तीयमध्यमार्कः पदवशेन क्षितिजोऽर्ध्वेऽधश्च कोटिकर्णान्तरस्थः, (नाडीक्रान्तिध्रुवप्रोतवृत्तैरुत्पन्नजात्यत्रिभुजीयकोटिकर्णयोरन्तरस्थः स्यादिति) अत्रोक्त ग्रहोदययोरन्तरमुदयान्तरं परममप्यल्पमेवातः क्षितिजसन्निधिग इति कथ्यते भास्करेण, परं ब्रह्मगुप्तेन तदन्तरं (उदयान्तरं) शून्यं मत्वा "लङ्कायां भास्करौदयिकः" कथ्यते, अत्र भास्करेण यदुदयान्तरं स्वीकृत्य 'क्षितिजसन्निधिगे' यत्कथ्यते तद्ब्रह्मगुप्तोक्ता- 'लङ्कायां भास्करौदयिकः' पेक्षया समीचीन इति मध्यस्थबुद्धया विवेचनीयं सुधीभिरिति।

अधुना प्रसङ्गादुदयान्तरसम्बन्धे किञ्चिद्विचार्यते

क्रान्तिवृत्त यत्र मध्यमरविस्तदुपरिगतं ध्रुवप्रोतवृत्तं (निरक्षक्षितिजं) यत्र नाडीवृत्ते लगति तस्माद् गोलसन्धि यावन्मध्यमरविगतिकलोत्पन्नासवो विषुवांशा वा, एतन्मध्यमरविगतिकलोत्पन्नासुप्रमाणं नाक्षत्रषष्टिघटिकया युक्तं तदा स्पष्टसावनदिनं भवेत् तथा गोलसन्धि केन्द्रं मत्वा क्रान्तिवृत्तीयमध्यमरविभुजांशव्यासार्धवृत्तं यत्र नाडीवृत्ते लगति ततो गोलसन्धि यावन्मध्यमरविगतिकलातुल्यासवो मध्यमरविभुजांशा वा, एतन्मध्यमरविगतितुल्यासुयुतं नाक्षत्रषष्टिप्रमाणं मध्यमसावनदिनं भवति, अनयोः स्पष्टसावनमध्यमसावनदिनयोरन्तरम् = ६० + मध्यमरविगतिकलातुल्यासु − (६० + मध्यमरविगतिकलोत्पन्नासु) = मध्यमरविगतिकलातुल्यासु − मध्यमरविगतिकलोत्पन्नासु = उदयान्तरासु, एतत्सम्बन्धिग्रहगतिप्रमाणमानीयते, यथा यद्यहोरात्रासुभिर्ग्रहगतिकला लभ्यन्ते तदोदयान्तरासुभिः किमित्यनुपातेनोदयान्तरसम्बन्धिनी ग्रहगतिरागच्छति तत्स्वरूपम् $= \frac{\text{ग्रहगतिकला} \times \text{उदयान्तरासु}}{\text{अहोरात्रासु}}$ अनया गत्या रहिताः सहिताश्चाहर्गणोत्पन्ना ग्रहाः (नाडीवृत्तीयमध्यमार्कोदयकालिकग्रहाः) क्रान्तिवृत्तीयमध्यमार्कोदयकालिका (निरक्षक्षितिजस्थाः) ग्रहा भवन्त्येतावता "मध्यार्कभुक्ता असवो निरक्षे ये ये च मध्यार्ककलासमाना इत्यादि" भास्करोक्तमुपपद्यते। परमुदयान्तरासुमध्येऽपि ग्रहस्य कापि गतिर्भविष्यति तद्ग्रहणं भास्करेण न कृतमतः पूर्वोक्तयुक्त्योदयान्तरासुसम्बन्धिग्रहगत्यानयनं विधाय तत्संस्कृतोऽहर्गणोत्पन्नमध्यमार्कोदयकालिकग्रहो नहि वास्तविको निरक्षक्षितिजे क्रान्तिवृत्तीयमध्यमार्कोदयकालिकग्रहो भवितुमर्हत्यतो भास्करोक्तमानयनं न समीचीनमित्यतो वास्तवं तदानयनं प्रोच्यते।

अथ कल्प्यते वास्तवमुदयान्तरप्रमाणम्=य, एतेनैवौदयिको ग्रहो भवितुमर्हति, अस्मिन्नुदयान्तरकाले ग्रहगतिर्या भवेत्तदुत्पन्नासुभिः संस्कृतं भास्करोक्तमुदयान्तरं वास्तवमुदयान्तरं भवेद्यथा यद्यहोरात्रासुभिर्ग्रहगतिकला लभ्यन्ते तदा वास्तवोदयान्तरा (य) सुभिः किं समागच्छति तत्सम्बन्धिनी ग्रहगतिकला तत्स्वरूपम् = $\frac{\text{ग्रहगतिक} \times \text{य}}{\text{अहोरात्रासु}}$ =१ असुजग्रहगति × य, ततोऽनुपातो यदि राशिकलाभिरष्टादशशतकलाभिस्तद्राश्युदयासवो लभ्यन्ते तदा वास्तवोदयान्तरासुसम्बन्धिग्रहगतिकलाभिः किं समागच्छन्ति तत्सम्बन्धिनोऽसवः= $\frac{\text{राश्युदय} \times \text{वास्तवोदयान्तरासु सं ग्रहगतिकला}}{१८००}$

$= \frac{\text{राश्युदय} \times \text{ग्रहगतिकला} \times \text{य}}{१८०० \times \text{अहोरात्रासु}}$ = १ असुजग्रहगति × य × १ कलोत्पन्नासु...(१)

$\times \frac{\text{राश्युदय} \times १}{१८००}$ = १ कलोत्पन्नासु

(१) एतेन संस्कृतं भास्करोक्तमुदयान्तरं वास्तवमुदयान्तरं भवेत्
अतः भास्करोक्तोदयान्तर∓१ असुजग्रहगति × य × १ कलोत्पन्नासु=वास्तवोदयान्तर=य

=पूर्वोदयान्तर∓१ असुजग्रहगति × य × १ कलोत्पन्नासु=य

समशोधनेन

य±१ असुजग्रहग × य × १ कलोत्पन्नासु=पूर्वोदयान्तर

=य (१±१ असुजग्रहग × १ कलोत्पन्नासु)=पूर्वोदयान्तर

अतः $\frac{\text{पूर्वोदयान्तर}}{१ \pm १ \text{ असुजग्रहग} \times १\text{कलोत्पन्नासु}}$ =य

एतावता "एकासुजेनगतिसंगुणितैकलिप्तोत्पन्नासुराश्युदययुक्तविहीनितेन रूपेण पूर्वमुदयान्तरमत्र भक्तं स्वर्णं ग्रहे युगयुजोः पदयोः क्रमेण"

म० म० पण्डितसुधाकरद्विवेदिसूत्रमुपपद्यते

अत्रेनगतिः=सूर्यगतिः, सूर्यसम्बन्धेनैव वास्तवोदयान्तरसाधनं प्रदर्शितमस्ति द्विवेदिमहोदयेन अन्येषां ग्रहाणामपि स्वस्वगतिसम्बन्धेन तथैव तत्साधनं भवेद्यथोपरि प्रदर्शितमस्तीति ।

अधुनोदयान्तरस्य परमत्वं कुत्र भवेदिति विचार्यते

भुजांशविषुवांशयोरन्तरमुदयान्तरमित्युदयान्तरस्वरूपदर्शनात्स्फुटमस्त्यत उदयान्तरज्या=ज्या (भुजांश—विषुवांश) चापयोरिष्टयोरित्यादिना

$$\frac{\text{ज्याभु} \times \text{कोज्यावि} - \text{ज्यावि} \times \text{कोज्याभु}}{\text{त्रि}} = \text{उदयान्तरज्या} = \text{ज्याउ},$$

यतः $\frac{\text{कोज्याभु} \times \text{त्रि}}{\text{द्यु}} = \text{कोज्यावि}$.

तथा $\frac{\text{पद्यु} \times \text{ज्याभु}}{\text{द्यु}} = \text{ज्यावि}$, अत उदयान्तरज्यास्वरूपे समुत्थापनेन

$$\text{ज्याउ} = \frac{\text{ज्याभु} \times \text{कोज्याभु} \times \text{त्रि} - \text{पद्यु} \times \text{ज्याभु} \times \text{कोज्याभु}}{\text{त्रि} \cdot \text{द्यु}}$$

$$= \frac{\text{ज्याभु} \times \text{कोज्याभु} \ (\text{त्रि} - \text{पद्यु})}{\text{त्रि} \cdot \text{द्यु}}$$

$$= \frac{\text{ज्याभु} \times \text{कोज्याभु} \times \text{ज्याजिउ}}{\text{त्रि} \cdot \text{द्यु}}$$

अत्र ज्याजिउ = जिनांशोत्क्रमज्या

हरभाज्यौ 'त्रि+पद्यु' गुणितौ तदा $\frac{(\text{त्रि} + \text{पद्यु})\ (\text{ज्याभु} \times \text{कोज्याभु} \times \text{ज्याजिउ})}{\text{त्रि} \cdot \text{द्यु}\ (\text{त्रि} + \text{पद्यु})} =$

$$\frac{(\text{त्रि} \times \text{ज्याभु} \times \text{कोज्याभु} + \text{ज्याभु} \times \text{कोज्याभु} \times \text{पद्यु})\ \text{ज्याजिउ}}{\text{त्रि} \cdot \text{द्यु}\ (\text{त्रि} + \text{पद्यु})} = \text{ज्याउ}$$

$$= \frac{(\text{ज्याभु} \times \text{कोज्यावि} + \text{ज्यावि} \times \text{कोज्याभु})\ \text{ज्याजिउ}}{\text{त्रि}\ (\text{त्रि} + \text{पद्यु})}$$

$$= \frac{\text{ज्या}\ (\text{भु} + \text{वि})\ \text{ज्याजिउ}}{\text{त्रि} + \text{पद्यु}} = \text{ज्याउ} = (१)$$

(१) एतेन 'विषुवांशभुजांशयोगजीवा जिनभागोत्क्रमजज्यया विनिघ्नी ।
परमाल्पद्युज्यया विभक्ता त्रिभजीवायुतयोदयान्तरज्या ॥'
म० म० सुधाकरोक्तसूत्रमुपपद्यते ।

(१) अत्रै 'ज्याजिउ, त्रि+पद्यु' तयोर्गुणकहरयोः स्थिरत्वात्सिद्धं यद्यत्र ज्या (भु+वि) परमाऽर्थात्त्रिज्यासमा भवेत्तत्रैवोदयान्तरज्या परमा भवेदर्थात्तत्रैवोदयान्तरस्य परमत्वं भवेदिति । गोलसन्धौ (नाडीक्रान्तिवृत्तयोः सम्पाते) तथाऽयनसन्धौ मध्यमार्के, उदयान्तराभाव इत्युदयान्तरस्य भुजांशविषुवांशयोरन्तररूपस्य स्वरूपदर्शनेनैव स्फुटमिति ॥

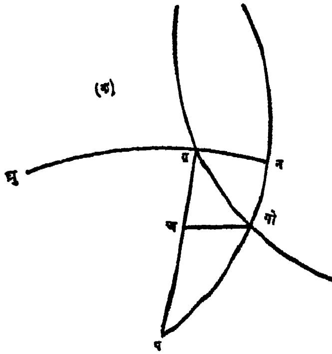
अधुना परमोदयान्तरकालीनभुजांशविषुवांशयोरानयनं क्रियते

पूर्वं सिद्धं यद्यदा भुजांशविषुवांशयोर्योगज्या त्रिज्यासमाऽर्थाद्भुजांशविषुवांशयोर्योगो नवत्यंशसमस्तदोदयान्तरस्य परमत्वं भवितुमर्हति तेन परमोदयान्तरे भुजांश+विषुवांश=९० तथा तदा भुजांशविषुवांशयोरन्तरम्=परमोदयान्तरम्,

ततः संक्रमणगणितेन $\frac{\text{९०}+\text{परमोदयान्तर}}{\text{२}}=\text{४५}+\frac{\text{परमोदयान्तर}}{\text{२}}=$ परमोदयान्तरकालीनभुजांशाः

तथा $\frac{\text{९०}-\text{परमोदयान्तर}}{\text{२}}=\text{४५}-\frac{\text{परमोदयान्तर}}{\text{२}}=$ परमोदयान्तरकालीनविषुवांशाः

अथवा



ध्रु=ध्रुवः। ग=क्रान्तिवृत्ते मध्यमार्कः। गो=गोलसन्धिः । गोग=भुजांशाः । गोन=विषुवांशाः, गोग्रभुजांशसमं नाडीवृत्ते गोप छित्वा पग्रवृत्तं कार्यं तथा गोपवृत्तोपरि गोबिन्दुतो गोचलम्बवृत्तं कार्यं तदा गोप+गोन=परमोदयान्तरकालीनभुजांशविषुवांशयोर्योगः = ९०, $<$ग्रगोन=जिनांश; $<$ग्रगोप=१८०—जिनांश $<\text{ग्रगोच}=\frac{<\text{ग्रगोप}}{\text{२}}=\frac{\text{१८०}-\text{जिनांश}}{\text{२}}$ $=\text{९०}-\frac{\text{जिनांश}}{\text{२}}=$ जिनांशार्धको ग्रनप-चापीय जात्यत्रिभुजे पनकोटिः=९० तदा पग्रकर्णोऽपि=९० तदा ग्रगोपचापीय त्रिभुजस्य समद्विबाहुकत्वात् ग्रच=चप=४५, $<$ग्रचगो=९० ततो गोचपचापीयजात्येऽनुपातेन $\frac{\text{त्रि}\times\text{ज्या ४५}}{\text{कोज्या}\frac{\text{जि}}{\text{२}}}=$ ज्यागोप=परमोदयान्तरकालीनभुजज्या, अस्याश्चापम्=परमोदयान्तरकालीनभुजांशाः, कोज्या$\frac{\text{जि}}{\text{२}}=$जिनांशार्धकोटिज्या, एतावताऽधोलिखितसूत्रमुपपद्यते ।

त्रिज्येषु वेदांशगुणेन ताडिता जिनार्धकोटयुत्थगुणेन भाजिता ।
तदीय चापेन समा भुजांशका यदा तदा तत्र परोदयान्तरम् ॥

एतेनैतन्मिते भुजभागे परमोदयान्तरं भवतीति सिद्धयति । वस्तुतस्तन्मानं कियदिति जिज्ञासायां $\text{उज्या}=\frac{\text{ज्या (वि+भु) उज्याजि}}{\text{त्रि}+\text{पद्यु}}$

$\therefore\ \text{परमोदयान्तर}=\frac{\text{त्रि}\times\text{उज्याजि}}{\text{त्रि}+\text{पद्यु}}$

$\therefore\ \text{वा}\ \frac{\text{त्रि. उज्याजि}\times\text{त्रि}^{\text{२}}}{\frac{\text{२ (त्रि+पद्यु)}\times\text{त्रि}^{\text{२}}}{\text{२}}}=\frac{\text{ज्या}^{\text{२}}\ \frac{\text{१}}{\text{२}}\ \text{जि. त्रि}^{\text{२}}}{\text{कोज्या}^{\text{२}}\ \frac{\text{१}}{\text{२}}\ \text{जि. त्रि}^{\text{२}}}$ (त्रिकोणगणितेन)

$$=\frac{\text{स्य}^2\,\frac{1}{2}\,\text{जि.}}{\text{त्रि.}}$$

यत: $\frac{\text{त्रि. उज्याजि}}{2}=\text{ज्या}^2\,\frac{1}{2}\,\text{जि.}$

$\frac{\text{त्रि (त्रि+पद्यु)}}{2}=\text{कोज्या}^2\,\frac{1}{2}\,\text{जि.}$

एतेन—

जिनांशार्धस्य य: स्पर्शरेखावर्गो विभाजित: ।
परमोदयान्तरज्या स्याल्लब्धिस्त्रिज्यकया स्फुटा ।।

अत्र लघुरिकथने—

स्य$\frac{1}{2}$ जि=९·३१७८७८९

∴ स्य^2 $\frac{1}{2}$ जि=१८·६६४७४७८

∴ $\frac{\text{स्य}^2\,\frac{1}{2}\,\text{जि}}{\text{त्रि}}$ =८·६६४७४७८

∴ परमोदयान्तरासव:=२° । =२५$'$=१४५

षड्भिर्भक्ता: पलानि=२५,

अत्र भास्कराचार्येण २६ पलानि गृहीतानि । भास्करोक्तमुदयान्तरं व्यर्थं दुराग्रहेण प्रखण्डितं कमलाकरेण । तदर्थं तत्त्वविवेको द्रष्टव्य: ।

एतद्बलेन "परमोदयान्तरज्ञानेनाहर्गणानयनं कथं भवेदेतस्य विलक्षणप्रश्न-स्योत्तरसिद्धिर्भवति" यथा परमोदयान्तरज्ञानेन पूर्वोक्तसूत्र 'त्रिज्येषु वेदांशगुणेने-त्यादि' द्वारा तत्कालीनभुजांशज्ञानं भवेत्ततो "निरग्रचक्रादपि कुट्टकेनेत्यादि विलोमेन" ऽहर्गणज्ञानं सुखेनैव भवेदिति, उदयान्तरखण्डनं कमलाकरेण कृतं तत्समी-चीनं नास्ति तथाऽन्येऽपि बहवो विशेषा: सन्त्युदयान्तरसम्बन्धे तेऽत्रविस्तृतिभयान्न लिख्यन्त इति ।। ३१ ।।

अब ग्रहानयन कहते हैं

हि. भा.—अहर्गण को इष्टग्रह के कल्प में पठित भगण से गुण कर कल्प सावन (कल्प कुदिन) से भाग देने से फल भगणादि मध्यम ग्रह लङ्काक्षितिजोदय (लङ्का सूर्योदय) कालिक होते हैं ।। ३१ ।।

उपपत्ति

$\frac{\text{कल्प ग्रहभगण} \times \text{ग्रहर्गण}}{\text{कल्पकुदिन}} = \frac{\text{ग्रहभ}}{\text{ककु}} + \frac{\text{भगणशे}}{\text{ककु}}$ यहाँ ग्रहर्गण के मध्यम सावनदिन समूह रूप होने के कारण उस पर से पूर्वोक्तानुपातद्वारा जो भगणादि मध्यम ग्रह आते हैं, वे भी मध्यम सावनान्त बिन्दुक ही होंगे, $\frac{\text{वर्षान्तःपातिस्पष्टसावनयोग}}{\text{वर्षान्तःपातिस्पष्टसावनसं}}$ = मध्यमसावन, वर्षान्तःपाति, स्पष्टसावनयोगसम्बन्धिनाक्षत्र = वर्षान्तःपातिस्पष्टसावनसंख्या + १ नाक्षत्र इसलिए

$\frac{\text{वर्षान्तः पातिस्पष्टसावन सं १ नाक्षत्र}}{\text{वर्षान्तःपातिस्पष्टसावनसं}} = १ \text{ ना} + \frac{१ \text{ ना}}{\text{वर्षान्तःपातिस्पसा}} = १ \text{ ना} +$

$\frac{२१६०० \text{ असु}}{\text{वर्षान्तःपातिस्पष्टसावनसं}}$ परं $\frac{२१६०० \text{ कला}}{\text{वर्षान्तःपातिस्पष्टसावनसं}}$ = मध्यगतिक; अतः मध्यमगति-

कलासमासु = $\frac{२१६०० \text{ असु}}{\text{वर्षान्तःपातिस्पष्टसावनसं}}$

इसलिए मध्यमसा = १ ना + मध्यगतिकलासमासु, लेकिन कला समान असु नाडीवृत्त ही में होती है इसलिए उक्त ग्रह नाडीवृत्त ही में चालनीय है, यह सिद्ध हुआ । इसलिए अपने कल्प पठित भगण से पूर्वोक्तानुपात से जो मध्यमग्रह आते हैं, वे क्रान्ति वृत्तीय भुजांशतुल्य नाडी-वृत्तीय चाप के अग्रबिन्दुक होते हैं अतः 'दशशिरः पुरि मध्यम भास्करे क्षितिज सन्निधिगे सति मध्यमः' भास्कराचार्य कहते हैं, गोल सन्धि बिन्दु से पूर्वाभिमुख चालित समान गति वेगक नाडीवृत्तीय और क्रान्तिवृत्तीय मध्यमार्कों में जब नाडीवृत्तीय मध्यमार्क लङ्काक्षितिज में होते हैं तब क्रान्तिवृत्तीय मध्यमार्क पदवश से क्षितिज से ऊपर और नीचे (भुजांश और विषु-वांश के अन्तर पर) होते हैं; दोनों ग्रहोदयों के अन्तर को उदयान्तर भास्कराचार्य कहते हैं परमोदयान्तर भी अल्प ही होता है इसलिए भास्कराचार्य 'क्षितिज सन्निधिगे' कहते हैं; इस अन्तर (उदयान्तर) को ब्रह्मगुप्त शून्य मानते हैं इसलिए 'लङ्कायां भास्करौदयिकः' कहते हैं यहां भास्कराचार्य का कथन ही ठीक है उदयान्तर नहीं मानना अनुचित है, भास्कराचार्य ने एक उदयान्तर रूप विलक्षण वस्तु दिखलाकर अपने अद्भुत पाण्डित्य का परिचय दिया है इस विषय पर ज्यौतिषिक लोग निष्पक्ष बुद्धि से विचार करें ॥ ३२ ॥

अब प्रसङ्ग से उदयान्तर के सम्बन्ध में कुछ विचार करते हैं

क्रान्तिवृत्त में जहां पर मध्यम रवि है उसके ऊपर ध्रुवप्रोतवृत्त (निरक्षक्षितिज) करने से नाडीवृत्त में जहां लगता है, वहां से गोलसन्धि पर्यन्त नाडीवृत्तीयचाप विषुवांश या मध्यमरविगतिकलोत्पन्नासु है, नाक्षत्र षष्टि (६०) घटी में मध्यमरविगतिकलोत्पन्नासु को

जोड़ने से स्पष्टसावन होता है, गोलसन्धि बिन्दु को केन्द्र मानकर क्रान्तिवृत्तीयमध्यमरवि भुजांश व्यासार्धवृत्त करने से नाडीवृत्त में जहां लगता है वहाँ से गोल सन्धि बिन्दु तक नाडीवृत्त में मध्यमरविगतिकलातुल्यासु है, नाक्षत्र षष्टि (६०) घटी में मध्यमरविगतिकला तुल्यासु को जोड़ने से मध्यम सावन होता है। इन दोनों (स्पष्टसावन और मध्यम-सावन) के अन्तर करने से मध्यमरविगतिकलातुल्यासु-मध्यमरविगतिकलोत्पन्नासु = उदयान्तरासु, एतत्सम्बन्धिग्रहगति प्रमाण लाते हैं जैसे यदि अहोरात्रासु में ग्रहगति कला पाते हैं तो उदयान्तरासु में क्या इस अनुपात से उदयान्तरासु सम्बन्धिनी ग्रहगति आती है

$\frac{\text{ग्रहगतिकला} \times \text{उदयान्तरासु}}{\text{अहोरात्रासु}}$ = उदयान्तरासु सम्बन्धिनी ग्रहगति, इसको अहर्गणोत्पन्न ग्रह में घटाने से और जोड़ने से निरक्षक्षितिजस्थ (क्रान्तिवृत्तस्थ मध्यमरविगत ध्रुवप्रोतवृत्त नाड़ीवृत्त सम्पात बिन्दुक) ग्रह होते हैं। इसी विषय को सिद्धान्त शिरोमणि में भास्कराचार्य 'मध्यार्क भुक्ता असवो निरक्षे ये ये च मध्यार्ककला 'समाना' इत्यादि से कहते हैं। लेकिन उदयान्तरासु के मध्य में भी ग्रह की कुछ गति होगी। उस गति का ग्रहण भास्कराचार्य नहीं किये हैं, इसलिए पूर्व प्रदर्शित उदयान्तरासुसम्बन्धिनी ग्रहगतिसम्बन्ध से जो निरक्षक्षितिजोदय कालिक ग्रह लाये हैं सो ठीक नहीं है इसलिए भास्करोक्त उदयान्तरानयन ठीक नहीं है, यह सिद्ध हुआ।

अब वास्तव उदयान्तर साधन करते हैं

वास्तव उदयान्तर प्रमाण = य मानते हैं, इसी से औदयिक ग्रह होते हैं, इस उदयान्तर काल में ग्रह की जो गति होती है, तदुत्पन्नासु करके संस्कृत भास्करोक्त उदयान्तर वास्तव उदयान्तर होता है। यथा यदि अहोरात्रासु में रविगतिकला पाते हैं तो वास्तवोदयान्तरा (य) सु में क्या इस अनुपात से वास्तवोदयान्तरासु सम्बन्धिनी रविगति कला आती है,

$\frac{\text{रविगकला} \times \text{य}}{\text{अहोरात्रासु}}$ = एकासुजरविग × य, फिर अनुपात करते हैं यदि राशि कला (१८००) में उस राशि का उदयासु पाते हैं तो वास्तवोदयान्तरासुसम्बन्धिनी रविगतिकला में क्या इस अनुपात से तत्सम्बन्धि असु प्रमाण आता है $\frac{\text{राश्युदयासु} \times \text{वास्तवोदयान्तर संरविगतिक}}{१८००}$ =

$$\frac{\text{राश्युदय} \times \text{रविगतिकला} \times \text{य}}{१८०० \times \text{अहोरात्रासु}} = \text{एकासुजरविगति} \times १ \text{ कलोत्पन्नासु} \times \text{य} \cdots (१)$$

$\because \frac{\text{राश्युदय} \times १}{१८००}$ = १ कलोत्पन्नासु, भास्करोक्तोदयान्तर में (१) इसको संस्कार करने से वास्तव उदयान्तर होता है, अतः भास्करोक्तोदयान्तर ∓ एकासुजरविग × १ कलोत्पन्नासु × य = य = पूर्वोदयान्तर ∓ एकासुजरविग × १ कलोत्पन्नासु × य समशोधन करने से य ± एकासुजरविग × १कलोत्पन्नासु × य = पूर्वोदयान्तर = य (१ ± एकासुजरविग × १कलोत्पन्नासु)

$$\therefore \text{य} = \frac{\text{पूर्वोदयान्तर}}{१ \pm \text{एकासुजरविग} \times १\text{कलोत्पन्नासु}} \cdots\cdots\cdots (\text{क})$$

यहां इनगति=सूर्यगति, सूर्यगतिकलासम्बन्ध से वास्तव उदयान्तर साधन किय गया है, अपनी-अपनी गति के सम्बन्ध से अन्य ग्रहों का साधन उसी तरह से होता है।

(क) इससे 'एकासुजेनगतिसङ्गुणितैकलिप्तोत्पन्नासु राश्युदययुक्तविहीनितेन' इत्यादि संस्कृतोपपत्तिस्थ म० म० पण्डित सुधाकर द्विवेदी जी का सूत्र उपपन्न होता है।

अब उदयान्तर का परमत्व कहां होता है, विचार करते हैं

भुजांश और विषुवांश का अन्तर उदयान्तर है; इसलिए उदयान्तरज्या=(भु—वि)

चापयोरिष्टयोः इत्यादि से $\frac{\text{ज्याभु} \times \text{कोज्यावि} - \text{ज्यावि} \times \text{कोज्याभु}}{\text{त्रि}}$ = उदयान्तरज्या,

यतः $\frac{\text{कोज्याभु} \times \text{त्रि}}{\text{द्यु}}$ = कोज्यावि

तथा $\frac{\text{पद्यु} \times \text{ज्यासु}}{\text{द्यु}}$ = ज्यावि, उदयान्तरज्या स्वरूप में उत्थापन से

$$\frac{\text{ज्याभु} \times \text{कोज्याभु} \times \text{त्रि} - \text{पद्यु} \times \text{ज्याभु} \times \text{कोज्याभु}}{\text{त्रि. द्यु}} = \frac{\text{ज्याभु} \times \text{कोज्याभु}\ (\text{त्रि} - \text{पद्यु})}{\text{त्रि. द्यु}}$$

$$= \frac{\text{ज्याभु} = \text{कोज्याभु} \times \text{ज्याजिउ}}{\text{त्रि. द्यु}}$$ = उदयान्तरज्या, ज्याजिउ=जिनांशोत्क्रमज्या।

यहां हर और भाज्य को 'त्रि×पद्यु' इससे गुण देने से

$$\frac{(\text{त्रि} + \text{पद्यु})\ (\text{ज्याभु} \times \text{कोज्याभु} \times \text{ज्याजिउ})}{\text{त्रि. द्यु. } (\text{त्रि} + \text{पद्यु})}$$

$$= \frac{(\text{त्रि. ज्याभु. कोज्याभु} + \text{ज्याभु. कोज्याभु. पद्यु})\ \text{ज्याजिउ}}{\text{त्रि. द्यु } (\text{त्रि} + \text{पद्यु})}$$

$$= \frac{(\text{ज्याभु. कोज्यावि} + \text{ज्यावि. कोज्याभु})\ \text{ज्याजिउ}}{\text{त्रि. } (\text{त्रि} + \text{पद्यु})}$$

$$= \frac{\text{ज्या}\ (\text{भु} + \text{वि})\ \text{ज्याजिउ}}{\text{त्रि} + \text{पद्यु}}$$ = उदयान्तरज्या...(१)

(१) इससे "विषुवांशभुजांशयोगजीवा" इत्यादि संस्कृतोपपत्तिस्थ म० म० पण्डित सुधाकर द्विवेदी जी का सूत्र उपपन्न होता है।।

(१) इसमें ज्याजिउ, त्रि+पद्यु इन दोनों गुणक और हर के स्थिरत्व के कारण जहाँ ज्या (भु+वि) इसका परमत्व होगा वहीं पर उदयान्तरज्या का परमत्व होगा अर्थात् उदयान्तर का परमत्व होगा। परन्तु ज्या त्रिज्या से अधिक नहीं होती है इसलिए

जहां ज्या (भु+वि)=त्रि होती है, वहीं पर उदयान्तर का परमत्व होता है, यह सिद्ध हुआ। गोलसन्धि (नाड़ीवृत्त और क्रान्तिवृत्त के सम्पात) में भुजांश और विषुवांश के अभाव से उन दोनों के अन्तररूप उदयान्तर का अभाव होता है तथा अयन सन्धि में मध्यमार्क के रहने से भुजांश और विषुवांश के नवत्यंश के बराबर होने से दोनों के अन्तररूप उदयान्तर का अभाव होता है, यह सिद्ध हुआ।

अब परमोदयान्तरकालीन भुजांश और विषुवांश के साधन करते हैं

पहले सिद्ध हुआ है कि जब भुजांश और विषुवांश की योगज्या त्रिज्या के बराबर होती है अर्थात् भुजांश और विषुवांश का योग नवत्यंश के बराबर होता है तब उदयान्तर का परमत्व होता है, इसलिए परमोदयान्तर में भुजांश+विषुवांश=९०, और उस अवस्था में भुजांश और विषुवांश का अन्तर=परमोदयान्तर, तब संक्रमण गणित से

$$\frac{९० + \text{परमोदयान्तर}}{२} = ४५ + \frac{\text{परमोदयान्तर}}{२} = \text{परमोदयान्तर कालीन भुजांश}$$

तथा $$\frac{९० - \text{परमोदयान्तर}}{२} = ४५ - \frac{\text{परमोदयान्तर}}{२} = \text{परमोदयान्तर कालीन विषुवांश}।$$

अथवा

ध्रु=ध्रुव। अ=क्रान्तिवृत्त में मध्यमार्क, गो=गोलसन्धि, गोअ=भुजांश, गोन=विषुवांश नाड़ीवृत्त में गोअ भुजांश तुल्य गोप काटकर पअ वृत्त बना दीजिये, गो बिन्दु से पअ के ऊपर गोच लम्ब वृत्त कर दीजिये, गोन+गोप=विषुवांश+भुजांश यह जब नवत्यंश के बराबर होता है तब ही उदयान्तर का परमत्व होता है, इसलिए उदयान्तर के परमत्व में गोन+गोप=विषुवांश+भुजांश=९० अनप चापीय जात्यत्रिभुज में पनकोटि=९० अतः पअकर्णोऽपि=९०, तदा अच= चप=४५ (अगोपचापीय त्रिभुज के समद्विबाहुकत्व के कारण), $\angle$अचगो=९०, $\angle$अगोन=जिनांश $\angle$अगोप=१८०—जिनांश, $\angle$अगोच= $\frac{\angle \text{अगोप}}{२} = \frac{१८० \text{ जिनांश}}{२}$

$= ९० - \frac{\text{जिनांश}}{२}$ =जिनांशार्धं को तब गोचपचापीय जात्यत्रिभुज में अनुपात से

$\frac{\text{त्रि} \times \text{ज्या } ४५}{\text{कोज्या}\frac{\text{जि}}{२}}$ =ज्या गोप=परमोदयान्तर कालीन भुजज्या, इसके चाप करने से परमो-दयान्तर कालीन भुजांश हुआ, कोज्या $\frac{\text{जि}}{२}$ =जिनांशार्धकोटिज्या, इससे संस्कृतोपपत्तिस्थ 'त्रिज्येषु वेदांशगुणेन ताडिता' इत्यादि सूत्र उपपन्न हुआ। यहाँ संस्कृतोपपत्तिस्थ (क) क्षेत्र देखिये ॥

उपर्युक्त उपपत्ति के बल से "परमोदयान्तर ज्ञान से ग्रहगंण ज्ञान कैसे होगा, इस विलक्षण प्रश्न का उत्तर सुलभ ही होता है" जैसे परमोदयान्तर ज्ञान से उपर्युक्तोपपत्ति द्वारा तत्कालीन भुजांश ज्ञान हो जायगा तब 'निरग्रचक्रादपि कुट्टकेन' इत्यादि के विलोम से अहर्गण ज्ञान सुलभेन हो जायगा, उदयान्तर का खण्डन सिद्धान्ततत्त्वविवेक में कमलाकर जी ने किया है सो ठीक नहीं है, उदयान्तर के सम्बन्ध में बहुत अन्य विशेष विषय है जो विस्तृति भय से नहीं लिखते हैं इति ।।३२।।

इदानीं स्वसिद्धान्तप्रशंसार्थमार्यामाह—

आनयति दिवसवारं स्मृत्यविरोधेन मध्यमथवा वा ।
ब्राह्मादन्यैस्तन्त्रैरार्यभटाद्यैर्न कश्चिदपि ॥ ३३॥

वा. भा.—ब्राह्मादन्यैस्तंत्रैः (मदुक्तब्रह्मसिद्धान्तभिन्नैः) आर्यभटाद्यैः आर्यभटै-स्तदनुयायिभिस्तथाऽऽर्यभटमतं स्वीकृत्य ग्रन्थकृद्भिराचार्यैश्च भिन्नैः कोऽप्याचार्यः स्मृत्यविरोधेन स्मृतिसंगतेन दिवसवारं अहर्गणं, न केवलमहर्गणमपितु मध्यमग्रहान् अपि न आनयति । इत्यनेन स्वतन्त्रस्य प्रौढ़ित्वं प्रकटयति अन्यानधिक्षिपतिश्च ग्रन्थकारः ।

वि. भा.—स्मृत्यविरोधेन (स्मृतिशास्त्रानुकूलेन) कारणेन, ब्राह्मात् (आचार्यकथितात्तन्त्रादेव) दिवसवारं (अहर्गणं) अथवा मध्यं (मध्यग्रहान्) गणक आनयति, अन्यैः (भिन्नैः) आर्यभटाद्यैः (आर्यभटादिरचितैः) तन्त्रैः कश्चिदपि दिवसवारं मध्यग्रहांश्च नाऽऽनयति स्मृतिशास्त्रप्रतिकूलादिति,

आचार्येण कथ्यते यत्स्मृतिशास्त्रानुकूलान्मत्प्रणीततन्त्रादेव गणका अहर्गण-मध्यग्रहादिसाधनं कुर्वन्ति, आर्यभटादिप्रणीततन्त्रात्स्मृतिशास्त्रप्रतिकूलात्कोऽपि दिवसवारमध्यग्रहादिसाधनं न करोतीति ।।३३।।

आचार्य अपने आनयन की प्रशंसा कहते हैं

हि. भा.—स्मृतिशास्त्रानुकूल हमारे तन्त्र ही से ज्योतिषिक लोग अहर्गण और मध्यग्रहों को लाते हैं, स्मृतिशास्त्र प्रतिकूल आर्यभटादि आचार्य प्रणीत तन्त्रों से कोई भी अहर्गण-मध्यग्रहों को नहीं लाते हैं ।।३३।।

इदानीं येऽर्धरात्रे वारप्रवृत्तिमिच्छन्ति तान्प्रत्याह

जगति तमोभूतेऽस्मिन्सृष्ट्यादौ भास्करादिभिः सृष्टैः ।
यस्माद्दिनप्रवृत्तिर्दिनवारोऽर्कोदयात्तस्मात् ॥ ३४ ॥

वा. भा.—अयमर्थः सृष्ट्यादौ यत्रैव काले भास्करोदये ग्रहाः सृष्टास्तत एव कालाद्द्वापरप्रवृत्तिः। यतः प्रथमं दिनं पश्चाद्रात्रिः। षट्प्रहराश्च वाररहिता भवन्तीत्येतदपि न शक्यते वक्तुम्। सृष्ट्यादेः पूर्वार्धरात्रे चेत्तदपि न यस्मात् "सति धर्मिणि-धर्माश्चिन्त्यन्ते" इति यावान्नार्कोदयः सृष्टस्तावदियं रात्रिरयं दिवसः इति कथमुच्यते। सृष्टेश्चप्राक् सर्वमेव तमोभूतमासीत्। अत्र भगवान्मनुः—आसीदिदं तमोभूतमप्रज्ञातमलक्षणम्। अप्रतर्क्यमनाघृष्टं प्रसुप्तमिव सर्वतः इति। अत्र लंकासमयाम्योत्तर रेखापेक्षयोच्यते। अर्धरात्रे वारप्रवृत्तिर्न भवति अन्यथा रोमके सर्वदैव वारप्रवृत्तिरर्धरात्रेऽन्यत्रास्तमयेऽन्यत्रमध्याह्नेऽन्यत्रेष्टकाले इत्यादि योज्यम्।

वि. भा.—यस्मात् कारणात्–अस्मिन् तमोभूते प्राकृतिकप्रलये सूर्यादीनामभावादन्धकारमये जगति (संसारे) ब्रह्मणा सृष्टैः (रचितैः) भास्करादिभिः (सूर्याद्यैः) सृष्ट्यादौ (सृष्ट्यादिकाले) दिनप्रवृत्तिर्जाताऽर्थात्सृष्टैर्भास्करादिभिरित्यनेन सर्वप्रथमं सूर्यस्यैव रचना कृता तत्समय एव वारप्रवृत्तिरभवत्—तस्मात् कारणादर्कोदयादेव (सूर्योदयादेव) दिनवारो ज्ञातव्य इति, आचार्योक्तमिदं तदैव समीचीनं भवितुमर्हति यदा प्राकृतिकप्रलये सूर्यस्य लयो भवेत् परं 'सूर्याचन्द्रमसौ धाता यथा पूर्वमकल्पयदिति' वेदोक्त्या सूर्यस्य नित्यत्वं सिद्धयति, सृष्ट्यादौ ब्रह्मणा किञ्चित्प्रकाशवति सूर्येऽतिप्रकाशवर्धनार्थमेकः सीसकरूपपदार्थो निवेशितो यद्द्वारा सूर्येऽतीवप्रकाशः परिलक्ष्यते, 'सूर्य आत्माजगतस्तस्थुषश्चेति' वेदोक्त्या ब्रह्मा सूर्यस्य पुत्रोऽस्तीति सिद्धयति तर्हि ब्रह्मणा सूर्यस्यरचना कथं भवेत् पुत्रद्वारा पितुः सृष्टेरभावात् सूर्यरचनासम्बन्धे सूर्येण सह ब्रह्मणः केवलमेतावानेव सम्बन्धो यश्च सृष्ट्यादौ किञ्चित्प्रकाशवति सूर्ये प्रकाशवर्धनार्थमुपरि मया प्रदर्शित इति। अन्येषां मते—सृष्टैरित्यत्र सूर्यादीनां नवीना सृष्टिरासीदिति न भ्रमितव्यम्। न चात्र पितापुत्रयोः सम्बन्धोऽपेक्ष्यते येन सृष्टौ वैषम्यमापद्येत। अत्र सृजनं पार्थिवजीवानां भवति। तथा सति सृष्ट्यादौ नित्याम्बरवासिनां तेषां सूर्यादीनां प्रथमं संदर्शनं भवेदित्येव सृष्टिपदस्य तात्पर्यम्। "भूगतानां विनाशः स्यान्नो नित्याम्बरवासिनामिति कमलाकरोक्तेः"। सूर्य आत्मा जगतस्तस्थुषश्चेति वेदे उक्तः ॥३४॥

अब दिन प्रवृत्ति को कहते हैं

हि. भा.—जिस कारण से प्राकृतिक प्रलय में सूर्यादिग्रहों के अभाव से अन्धकारमय इस संसार में ब्रह्मा ने सूर्यादि की रचना की, इससे सृष्ट्यादि काल में दिन प्रवृत्ति हुई अर्थात् ब्रह्मा ने सबसे पहले सूर्य की रचना की, उसी समय वार प्रवृत्ति हुई, इस कारण से सूर्योदय ही से दिनवार समझना चाहिये,

आचार्य का यह कथन तब ही ठीक हो सकता है जब कि प्राकृतिक प्रलय में सूर्य का लय हो, लेकिन 'सूर्याचन्द्रमसौ धाता यथापूर्वमकल्पयत्' इस वेदोक्ति से सूर्य नित्य है यह

सिद्ध होता है। सृष्ट्यादि काल में किञ्चित्प्रकाशवान् सूर्य में अतिशय प्रकाश बढ़ाने के लिये ब्रह्मा ने एक सीसा रूप पदार्थ सूर्य मण्डल में दे दिया जिसके द्वारा सूर्य-मण्डल में अतीव प्रकाश फैलने की शक्ति हुई, 'सूर्य आत्मा जगतस्तस्थुषश्च' इस वेदोक्ति से ब्रह्मा सूर्य के पुत्र सिद्ध होते हैं तब पुत्र द्वारा पिता की सृष्टि कैसे हो सकती है इससे सिद्ध होता है कि ब्रह्मा द्वारा सूर्य की सृष्टि नहीं होती है, सूर्य रचना के विषय में सूर्य के साथ ब्रह्मा का सम्बन्ध वही है जो पहले सूर्य के प्रकाश बढ़ने के लिये कहा गया है ।।३४।।

इदानीं य एते मध्यमा आनीता तेषां देशनियमार्थमार्ययाह—

लङ्कासमयाम्योत्तररेखायां भास्करोदये मध्याः ।
देशान्तरोनयुक्ता रेखायाः प्रागपरदेशेषु ॥३५॥

वा. भा.—लंकाउत्तरेण मेरुं यावत् उज्जयिन्यादिदेशानां मध्येन या याम्योत्तररेखा सा लंकासमयाम्योत्तररेखा तत्र यो भास्करोदयकालः तत्रैव ते पूर्वानीता ग्रहा मध्याः। न तु पारे शेषदेशेष्वित्यर्थः किन्तु विषुवतीति वक्तव्यम्। यस्माच्चरदलवशात् अन्यत्र-कालेऽर्कोदयरेखास्थदेशेष्वपि भिद्यते विषुवद्दिवसे, पुनः तुल्योऽर्कोदयो रेखावा-सिनामेतत्सर्वं गोले प्रदर्शयेत्। परिशेषदेशेषु विषुवद्दिवसे यथा मध्यमाः पूर्वानीताः स्वौदयिका भवन्ति। देशान्तरफलेन यथासंख्यमूनयुक्ताः संतः प्राग्परदेशेषु मध्या स्वोदये विषुवद्दिने भवन्ति। यस्माद्रेखातः पूर्वेण यो द्रष्टा स रेखास्थद्रष्टुः सकाशात्पूर्वमेव रविमुद्यन्तं पश्यति। अतो ग्रहफलं तत्र विशोध्यते। नागतदर्शना-त्पश्चात्तु दीयते वैपरीत्वादुपपन्नमेतद्। प्रवृत्तत्वाद्भूमेः एतत्सर्वं गोले प्रदर्शयेत्। वारप्रवृत्तिरपि याऽर्कोदये पूर्वमभिहिता सापि लंकासमयाम्योत्तरे रेखायां, नान्यत्र तावता च कालेनान्यदेशेषु विषुवद्दिने भवति।

वि. भा.—लङ्कासमयाम्योत्तररेखायां (लङ्कायाम्योत्तररेखायां) स्थितानां मानवानां भास्करोदये (मध्यमार्कोदयकाले) मध्याः (अहर्गणसाधिता) मध्यमाः ग्रहा भवन्ति। रेखायाः प्रागपरदेशेषु (रेखातः पूर्वपश्चिमदेशेषु) गणितागतग्रहा देशान्तरोनयुक्ताः (देशान्तरफलेनोनयुताः) तदा स्वनिरक्षोदय-कालिका भवन्तीति ।।३५।।

अत्रोपपत्तिः

एतेनाऽचार्येणो- (ब्रह्मगुप्तेन) दयान्तरं न स्वीक्रियते तदाल्वहर्गणेन (मध्यमसावनदिनसमूहेन) साधिता ग्रहा वस्तुतोऽहर्गणान्तेऽर्थान्मध्यमसावनान्ते समागच्छन्तोऽपि लङ्कायाम्योत्तररेखायां समागच्छन्ति, रेखातः पूर्वदेशे पूर्वमेव ग्रहदर्शनं भवति तेन रेखादेशीयग्रहादिष्टदेशीयग्रहस्याल्पत्वाद्देशान्तरफलेन स्पष्टभूपरि-धिना ग्रहगतिस्तदा देशान्तरयोजनैः किमित्यनुपातेन समागतदेशान्तरयोजनः-

सम्बन्धिकलात्मकफलेन हीनो रेखादेशीयग्रहोऽभीष्टदेशीयग्रहो भवेत् रेखातः पश्चिम-देशे तु पश्चाद्ग्रहदर्शनं भवत्यतस्तत्र रेखादेशीयग्रहादभीष्टदेशीयग्रहस्याधिकत्वेन देशान्तरफलेन सहितो रेखादेशीयग्रहोऽभीष्टदेशीय ग्रहो भवेदिति ।।३५।।

अब अहर्गण से साधित ग्रह कहां आते हैं सो कहते हैं

हि. भा.—लङ्कायाम्योत्तररेखा में स्थित मनुष्यों के मध्यमरव्युदय काल में अहर्गण द्वारा साधित मध्यम ग्रह होते हैं, रेखा से पूर्व और पश्चिम देशों में क्रम से गणितागतग्रह में देशान्तर फल को घटाने और जोड़ने से अपने निरक्षोदयकालिक ग्रह होते हैं ।।३५।।

उपपत्ति

अहर्गण मध्यम सावन दिनों का समूह है इसलिए अहर्गण से साधित मध्यमग्रह अहर्गणान्त बिन्दुक होते हैं, वह बिन्दु (मध्यम सावनान्त बिन्दु) क्रान्तिवृत्तस्थ मध्यमार्कोपरिगत ध्रुव प्रोतवृत्त नाडीवृत्त के सम्पात बिन्दु (स्पष्ट सावनान्त बिन्दु) से पदवश से ऊपर और नीचा होता है दोनों बिन्दुओं (मध्यमसावनान्त बिन्दु और स्पष्ट सावनान्तबिन्दु) के अन्तर को भास्कराचार्य उदयान्तर कहते हैं परन्तु ब्रह्मगुप्त उदयान्तर नहीं स्वीकार किये हैं इसलिए इनके मत से अहर्गण द्वारा सिद्ध ग्रह लङ्कायाम्योत्तर रेखा में जो रहते हैं उनके मध्यमरव्युदय काल में होते हैं, रेखा से पूर्व देश में पहले ही ग्रह दर्शन होता है इसलिए रेखादेशीय ग्रह से अभीष्ट देशीय ग्रह के अल्पत्व के कारण देशान्तर फल को रेखादेशीय ग्रह में हीन करने से अभीष्ट देशीय ग्रह होते हैं। रेखा से पश्चिम देश में पीछे ग्रह दर्शन होता है इसलिए वहां रेखा देशीय ग्रह से अभीष्ट देशीय ग्रह के अधिकत्व के कारण रेखा देशीय ग्रह में देशान्तर फल को जोड़ने से अभीष्ट ग्रह होते हैं, इति ।।३५।।

इदानीं तत्प्रतिपादनार्थमार्यामाह—

दिनवारादिः पश्चादुज्जयिनी दक्षिणोत्तरायाः प्राक् ।
देशान्तरघटिकाभिः पश्चात्प्राग् भवति रव्युदयात् ।।३६।।

वा. भा.—दिनवारादिर्वारप्रवृत्तिरित्यर्थः, सा पश्चाद् भवति, स्वरव्युदयात् । क्व उज्जयिनी दक्षिणोत्तरायाः प्राक् लंकासमयाम्योत्तररेखातः पूर्वदेशेष्वित्यर्थः । कियता कालेन देशान्तरघटिकाभिरिति, यतः पूर्वमेव रेखार्कोदयादर्कोदयस्तेषु देशेषु, न च तत्र काले वारप्रवृत्तिरद्यापि रेखार्कोदयकाले यस्माद् भविष्यतीति दिनवारादिः। स च देशान्तरघटिकाभिः व्यवहितं इत्यत उपपन्नं भुवो वृत्तत्वात् । पश्चात् प्राग्भवति इति, उज्जयिनी दक्षिणोत्तररेखातः पश्चात्तु देशेषु प्राग्भवति, स्वरव्युदयात्, पूर्वदिनवारप्रवृत्तिः पश्चाद्रव्युदयस्तेषु यस्माद्रेखार्कोदयादतः प्राग्वारादिः तेषु देशान्तर-

घटिकाभिरेव विषुवद्दिवस एतत्सर्वं गोले प्रदर्शयेत् । चरदलं चान्यत्रकाले स्वधिया योज्यम् , यथास्वभावम् । तत्रायं प्रयोगः स्वदेशान्तरघटिकाः पञ्चदशभ्यो विशोध्यावशेषा या घटिकास्ताभिः मध्याह्नात् प्राग्वारादिः स्वदेशे नित्यं वक्तव्याः । रेखातः प्राक्पश्चात्त्वर्धरात्रादूर्ध्वं तावतीभिरेव घटिकाभिर्दिनवारादिः प्रथमं-पश्चाद्वा भवति, तन्न ज्ञायते ।

वि. भा.—उज्जयिनीदक्षिणोत्तरायाः (रेखातः) प्राग्देशे (पूर्वदेशे) रव्युदयात् (सूर्योदयात्) देशान्तरघटिकाभिः पश्चात् दिनवारादिः (वारप्रवृत्तिः) भवति, रेखातः पश्चात् (पश्चिमदेशे) रव्युदयाद्देशान्तरघटिकाभिः प्राक् (पूर्वं) दिनवारादिर्भवतीति ।।३६।।

अत्रोपपत्तिः

यतो लङ्कोदये वारादिरितिनियमेन रेखातः पूर्वदेशे सूर्योदयाद्देशान्तरघटीभिः पश्चात् , पश्चिमदेशे तु ताभिरेव घटीभिः पूर्वं वारप्रवृत्तिर्भवितुमर्हति, भास्कराचार्येणापि सिद्धान्तशिरोमणौ "अर्कोदयादूर्ध्वमधश्च ताभिः प्राच्यां प्रतीच्यां दिनप्रवृत्तिरित्यनेन" ब्रह्मगुप्तोक्तमेव कथ्यते, कदाप्रभृति वारप्रवृत्तिर्भवत्येतद्विषये बहूनामाचार्याणां बहूनि भिन्नानि मतानि सन्ति यथा आर्यभटसिंहाचार्यादयो रवेरुदयात् (अर्धोदितरविबिम्बात्) दिनारम्भकालं कथयन्ति, अन्ये दिनार्धात्कथयन्ति, लाटदेवादयो रवेरर्धास्तमयकालमारभ्य तं कथयन्ति, यवननृपतिर्निशि दशभिर्मुहूर्तैस्तं कथयति, लाटाचार्यः पुनः स्वसिद्धान्तेऽर्धरात्रौ तं कथयतीति । पञ्चसिद्धान्तिकायां वराहमिहिरेण तथैवोक्तम्—

दिनवारप्रवृत्तिर्न समा सर्वत्र कारणे कथिता ।
नेहापि भवति यस्माद्विप्रवदन्तेऽत्र दैवज्ञाः ।।
द्युगणाद्दिनवाराप्तिर्द्युगणोऽपि च देशकालसम्बन्धः ।
लाटाचार्येणोक्तो यवनपुरे चास्तगे सूर्ये ।।
रव्युदये लङ्कायां सिंहाचार्येण दिनगणोऽभिहितः ।।
यवना निशीह दशभिर्गतैर्मुहूर्तैश्च तद् गुरुणा ।
लङ्काऽर्धरात्रसमये दिनप्रवृत्तिं जगाद चार्यभटः ।
भूयः स एव चार्कोदयात्प्रभृत्याह लङ्कायाम् ।।

सिद्धान्तशेखरे श्रीपतिनाऽऽर्यभटादिमतखण्डनपुरःसरं ब्रह्मगुप्तमतानुरूपमेव स्वमतं कथ्यते यथा—

सृष्टेर्मुखे ध्वान्तमये हि विश्वे ग्रहेषु सृष्टेष्विनपूर्वकेषु ।
दिनप्रवृत्तिस्तदधीश्वरस्य वारस्य तस्मादुदयात्प्रवृत्तिः ।।

सिद्धान्तशेखरे एवैतस्य व्याख्या तट्टीकाकर्त्रा मक्किभट्टेनैवं क्रियते—सृष्टेर्मुखे पूर्वं विश्वे ध्वान्तमये तमोमये भूते सति पश्चादिनपूर्वकेष्वर्कपूर्वकेषु ग्रहेषु सत्सु दिनप्रवृत्तिर्यस्मात्तस्मात् तदधीश्वरो यो ग्रहः अर्कादिस्तत्सम्बन्धिनो वारस्योदयाद-र्कोदयमारभ्य प्रवृत्तिरित्यर्थः। विश्वशब्दस्य नामत्वसंज्ञात्वात्तेन विश्वस्मिन्निति प्रयोगो न भवति, एतदुक्तं भवति सृष्टेः पूर्वं विश्वमन्धकमभूत्।

यथाह भगवान् मनुः—

आसीदिदं तमोभूतमप्रज्ञातमलक्षणम्।
अप्रतर्क्यमनाधृष्यं प्रसुप्तमिव सर्वतः॥ इति

नह्येवंविधे काले वारप्रवृत्तिविचारः सम्भवति वाराधीश्वराणां ग्रहाणाम-भावात् तस्माद्रात्रौ वारप्रवृत्तिपक्षो न सम्भवति नापि मध्याह्नास्तमयकालावारभ्य वारप्रवृत्तिः। तथा सति तावन्तं कालं वारेण दिनेन भवितव्यम्। तथा च लोक-व्यवहारलोपप्रसङ्गः। तस्मादर्कोदयपक्ष एव श्रेयानिति। अस्मिन्नपि पक्षे देश-भेदाद्वारप्रवृत्तिभेदो भवति यथा—

वारप्रवृत्तिं मुनयो वदन्ति सूर्योदयाद्रावणराजधान्याम्।
ऊर्ध्वं तथाऽधोऽप्यपरत्र तस्याश्चरार्धदेशान्तरनाडिकाभिः॥

एतदेव स्पष्टयति—

लङ्कोदग्याम्यसूत्रात्प्रथममपरतः पूर्वदेशे च पश्चा—
दध्वोत्थाभिर्घटीभिः सवितुरुदयतो वासरेशप्रवृत्तिः॥
ज्ञेया सूर्योदयात् प्राक् चरशकलभवैश्चासुभिर्याम्यगोले।
पश्चात्तैः सौम्यगोले युतिवियुतिवशाच्चोभयोः स्पष्टकालः इति॥३६॥

अब वारादि को कहते हैं

हि. भा.—उज्जयिनी की दक्षिणोत्तर रेखा (रेखा) से पूर्वदेश में सूर्योदय के बाद देशान्तर घटी करके दिनवारादि वारप्रवृत्ति होती है, रेखा से पश्चिम देश में देशान्तर घटी करके सूर्योदय से पहले दिनवारादि होती है॥३६॥

उपपत्तिः

लङ्कोदय काल में वारादि होती है. इस परिभाषा से रेखा से पूर्वदेश में सूर्योदय के बाद देशान्तर घटी करके वारप्रवृत्ति होती है, रेखा से पश्चिम देश में सूर्योदय से पहले उतने (देशान्तर घटी) ही काल पश्चात् प्रवृत्ति होती है। सिद्धान्त-शिरोमणि में भास्कराचार्य भी "अर्कोदयादूर्ध्वमधश्च ताभिः प्राच्यां प्रतीच्यां दिनप-

प्रवृत्तिः" इससे इसी ब्रह्मगुप्तोक्त बात को कहते हैं। वारप्रवृत्ति कब से होती है, इस विषय में बहुत आचार्यों के भिन्न-भिन्न बहुत मत हैं। जैसे आर्यभट, सिंहाचार्य आदि आचार्य अर्धोदित रवि बिम्ब से दिनारम्भकाल को कहते हैं। अन्य आचार्य दिनार्ध से दिनारम्भ कहते हैं। लाटदेव आदि आचार्य रवि के अर्धास्तकाल से उसको कहते हैं। यवन राजा रात्रि में दश मुहूर्त करके उसको कहते हैं, लाटाचार्य अपने सिद्धान्त ग्रन्थ में अर्धरात्रि से उसको कहते हैं। पञ्चसिद्धान्तिका में वराहमिहिराचार्य संस्कृतोपपत्ति में लिखित 'दिनवारप्रवृत्तिर्न समा सर्वत्र कारणे कथिता' इत्यादि पद्यों से इन्हीं विषयों को कहते हैं। सिद्धान्तशेखर में श्रीपति ने उपर्युक्त आर्यभटादि आचार्यों के मत का खण्डन किया है और ब्रह्मगुप्त कथित बात को स्वीकार किया है। जैसे—

सृष्टेर्मुखे ध्वान्तमये हि विश्वे ग्रहेषु सृष्टेष्विनपूर्वकेषु।
दिनप्रवृत्तिस्तदधीश्वरस्य वारस्य तस्मादुदयात्प्रवृत्तिः॥

सृष्ट्यादि से पहले विश्व अन्धकारमय था जो संस्कृतोपपत्ति में लिखित भगवान् मनु 'आसीदिदं तमोभूतमप्रज्ञातमलक्षणम्' इत्यादि के इस वचन से विदित होता है, ऐसे समय में वारप्रवृत्ति के विचार सम्भव नहीं हैं क्योंकि उस समय में वारेश्वरग्रहों का अभाव रहता है। इसी कारण से रात्रि में वारप्रवृत्ति कहने वालों के मत ठीक नहीं कहे जा सकते हैं। मध्याह्न काल और अस्तमय काल से आरम्भ कर वारप्रवृत्ति कहना भी ठीक नहीं है, क्योंकि इस बात को स्वीकार करने से उतने काल तक दिन मानना पड़ेगा जो कि असङ्गत है। इसलिए रव्युदय काल से वारप्रवृत्ति मानने वाले आचार्य का मत ही ठीक है। इस मत में भी देश भेद से वारप्रवृत्ति में भेद होता है, जैसे—

संस्कृतोपपत्ति में लिखित 'वारप्रवृत्तिं मुनयो वदन्ति सूर्योदयाद्रावणराजधान्याम्' इत्यादि पद्य से विदित होता है, इसी को संस्कृतोपपत्ति में लिखित 'लङ्कोदग्याम्यसूत्रात्प्रथममपरतः पूर्वदेशे च पश्चात्'— इत्यादि पद्य द्वारा स्पष्ट किया है इति ॥३६॥

इदानीं तदर्थं देशान्तरकर्मणा त्रयेण प्रदर्शयति

भूपरिधिः खखखशरारेखा स्वाक्षान्तरांशसङ्गुणिताः।
भगणांशहृताः फलकृतिहीना देशान्तरस्य कृतिः ॥३७॥
शेषपदगुणाभुक्तिर्भूपरिधिहृता कलादिलब्धमृणम्।
उज्जयिनीयाम्योत्तररेखायाः प्राग् धनं पश्चात् ॥३८॥
मध्यग्रहे स्फुटे वा भूपरिधिहृतात् पदात् गुणात् षष्ट्या।
लब्धं घटिका अथवा कर्मतिथावृणधनं ग्रहवत् ॥३९॥

वा. भा.—भूपरिधिः भूगोलस्य परिणाहः कियानित्यत आह खखखशरा इति पञ्चसहस्राणि योजनानामित्यर्थः। अत्र च देशान्तरकक्ष्योन्नत्यादयः प्रमाणं

भुवो महत्वनिराकरणगोलाध्याये च मयाऽयमर्थोऽतिविस्तरेण व्यावर्णितः पूर्वमेव। देशान्तरकर्मैव साम्प्रतमुच्यते। भूपरिधेर्ये खखखशराः ते रेखाक्षस्वाक्षान्तरांशसंगुणिता भगणांशहृताश्च सन्तः फलत्वं व्रजन्ति। रेखाख्योभीष्ट एव रेखास्थस्य देशसंबंधी अक्षो गृह्यते यस्य देशस्य स्वदेशेन सहान्तरयोजनानि ज्ञायन्ते। स्वाक्षस्तु पुनः ज्ञायत एव तयोरन्तरे ये अंशास्तैः खखखशरान् संगुण्य षष्टिशतत्रयेण विभजेदत्रायमर्थः स्वदेशेन सह तुल्याख्यो यो रेखायां स्थितो देशः तस्याभीष्टाक्षकस्य रेखास्थदेशस्य चान्तरं कियति योजनानि। इति तदर्थं त्रैराशिकं यदि षष्टिशतत्रयभागकल्पितस्य भूगोलस्य पंचयोजनसहस्राणि तदस्येष्टभूगोलभागस्य रेखास्थस्वाक्षांतरांशमितस्य कियंति योजनानि भवन्तीति। तदर्थमक्षान्तरांशैः खखखशरान्संगुण्य भांशैश्च विभज्य फलं दक्षिणोत्तरयोजनात्मिकाभुजा रेखास्थयोरन्तरम्। स्वदेशस्य ज्ञाताध्वरेखास्थदेशस्य चान्तरं कर्णः। कर्णकृतेर्भुजाकृतिं विशोध्य शेषपदं कोटिः योजनात्मिका पूर्वापरा। स्वदेशतुल्याक्षरेखास्थदेशयोरन्तरम् ॥३७॥

तेन शेषपदेनेष्टग्रहस्य गुणा भुक्तिः, भूपरिधिहृता फलं भवति, यस्मादुक्तं फलकृतिहीना देशान्तरस्य कृतिः। शेषपदगुणा भुक्तिः भूपरिधिहृता कलादिलब्धमिति। अत्र तावत् स्वदेशे भूपरिधिरेव देशान्तरकर्मायोग्यः साध्यते ग्रहदेशान्तरफलानयनम् त्रैराशिकार्थं तद्यथा यत्र व्यासार्धतुल्यो विषुवदवलंबकः तत्र पञ्चसहस्रः परिधिः यत्रेष्टौ विषुवदवलम्बकः, तत्रः कः परिधिरिति स्वदेशावलंबज्यया खखखशरान्संगुण्य व्यासार्धेन विभजेत्। लब्धं स्वदेशप्रदेशे देशान्तरपरिधिर्यस्मात्स्वदेशाक्षांशान्नवतेः प्रोह्य शेषभागतुल्येन सूत्रेण मेरुं मध्यं कृत्वा यद्वृत्तमुत्पद्यते स देशान्तरकर्मपरिधिः। तया गत्या निरक्षपूर्वापरगतेत्यर्थः। नायमर्थः आचार्येणोक्त इति चेत्। उक्त एव स्वाक्षतुल्यरेखास्थदेशस्वदेशयोरन्तरे देशान्तराभ्युपगमात्। तत्र स्फुटभूपरिधिना यदभीष्टग्रहभुक्तिर्भवति, तद्देशान्तरयोजनैः किमिति सर्वेषां फलानयनमेव तच्च कलादिकं भवति, तद्दणमुज्जयिनीयाम्योत्तररेखाया एव, अत्र वासना पूर्वमेव व्याख्याता ॥३८॥

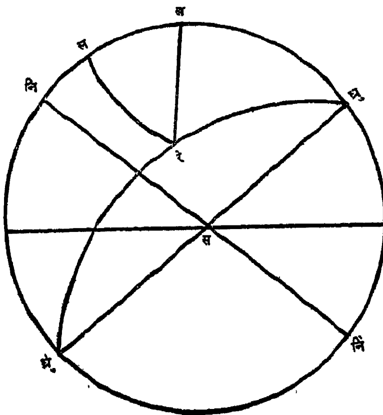
मध्यग्रहं स्फुटे चेति, यदि मध्यभुक्त्या तत् स्फुटग्रहे देशान्तरफलमित्यर्थः। एवं कृते स्वदेशे मध्यमो ग्रह उन्मण्डले भवति। अथवान्यदेशान्तरकर्मप्रकारः, भूपरिधिहृतात् यद्गुणात्षष्ट्या लब्धं घटिकाद्यथवा कर्मतिथिष्वृणं धनं ग्रहवत्। अत्र कालेन सह त्रैराशिकं यदि स्फुटपरिधियोजनैः षष्टिघटिका भवन्ति तदेष्टदेशांतरयोजनैः कियत्य इति लब्धाः घटिकाः कर्मयोग्यासु तिथिषु ग्रहवत्कार्याः यस्मात्ता एवतिथयः सावनी भविष्यन्त्यन्यथा सावनदिवसेषु तत्फलं भवति घटिकादिकम्। तथा च क्रियमाणेऽवमशेषान्तरं भवत्यत उक्तम्, कर्मतिथिष्विति। ततस्ताभिर्देशान्तरसंस्कृताभिः तिथिभिरहर्गणादिकं कृत्वा यद् ग्रहानयनं तद्देशान्तरकृतमेवागच्छति एतत् सर्वं देशान्तरकर्मयथास्थिते गोले प्रदर्शयेत्। यदत्र परिधिगतैर्भुजकोटिकर्णैः

कल्पना कृता सातिशोभनास्माकं न प्रतिभाति भुवो निम्नोन्नतत्वात् । इष्टरेखास्थ-देशान्तरयोजनानां सम्यग् परिज्ञानाच्च महापर्वताद्यन्तरितत्वाच्च, पथो वक्रत्वं यतः संभवति, लोकप्रसिद्धेरनैकांतिकत्वाच्च तस्माद्देशान्तरयोजनैर्ज्ञातैरेव कर्म कर्त्तव्यम् । देशान्तररेखा च योजने लिखे प्रथते । उज्जयिनीरोहीतककुरुयमुनाहिमनिवासिमरूणां देशान्तरं न कार्यम् । तल्लेखामध्यस्थत्वात् । अत्राचार्येणापि दृक्प्रग्रहणयोरन्तरा-द्देशान्तरयोजनानयनमभिहितम् । ग्रहणोत्तरे यत्तदपि अस्माकं न प्रतिभाति । यतस्तिथ्यन्तचलनं बहुप्रकारमिति । एवं तावत्कल्पगताहर्गणेन ग्रहानयन-मभिहितम् ॥३९॥

वि. भा.—भूपरिधिः खखखशराः ५००० रेखादेशस्वदेशयोरक्षांशा-न्तरेण गुणिता भगणांशै ३६० र्भक्ता सन्तो यत्फलं (लब्धं) तद्वर्गहीना देशा-न्तरस्य (योजनात्मकस्य रेखास्वदेशयोरन्तरस्य) कृतिः (वर्गः) शेषस्य पदेन (मूलेन) गुणा भुक्तिः (ग्रहगतिः) भूपरिधिहृता (स्पष्टभूपरिधिभक्ता) कलादिलब्धं यत्तत् उज्जयिनीयाम्योत्तररेखायाः पूर्वदेशे मध्यग्रहे स्फुटग्रहे वा ऋणं कार्यं, उज्जयिनीयाम्योत्तररेखायाः पश्चात् (पश्चिमदेशे) मध्यमग्रहे स्फुटग्रहे वा धनं कार्यम् । पदात् षष्ट्या गुणात् भूपरिधिहृतात् (स्पष्टभूपरिधि-भक्तात्) लब्धं घटिकात्मकं फलं ग्रहवत्तिथावृणं धनं कार्यमिति ॥३७-३८-३९॥

अत्रोपपत्तिः

यदि व्यासमानम्=१५८१ तदा व्यासवर्गाद्दशगुणात्पदं भूपरिधिर्भ-वेदिति सूर्यसिद्धान्तोक्त्या भूपरिधिमान ५००० मागच्छति ब्रह्मगुप्तमते ।



ध्रु-ख-ल-नि ध्रु'=स्वयाम्योत्तरवृत्तम् । ध्रु, ध्रु' ध्रुवौ, ख=स्वखस्वस्तिकम्, नि=स्वनिरक्षखस्वस्तिकम् । ध्रु-रे ध्रु'=लङ्का-याम्योत्तरवृत्ते रे कोऽपि रेखादेशः । नि-स-नि'=नाडीवृत्तम् । रे-ल=नाडीवृत्तसमा-नान्तरं लघुवृत्तम् । ल-नि=तद्रेखादेशा-क्षांश सम्बन्धीनि योजनानि । यदि भग-णांशैर्भूपरिधियोजनानि लभ्यन्ते तदा स्वाक्षांशैः किमित्यनुपातेन स्वदेशाक्षांश-योजनानि $=\frac{\text{भूप} \times \text{अक्षांश}}{३६०}$, एवमेव यदि-भगणांशैर्भूपरिधियोजनानि लभ्यन्ते तदा रेखादेशाक्षांशैः किमित्यनुपातेन

रेखादेशाक्षांशयोजनानि $= \frac{\text{भूप} \times \text{रेखाक्षांश}}{३६०}$, रे-ख = रेखास्वदेशयोरन्तरयोजनानि ।

अत्राचार्येण रे-ल-ख त्रिभुजं सरलजात्यं स्वीकृतम् । तत्र रे-ल पूर्वापरान्तरं देशान्तर-योजनतुल्यम् । एतदानयनं क्रियते

$$\sqrt{\text{रेख}^2 - \text{लख}^2} = \sqrt{\text{रेख}^2 - \left\{ \frac{\text{भूप}}{३६०} (\text{स्वाक्षांश} - \text{रेखाक्षांश}) \right\}^2} = \text{रे-ल},$$

ततोऽनुपातो यदि स्फुटपरिधिना ग्रहगतिर्लभ्यते तदा देशान्तरयोजनैः किमित्यनुपातेन यत्कलात्मकं फलमागच्छति तद्रेखातः पूर्वदेशे पश्चिमदेशे च मध्यग्रहे स्फुटग्रहे वा क्रमशो हीनं धनं कार्यं तदा स्वदेशीयग्रहो भवति । एवं यदि स्पष्टभूपरियोजनैः षष्टिघटिका लभ्यन्ते तदा देशान्तरयोजनैः किमित्यनुपातेन यद् घट्यात्मकं फलमागच्छति तत्पूर्वपश्चिमदेशवशेन ग्रहवत्तिथावृणधनं कार्यमिति,

ब्रह्मगुप्तेनात्र स्फुटभूपरिधेश्चर्चा न क्रियते, मध्यमभूपरिधिसम्बन्धेनैव देशान्तरघट्यानयनं कृतमतो न समीचीनमिति विवेचनीयं विज्ञैरिति ॥३७-३८-३९॥

अब देशान्तर कहते हैं

हि. भा.—भूपरिधि ५००० पांच हजार है, इसको स्वदेश और रेखादेश के अक्षांशान्तर से गुणा कर भगणांश (३६०) से भाग देने से जो फल हो उसके वर्ग को देशान्तर (रेखादेश और स्वदेश के योजनात्मक अन्तर) वर्ग में घटाकर जो शेष रहे उसके मूल से ग्रहगति को गुणकर भूपरिधि (स्पष्टभूपरिधि) से भाग देने से जो कलात्मक फल हो उसको उज्जयिनीयाम्योत्तररेखा से पूर्वदेश में मध्यमग्रह में या स्फुटग्रह में ऋण करना, पश्चिमदेश में धन करना चाहिये, पद याने मूल (देशान्तर योजन) को साठ से गुणा कर भूपरिधि (स्पष्टभूपरिधि) से भाग देने से जो घट्यात्मक फल हो उसको पूर्व और पश्चिम देश में ग्रहवत् तिथि में (तिथिभुक्त घटी) संस्कार करना चाहिये ॥३७-३८-३९॥

उपपत्ति

यदि व्यासमान=१५८१ मानते हैं तब 'व्यासवर्गाद्दशगुणात्पदं भूपरिधिर्भवेत्' इस सूर्यसिद्धान्तोक्त प्रकार से भूपरिधिमान=५००० आता है, यही ब्रह्मगुप्तमत में भूपरिधिमान है । संस्कृतोपपत्ति में जो क्षेत्र लिखा हुआ है, वही यहां देखना चाहिये ।

ध्रु-ख-ल-ध्रु॑=स्वयाम्योत्तरवृत्त है, ध्रु, ध्रु॑ दोनों ध्रुव हैं । ख=स्वखस्वस्तिक है, नि=स्वनिरक्ष खस्वस्तिक है, ध्रु-रे-ध्रु॑ लंकायाम्योत्तरवृत्त में रे कोई रेखादेश है, नि-स-नि=नाडीवृत्त है, रे-ल=नाडीवृत्त के समानान्तर लघुवृत्त है, ल-नि=रेखादेशाक्षांश-

सम्बन्धियोजन है, अब अनुपात करते हैं यदि भगणांश में भूपरिधियोजन पाते हैं तो स्वाक्षांश में क्या इस अनुपात से स्वदेशाक्षांशयोजनमान $= \frac{\text{भूप} \times \text{अक्षांश}}{३६०}$, इसी तरह भगणांश में यदि भूपरियोजन पाते हैं तो रेखादेशाक्षांश में क्या इस अनुपात से रेखादेशाक्षांशयोजन $= \frac{\text{भूप} \times \text{रेखाक्षांश}}{३६०}$, रे-ख=रेखादेश और स्वदेश के अन्तर योजन

हां आचार्य ने रे-ल-ख त्रिभुज को सरलजात्य मान लिया है, रेल पूर्वापरान्तर=देशान्तर-योजन इसका आनयन करते हैं

$$\sqrt{\text{रेख}^2 - \text{लख}^2} = \sqrt{\text{रेख}^2 - \left\{ \frac{\text{भूप}}{३६०} (\text{स्वाक्षांश} - \text{रेखाक्षांश}) \right\}^2} = \text{रेल}, \text{ अब}$$

अनुपात करते हैं, यदि स्फुटपरिधि में ग्रहगति कला पाते हैं तो देशान्तरयोजन में क्या इस अनुपात से जो कलात्मक फल आता है उसको रेखा से पूर्वदेश में और पश्चिमदेश में मध्यमग्रह में या स्फुटग्रह में क्रम से ऋण और धन करने से स्वदेशीय ग्रह होते हैं। इसी तरह यदि स्फुट भूपरियोजन में साठ घटी पाते हैं तो देशान्तरयोजन में क्या इस अनुपात से जो घट्यात्मक फल आता है उसको पूर्व और पश्चिम देशवश से ग्रह की तरह तिथि (तिथि भुक्तघटी) में ऋण और धन करना चाहिये, यहां आचार्य (ब्रह्मगुप्त) स्फुट-भूपरिधि की चर्चा नहीं करते हैं, मध्यमभूपरिधि के सम्बन्ध ही से देशान्तर घट्यादि साधन करते हैं इसलिये यह ठीक नहीं है, इस विषय को विज्ञ लोग सोचें इति ।। ३७-३८-३९ ।।

इदानीं वर्षादौ दिनाद्यवमदिनादिसाधनमाह

कल्पगताब्दा गुणिता रूपाष्टजिनैर्नवाग्निसप्तनगैः ।
खखरसनवभिर्भक्ता दिनावमान्यंशकाः शेषाः ।। ४० ।।

वा. भा.—अभीष्टे रविमण्डलान्ते ये कल्पगताब्दाः तेऽत्र गृह्यन्ते कल्पगताब्दाः गुणिताः कैरित्याह। रूपाष्टजिनैः २४८१ अन्यत्र नवाग्निसप्तनगैः ७७३९ तत उभयतोऽपि खखरसनवभिर्भक्ताः ९६०० फलानि यथासंख्यं दिनान्यवमानि चांशकाः शेषा द्वयोरपि स्थानयोः एतदुक्तं भवति। कल्पगताब्दा रूपाष्टजिनैः संगुण्य खखरसनवभिर्विभजेत्फलं दिनानि भवन्ति। तत्र यद्विकलं तद् दिनांशशब्देनोच्यते, तत्र दिनानि दिनांशश्च स्वच्छेदेन सहैकान्ते स्थापयेदत्रेयं वासना यदि कल्परविवर्षैः कल्पसौरसावनान्तरदिनानि लभ्यन्ते खचतुष्टय-शरकृतरसेन्दुनगद्वियमसंख्यानि, २२७१६४५०००० तदेकेन रविवर्षेण किमिति-लब्धं ५ विकलम् खचतुष्टयशरवेदरसरुद्रचन्द्रसंख्यं छेदश्च सप्तशून्यानि रदवेदा $\frac{११६४५००००}{४३२००००००००}$ अनयोश्छेद्यछेदकराश्योरपवर्त्तनं कृत्वा खचतुष्टयभूतवेदै जातौ राशी रूपाष्टजिना उपरि, खखरसनवाधः $\frac{२४८१}{९६००}$ एतावद्विकलं पंचानां दिना-

नामुपर्येकस्मिन् रविवर्षेऽतस्त्रैराशिकमाचार्येण प्रकल्पितम् । तद्यथा यद्येकस्य रविवर्षस्य दिनांशविकलमेतत्कल्पादेरारभ्य ये गताब्दाः तेषां किमिति

कल्पगताब्दा रूपाष्टजिनैः संगुण्यते रूपेण खखरसनवसंख्येन गुणकारच्छेदेन च विभज्यते । फलं दिनानि सविकलानि भवंति । ततः पुनरपि कल्पगताब्दान्नवाग्निसप्तनगैः संगुण्य खखरसनवभिर्विभजेत्, फलमवमानि भवन्ति यद्विकलमवमांशशब्देनोच्यते ऽन्यत्राथवा अवमाशांश्च स्वच्छेदेन सहैकांते स्थापयेत् । तत्रोपपत्तिर्यदि कल्परविवर्षैः कल्पोनरात्रा लभ्यन्ते तदेकेन वर्षेण किमिति फलं पंचावमानि लभ्यन्तेऽवमानि ५ शेषं विकलं खचतुष्टयशरबाणयमवसुकृताग्निसंख्यकल्परविवर्षच्छेद्यं तच्चेदं $\frac{३४८२५५००००}{४३२०००००००}$ अनयो राश्योरपवर्त्तनं कृत्वा खचतुष्टयभूतवेदैर्जातौ राशी नवाग्निसप्तनगा उपरि खखरसनवाधः $\frac{७७३९}{९६००}$ एतावता विकलेन पञ्चोनरात्राण्यधिका भवन्ति । रव्यब्देऽतस्त्रैराशिककल्पना कृताचार्येण । यद्येकस्य रविवर्षस्य पञ्चभ्योऽवमेभ्यः एतावदधिकमवशेषं तदा कल्पगतानां किमित्यतः कल्पगताब्दा नवाग्निसप्तनग संगुण्यन्ते रूपेण खखरसनवभिः विभज्यन्ते फलमवमानि शेषमवमानि दिनानि शेषं कल्पवर्षैः सावनदिनैः रविवर्षोत्थसावनदिनानयने प्रथमं त्रैराशिकं यदि कल्पसावनवर्षैर्दिनैः कल्परविदिनानि वर्षाणि लभ्यन्ते तदेकेन रविवर्षेण किमिति न्यासः ४३२००००००० । २५७७९१६४५०००० । १११६६४५००००००० फलं ३६५ । १५७७९१६४५०००० । २५०८२५५०००० । ४३२००००००० एभिः कल्पसावनदिनैः सहावमानयनार्थं द्वितीयत्रैराशिकम् । कल्पभूदिवसैः कल्पावमानि लभ्यन्ते तदेभिः रविवर्षोत्थसावनदिवसैः किमिति न्यासः सवर्णिता रविवर्षोत्थसावनाः अत्रोनरात्राणां भूदिवसतुल्यौ गुणकारभागहारौ तयोर्नाशे कृते कल्पोनरात्राणामेकको गुणकारः कल्परविवर्षाणि भागहारो फलं तावन्त्येवावमानि लब्धानि ७ $\frac{७३५९}{९६००}$ ॥४०॥

वि. भा.—कल्पगताब्दा (कल्पादितो गतवर्षाणि) एकत्र रूपाष्टजिन २४८१ रन्यत्र नवाग्निसप्तनगैः ७७३९ गुणिताः खखरसनवभिः ९६०० भक्तास्तदा फलं प्रथमस्थाने दिनानि (सावनदिनानि) द्वितीयस्थानेऽवमानि (अवमदिनानि) स्युः, शेषाः क्रमेणांशकाः (दिनांशका अवमांशकाश्च) बोध्या इति ॥४०॥

अत्रोपपत्तिः

गताब्दा विभक्ताः समुद्रैः खसूर्यैः खखाङ्गाङ्ककैर्वा फलैक्यं दिनाद्यमिति भास्करोक्तसूत्रेण $\frac{गव}{४}+\frac{गव}{१२०}+\frac{गव}{९६००}=\frac{२४०० \text{ गव}+८० \text{ गव}+\text{गव}}{९६०}$

$=\frac{२४८१ \text{ गव}}{९६००}=$दिनाद्यम् ।

तथा स्वषष्ट्यंश हीनाब्दखाङ्गेन्दुभागः स्वपञ्चांशहीनाब्दयुग्बाक्षयाहा इति सिद्धान्तशिरोमणिस्थभास्करोक्तपद्येन $\frac{गव-\frac{गव}{५}+गव-\frac{गव}{६०}}{१६०}$=क्षयाहाद्यम्।

अत्र सवर्णेन $\frac{४ गव}{५}+\frac{६० गव-गव}{९६००}=\frac{४ गव}{५}+\frac{५९ गव}{९६००}=\frac{७६८० गव+५९ गव}{९६००}$

$=\frac{७७३९ गव}{९६००}$=क्षयाहादिः एतेनोपपन्नमाचार्योक्तमिति ॥४०॥

अब वर्षादि में दिनादि और अवमदिनादि साधन को कहते हैं

हि. भा.—कल्पादि से जो गतवर्ष हैं उनको एक स्थान में २४८१ इनसे और द्वितीय स्थान में ७७३९ इनसे गुणाकर दोनों स्थानों में ९६०० इनसे भाग देने से फल (लब्धि) प्रथम स्थान में दिन (सावनदिन) और द्वितीय स्थान में अवमदिन होते हैं, शेष क्रम से दिनांश और अवमांश समझने चाहियें इति ॥४०॥

उपपत्ति

'गताब्दा विभक्ताः समुद्रैः खसूर्यैः' इत्यादि सिद्धान्तशिरोमणिस्थभास्करोक्त सूत्र से

$\frac{गव}{४}+\frac{गव}{१२०}+\frac{गव}{९६००}=\frac{२४०० गव+८० गव+गव}{९६००}=\frac{२४८१ गव}{९६००}$=दिनादि।

तथा 'स्वषष्ट्यंशहीनाब्दखाङ्गेन्दुभागः स्वपञ्चांशहीनाब्दयुग्वाक्षयाहा' इस भास्करोक्त सूत्र से $\frac{गव-\frac{गव}{५}+गव-\frac{गव}{६०}}{१६०}=\frac{४ गव}{५}+\frac{५९ गव}{६०\times१६०}=\frac{४ गव}{५}$

$+\frac{५९ गव}{९६००}=\frac{७६८० गव+५९ गव}{९६००}=\frac{७७३९ गव}{९६००}$=क्षयाहादिः, इससे आचार्योक्त उपपन्न हुआ ॥४०॥

इदानीं वर्षादावधिमाससाधनमाह

तद्दिग्गुणाब्दयोगा अधिमासास्त्रिशता हृता लब्धम् ।
शेषास्तिथयः शुद्धिर्दिनानि विकलं दिनांशेभ्यः ॥४१॥

वा. भा.—तद्दिग्गुणाब्दयोगादधिमासास्त्रिशता गुणा लब्धमिति तदित्यनेनांतरागतानां दिवसानामवमानां च परामर्शः। दिग्गुणाब्दाश्च कल्पगताब्दा दशगुणिता उच्यन्ते। तेनायमर्थः तेषां दिनावमानां दशगुणितकल्पगताब्दानां च यो योगस्तस्मादधिमासा भवन्ति। त्रिशता हृता लब्धं यत्। इयमत्र युक्तिः

यानि पञ्चदिनानि सौरसावनयोरन्तरोत्पन्नानि प्रागार्यायां प्रदर्शितानि यानि च पञ्चावमानि सावनचान्द्रयोरंतरोत्पन्नानि रव्यब्दे तानि मिलितानि दश भवन्ति अतस्त्रैराशिकम्। यद्येकेन रविवर्षेण दशदिनानि, तत् कल्पगताब्दानां कियंतीत्यतो दशभिः कल्पगताब्दा गुण्यन्ते। एकेन च विभज्यन्ते, ततः पञ्चकराश्याप्तं विकल्पद्वयं। ततोऽपि प्रागार्योक्तविधिना यानि दिनावमानि चाप्तानि तेषु गुणिताब्देषु संयोज्य कल्पादेरारभ्य गताधिमासकदिनानि भवन्ति, यतः सौरमानमूलत्वेन सर्वमानानां परिच्छित्तिः। तत्प्राधान्याद् ग्रहगत्युपलब्धावतः सौरवर्षं यदा रविदिवसैः परिच्छिद्यन्ते तदा षष्टिशतत्रयं भवन्ति। यदा सावनदिवसैः परिच्छिद्यन्ते तदा पंचषष्ट्यधिकानि त्रीणि शतानि रूपाष्टजिनतुल्यं विकल्पसहितानि भवन्ति यदा पुनश्चान्द्रैर्दिवसैः परिच्छिद्यन्ते, तदैकसप्तत्यधिकानि त्रीणि शतानि भवन्ति। सविकलसहितानि तद्विकलं च खयमरससंख्यं खखनवरसनवच्छेद्यमधिकदिनान्यपि सौरचान्द्रदिनानामन्तरस्थान्युच्यन्ते। अतस्तथैवाचार्येणैव निबद्धं; प्रथमं सौरसावनान्तरं साधितं। तच्च सौरे निक्षिप्य सावनं भवति। अतस्तेषां सावयवानां सावनानामूनरात्राण्यपि साधितानि। तानि सावने प्रक्षिप्य चान्द्रो भवति। सौरेण सहान्तरे कृतेऽधिमासदिनान्येव केवलान्यतिरिच्यन्ते तथैवास्माभिरथाधिकमेवोदाहृतमुपपन्नम्। ततोधिकदिनानां त्रिंशता भागे हृते कल्पगता अधिकमासा भवन्ति तैर्न प्रयोजनम् वर्षान्तिकाहर्गणे शेषास्तिथयः शुद्धिदिनानि विकलं दिनांशेभ्य इति चन्द्रदिनानि तिथयो भवन्त्येव शुद्धिरपि भवति। शोधनत्वात् विकलं दिनांशेभ्यः कृत्वा सावनदिनानि तान्येव भवन्ति, चैत्रादिप्रथमार्कोदयरविमण्डलान्तयोरन्तरे सावनोऽहर्गणो भवतीत्यर्थः। एतदुक्तं भवति, तद्दिग्गुणाष्टयोगे त्रिंशदुद्धृते शेषाण्यधिमासकदिनानि चान्द्राण्यवशिष्यन्ते। तान्येव सावनदिनानि चैत्राद्यार्कोदयात्प्रभृति कल्प्यन्ते। यतस्तेषां शुद्धिदिनानां सम्बन्धि यदवमशेषं तच्चैत्रादि तदर्कोदयान्तरमवशेषे मिलितं तिष्ठति। येऽवमांशाः भवद्भिरभिधीयन्ते। अन्यथामावस्यान्तामवशेषं तदर्कोदयामावास्यां तयोरन्तरं भवति तच्च पृथक्भूतामाचार्येणानीतम्। शुद्धिदिनान्यवमावनदिनानि कल्पितानि, एवं कृतेऽमावास्यानां तदार्कोदययोरन्तरं शुद्धं चान्द्रसावनदिनानामन्तरं चावमांशैः संगृहीतं भवति। तत ऊर्ध्वं शुद्धिसावनदिनैः संगृहीतं तावद्यावदर्कोदयदिने रविमण्डलान्ते भविष्यति। चैत्र प्रथमार्कोदयात्पूर्वं तत ऊर्ध्वं तत्रैव दिने या घटिकाः तदर्को रविमण्डलान्तरे स्थिताः तास्व दिनांशेभ्यः षष्टिगुणेभ्यो विभक्तेभ्यः स्वच्छेदेन भवन्ति यस्मात् तद्दिग्गुणाब्दयोगो यदा कृतः तदा सावनदिनानामधो दिनांशा आसंस्तेभ्यश्च या घटिकास्ता अपि तावन्त्यो भवन्तीत्युपपन्नम्। एवं शुद्धि दिनघटिकांतिकां वर्षोपयोगिनीं स्थापयेदवमांशांश्च ॥४१॥

वि. भा.—तत् (तयोः) पूर्वसाधितदिनादिक्षयाहाद्योर्दशगुणितगतवर्षस्य च योगास्त्रिंशता हृताः (भक्ता) लब्धं गताधिमासा भवन्ति, दिनांशेभ्योऽवमदिनां-

शेभ्यो त्रिकलं सद्दिनानि शुद्धिर्भवत्यर्थादधिशेषतिथयः क्षयशेषरहिताः सत्यः शुद्धिसंज्ञकं भवतीति ॥ ४१ ॥

अत्रोपपत्तिः

एकस्मिन् वर्षे सावनदिनानि=३६५।१५।३०।२२।३०=३६५+
एकवर्षसम्बन्धिदिनाद्यम् ।

एकस्मिन् वर्षे क्षयाहाद्यम् =५।४८।२२।७।३०=५+
एकवर्षसम्बन्धिक्षयघट्यादि ।

द्वयोर्योगेन

एकस्मिन् वर्षे चान्द्राहाः =३७१।३।५२।३०=३७०+एकवर्षसंदिनादि
+एकवर्षसम्बन्धिघट्यादि

एकस्मिन् वर्षे सौराहाः =३६० =३६०

अनयोरन्तरेण

एकस्मिन् वर्षेऽधिदिनानि =११।३।५२।३० = १०+एकवर्षसंदिनादि
+एकवर्षसम्बन्धिक्षयाहादि

ततोऽनुपातेन

$$\text{गताधिमासाः}=\frac{\text{१ वर्ष सं अधिदिन}\times\text{गतवर्ष}}{\text{१ वर्ष}\times\text{३०}}$$

$$=\frac{(\text{१०+एकवर्षसंदिनादि+एकवर्ष सम्बन्धिक्षयाहादि})\ \text{गतवर्ष}}{\text{३०}}$$

$$=\frac{\text{१०गव+एकवर्षसंदिनादि}\times\text{गव+एकवर्षसंक्षयाहादि}\times\text{गव}}{\text{३०}}$$

$$=\frac{\text{१० गव+गतवर्ष सं दिनादि+गतवर्षसंक्षयाहादि}}{\text{३०}}$$

अत्र अधिशेषे—वर्षान्तक्षयघटी=शुद्धिरितिपरिभाषितमत उपपन्नमाचार्योक्तमिति ॥ ४१ ॥

अब वर्षादि में अधिमासानयन करते हैं

हि.भा.—पूर्वसाधित दिनादि—क्षयाहादि और दशगुणित गतवर्षों के योग को तीस से भाग देने से अधिमास होता है, दिनांश (अवमदिनांश) से जो शेष रहता है

वह दिनादि शुद्धि होती है अर्थात् अधिशेष तिथि में क्षयशेष को घटाने से शेष शुद्धि संज्ञक होता है ॥ ४१ ॥

उपपत्ति

एकवर्ष में सावन दिन=३६५।१५।३०।२२।३०=३६५+१ वर्षसंदिनादि
एकवर्ष में क्षयाहादि = ५।४८।२२। ७।३०= ५+१ वर्षसंक्षयघट्यादि

दोनों के योग करने से

एकवर्ष में चान्द्रदि =३७१।३।५२।३० =३७०+१ वर्षसंदिनादि+१ वर्ष-संक्षयाहादि
एकवर्ष में सौरदिन =३६० =३६०

दोनों के अन्तर करने से

एकवर्ष में अधिदिन=११।३।५२।३० =१०+१ वर्षसंदिनादि +१ वर्षसंक्षयाहादि

∴ अनुपात करने से

$$\text{गताधिमास} = \frac{\text{१ वर्षसं अधिदिन} \times \text{गतवर्ष}}{\text{१ वर्ष ३०}}$$

$$= \frac{(\text{१०} + \text{१ वर्ष सदिनादि} + \text{१ वर्षसंक्षयाहादि})\ \text{गव}}{\text{३०}}$$

$$= \frac{\text{१० गव} + \text{१ वर्ष संदिनादि} \times \text{गव} + \text{१ वर्षसंक्षयाहादि} \times \text{गव}}{\text{३०}}$$

$$= \frac{\text{१० गव} + \text{गतवर्ष संदिनादि} + \text{गतवर्षसंक्षयाहादि}}{\text{३०}}$$

यहाँ अधिशेष—वर्षान्तक्षयशे=शुद्धिसंज्ञक, इससे आचार्योक्त उपपन्न हुआ ॥४१॥

इदानीं वर्षेशानयनं लघ्वहर्गणानयनं चाह

कल्पगताब्ददिनयुतः सूर्याद्योऽब्दाधिपोऽब्दभगणवधः ।
कल्पाब्दहृतो भगणादिमध्यमाः सूर्यभगणान्ते ॥ ४२ ॥
चैत्रसिताद्यास्तिथयः शुद्धिविहीनाः पृथक्गुणा रुद्रैः ।
अवमांशेभ्यो यमनवरसगुणितेभ्यो विभक्तेभ्यः ॥ ४३ ॥
स्वच्छेदेन फलयुता हृतास्त्रिखाग्नैः ७०३ फलावमविहीनाः ।
रविमेषादिद्युगणो मुनिहृत् शेषोऽब्दपत्यादिः ॥ ४४ ॥

वा. भा.—कल्पगताब्दानामन्तरानीतदिनानां च या युति, ततो वाराधिपो वर्षान्तिकस्याहर्गणस्य रव्यादिको भवत्यत्रेयं वासना रविवर्षणसावनदिनानां पञ्चषष्ट्याधिकं शतत्रयं सविकलं भवति। तत्र पञ्चषष्ट्याधिकेन शतत्रयेण सप्तहृते सत्येकदिवसो ऽवशिष्यते। वाराधिपोऽपि सावनदिनमेकं भुंक्ते, अतोब्दसमवारा गृह्यन्ते। विकलोत्था अपि सावनदिवसा रूपाष्टजिनैरित्यादिना ये कृताः तावन्त एव वारास्तत्र गतवर्षतुल्यसंख्यावारेषु प्रक्षिप्यन्ते। ततो वारगणात् सप्तहृतावशेषः सूर्याद्यो दिनपः तद्दिनार्कोदये भुक्तो लभ्यते। तदनन्तरग्रहो वाराधिपतिः, तत्र दिने भवति स एवाब्दाधिपतिर्भवति, यतो रविमेषादिकस्थाहर्गणस्य स एव प्रथमो दिवसोऽतः कल्पगताब्दयुतो यो वाराधिपः ततोऽपि यो ग्रहो द्वितीयो भवति तदादिका वारगणना मेषाद्यहर्गणस्था कार्या यतो भुक्तो वाराधिपो लभ्यते। अत्र सिद्धान्ते मेषादिद्युगणस्य तदादिका वारगणना कार्येति। अब्दभगणवधः कल्पाब्दहृत इति। सामान्योक्ता अप्यब्दाः कल्पगताब्दा गृह्यन्ते। तेषां भगणानाञ्च यो वधोऽसौ कल्पाब्दहृतो रविमण्डलस्थान्तिको मध्यग्रहो भवति, त्रैराशिकमेतत्। एवं सर्वग्रहादयो रविमण्डलान्तिका वर्षोपयोगिनः स्थाप्यन्ते।

चैत्रसितप्रतिपदाद्यभीष्टे दिने या व्यतीततिथिसंहितास्ता अत्र गृह्यन्ते चत्रसिताद्यास्तिथयः। शुद्धिविहीनाः पृथग्गुणा रुद्रैरिति चैत्रसिताद्यास्तिथयः गताः ताभ्यः शुद्धि विशोध्य शेषास्तिथयः पृथगृतष्टाः रुद्रगुणकार्या इत्यर्थः। ततोऽवमांशेभ्यो यमनवरसगुणितेभ्यो विभक्तेभ्यः स्वछेदेन फलयुता रविमण्डलान्ते येऽनन्तरमेवानीता अवमांशाः तान्यमनवरसैः संगुण्य खखरसनवसंख्येन स्वछेदेन विभज्य यदवाप्तं फलं तेन युतास्ताः कार्या इति। तत एवंविधास्ता हृतास्त्रिखागैः ७०३ यत्फलं तान्यवमानि तैर्विहीना, पृथक्स्थो रविमेषादिद्युगणो भवति, यस्मिन् काले मध्यमो रवि मेषं याति तत्कालात्प्रभृतिसावनान्तोऽहर्गणो भवति सविकलो मुनिहृतशेषः सप्तविभक्तशेषेऽब्दपत्यादिरेव समादिनाधिपस्तत्र दिने भवतीति वाक्यशेषः यदा पुनश्च चैत्रसितादिभ्यस्तिथिभ्यः शुद्धिर्न शुध्यति तदा विपरीतशोधने कृते शेषो रविमण्डलान्ताद्विपरीताहर्गणो भवति, तमेकादशगुणं रविमण्डलान्तावमाद्विशोधयेत्। शेषं तत्र दिनेऽवमशेषं भवति, न शुध्यति चेत्तदा गुणखमुनियुताद्रविमण्डलान्तावमशेषादिको न विपरीताहर्गणं रुद्रगुण विशोधयेदेकोन एव यतस्तत्र विपरीताहर्गणो भवति। वारोऽपि रविमण्डलान्तवारविपरीतवारगणनया गणनीया इति, मध्यमाश्च भौमाद्या रविमण्डलान्तिका विपरोताहर्गणफलेनोना तद्दैवसिका भवन्तीत्यत्रेयं वासना चैत्रसिताद्यास्तिथयो यदा शुद्धिसावनदिनैः नूनं क्रियते। तदा चैत्राद्यवमशेषे रव्युदयामावस्यां तयोरन्तरं शुद्धिदिनावमशेषं चान्द्रसावनदिनानामन्तरं द्वे अप्येकत्र मिलितेऽवमांशत्वं गते भवतः अवमांशा अधिकाः शुद्धोनाः सतिथिभ्यो रविमण्डलान्तचैत्रसिताद्योरन्तरं चान्द्रशुद्धं भवति सर्वं केवलमवमांशांशं अद्यापि शुध्यतीत्यर्थः। पृथक्गुणा-

रित्यत्र त्रैराशिकं यदिति त्रिखमुनिसंख्यैश्चन्द्रदिनैरेकादशावमानि भवन्ति, तत्प्रतिमण्डलान्तादारभ्य यास्तिथयो गताः सविकलाः तासां किमित्यत एकादशगुणानां तासां त्रिखसंख्यो भागहारः। एवं स्थिते रविमण्डलान्ते यदवमशेषं तत्तत्र योज्यते यतः शुद्धिविशोधनकाले तन्न शोधितं यदेवावमशेषं तद्योज्यते, तदेव शुद्धं भवति, चन्द्रदिनान्युपरि शुद्धानि स्थितानि भवन्ति। अतोऽवमांशास्त्रिखागैर्गुणिताः सवर्णाः भवन्तीत्येवं सवर्णो योजयितुं प्राप्तः, एकादशगुणितासु तिथिषु यावदवमांशास्तेष्वेव तिथिष्वधिकास्तिष्ठन्ति ते च तिथिभिः सह एकादशगुणाः सम्पन्नाः अतस्त्रिखागेभ्य एकादशसंशोध्य द्विनवरसा एवावमांशानां गुणकारः स्वच्छेदो भागहारश्च फलं रुद्रगुणितासु तिथिषु प्रयोज्यावमशेषं राशिर्भवति। ततस्त्रिखागैर्विभज्योनरात्रा लभ्यन्ते शेषामिष्टदिने सावनमवशेषं लब्धोनरात्रांश्च रविमण्डलान्तात् गततिथिगणात् विशोध्य रविमेषाद्यहर्गणो भवतीत्युपपन्नं सचाहर्गणो मुनिहृतशेषोऽब्दपत्यादि यो ग्रहो भवति, ततोऽपि यो द्वितीयः सावनाधिपो भवति यतः सविकलोऽहर्गण इति ॥४२-४३-४४॥

वि. भा.—कल्पादेर्ये गताब्दास्तेषां गतवर्षसम्बन्धिदिनाद्यानाञ्च योगः सूर्याद्योऽब्दाधिपः (रव्यादिवर्षपतिः) भवति, अब्दभगणवधः (कल्पगतवर्षकल्पग्रहभगणघातः) कल्पाब्दहृतः (कल्पवर्षभक्तः) तदा सूर्यभगणान्ते (सौरवर्षान्ते) भगणादिमध्यमा ग्रहा भवन्ति चैत्रशुक्लप्रतिपदादितो वर्त्तमानमासेष्टतिथिपर्यन्तं यास्तिथयस्ताः शुद्धिरहिताः पृथक् (स्थानद्वये स्थापिताः) रुद्रै (एकादशभिः) र्गुणिताः यमनवरस ६९२ गुणितेभ्योऽवमांशेभ्यः (वर्षान्तक्षयशेषेभ्यः) स्वच्छेदेन (९६००) विभक्तेभ्यः फलयुताः, त्रिखागैर्हृताः (७०३ एभिर्भक्ताः) फलावमविहीनाः पूर्वस्थापितास्तदा रविमेषादिद्युगणो (यस्मिन् काले रविर्मेषं याति तस्मात्कालादहर्गणः) भवति, मुनिहृत् (सप्तभक्तः) शेषोऽब्दपत्यादिर्भवतीति ॥४२-४३-४४॥

अत्रोपपत्तिः

एकस्मिन् वष सावनदिनादयः=३६५।१५।३०।२२।३० ततोऽभीष्टवर्षान्ते सावनदिनादयः=(३६५।१५।३०।२२।३०) गव=३६५ गव+गव (१५।३०।२२।३०)=३६५ गव+गतवर्षसंदिनादि=कल्पादित इष्टवर्षान्ते सावयवोऽहर्गणस्तत्र दिनादिबोधकं द्वितीयखण्डमेवास्ति, अत्र सप्तभक्तावशिष्टोऽहर्गणो वारनियामकस्तेनात्र ३६५ यावत्सप्तभिर्विभज्यते तावद्रूपसममेव शेषम्। तेन कल्पगताब्ददिनयुत इत्युक्तं युक्तम् रव्यादिको वर्षपतिर्भवेत्कल्पादौ रविवारस्य सद्भावादिति। अथ रव्यब्दान्ते ग्रहानयनं क्रियते यदि कल्पवर्षैः कल्पग्रहभगणा लभ्यन्ते तदा गतवर्षैः किमित्यनुपातेन रविवर्षान्ते (सूर्यभगणान्ते) मध्यमा ग्रहाः समागच्छन्तीत्यत आचार्योक्तमुपपन्नम् ॥४२॥

लघ्वहर्गणसाधनार्थं वर्षादितो गततिथयः = इष्टतिथि — अधिशेतिथि, तथा स्वल्पान्तरात् ७०३ चान्द्रदिनैरेकादश ११ मितान्यवमानि भवन्तीति स्वीकृत्यानुपातेन यदि ७०३ चान्द्रदिनैरेकादशमितान्यवमानि लभ्यन्ते तदा वर्षादितो गततिथिभिः किमित्यनुपातेन यत्फलं तत्र वर्षादिक्षयशेषयुतं तदाऽवमानि भवन्ति

$$\text{तत्स्वरूपम्} = \frac{११ \,(\text{इष्टतिथि} - \text{अधिशेति})}{७०३} + \frac{\text{वर्षादिक्षशे}}{९६००}$$

$$= \frac{११\,(\text{इष्टति} - \text{अधिशेति}) + \frac{७०३ \text{ वर्षादिक्षशे}}{९६००}}{७०३}$$

$$= \frac{११(\text{इष्टति} - \text{अधिशेति}) + \frac{११ \text{ वक्षशे}}{९६००} + \frac{६९२ \text{ वक्षशे}}{९६००}}{७०३}$$

$$= \frac{११\left\{\text{इष्टति} - \left(\text{अधिशेति} - \frac{\text{वक्षशे}}{९६००}\right)\right\} + \frac{६९२ \text{ वक्षशे}}{९६००}}{७०३}$$

$$= \frac{११\,(\text{इष्टति} - \text{शुद्धि}) + \frac{६९२ \text{ वक्षशे}}{९६००}}{७०३} = \text{अवमानि}$$

ततो लघ्वहर्गणः = (इष्टति — शुद्धि) — अवम एतदनुरूप एव चैत्रसितादिगतस्थितिसंघ इति भास्कराचार्य प्रकारः। अत्रापि सैव स्थूलता या च भास्करानयनेऽपि वर्तते। एतेनाचार्योक्तमुपपद्यत इति ॥४३-४४॥

अथ लघ्वहर्गणः कदा सावयवो निरवयवश्च भवतीति विचार्यते यदाऽवमशेषाभावस्तदा सूर्योदयामान्तवर्षान्तमेकत्र स्थितत्वात्सौराहर्गणचान्द्राहर्गणसावनाहर्गणानां निरवयवत्वमन्यथा सावयवत्वमिति । कल्पे निरग्रलक्षणं कियन्मितमित्येतदर्थं यदा निरग्रलक्षणमस्ति तदाऽहर्गणानां (सौरचान्द्रसावनाहर्गणानां) महत्तमापवर्त्तनाङ्कमन्विष्य तेनापवर्त्तितास्तेऽहर्गणाः कार्यास्तदा लब्धितुल्यवर्षैः पुनः पुनस्तेषां निरवयवत्वं भविष्यतीति। अथापवर्त्तितसौराहर्गणमानानि कियद्भिर्वर्षैर्वर्षान्ते भविष्यतीति विचारः महत्तमापवर्त्तनाङ्केनापवर्त्तनेन यावन्ति दिनान्यागच्छन्ति तान्ये ३६० भिर्भजनेन यानि शेषमानानि तानि येनाङ्केन गुणनेन ३६० तद् भवेत्तैरेव गुणकतुल्यवर्षैस्तान्यपवर्त्तितसौराहर्गणमानानि वर्षान्ते भविष्यन्तीति सिद्धान्तितम् । एवं चापवर्त्तितचान्द्राहर्गणसावनाहर्गणमाने-कियद्भिर्वर्षैर्वर्षान्ते भविष्यत इति विचार्यते। सौराहर्गणेन साकं चान्द्राहर्गणसावनाहर्गणयोर्महत्तमापवर्त्तनाङ्कमन्विष्य तेनापवर्त्तनाङ्केन चान्द्रसावनाहर्गण-

मानेऽपवर्त्तिते कार्ये तदा लब्धितुल्यवर्षैः पुनर्वर्षान्ते तावहर्गणौ भविष्यत इति दिक् । विषयोऽयं वटेश्वरसिद्धान्तेऽपि मया प्रदर्शितोऽस्तीति ।

अब वर्षेशानयन और लघ्वहर्गणानयन कहते हैं

हि. भा.—कल्पादि से जो गतवर्ष है उसका और गतवर्षसम्बन्धि दिनाद्यों का योग सूर्यादि वर्षपति होते हैं । कल्पगतवर्ष और कल्पग्रहभगण के घात (गुणनफल) को कल्पवर्ष से भाग देने से जो फल होता है वह सूर्यभगणान्त में (रविवर्षान्त में) मध्यमग्रह होते हैं । चैत्रशुक्लप्रतिपदादि से वर्त्तमान मास की इष्टतिथि पर्यन्त जो तिथियां हैं उनमें शुद्धि को घटा देने से जो हो उसको दो स्थान में स्थापित करना, एक स्थान में उसे ग्यारह ११ से गुण देना, वर्षादिक्षयशेष को ६६२ इनसे गुणा कर अपने हर ९६०० से भाग देकर जो फल हो उसे ग्यारह गुणित शुद्धि रहित इष्टतिथि में जोड़ देना ७०३ इनसे भाग देने से जो लब्धि अवम हो उसको पूर्वस्थापित (द्वितीय स्थान स्थित शुद्धि रहित इष्टतिथि) में घटाने से रविमेषादि (जिस काल में रविमेष में जाते हैं उस काल) से अहर्गण (लघ्वहर्गण) होता है, इसको सात से भाग देने से जो शेष रहता है वह अब्दपत्यादि (वर्षपत्यादि) होते हैं ।।४२-४३।।

उपपत्ति

एक वर्ष में सावनदिनादि=३६५।१५।३०।२२।३०, इष्टवर्षान्त में सावनदिनादि= गव (३६५।१५।३०।२२।३०)=गव × ३६५ + गव (१५।३०।२२।३०)=गव ३६५ + गतवर्षसंदिनादि=कल्पादि से इष्टवर्षान्त में सावनाहर्गण इसमें दिनादिबोधक द्वितीय खण्ड ही है, आनीत सावनाहर्गण में सात से भाग देने जो शेष रहता है वह रव्यादि वर्ष-पति होते हैं कल्पादि में रविवार था इसलिये रवि ही से गणना करते हैं, अब रविभगणान्त (रविवर्षान्त) में ग्रहानयन के लिये अनुपात करते हैं यदि कल्पवर्ष में कल्पग्रह भगण पाते हैं तो गतवर्ष में क्या इस अनुपात से रविवर्षान्त में मध्यमग्रह आते हैं, इससे आचार्योक्त उपपन्न हुआ ।।४१।।

लघ्वहर्गण साधन के लिये वर्षादि से गततिथि=इष्टतिथि—अधिशेति; तथा स्वल्पान्तर से ७०३ चान्द्र दिनों में ग्यारह ११ अवम होते हैं यह मानकर अनुपात 'यदि ७०३ चान्द्रदिनों में ग्यारह ११ अवम पाते हैं तो वर्षादि से गततिथि में क्या' इससे जो फल आता है उसमें वर्षादिक्षय शेष जोड़ने से पूरे अवम होते हैं, उसका स्वरूप यह है जैसे—

$$\frac{११ \text{ (इष्टति—अधिशेति)}}{७०३} + \frac{\text{वर्षादिक्षशे}}{९६००}$$

$$=\frac{११\ (\text{इष्टति}-\text{अधिशेति})+\frac{७०३\ \text{वक्षशे}}{९६००}}{७०३}$$

$$=\frac{११\ (\text{इष्टति}-\text{अधिशेति})+\frac{११\ \text{वक्षशे}}{९६००}+\frac{६९२\ \text{वक्षशे}}{९६००}}{७०३}$$

$$=\frac{११\left\{\text{इष्टति}-\left(\text{अधिशेति}-\frac{\text{वक्षशे}}{९६००}\right)\right\}+\frac{६९२\ \text{वक्षशे}}{९६००}}{७०३}$$

$$=\frac{११\ (\text{इष्टति}-\text{शुद्धि})+\frac{६९२\ \text{वक्षशे}}{९६००}}{७०३}=$$

अवम

∴ लघ्वहर्गण = (इष्टति—शुद्धि)—अवम इससे आचार्योक्त उपपन्न हुआ ।।४३-४४।।

लघ्वहगण कब सावयव और निरवयव होता है इसके लिये विचार करते हैं। जब अवमशेष का अभाव होगा तब सूर्योदय—अमान्त और वर्षान्त के एक ही स्थान में रहने के कारण चान्द्राहर्गण-सौराहर्गण और सावनाहर्गण निरवयव होगें यह सिद्ध हुआ। कल्प में निरग्रलक्षण कितने होते हैं इसके लिये विचार—जब निरग्रलक्षण हैं तब अहर्गणों- (सौराहर्गण-चान्द्राहर्गण और सावनाहर्गण) के महत्तमापवर्त्तनाङ्क निकालना उससे पूर्वोक्त अहर्गणों को अपवर्त्तित करने से जो लब्धियां हों तत्तुल्य वर्षों में फिर फिर वे अहर्गण निरवयव होंगे। अपवर्त्तित सौराहर्गण मान कितने वर्षों में वर्षान्त में होता है उसके लिये विचार—सौराहर्गण को महत्तमापवर्त्तनाङ्क से अपवर्त्तित करने से जितने दिने आवें उनको तीन सौ साठ ३६० से भाग देने से जो शेष रहे उसको जिस अङ्क से गुणने से तीन सौ साठ ३६० हो उसी गुणक तुल्य वर्षों में अपवर्त्तित सौराहर्गण वर्षान्त में होगा यह सिद्ध हुआ। इसी तरह अपवर्त्तित चान्द्राहर्गण और सावनाहर्गण कितने वर्षों में वर्षान्त में होगें इसका भी विचार करना। जैसे सौराहर्गण के साथ चान्द्राहर्गण और सावनाहर्गण का महत्तमापवर्त्तनाङ्क निकालना तब उस अपवर्त्तनाङ्क से चान्द्राहर्गण और सावनाहर्गण को अपवर्त्तित करना तब लब्धि तुल्य वर्षों में फिर वे दोनों वर्षान्त में होगें। यह विषय वटेश्वर सिद्धान्त में भी मैंने लिखा है इति ।।४३-४४।।

इदानीमहर्गणग्रहानयनविवक्षुरादौ तावद्रविसितबुधानां कुजगुरुशनिशीघ्रोच्चानां चानयनायार्यामाह।

द्युगणात्सप्तत्यंशं स्वनवाकांशाधिकं विशोध्यांशाः।
मध्यबुधसूर्यसिताः शीघ्रोच्चं कुजगुरुशनीनाम् ।।४५।।

वा. भा.—द्युगणात् सप्ततितमोंऽशः स्वेन नवार्कांशेनाधिकः स्वनवार्कांशाधिकोऽतस्तं सप्तत्यंशं स्वनवार्कांशाधिकं विशोध्य द्युगणा देवांशाः भवन्ति, यतः सौरास्तावतैव सावनमधिकम्, अतएव सावनाद्विशोध्यतेऽधिकं चतुर्थी जातिरियं तद्यथा $\frac{1}{70}\frac{1}{129}$ सवर्णने समशून्यनिपाते च कृते जातमुपरि त्रयोदश, अधस्त्रिखनन्दाः अत्रैतज्जातमिष्टाहर्गणं रविमेषादिकं त्रयोदशभिः $\frac{13}{903}$ संगुण्य त्रिखनन्दैर्विभज्य भागादिफलं यल्लब्धं तस्मादेवाहर्गणाद्विशोध्य भागा भवन्ति ६०३ मध्यमरविसितबुधानां शीघ्रोच्चस्य कुजगुरुशनीनां भागैश्च राश्यादिको ग्रहः कार्य इत्यत्रैयं युक्तिर्यदि कल्पार्कसावनदिनेभ्यः सौरसावनदिवसान्तरतुल्यानि दिनानि विशोध्य सावनदिवसा एव भागा रवेर्भवन्ति तदेकस्मात् सावनदिवसात् किं विशोध्यते येनासौ रविभागो भवतीत्यत्र सौरसावनदिवसांतरतुल्येन राशिनापवर्त्तने कृते त्रैगुणकारभागहारयोस्त्रैराशिकस्थापनभागहारः एकोनसप्ततिःविंशाधिकशतभागानां पंचपंचाशदधिकगुण्यगुणकारस्थापनयोरेकैकौ ६९ ।। अत्र भागहारे सप्ततिः कियन्नूना अतो भागहारं सप्ततेर्विशोध्य शेषं $\frac{1}{\frac{0}{5}}$ $_{12}$ अनेन भागहारेण $\frac{45}{120}$ विभज्य लब्धं नवार्काः १२९ । अतएव सप्तत्यंशः स्वनवार्कांशेनसंयुतः क्रियते । लघुत्वात्भागहारस्य सप्ततेरितिलब्धमेकसावनदिनस्य शोध्यं भवतीति ।।४५।।

वि. भा.—स्वनवार्कांशाधिकं (स्वकीयै १२९ तन्मितांशेन युतं) अहर्गणस्य सप्तत्यंशं (अहर्गणस्यै ७० तन्मितमंशं) द्युगणात् (अहर्गणात्) विशोध्यावशिष्टांशा मध्यमबुधसूर्यसिता भवन्ति, कुजगुरुशनीनां तदेव शीघ्रोच्चमपि भवत्यर्थान्मध्यमरविसमावेव मध्यमबुधशुक्रौ भवतस्तथा मध्यमरविरेव कुजगुरुशनीनां शीघ्रोच्चमस्ति तेन साधितमध्यमरविरेव मध्यमबुधशुक्रौ, कुजगुरुशनीनां च शीघ्रोच्चं भवेदिति ।

अब रवि का आनयन करते हैं

हि. भा.—अहर्गण के सत्तरवें अंश में अपने १२९ अंश को जोड़कर जो होता है उसको अहर्गण में घटाने से मध्यम बुध, मध्यमसूर्य और मध्यमशुक्र होते हैं, तथा वही कुज, गुरु और शनि इनके शीघ्रोच्च होते हैं, अर्थात् मध्यमरवि ही के बराबर मध्यमबुध और मध्यमशुक्र होते हैं और मध्यमरवि ही कुज, गुरु और शनि इन ग्रहों का शीघ्रोच्च है इसलिये साधित मध्यमरवि ही मध्यमबुध और शुक्र होते हैं और वही कुज, गुरु और शनि इनके शीघ्रोच्च होते हैं, गणितन्यास से अंशादि मध्यम (रवि, बुध और शुक्र)

$$=\text{अहर्गण}-\left(\frac{\text{अहर्गण}}{७०}+\frac{\text{अहर्गण}}{७०\times १२९}\right)=\text{कुज, गुरु और शनि इनके शीघ्रोच्च}$$

इति ।।४५।।

उपपत्ति

रूपतुल्य अहर्गण से आचार्य के मत में कलादिक रविगति=५९'।८"।१०'''।२२'''' तब अनुपात करते हैं यदि एक दिन में यह रविगति पाते हैं तो अहर्गण में क्या

इससे मध्यमरवि आते हैं, यहां गति के अंकों के सवर्णन आदि करने से ऐसा स्वरूप होता है अहर्गण—$\left(\frac{\text{अहर्गण}}{\text{७०}} + \frac{\text{अहर्गण}}{\text{७०} \times \text{१२६}}\right)$ = मध्यमरवि = मध्यमबुध = मध्यमशुक्र भास्कराचार्य के मत से एकदिन में रविगति = ५९'।८''।१०'''।२१'''' आती है इति ॥४५॥

प्रकारान्तरम्

कल्पे रविभगणाः = ४३२०००००० ३६० एभिर्गुणिता अंशा भवन्त्यतः

अंशाः = १५५५२००००००००

अतोऽनुपातेनाहर्गणान्ते भागात्मको रविः

$$= \frac{\text{अ. १५५५२००००००००}}{\text{१५७७९१६४५००००}}$$

$$= \text{अ.} \frac{\text{१५५५२००००}}{\text{१५७७९१६४५}}$$

अत्रासन्नमानग्रहणेन—

$$\frac{\text{१५५५२००००}}{\text{१५७७९१६४५}} = \text{०} + \cfrac{\text{१}}{\text{१} + \cfrac{\text{२२७१६४५}}{\text{१५५५२००००}}}$$

$$= \text{०} + \cfrac{\text{१}}{\text{१} + \cfrac{\text{१}}{\text{६८} + \cfrac{\text{१०४८१४०}}{\text{२२७१६४५}}}}$$

$$= \text{०} + \cfrac{\text{१}}{\text{१} + \cfrac{\text{१}}{\text{६८} + \text{१} + \cfrac{\text{१०४८१४०}}{\text{२२७१६४५}} - \text{१}}}$$

$$= \text{०} + \cfrac{\text{१}}{\text{१} + \cfrac{\text{१}}{\text{६९} - \cfrac{\text{२२७१६४५} - \text{१०४८१४०}}{\text{२२७१६४५}}}}$$

$$= \text{०} + \cfrac{\text{१}}{\text{१} + \cfrac{\text{१}}{\text{६९} - \cfrac{\text{१२२३५०५}}{\text{२२७१६४५}}}}$$

अत्र ऋणं खण्ड $\frac{१२२३५०५}{२२७१६४५}$ मिदं यदि त्यज्यते तदाऽऽसन्नमानग्रहणेन—

लब्धयः ०, १, ६६

आसन्नमानानि $\frac{०}{१}$, $\frac{१}{१}$, $\frac{६६}{७०}$

अत्राचार्येण $\frac{६६}{७०}$ आसन्नमानं गृहीतम्।

अथ वास्तवभिन्नेऽ $\frac{१५५५२००००}{१५७७६१६४५}$ स्मिन्

समयोगवियोगेन—

$$\frac{६६}{७०}+\frac{१५५५२००००}{१५७७६१६४५}-\frac{६६}{७०}$$

$$=\frac{६६}{७०}-\frac{६६\times१५७७६१६४५-७०\times१५५५२००००}{७०\times१५७७६१६४५}$$

$$=\frac{६६}{७०}-\frac{१०८८७६२३५०५-१०८८६४०००००}{७०\times१५७७६१६४५}$$

$$=\frac{६६}{७०}-\frac{१२२३५०५}{७०\times१५७७६१६४५}$$

$$=\frac{६६}{७०}-\frac{१}{७०\times१२६}$$

अत्राचार्येण $\frac{१५७७६१६४५}{१२२३५०५}$ स्वल्पान्तरेण अर्णाधिकग्रहणेन १२६ लब्धिः स्वीकृतेति।

अतोंऽशादिको रविः $=$ अ $\left(\frac{६६}{७०}-\frac{१}{७०\times१२६}\right)$

$$=\text{अ}\left(१-\frac{१}{७०}-\frac{१}{७०\times१२६}\right)^\circ$$

$$=\text{अ}\left\{१-\left(\frac{१}{७०}+\frac{१}{७०}\times\frac{१}{१२६}\right)\right\}^\circ$$

$$= अ^{\circ} - अ\left(\frac{१}{७०} + \frac{१}{७० \times १२६}\right)^{\circ}$$

उपपन्नमाचार्योक्तम् । रविमध्यमतुल्यावेव मध्यमबुधशुक्रौ भवतः । "रवेरग्रतः पृष्ठतो वा ह्यनुचराविव बुधशुक्रौ सदैव दृश्येते । अतो रविभगणसमा एव तयोर्भगणा भवन्ती"ति भगणाध्याये वासनाभाष्ये भास्कराचार्याः प्रोचुस्तदर्थं शिरोमणिर्द्रष्टव्यः । तथा च रविमध्यमसमा एव कुजगुरुशनीनां शीघ्रोच्चभगणाः । तेषां शीघ्रोच्चं मध्यमरविरेव भवतीत्यपि भगणाध्याये प्रतिपादितं भास्करेण ।।

इदानीं मध्यमचन्द्रानयनमाह

त्रिगुणमवमावशेषं विभजेद् गुणसप्तशशिभिराप्तांशैः ।
पृथगधिकोऽर्को रविगुणतिथ्यंशैः संयुतश्चन्द्रः ।।४६।।

वा. भा.—त्रिगुणमवमावशेषं विभजेत् । कैरित्याह गुणसप्तशशिभिस्तत्र ये आप्ता अंशास्तैः पृथक् यथाधिकः कार्यः पूर्वमेव यदनष्टमवमावशेषं स्थापितं तत्त्रिगुणं कृत्वा गुणसप्तशशिभिर्विभजेत् । लब्धमंशाधिकं भवति द्वितीयस्थानस्थे रवौ योज्यमित्यर्थः । तत स तादृगर्को रविगुणिततिथ्यंशैश्च सहितश्चन्द्रो भवति । अहर्गणानयनवर्त्तमाने मासे सितप्रतिपदादिका यास्तिथयो दत्ताः ता रविगुणद्वादशगुणिताः सत्यस्तिथय एव चन्द्रांशा भवन्ति तैश्चांशै संयुतोऽर्कः पृथक्स्थोऽवमफलसंस्कृतः कार्य इत्यर्थः कृतोऽर्कश्चन्द्रो भवति । अत्रेयं वासना, रविचन्द्रौ द्वावपि अमावास्यान्ते तुल्यौ भवतः तत आरभ्य यावत्यस्तिथयोऽतीताः तावदन्तरं तयोः तिथौ द्वादशचन्द्रभागा भवन्ति, यस्माच्चन्द्रलिप्ताभिः खयमस्वरसंख्याभिस्तिथिः भचक्रत्रिंशांशेन चैतावत्य एव लिप्ता भवन्ति तिथयश्च त्रिंशत् । तस्मादुपपन्नं रविगुणास्तिथयश्चन्द्रभागा भवन्ति । तैर्युक्तश्चन्द्रस्तत्र दिने मध्यमः तिथ्यन्तकालिकः भवत्यतोऽवमशेषेणार्कोदयकालिकः क्रियते । तद्यथा यदि सावनदिवसशेषेण यमनवरससंख्येनैकं चन्द्रदिनं चन्द्रदिनञ्च द्वादशभागा भवन्ति । तदेष्टेनावमशेषेण किमित्यत्र गुणकारिभागहारयोः तुल्यछेदस्त्रिस्वमुनिसंख्यः तस्मिन् नष्टे प्रथमराशेश्चतुर्भागेन गुणसप्तशशिनो द्वितीयराशेश्चतुर्भागेन द्वादशानां त्रयो तत इष्टावमशेषस्य सर्वदा त्रिको गुणकारः । अग्रशशिनो भागहारः फलं भागादि चन्द्रमसः तत्तिथ्यन्तकालिके चन्द्रमसि संयोज्यार्कोदयकालिको संकायां भवतीत्युपपन्नम् । अनयैव विपरीतवासनया चन्द्रे ज्ञाते अवमावशेषमानयेत् यो मध्यमः इति ।। ४६ ।।

वि. भा.—अवमावशेषं (क्षयशेषं) त्रिगुणं गुणसप्तशशिभिः (१७३ एभिः) विभजेत्, लब्धांशैः पृथगर्को युतो रविगुणतिथ्यंशैः (द्वादशगुणिततिथ्यंशैः) संयुतस्तदा चन्द्रो भवतीति ।।४६।।

उपपत्तिः

अत्राचार्यमतेनावमशेषम् $= \frac{\text{अशे}}{७०३}$,

इदं सावनं, चान्द्रकरणेन—

चान्द्रावमशेषम् $= \frac{\text{अशे} \times ७०३}{७०३ \times ६९२} = \frac{\text{अशे}}{६९२}$

द्वादशगुणमंशात्मकम् $= \frac{\text{अशे} \times १२}{६९२} = \frac{\text{अशे} \times ३}{१७३}$

अथ चन्द्रार्कयोरन्तरभागा द्वादशभक्ता तिथिः स्यात्

$\therefore$ तिथ्यन्ते रविचन्द्रान्तरभागाः $= १२$ ति $=$ चा-र.

$\therefore$ च $= १२$ ति $+$ र अत्रावमभागयोगेनौदयिकश्चन्द्रः $= १२$ ति $+$ र $+$ $\frac{३ \text{ अशे}}{१७३}$ उपपन्नमाचार्योक्तम् ।

अब चन्द्रानयन कहते हैं

हि. भा.—अवमावशेष (क्षयशेष) को तीन से गुणाकर एक सौ तेहत्तर १७३ से भाग देने से जो लब्धांश होता है रवि में जोड़ना और बारह गुणित तिथ्यंश को जोड़ने से अंशात्मक चन्द्र होते हैं इति ॥४६॥

हिन्दी में अन्य ढंग से उपपत्ति

अहर्गणान्त कालिक तिथि $=$ गति $+$ क्षयघटीसंचान्द्र, $\frac{\text{अंशात्मक चं} - \text{अंशात्मक र}}{१२} =$ तिथि

इसलिए अंशात्मक चं $=$ अंशात्मक र $+ १२$ तिथि, अतः अहर्गणान्तकालिक चं $=$ अंशात्मक र $+ १२$ (गति $+$ क्षयसंचां) $=$ अंशात्मक र $+ १२$ गति $+ १२$ क्षयसंचां $\frac{१ \text{ क्षदि} \times \text{इचां}}{६४ \text{ चान्द्र}}$ $=$ गक्षदि $+ \frac{\text{क्षशे}}{६४}$ $\therefore \frac{\text{क्षयशे}}{६४} = \frac{\text{क्षघ}}{६०}$ इसलिए अनुपात से क्षयघटीसंचांदि $= \frac{६४ \text{ चां} \times \text{क्षशे}}{६३ \text{ सावन} \times ६४} = \frac{\text{क्षशे}}{६३}$ $\therefore १२$ क्षघसंचां $= \frac{१२ \text{ क्षशे}}{६३}$ एतत्सम्बन्धी कलात्मक फल $= \frac{१२ \times ६० \times \text{क्षशे}}{६३} = \frac{२० \times १२ \times \text{क्षशे}}{२१} = \frac{२० \times ४ \text{ क्षशे}}{७} = \frac{८० \text{ क्षशे}}{७}$ इसको अंशात्मक करने

से $\frac{८० \text{ क्षशे}}{६० \times ७} = \frac{८० \text{ क्षशे} \times ३}{६० \times ७ \times ३}$ = परन्तु आचार्य कथित क्षयशेष को ग्यारह से भाग देने से भास्कर-

कथित क्षयशे = $\frac{\text{क्षयशे}}{११}$ $\therefore \frac{८० \text{ क्षशे} \times ३}{६० \times ११ \times ७ \times ३} = \frac{\text{क्षशे} \times ३}{\frac{७ \times ११ \times ६० \times ३}{८०}} = \frac{\text{क्षशे} \times ३}{\frac{१३८६}{८}}$

$= \frac{\text{क्षशे} \times ३}{\frac{६९३}{४}} = \frac{\text{क्षशे} \times ३}{१७३}$ = १२ क्षयघसंचां अतः अहर्गणान्त कालिक अंशात्मक चन्द्र =

अंशात्मकरवि + १२ गति + $\frac{\text{क्षशे} \times ३}{१७३}$ इससे आचार्योक्त उपपन्न हुआ इति ॥४६॥

इदानीं वर्षान्तिकादहर्गणात् भौमादिग्रहमन्दफलानयनार्थमार्याचतुष्टयमाह

एकादशलिप्तांशा भौमः शरसप्तवसुभि ८७५ रिन्दुयमैः २१ ।
कृतगुणितद्युगणांशाः पञ्चरसैः ६५ षट्बुधः शीघ्रम् ॥४७॥

वा. भा.—भागो नन्दशशांकैः शशिसूर्यस्वरयमैश्च शशिपातः रविमण्डलान्तिकयुता मध्या भगणान्तिका शेषाः। स्पष्टार्थमिदमार्याचतुष्टयम्। यतस्त्रैराशिकेन सर्वग्रहाणां फलानयनम्। भौमस्य तावद्यद्येकविंशकेनाहर्गणेनैकादशांशान्भौमो भुङ्क्ते तदिष्टाहर्गणेन किमिति तथा शरसप्त च त्रिभिश्च दिनैः सावनैर्यद्येकादशलिप्ताश्च भौमो भुङ्क्ते तदिष्टाहर्गणेन कियतीरिति। लब्धं फल द्वययोगो रविमण्डलाद् भवति भौमः। एवं बुधोऽपि यद्येकसंख्येनाहर्गणेन चत्वारोंऽशा बुधस्य भवन्ति तदिष्टाहर्गणेन किमिति पुनः पञ्चरसैर्दिने यदि षट्भागा भवन्ति, तदिष्टाहर्गणेन किमिति, पुनर्यदि कृतरसगुणतुल्यैर्दिनैः पञ्चलिप्ताः साध्यन्ते। लब्धफलद्वययोगो बुधः ॥४७॥

वि. भा.—कुजः = $\frac{११ \text{ अहर्गण}}{२१}$ अंशाः + $\frac{११ \text{ अहर्गण}}{८७५}$ कलाः। तथा बुधशीघ्रोच्चमंशाद्यम् = ४ अहर्गण + $\frac{६ \text{ अहर्गण}}{६५}$ ॥४७॥

अत्रोपपत्तिः

अत्र रूपमितमहर्गणं प्रकल्प्य 'महीमितादहर्गणात्फलानि यानीत्यादि' भास्करोक्तप्रकारेण कुजस्याऽऽचार्यप्रकारेण मध्यमा गतिर्यद्यानीयते तदा ३१'।२६"। २८'''।७'''' भवति, भास्कराचार्योक्तापोयमेव ततो विलोमविधिना खण्डगुणनयोगादिनाऽऽचार्योक्तमध्यमकुजसिद्धिर्भवतीति ॥४७॥

अथ बुधशीघ्रोच्चानयनार्थं

पूर्वोक्तप्रकारेणैकस्मिन् दिनेऽऽचार्योक्तप्रकारेण बुधशीघ्रोच्चगतिः= ४°।५′।३२″।१८‴।२८⁗ ततोऽनुपातेन बुधशीघ्रोच्चांशाः=अहर्गण (४°।५′।३२″।१८‴।२८⁗)=४×अहर्गण+अहर्गण (५′।३२″।१८‴।२८⁗) अथा ५′।३२″।१८‴।२८⁗ स्य स्वरूपान्तरं क्रियते $५।३२।१८+\frac{२८}{६०}=५।३२।१८+\frac{७}{१५}=५।३२।$

$\frac{२७०+७}{१५}=५।३२।\frac{२७७}{१५}=५।३२+\frac{२७७}{६०\times१५}=५।\frac{२८८००+२७७}{६००}$

$=५।\frac{२९०७७}{९००}=५+\frac{२९०७७}{६०\times९००}=५+\frac{२९०७७}{५४०००}$

$=\frac{२७००००+२९०७७}{५४०००}=\frac{२९९०७७'}{५\ ०००}$

ततः $\left(४°\frac{२९९०७७'}{५४०००}\right)$अहर्गण$=४°$ अहर्गण$+\frac{२९९०७७}{६०\times५४०००}\times$ अहर्गण

$=\left(४+\frac{२९९०७७}{६०\times५४०००}\right)^{\circ}$ अहर्गण

$=\left(४+\frac{१\times१२}{\frac{६०\times५४०००\times१२}{२९९०७७}}\right)^{\circ}$ अहर्गण$=\left(४+\frac{१२}{१३०}\right)^{\circ}$ अहर्गण

$=४$ अहर्गण$^{\circ}+\frac{६\ \text{अहर्गण}^{\circ}}{६५}$=बुधशीघ्रोच्चमंशाद्यम्, एतावताऽऽचार्योक्तमुपपद्यते।

$\left(४+\frac{१२}{१३०}\right)$ अहर्गण$=४$ अहर्गण$+\frac{४\times३\ \text{अहर्गण}}{१३०}$=बुधशीघ्रोच्चमंशाद्यम्, एतेन 'दिनगणः कृतसङ्गुणित' इत्यादि भास्करोक्तमप्युपपद्यत इति ॥ ४७ ॥

अथवोपपत्तिः

४°।५′।३२″।१८‴२८⁗=वास्तवबुधशीघ्रोच्चगतिः। ४°= अवास्तवबुधशीघ्रोच्चगतिः ३६०×कल्पबुधशीघ्रोच्चभगण=कल्पांशा बुधस्य, $\frac{४\times\text{ककु}}{१}$ =कल्पेऽवास्तवांशा बुधस्य।

अनयोरन्तरम्

$360 \times$ कल्पबुशीउभ $- 4$ कku $=$ कल्पेऽन्तरांशाः, ततोऽहर्गणस-अन्तरांशाः $=$

$$\frac{(३६० \times \text{कल्पबुशीउभ} - ४\text{ककु})\ \text{अहर्गण}}{\text{ककु}} = \frac{१२\ \text{अहर्गण}}{\dfrac{१२\ \text{ककु}}{३६०\ \text{कबुशीउभ} - ४\ \text{ककु}}}$$

$$= \frac{१२\ \text{अहर्गण}}{१३०}$$

अतोऽहर्गणसम्बन्धिवास्तवबुधशीघ्रोच्चांशाः $= ४$ अहर्गण $+ \frac{१२\ \text{अहर्गण}}{१३०}$

$= ४$ अहर्गण $+ \frac{६\ \text{अहर्गण}}{६५}$ एतेनाप्याचार्योक्तमुपपन्नम् ।।४७।।

अब मध्यम कुज और बुधशीघ्रोच्च के आनयन को कहते हैं

हि. भा.—कुज $= \frac{११\ \text{अहर्गण}}{२१}$ अंश $+ \frac{११\ \text{अहर्गण}}{८७५}$ कला तथा अंशादिबुधशीघ्रोच्च $= ४$ अहर्गण $+ \frac{६\ \text{अहर्गण}}{६५}$ ।।४७।।

उपपत्ति

रूपतुल्य अहर्गण मानकर 'महीमितादहर्गणात्फलानि यानि इत्यादि' भास्करोक्तविधि से कुज के आचार्योक्त प्रकार से यदि मध्यमगति लाते हैं तो ३१′।२६″।२८‴।७⁗ होती है, इतनी ही भास्करोक्त भी है, इस पर से विलोम विधि और खण्डगुणन सवर्णन आदि से आचार्योक्त मध्यम कुजानयन उपपन्न होता है ।।४७।।

बुधशीघ्रोच्चानयन के लिये विचार करते हैं

पूर्वोक्त प्रकार से आचार्योक्त विधि से एक दिन में बुधशीघ्रोच्च गति=४°।५′।३२″।१८‴।२८⁗ इससे अनुपात द्वारा बुधशीघ्रोच्चांश = अहर्गण (४°।५′।३२″।१८‴।२८⁗) = ४° अहर्गण + अहर्गण (५′।३२″।१८‴।२८⁗) अब ५′।३२″।१८‴।२८⁗ इसका स्वरूपान्तर करते हैं ५।३२।१८ $+ \frac{२८}{६०} =$ ५।३२।१८ $+ \frac{७}{१५}$

$$= ५।३२।\frac{२७० + ७}{१५} = ५।३२।\frac{२७७}{१५} = ५।३२ + \frac{२७७}{१५ \times ६०} = ५ + ३२ + \frac{२७७}{९००}$$

$$= ५।\frac{२८८०० + २७७}{९००} = ५।\frac{२९०७७}{९००} = ५ + \frac{२९०७७}{६० \times ९००} = ५ + \frac{२९०७७}{५४०००}$$

$$=\frac{२७०००० + २६०३३}{५००००} = \frac{२९६०७७}{५४०००} \therefore \left(४^\circ । \frac{२९६०७७'}{५४०००}\right) \times अहर्गण = ४^\circ अहर्गण$$

$$+ \frac{२९६०७७ अहर्गण}{६० \times ५४०००} = \left(४ + \frac{२९६०७७}{६० \times ५४०००}\right)^\circ \times अहर्गण$$

$$= \left(४ + \cfrac{१ \times १२}{\cfrac{६० \times ५४००० \times १२}{२९६०७७}}\right)^\circ + अहर्गण = \left(४ + \frac{१२}{१३०}\right)^\circ \times अहर्गण$$

$$= ४ अहर्गण^\circ + \frac{६ अहर्गण^\circ}{६५}$$ = अंशादिबुधशीघ्रोच्च, इससे आचार्योक्त उपपन्न हुआ।

$$\left(४ + \frac{१२}{१३०}\right) \times अहर्गण = ४ अहर्गण + \frac{४ \times ३ \times अहर्गण}{१३०}$$ = अंशादिबुशीउ,

इससे 'दिनगणः कृतसङ्गुणितः' इत्यादि भास्करोक्त उपपन्न हुआ ॥ ४७ ॥

अथवा

$४^\circ । ५' । ३२'' । १८''' । २८''''$ = वास्तवबुधशीघ्रोच्चगति, ४° = अवास्तव, बुधशीघ्रोच्चग $३६० \times$ कल्पबुधशीघ्रोच्चभगण = बुधशीघ्रोच्च के कल्पांश। $\frac{४ \times ककु}{१}$ = कल्प में अवास्तवबुधशीघ्रोच्चांश।

दोनों के अन्तर करने से

$३६० \times$ कल्प बुधशीउभ — ४ ककु = कल्प में वास्तव और अवास्तव के अन्तरांश

$$अतः अहर्गणसं अन्तरांश = \frac{(३६० \times कल्पबुशीउभ — ४ ककु) अहर्गण}{ककु}$$

$$= \cfrac{१२ अहर्गण}{\cfrac{१२ ककु}{३६० कबुशीउभ — ४ ककु}}$$

$$= \frac{१२ अहर्गण}{१२०} = अन्तरांश$$

इसलिए अहर्गणसंअवास्तवबुशीउच्चांश + अन्तरांश = वास्तवबुधशीघ्रोच्चांश-

$$= ४ अहर्गण + \frac{१२ अहर्गण}{१३०} = ४ अहर्गण + \frac{६ अहर्गण}{६५}$$ इससे भी आचार्योक्त उपपन्न हुआ ॥४७॥

प्रकारान्तरेणोपपत्तिः

अथ कल्पकुजभगणाः = २२९६८२८५२२,

कल्पकुदिनानि = १५७७९१६४५००००

ततोऽनुपातेन भागात्मिका दैनन्दिनी

$$\text{कुजगतिः} = \frac{\text{२२९६८२८५२२} \times \text{१२} \times \text{३०}}{\text{१५७७९१६४५००००}}$$

चतुर्भिरपवर्तनेन—

$$= \frac{\text{२२९६८२८५२२} \times \text{३} \times \text{३०}}{\text{३९४४७९११२५००}}$$

$$= \frac{\text{२०६७१४५६६९८०}}{\text{३९४४७९११२५००}}$$

$$= \text{०} + \cfrac{\text{१}}{\text{१} + \cfrac{\text{१}}{\text{१} + \cfrac{\text{१}}{\text{९} + \text{१} - \text{१} + \cfrac{\text{१७२१४३५२३८०}}{\text{१८९५००२१४६०}}}}}$$

$$= \text{०} + \cfrac{\text{१}}{\text{१} + \cfrac{\text{१}}{\text{१} + \cfrac{\text{१}}{\text{१०} - \left(\text{१} - \cfrac{\text{१७२१४३५२३८०}}{\text{१८९५००२१४६०}}\right)}}}$$

$$= \text{०} + \cfrac{\text{१}}{\text{१} + \cfrac{\text{१}}{\text{१} + \cfrac{\text{१}}{\text{१०} - \cfrac{\text{१७३५६६९०८०}}{\text{१८९५००२१४६०}}}}}$$

अत्रासन्नमानग्रहणेन—

लब्धयः क्रमेण = ०, १, १, १०

$$\text{आसन्नमानानि} = \frac{\text{०}}{\text{१}}, \frac{\text{१}}{\text{१}}, \frac{\text{१}}{\text{२}}, \frac{\text{११}}{\text{२१}},$$

अत्राचार्येण $\frac{\text{११}^{\circ}}{\text{२१}}$ दं मानं संगृह्य कर्म कृतम् ।

अत्र वास्तवभिन्नेऽ $\frac{२०६७१४५६६६८०}{३९४४७९११२५००}$ स्मिन्

समयोगवियोगेन—

भागात्मककुजः $= \frac{११^\circ}{२१} + \frac{२०६७१४५६६६८०}{३९४४७९११२५००} - \frac{११^\circ}{२१}$

$= \frac{११^\circ}{२१} + \frac{२१ \times २०६७१४५६६६८० - ११ \times ३९४४७९११२५००}{२१ \times ३९४४७९११२५००}$

$= \frac{११^\circ}{२१} + \frac{१७३५६६९०८०}{२१ \times ३९४४७९११२५००}$

$= \frac{११^\circ}{२१} + \frac{१७३५६६९०८० \times ६० \times ११}{२१ \times ३९४४७९११२५०० \times ११}$

$= \frac{११^\circ}{२१} + \frac{१७३५६६९०८० \times २० \times ११}{७ \times ३९४४७९११२५०० \times ११}$

$= \frac{११^\circ}{२१} + \frac{१७३५६६९०८० \times १० \times ११}{७ \times १९७२३९५५६२५० \times ११}$

$= \frac{११^\circ}{२१} + \frac{१७३५६६९०८०० \times ११'}{१५१८७४४५८३१२५०}$

$= \frac{११^\circ}{२१} + \frac{११'}{८७५ + \frac{३४१३८१२५०}{१७३५६६९०८००}}$

अत्र भिन्न $\frac{३४१३८१२५०}{१७३५६६९०८००}$ मिदं रूपाल्पत्वात् त्यक्तमाचार्येण।

अतो मध्यमः कुजोऽहर्गणान्ते भागादिकः

$= \left(\frac{११^\circ}{२१} + \frac{११'}{८७५}\right)$ अ

$= \frac{११अ^\circ}{२१} + \frac{११अ'}{८७५}$ उपपन्नं कुजानयनम्।

अत्र भाष्यकर्त्रा चतुर्वेदाचार्येण कुजानयनार्थं विलक्षणैव रीतिः प्रतिपादिता स्ववासनायाम्। तेन कल्पकुजभगणभागानां खण्डद्वयं विहितम्। तत्रैकखण्डम्=

८२६५२७६६४२८१, द्वितीयखण्डम्=३३०६०३६३९ अनयोर्योगः कल्पभूदिनभक्तो भागात्मकः कुजो भवति ।

$$\text{यथा}\ \frac{११\times ८२६५२७६६४२८१}{११\times १५७७९१६४५००००}+\frac{३३०६०३६३९\times ६०\times ११}{१५७७९१६४५०००० \times ११}$$

$$=\frac{११^{\circ}}{२१}+\frac{११'}{८७५}$$ उपपन्नं यथोक्तमिति ।

अथवा प्रकारान्तरेणोपपत्तिः

अत्राप्यनुपातेन भागात्मिका दैनन्दिनी बुधशीघ्रोच्चगतिः

$$=\frac{१७९३६९९८९८४}{४३८३१०१२५०}$$

$$=४^{\circ}+\frac{४०४५९३९८४^{\circ}\times १२}{४३८३१०१२५०\times १२}$$

$$=४^{\circ}+\frac{१२^{\circ}}{१३०}$$ स्वल्पान्तरात् ।

$$=४^{\circ}+\frac{६^{\circ}}{६५}\ \cdots\cdots\cdots\cdots(१)$$

अतोऽहर्गणान्ते भागादिक बुधशीघ्रोच्चम्$=४\ \text{अ}^{\circ}+\frac{६\ \text{अ}^{\circ}}{६५}$ अत्र (१) समीकरणेन भास्कराचार्योक्तम् ।

हि. भा.—आचार्य के मत से कल्प में पठित कुज का भगण—यहां भास्कराचार्य ने $\frac{१}{२}$ आसन्नमान स्वीकार कर यथोक्त रूप से क्रिया करने पर "दिनगणार्धमधो गुणसंगुणं" इत्यादि भास्कर का प्रकार और $\frac{११}{२१}$ इस आसन्न मान पर से "अहर्गणे युगाहते" इत्यादि श्रीपति का राश्यादिक कुजानयन उपपन्न होता है ।।४७।।

इदानीं गुरुशुक्रशीघ्रोच्चयोरानयनमाह

द्युगणेषु वधो लिप्ता जीवः कृतशरगुणैः शरकलोनः ।
भागकलाः सितशीघ्रं विषयैर्वसवो द्विषष्ट्याष्टौ ।। ४८ ।।

वा. भा.—तथा जीवस्य, यद्येकेन दिनेन पञ्चलिप्तास्तदिष्टाहर्गणेन किमिति । तदिष्टाहर्गणादिनैः कियत्य इति लब्धा फलद्वयान्तररविमण्डलान्तात् गुरुः । शुक्रस्यापि यदि पञ्चभिर्दिनैरष्टौ भागा भवन्ति तदिष्टाहर्गणेन किमिति । पुनर्यदीष्टदिनैरष्टौ लिप्ता भवन्ति तदिष्टाहर्गणेन किमिति फलद्वययोगः शुक्रः ।।४८।।

वि. भा.—कलात्मको गुरुः=५ अहर्गण—$\frac{\text{५ अहर्गण}}{\text{३५४}}$, महीमितादहर्गणादित्यादिना रूपतुल्याहर्गणेऽर्थादेकस्मिन् दिने कलादिका गुरुगतिः=०।४'।५९''।९'''।९'''' भास्करोक्तापीयमेव।

एवं शुक्रशीघ्रोच्चम्=$\frac{\text{८ अहर्गण}}{\text{५}}$ अंशाः—$\frac{\text{८अहर्गण}}{\text{६२}}$ कलाः, अत्राप्येकस्मिन् दिनेंऽशादिका शुक्रशीघ्रोच्चगतिः=१°।३६'।७''।४४'''।३१'''' अत्र भास्करमतेन ३१ स्थाने ३५ समागच्छन्ति सावयवे ॥४८॥

अत्रोपपत्तिः

एकस्मिन् दिने गुरोः कलादिकागतिः=४'।५९''।९'''।९'''', अत्र ५'=अवास्तवगतिर्गुरोः स्वीक्रियते तदा वास्तवावास्तवगत्योरन्तरम्=अवास्तवगुगति—वास्तवगुगति=५'—(४'।५९''।९'''।९'''')=०'।०''।५०'''।५१''''।०''।५०'''।५१''''

एतस्य स्वरूपान्तरं क्रियते ५०'''।५१''''=५०+$\frac{५१}{६०}$=५०+$\frac{१७}{२०}$=$\frac{१०००+१७}{२०}$

=$\frac{१०१७'''}{२०}$ ततः ०''+$\frac{१०१७}{२०\times६०}$=$\frac{१०१७''}{१२००}$ ∴ ०'+$\frac{१०१७}{१२००\times६०}$=$\frac{१०१७}{७२०००}$

=$\frac{१}{\frac{७२०००}{१०१७}}$=$\left(\frac{१}{७१}\right)'$ स्वल्पान्तरात्=$\frac{५}{७१\times५}$=$\frac{५}{३५५}$=$\frac{५'}{३५८}$ अतो गुरोवास्तवगतिः=५'−$\frac{५'}{३५४}$ ततोऽहर्गणसम्बन्धिकलात्मकगुरुः=५ अहर्गण—$\frac{\text{५ अहर्गण}}{\text{३५४}}$

एतावताऽऽचार्योक्तं गुरोरानयनमुपपन्नम्। ५'—$\frac{१'}{७१}$=वास्तवगुरुगति। अत्र प्रथमखण्डस्यांशात्मककरणेन $\frac{५}{६०}$−$\frac{१'}{७१}$=$\left(\frac{१}{१२}\right)^{\circ}$−$\left(\frac{१}{७१}\right)'$ ततोऽहर्गणसम्बन्धिगुरुः=$\left(\frac{\text{अ}}{१२}\right)^{\circ}$−$\left(\frac{\text{अहर्गण}}{७१}\right)'$ एतावता 'द्युमणिभिः कुनगैरित्यादि' भास्करोक्तमप्युपपद्यत इति।

अब गुरु और शुक्रशीघ्रोच्च का आनयन करते हैं

हि. भा.—कलात्मक गुरु=५ अहर्गण—$\frac{\text{५ अहर्गण}}{\text{३५४}}$, रूपतुल्य अहर्गण से कलादिक गुरुगति =४'।५९''।९'''।९'''' यही भास्करोक्त भी है। एवं शुक्रशीघ्रोच्च=$\frac{\text{८ अहर्गण}}{\text{५}}$ अंश—

$\frac{\text{८ अहर्गण}}{\text{६२}}$ कला, यहां भी एक दिन में शुक्रशीघ्रोच्चगति अंशादिक $=१^{\circ}।२६'।७''।४४'''।$
$३१''''$ भास्कर मत से ३१ के स्थान में ३५ आता है ।

गुरु के आनयन के लिये विचार करते हैं

एक दिन में गुरु की कलादिक गति $=४'।५९''।८'''।९''''$, यहां $५'$ गुरु की अवास्तव गति मानते हैं तब वास्तव और अवास्तव गतियों के अन्तर $=$ अवास्तवगुरुगति $-$ वास्तवगुरुगति $=५'-(४'।५९''।८'''।९'''')=०'।०''।५०'''।५१''''$ यहां $०''।५०'''।५१''''$ इसका स्वरूपान्तर करते हैं $५०'''।५१''''=५०+\frac{५१}{६०}=५०+\frac{१७}{२०}$
$=\frac{१०००+१७}{२०}=\frac{१०१७'''}{२०}\therefore ०''+\frac{१०१७}{२०\times ६०}=\frac{१०१७''}{१२००}$ कलात्मक करने से $०'+$
$\frac{१०१७}{६०\times १२००}=\frac{१०१७}{७२०००}=\frac{१}{\frac{७२०००}{१०१७}}=\left(\frac{१}{७१}\right)'$ स्वल्पान्तर से, $\frac{१}{७१}=\frac{५}{७१\times ५}=\frac{५}{३५५}$
$=\left(\frac{५}{३५४}\right)'$ $\therefore$ गुरुवास्तवगति $=५'-\frac{५'}{३५४}$, अहर्गणसम्बन्धि कलात्मक गुरु $=$ $(५\text{ अहर्गण})'-\left(\frac{५\text{ अहर्गण}}{३५४}\right)'$ इससे आचार्योक्त उपपन्न हुआ ।

$५'-\frac{१'}{७१}=$ वास्तव गुरुगति, यहां प्रथम खण्ड को अंशात्मक करने से $\frac{५}{६०}-\frac{१'}{७१}$
$=\left(\frac{१}{१२}\right)^{\circ}-\left(\frac{१}{७१}\right)'\therefore$ अहर्गणसम्बन्धि गुरु $=\left(\frac{\text{अहर्गण}}{१२}\right)^{\circ}-\left(\frac{१}{७१}\right)'$ इससे 'द्युमणिभिः कुनगैः' इत्यादि भास्करोक्त उपपन्न होता है ।

शुक्रशीघ्रोच्चानयनार्थमुपपत्तिः

अत्रैकदिने शुक्रशीघ्रोच्चगतिः $=१^{\circ}।३६'।७''।४४'''।३५''''$, अत्र स्वल्पान्तरात् $१^{\circ}।४०'$ इति गृह्यते तदा $१^{\circ}।४०'=$ अवास्तवशुशीउग । अथ वास्तवावास्तवशुक्रशीघ्रोच्चगत्योरन्तरम् $=१^{\circ}।४०-(१^{\circ}।३६'।७''।४४'''।३५'''')=३'।५३''।१५'''।२५''''$ अथ $१^{\circ}।४०'$
$=१+\frac{४०}{६०}=१+\frac{२}{३}=\frac{३+२}{३}=\frac{५}{३}=$ प्रथमखण्डम् । $३'।५२''।१५'''।२५''''=$ द्वितीयखण्ड, प्रथमखण्ड $-$ द्वितीयखण्ड $=१^{\circ}।३६'।७''।४४'''।३५''''=$ वास्तवशुशीउगति ।

$$\text{३}'।\text{५२}''।\text{१५}'''।\text{२५}'''' = \text{३।५२।१५} + \frac{\text{२५}}{\text{६०}} = \text{३।५२।१५} + \frac{\text{५}}{\text{१२}} = \text{३।५२।}$$

$$\frac{\text{१८०}+\text{५}}{\text{१२}} = \text{३।५२।}\frac{\text{१८५}}{\text{१२}} = \text{३।५२} + \frac{\text{१८५}}{\text{१२}\times\text{६०}} = \text{३।५२} + \frac{\text{३७}}{\text{१२}\times\text{१२}} = \text{३।५२}$$

$$+\frac{\text{३७}}{\text{१४४}} = \text{३।}\frac{\text{५२}\times\text{१४४}+\text{३७}}{\text{१४४}} = \text{३।}\frac{\text{७५२५}}{\text{१४४}} = \text{३} + \frac{\text{७५२५}}{\text{६०}\times\text{१४४}} = \text{३} + \frac{\text{१५०५}}{\text{१२}\times\text{१४४}}$$

$$= \frac{\text{३}\times\text{१२}\times\text{१४४}+\text{१५०५}}{\text{१७२८}} = \frac{\text{६६८९}}{\text{१७२८}} \text{ ततः } \left(\frac{\text{६६८९}}{\text{६०}\times\text{१७२८}}\right)^\circ = \left(\frac{\text{६६८९}}{\text{१०३६८०}}\right)^\circ$$

$$= \frac{\text{१०}^\circ}{\frac{\text{१०३६८००}}{\text{६६८९}}} = \frac{\text{१०}^\circ}{\text{१५५}} \text{ स्वल्पान्तरात् } \therefore \text{ प्रथमखं — द्वितीयखं = वास्तवशुशीउग} = \frac{\text{५}}{\text{३}}$$

$$-\frac{\text{१०}}{\text{१५५}} = \frac{\text{१०}}{\text{६}} - \frac{\text{१०}}{\text{१५५}} = \frac{\text{१०}\times\text{८}}{\text{६}\times\text{८}} - \frac{\text{२}}{\text{३१}} = \frac{\text{८}}{\frac{\text{६}\times\text{८}}{\text{१०}}} - \frac{\text{२}}{\text{३१}} = \frac{\text{८}}{\frac{\text{४८}}{\text{१०}}} - \frac{\text{२}}{\text{३१}} = \frac{\text{८}}{\text{५}} - \frac{\text{२}}{\text{३१}}$$

$$= \frac{\text{८}}{\text{५}} - \frac{\text{४}}{\text{६२}}$$ अत्र द्वितीयखण्डस्य कलात्मककरणेन $\frac{\text{८}}{\text{५}} = \frac{\text{४}}{\text{६२}}\times\text{६०} = \frac{\text{८}}{\text{५}} - \frac{\text{४}\times\text{२}}{\text{६२}}$ $\times\,\text{३०} = \frac{\text{८}}{\text{५}} - \frac{\text{८}}{\text{६२}}\times\text{३०}$ पूर्वमाचार्योक्तशुक्रशीघ्रोच्चगतौ १°।३६'।७''।४४'''।३१'''' ३१ स्थाने ३५ गृहीत्वोपपत्तिः कृतेत्यतः स्वल्पान्तरात् $\frac{\text{८}}{\text{५}} - \frac{\text{८}}{\text{६२}}$ गृहीतम् ततोऽहर्गणसम्बन्धिशुक्रशीघ्रोच्चम् $- \frac{\text{८ अहर्गण}}{\text{५}} - \frac{\text{८ अहर्गण}}{\text{६२}}$ एतेनोपपन्नमाचार्योक्तम् । तथा च पूर्वोक्तोपपत्तौ प्रथमखं — द्वितीयखं $= \frac{\text{५}^\circ}{\text{३}} - \frac{\text{१०}^\circ}{\text{१५५}} = \frac{\text{१०}}{\text{६}} - \frac{\text{१०}^\circ}{\text{१५५}} =$ वास्तवशुशीउग, ततः शुक्रशीघ्रोच्चम् $= \frac{\text{१०}^\circ\text{ अहर्गण}}{\text{६}} - \frac{\text{१०}^\circ\text{ अहर्गण}}{\text{१५५}}$ एतेन 'ऋतुभिरक्षदिनैरित्यादि' भास्करोक्तमपि शुक्रशीघ्रोच्चानयनमुपपद्यत इति ॥४८॥

शुक्रशीघ्रोच्चानयन के लिये उपपत्ति

एक दिन में शुक्रशीघ्रोच्चगति = १°।३६'।७''।४४'''।३१'''' यहां अन्तिमावयव ३१ के स्थान में ३५ लेकर क्रिया करते हैं तब शुक्रशीउग = १°।३६'।७''।४४'''।३५'''' यहां स्वल्पान्तर से १°।४०' ग्रहण करते हैं तब १°।४०' = अवास्तवशुशीउग, अब वास्तव और अवास्तव शुक्रशीघ्रोच्चगति के अन्तर करने से १°।४०' — (१°।३६'।७''।४४'''।३५'''') = ३'।५२''।१५'''।२५'''', यहां १°।४०' = प्रथमखण्ड, ३'।५२''।१५'''।२५'''' = द्वितीयखण्ड तब प्रथम खण्ड — द्वितीय खण्ड = १°।४०' — (३'।५२''।१५'''।२५'''') = १°।३६'।७''।४४''।

३५''''=वास्तवशुशीउग $१^{\circ}।४'०=१+\frac{४०}{६०}=१+\frac{२}{३}=\frac{३+२}{३}=\frac{५^{\circ}}{३}=$ प्रथम खण्ड,

$३'।५२''।१५'''।२५''''=३।५२।१५+\frac{२५}{६०}=३।५२।१५+\frac{५}{१२}=३।५२।\frac{१८०+५}{१२}=३।५२।$

$\frac{१८५}{१२}=३।५२+\frac{१८५}{६०\times १२}=३।५२+\frac{३७}{१२\times १२}=३।५२+\frac{३७}{१४४}=३।$

$\frac{५२\times १४४+३७}{१४४}=३।\frac{७५२५}{१४४}=३+\frac{७५२५}{६०\times १४४}=३+\frac{१५०५}{१२\times १४४}$

$=\frac{३\times १२\times १४४+१५०५}{१७२८}=\frac{६६८९}{१७२८}$ अंशात्मक करने से $\frac{६६८९}{६०\times १७२८}=\frac{६६८९}{१०३६८०}$

$=\frac{६६८९\times १०}{१०३६८०\times १०}=\frac{१०}{\frac{१०३६८०\times १०}{६६८९}}=\frac{१०}{१५५}$ स्वल्पान्तर से,

∴ प्रथम खण्ड—द्वितीय खण्ड=वास्तव शुक्रशीउग= $\frac{५}{३}-\frac{१०}{१५५}=\frac{१०}{६}-\frac{१०}{१५५}$

$=\frac{१०\times ८}{६\times ८}-\frac{२}{३१}=\frac{८}{\frac{६\times ८}{१०}}-\frac{२}{३१}=\frac{८}{\frac{४८}{१०}}-\frac{२}{३१}=\frac{८}{५}-\frac{२}{३१}=\frac{८}{५}-\frac{४}{६२}$ यहां द्वितीय खण्ड

को कलात्मक करने से $\frac{८}{५}-\frac{४}{६२}\times ६०=\frac{८}{५}-\frac{८}{६२}\times ३०$ पहले शुक्रशीघ्रोच्चगति १°।३६'। ७''।४४'''।३१'''' में ३१ के स्थान में ३५ ग्रहण कर उपपत्ति की गई है, इसलिये स्वल्पान्तर से $\frac{८}{५}-\frac{८}{६२}$ यहीं ग्रहण करते हैं तब अहर्गण-सम्बन्धि-शुक्रशीघ्रोच्च= $\frac{८\text{ अहर्गण}}{५}$ $-\frac{८\text{ अहर्गण}}{६२}$ इससे आचार्योक्त उपपन्न हुआ। पहले की उपपत्ति में प्रथमखं—द्वितीयखं $=\frac{५}{३}-\frac{१०}{१५५}=\frac{१०}{६}-\frac{१०}{१५५}=$ शुक्रशीघ्रोच्चगति ∴ शुक्रशीघ्रोच्च= $\frac{१०^{\circ}\text{ अहर्गण}}{६}$ $-\frac{१०^{\circ}\text{ अहर्गण}}{१५५}$ इससे 'ऋतुभिरक्षदिनैः' इत्यादि भास्करोक्त शुक्रशीघ्रोच्चानयन उपपन्न हुआ ॥ ४८ ॥

प्रकारान्तरेणोपपत्तिः

कल्पशुक्रभगणैस्तत्रत्यैः कुदिनैश्चानुपातेन भागात्मिका दैनन्दिनी शुक्रगतिः= $\frac{७०२२३८९४९२^{\circ}}{४३८३१०१२५०}$

$$= १ + \cfrac{१}{१ + \cfrac{१}{१ + \cfrac{१}{१ + \cfrac{१}{१ + \frac{४७१३७४६०}{८४८३३७७७४}}}}}$$

अत्रासन्नमानानयने क्रमे लब्धयः

लब्धयः = १, १, १, १, १,

आसन्नमानानि $= \frac{१}{१}, \frac{२}{१}, \frac{३}{२}, \frac{५}{३}, \frac{८}{५}$ अत्राचार्येण $\frac{८}{५}$ दमासन्नमानं परिगृहीतम् । इदमासन्नमानं वास्तवभिन्नेऽ $\frac{७०२२३८६४६२}{४३८३१०१२५०}$ स्मिन् योजने वियोजने च तन्मौल्यं न हीयते ।

अतः शीघ्रोच्चगतिः शुक्रस्य

$$= \frac{७०२२३८६४६२}{४३८३१०१२५०} + \frac{८}{५} - \frac{८}{५}$$

$$= \frac{८^{\circ}}{५} + \frac{७०२२३८६४६२}{४३८३१०१२५०} - \frac{८}{५}$$

$$= \frac{८^{\circ}}{५} + \frac{५ \times ७०२२३८६४६२ - ८ \times ४३८३१०१२५०}{५ \times ४३८३१०१२५०}$$

$$= \frac{८^{\circ}}{५} + \frac{४७१३७४६० \times ६० \times ८}{५ \times ४३८३१०१२५० \times ८}$$

$$= \frac{८^{\circ}}{५} + \frac{८'}{६२}$$

अत्र $\frac{५ \times ४३८३१०१२५० \times ८}{४७१३७४६० \times ६०}$

$$= \frac{४३८३१०१२५० \times २}{४७१३७४६० \times ३}$$

= ६२ स्वल्पान्तरादर्धाधिके रूपग्रहणाच्च ।

अतोऽहर्गणान्ते

$$\text{शुक्रः} = \frac{\text{अ ८}'}{५} + \frac{\text{८ अ}'}{६२}$$ उपपन्नमाचार्योक्तम् ।

इदानीं शनिचन्द्रोच्चयोरानयनमाह

द्विगुणः कला दिनगणस्तिथिरामैर्द्वे कले च सूर्यसुतः ।
नवभिर्भागः सागरखशून्यवेदैश्च चन्द्रोच्चम् ॥ ४९॥

वा. भा.—शनेरपि यद्येकेन दिनेन लिप्ताद्वयं तदिष्टाहर्गणेन किमिति पुनश्च तिथिरामसंख्यैर्दिनैर्यदि द्वे कले भवतः तदिष्टाहर्गणेन किमिति फलद्वययोगः शनिः । अथ चन्द्रोच्चस्य यदि नवभिर्दिनैः भागो भवति तदिष्टाहर्गणेन किमिति पुनश्च सागरखशून्यवेदैश्च यदि सावनैरेको भागः तदिष्टाहर्गणेन किमिति फलद्वय-योगः चन्द्रोच्चम् ॥४९॥

वि. भा.—श्लोकोक्त्या कलात्मकशनिः $= २ \text{ अहर्गण} + \frac{२ \text{ अहर्गण}}{३१५}$,

$$\text{चन्द्रोच्चमंशाद्यम्} = \frac{\text{अहर्गण}}{९} + \frac{\text{अहर्गण}}{४००४}$$ ॥४९॥

अत्रोपपत्तिः

अत्रैकदिने शनेः कलादिकागतिः $= २'।०''।२२'''।५१''''$, एतावत्येव भास्क-रोक्ताप्यस्ति ।

अथ $०''।२२'''।५१'''' = ०।२२ + \frac{५१}{६०} = ०।२२ + \frac{१७}{२०} = ०।\frac{४४० + १७}{२०} = ०।\frac{४५७}{२०} = ० + \frac{४५७}{६० \times २०} = \frac{४५७}{१२००} = \frac{४५७ \times २}{१२०० \times २} = \frac{२}{\frac{१२०० \times २}{४५७}} = \frac{२''}{५}$ कला-त्मक करणेन $\frac{२}{५ \times ६०} = \frac{२}{३००} = \frac{२}{३१५}$ स्वल्पा ततः शनिगतिः $२' + \frac{२'}{३१५}$ ततः कलात्मकशनिः $= २ \text{ अहर्गण}' + \frac{२ \text{ अहर्गण}'}{३१५}$ एतेनाचार्योक्तमुपपद्यते । यदि चै $\frac{'२}{'५}$ तत्कलात्मकं न क्रियते तदा $२' + \frac{२''}{५} = $ शनिगतिः, ततः शनिः $= २ \text{ अहर्गण}'$

$+\frac{\text{२ अहर्गण}''}{\text{५}}$ एतेन 'द्विघ्नो दिनौघः पृथगक्षभक्तो लिप्ता विलिप्ता ध्रुवकेस्वमार्किरिति' भास्करोक्तमुपपद्यत इति ।

एवमेवैकदिनसम्बन्धिनीमाचार्योक्तां कलादिकां ६'।४०''।५३'''।५६'''' चन्द्रोच्चगतिं संगृह्य पूर्वोक्तवत्क्रियाकरणेन चन्द्रोच्चमंशाद्यम् $+\frac{\text{अहर्गण}}{\text{९}}=\frac{\text{अहर्गण}}{\text{४००४}}$ एतावताऽऽचार्योक्तं सर्वमुपपद्यत इति ।।४९।।

अब शनि और चन्द्रोच्च के आनयन को कहते हैं

हि. भा.—श्लोकोक्ति से कलात्मकशनि $=$ २ अहर्गण $+\frac{\text{२ अहर्गण}}{\text{३१५}}$, अंशादि-चन्द्रोच्च $=\frac{\text{अहर्गण}}{\text{९}}+\frac{\text{अहर्गण}}{\text{४००४}}$ ।।४९।।

उपपत्ति

एकदिन में शनि की कलादिक गति $=$ २'।०''।२२'''।५१'''' भास्कराचार्योक्त भी इतनी ही है, ०''।२२'''।५१'''' $=$ ०।२२ $+\frac{\text{५१}}{\text{६०}}=$ ०।२२ $+\frac{\text{१७}}{\text{२०}}=$ ०। $\frac{\text{४४०+१७}}{\text{२०}}$

$=$ ०। $\frac{\text{४५७}}{\text{२०}}=$ ० $+\frac{\text{४५७}}{\text{६०}\times\text{२०}}=\frac{\text{४५७}}{\text{१२००}}=\frac{\text{४५७}\times\text{२}}{\text{१२००}\times\text{२}}=\frac{\text{२}}{\frac{\text{१२००}\times\text{२}}{\text{४५७}}}$

$=\frac{\text{२}''}{\text{५}}$ कलात्मक करने से $\frac{\text{२}}{\text{५}\times\text{६०}}=\frac{\text{२}}{\text{३००}}=\frac{\text{२}}{\text{३१५}}$ स्वल्पान्तर से ∴ शनिगति $=$ २' $+\frac{\text{२}'}{\text{३१५}}$ अतः कलात्मकशनि $=$ २ अहर्गण' $+\frac{\text{२ अहर्गण}'}{\text{३१५}}$ इससे आचार्योक्त उपपन्न हुआ । यदि $\frac{\text{२}''}{\text{५}}$ इसको कलात्मक नहीं करते हैं तो शनिगति $=$ २' $+\frac{\text{२}''}{\text{५}}$ अतः शनि $=$ अहर्गण $\left(\text{२}'+\frac{\text{२}''}{\text{५}}\right)=$ २ अहर्गण' $+\frac{\text{२ अहर्गण}'}{\text{५}}$ इससे 'द्विघ्नो दिनौघः पृथगक्षभक्तो लिप्ता विलिप्ता इत्यादि' भास्करोक्त उपपन्न होता है ।। एवं एकदिनसम्बन्धिनी आचार्योक्त कलादिक चन्द्रोच्चगति ६'।४०''।५३'''।५६'''' से पूर्वोक्तवत् क्रिया करने से

अंशादि चन्द्रोच्च $= \frac{\text{अहर्गण}}{९} = \frac{\text{अहर्गण}}{४००४}$ होता है, इससे आचार्योक्त सब उपपन्न हुआ ॥४९॥

प्रकारान्तरेण वोपपत्तिः

अत्रापि कल्पशनिभगणैः कुदिनैश्च कलात्मिका दैनन्दिनी शनिगतिः

$$= \frac{१४६५६७२९८ \times १२ \times ३० \times ६०}{१५७७९१६४५००००}$$

$$= \frac{१४६५६७२९८० \times ६०}{४३८३१०१२५००} = \frac{८७९४०३७८८००}{४३८३१०१२५००}$$

$$= २' + \frac{२७८३५३८० \times २}{४३८३१०१२५० \times २} = २' + \frac{२'}{३१५}$$ स्वल्पान्तरात् अतोऽहर्गणान्ते

कलात्मिका शनिगतिः $= २\ अ' + \frac{२\ अ'}{३१५}$

अथवा प्रकारान्तरेण चन्द्रोच्चमध्यमानयनोपपत्तिः। अत्रानुपातेन भागात्मिका दैनन्दिनी चन्द्रोच्चगतिः

$$= \frac{४८८१०५८५८}{४३८३१०१२५०}$$

$$= ०^{\circ} + \cfrac{१}{८ + \cfrac{४५८२५४३८६}{४८८१०५८५८}}$$

$$= ०^{\circ} + \cfrac{१}{८ + \cfrac{१}{१ + \cfrac{२९८५१४७२}{४५८२५४३८६}}}$$

अत्रासन्नमानानयने—

लब्धयः क्रमेण $= ०, ८, १$

आसन्नमानानि $= \frac{०}{१}, \frac{१}{८}, \frac{१}{९}$ अत्राचार्येण $\frac{१}{९}$ दमासन्नमानं स्वीकृतम्।

ततो वास्तवभिन्नेना $\frac{४८८१०५८५८}{४३८३१०१२५०}$ नेन सह योगान्तरेण लब्धौ विकाराभावात्

$$\text{भागात्मक चन्द्रोच्चम्} = \frac{१^\circ}{९} + \frac{४८८१०५८५८}{४३८३१०१२५०} - \frac{१}{९}$$

$$= \frac{१^\circ}{९} + \frac{४३९२९५२७२२ - ४३८३१०१२५०}{९ \times ४३८३१०१२५०}$$

$$= \frac{१^\circ}{९} + \frac{९८५१२७२}{३९४४७९११२५०}$$

$$= \frac{१^\circ}{९} + \frac{१^\circ}{४००४} \text{ स्वल्पान्तरात् ।}$$

अतोऽहर्गणान्ते चन्द्रोच्चम्

$$= \frac{\text{अ}^\circ}{९} + \frac{\text{अ}^\circ}{४००४} \text{ उपपन्नम् ।}$$

इदानीं चन्द्रपातानयनमिष्टदिने ग्रहानयनं चाह

द्युगणो नन्दशशाङ्कैः शशिशून्यस्वरयमैश्च शशिपातः ।
रविमण्डलान्तिकयुता मध्या भगणान्तगाः शेषाः ॥ ५० ॥

वा. भा.—अथ पातस्य यदि नन्दशशांकसंख्यैः सावनैरेको भागो भवति तदिष्टाहर्गणेन किमिति पुनश्च शशिशून्यस्वरयमसंख्यैर्यदि वासरैरेको भागो भवति तदिष्टाहर्गणेन किमिति फलद्वययोगश्चन्द्रपातः । एवं रविमण्डलान्ताहर्गणादिष्टादन्यस्मात् वा ग्रहात् फलानयनम् । वासना चात्र भूदिनैः कल्पभगणभागैश्च प्रदर्श्य सर्वेषां भौमस्य मया प्रदर्श्यते । तद्यथा कल्पार्कसावनदिनानां भौमकल्पभगणभागानां चापवर्त्तनं कथमपि न शक्यते कर्त्तुमतो भौमकल्पभगणभागस्य इष्टैः भागैस्तथोनः क्रियते यावद्भूदिनैः सहापवर्त्तनं प्रयच्छति ते चेष्टभागा नवगुणरसाग्निखरसशून्यत्रिगुणाः ३३०६०३६३९ एतैरूना कल्पे भौमभगणभागाः खयमनवागरसद्विवसुपंचाष्टरसद्विवसवः ८२६८५८२६७९२० जाताः शेषभागाः चन्द्राष्टद्विकुनरसषट्सप्तयमेषुरसद्विवसवः ८२६५२७६६४२८१ एतैः भूदिनानामपवर्त्तनं प्रयच्छन्ति अतस्तावदपवर्त्यते एत एव रूपागशरवसुत्रिचन्द्रशरागाः ७५१३८५७१ अपवर्त्तिता जाता एकादशभूदिवसाः । अथानेनैवापवर्त्तिता जाता एकविंशतिः एवमिन्दुयमैः सावनैरेकादशभागा भौमस्य भवन्तीदानीं पूर्वत्यक्तभागैः षष्टिगुणैः सह भूदिनानामपवर्त्तनं क्रियते । तद्यथा रसवसुखगुणाग्नित्रिवह्निशून्याष्टचन्द्रैः १८०३३३३०८६ भूदिवसा अपवर्त्तिता जाताः शरसप्तवसवः पूर्वत्यक्तभागैश्च षष्टिगुणा जाताः खवेदाग्निवसुचन्द्रद्विरसगुणाष्टनवचन्द्राः १९८३६२१८३४० अपवर्त्तिताः तेनैवापवर्त्तकराशिना जाता एकादशलिप्ताः यतः षष्ठगुण-

भागा अपवर्त्तिता अतः शरसप्तवसुभिः सावनै रेकादशलिप्ताश्च भवन्ति। एवं सर्वग्रहाणां मन्दशीघ्रपातानामपि स्वधियाचार्येण त्रैराशिकवासना प्रकल्पिता लघ्वर्थं गणकैरपि यथासम्भवं सर्वेषां योज्यं ततोऽनेन प्रकारेण ग्रहाः राश्यादिकाः समागतास्ते रविमेषादेरारभ्यते। रविमण्डलान्तिकयुतमध्या इति रविमण्डलान्तावधिः यवस्वनेन मध्यमेन युताः सन्तोऽभीष्टदिनोन्मण्डलकालिका मध्यरेखायां भवन्तीत्यर्थः। भगणान्तिका शेषा इति येषां वर्षांतिकादहर्गणादानयनं नोक्तं ते शेषाश्चन्द्रवर्जानां मध्यपाता रविमण्डलान्तावधिजा एव तेऽभीष्टदिने मध्यमाः भवन्ति यतस्तेषां वर्षमध्ये विशेषो नास्तीति स्वल्पत्वात्तद्गतेरतः किमायासेनेत्यर्थः। एवं तावदुन्मण्डलका मध्या आनीताः ॥५०॥

वि भा.—अंशात्मकश्चन्द्रपातः $=\frac{\text{अहर्गण}}{१९}+\frac{\text{अहर्गण}}{२००१}$, रविमण्डलान्तिकयुताः रविभगणान्तेऽर्थाद्रविवर्षान्ते पूर्वं ये ग्रहा आनीतास्तैरहर्गणोत्पन्नग्रहा युक्ताः तदेष्टदिनोदयकाले मध्या ग्रहा भवन्ति, शेषाः (मन्दोच्चादयः) भगणान्तगा अर्थाद्रविवर्षान्तोत्पन्ना एवेष्टदिने बोध्यास्तेषां गत्यल्पत्वादिति ॥५०॥

अत्रोपपत्तिः।

आचार्यमतेनैकस्मिन् दिने कलादिका चन्द्रपातगतिः $=३'।१०''।४८'''।२२''''$

एतद्वशेन पूर्वोक्तान्यग्रहादिसाधनोक्तक्रियाकरणेनांशात्मकश्चन्द्रपातः $=\frac{\text{अहर्गण}}{१९}+\frac{\text{अहर्गण}}{२७०१}$ सिद्धयतीति। शेषं भाष्ये स्पष्टं प्रतिपादितमेवेति ॥ ५० ॥

अब चन्द्रपातानयन और इष्ट दिन में ग्रहानयन को कहते हैं

हि. भा.—श्लोकोक्ति से अंशात्मक चन्द्रपात $=\frac{\text{अहर्गण}}{१९}+\frac{\text{अहर्गण}}{२००१}$, अहर्गणोत्पन्नग्रहों में रविवर्षान्तकालिकग्रहों (जो कि पहले साधित हैं) को जोड़ने से इष्ट काल में मध्यम ग्रह होते हैं, शेष (मन्दोच्चादि) रविवर्षान्तकालिक जो हैं वही इष्टकालिक भी समझने चाहियें क्योंकि उनकी गति बहुत अल्प है इति ॥ ५० ॥

उपपत्ति

आचार्यमत से एक दिन में चन्द्रपातगतिकलादिक $=३'।१०''।४८'''।२२''''$ इससे जैसे पहले तत्तद्ग्रहों की दैनन्दिनी गतिवश से साधन किया गया है, उसी तरह साधन

करने से अंशात्मक चन्द्रपात $= \frac{\text{अहर्गण}}{१९} + \frac{\text{अहर्गण}}{२७०१}$, शेष बातें भाष्य में प्रतिपादित हैं, इससे आचार्योक्त उपपन्न हुआ, इति ।। ५० ।।

प्रकारान्तरेणोपपत्तिः

अत्रापि प्राग्वदनुपातेन भागात्मिका दैनन्दिनी विलोमा चन्द्रपातगतिः

$$= \frac{२३२३१११६८}{४३८३१०१२५०}$$

$$= ० + \cfrac{१}{१८ + \cfrac{१}{१ + \cfrac{२०८१०९४२}{२११५००२२६}}}$$

अत्राप्यासन्नमानानयने

लब्धयः ०, ८, १

आसन्नमानानि $\frac{०}{१}$, $\frac{१}{१८}$, $\frac{१}{१९}$ अग्रिमेऽवयवत्यागात् ।

$$\therefore \text{ पातगतिः} = \frac{१^{\circ}}{१९} + \frac{२३२३१११६८}{४३८३१०१२५०} - \frac{१}{१९}$$

$$= \frac{१^{\circ}}{१९} + \frac{१९ \times २३२३१११६८ - ४३८३१०१२५०}{१९ \times ४३८३१०१२५०}$$

$$= \frac{१^{\circ}}{१९} + \frac{४४१३९१२१९२ - ४३८३१०१२५०}{८३२७८९२३७५०}$$

$$= \frac{१^{\circ}}{१९} + \frac{३०८१०९४२}{८३२७८९२३७५०}$$

$$= \frac{१^{\circ}}{१९} + \frac{१}{२७०३} \text{ स्वल्पान्तरात्}$$

अत्राचार्येण ३ स्थाने १ गृहीतमतोऽस्यां पातगतौ किञ्चिदन्तरं भवितुमर्हति । विद्भिर्विवेचनीयम् । वस्तुतो विचार्यमाणे तथा सति तत्प्रतिविकलायां नान्तरं पतति, किन्तु तदग्रेऽन्तरमापद्यते । ग्रन्थकारेण तदुपेक्षितम् । विकलावध्येव ग्रहसाधनत्वविधानात् । मन्मते तु "शशिशून्यस्वरयमै" रित्यत्र गुणशून्यस्वरयमैरिति पाठः साधीयान् ।

इदानीं यथाऽभीष्टकालिका भवन्ति तदर्थमार्यामाह

पादार्धविपाददिनै रात्र्यर्धास्तमय दिनदलौदयिकाः ।
ऊनाः कृत्वा तिथयो देशान्तरनाडिकोनयुताः ॥ ५१ ॥

वा. भा.—पादार्धविपाददिनैरूनीकृत्वा तिथयो यथासंख्यं रात्र्यर्धास्तमय-दिनदलौदयिका ग्रहा आगच्छन्ति । एतदुक्तं भवति, यास्तिथयोऽहर्गणानयने दीयन्ते पञ्चदशभिर्घटिकाभिरूना इत्यर्थः । तदात्र योऽहर्गणो भवति तेन ये ग्रहा आनीयन्ते तेऽतीतार्धरात्रकालिका भवन्ति । अथवार्धदिनेन तिथयः ऊनीकृत्वा दीयन्ते घटिकानां त्रिंशतेत्यर्थः तदा तदहर्गणादस्तमयका ग्रहा आगच्छन्ति वाऽतीते-दिनेऽस्तोन्मण्डले इत्यर्थः । अथ विपाददिनोना दीयन्ते तिथयो विगता पाददिनञ्च पञ्चचत्वारिंशद्घटिका इत्यर्थः । ताभिरूनास्तिथयो यदा दीयन्ते तदा तद-हर्गणाद्ये ग्रहा आगच्छन्ति, ततो दिनदलकालिका भवन्ति । अथ सकलेनैव दिनेनो-नास्तिथयो दीयन्ते तदा तदहर्गणाद्ये ग्रहा आगच्छन्ति, ततो दिवसोन्मण्डलकालिका आगच्छन्ति, किमेतावतैवोक्तकालिका भवन्ति नेत्याह, देशान्तरनाडिका फलोन-युता इति, स्वदेशे यावत्यो देशान्तरनाडिकास्ताभिर्यास्तिथयो यथासम्भवमून-युताश्च देशवसात् कृतास्ताः पादार्धविपाददिनैरूनीकृता यदाहर्गणे दीयन्ते तदा तदहर्गणादुक्तकालिका आगच्छन्ति ग्रहा अर्थादेव यदा देशान्तरनाडिकायुताः पादार्धविपाददिनैरधिकाः तिथयोऽहर्गणानयने दीयन्ते तदा गामिनीदिनदलास्त-मयार्धरात्रोदयादिषु कालेष्वागच्छन्ति ग्रहाः । एवमिष्टघटिकाभिरिष्टकालिका ग्रहाः आगच्छन्ति । एष्यदतीतयोरपि कालयोरित्यर्थः । अथवोपलक्षणार्थमेते तद्यथागतो एवान्यथादेशान्तरकृतमध्यास्तात्कालिकाः क्रियन्ते । अभीष्टे काले गते गम्ये वा स्वमध्यभुक्तिमिष्टनाडिकाहतां विभजेत् षष्ट्यावाप्तं ततो यत्फलं तेन ग्रहोऽतीतकाले ऊनः कार्यः, एष्यत्कालेऽधिकः एवंकृतस्तात्कालिको भवति ।

वि. भा.—पादार्धविपाददिनैरूनीकृत्य तिथयः क्रमशो रात्र्यर्धास्तमयदिन-दलौदयिका ग्रहाः समागच्छन्त्यर्थादहर्गणानयने यास्तिथयो दीयन्ते यदि ता दिन-पादमिताभिर्घटीभिरूना दीयन्ते तदा तत्र योऽहर्गणो भवति ततः समानीता ग्रहा गतरात्र्यर्धकालिका भवन्ति, यदि दिनार्धोनादहर्गणाद् ग्रहा आनीयन्ते तदा ते गतास्तमयकालिका भवन्ति, विपादोनादहर्गणाद्ये ग्रहाः समागच्छन्ति ते गत-दिनार्धकालिका भवन्ति, एवं दिनोनादहर्गणाद्ये ग्रहास्ते गतदिनौदयिका भवन्ति । एवं यद्यहर्गणानयने प्रागपरत्रदेशान्तरनाडिकोनयुतास्तिथयो दीयन्ते तदा स्वदेशे तत्तत्कालिका ग्रहा भवन्तीति ॥ अत्राचार्यकथनमेव प्रमाणं नान्यत्कारणं वक्तुं शक्यत इति ॥ ५१ ॥

अब ग्रहानयन में विशेष कहते हैं

हि. भा.—अहर्गणानयन में जो तिथि जोड़ते हैं, उन तिथियों में दिन के पाद (चतुर्थांश) तुल्य घटी को घटा कर जोड़ा जाय तब उस पर से जो अहर्गण होता है उस से साधितग्रह गत रात्र्यर्धकालिक होते हैं। दिनार्धोन (दिनार्धरहित) तिथि वश से जो अहर्गण होगा उस से साधित ग्रह गतास्तकालिक होते हैं। एवं त्रिपाददिनोनतिथि वश से जो अहर्गण होगा उस से साधित ग्रह गत दिनार्धकालिक होते हैं। दिनोनतिथिवश कर के जो अहर्गण होता है उस से साधित ग्रह गत दिनोदयिक होते हैं। इसी तरह पूर्वापर देश वश से देशान्तर घटी कर के हीन और युत तिथि को यदि अहर्गणानयन में जोड़ा जाय तब जो अहर्गण होगा उस से साधित ग्रह अपने देश में तत्तत्कालिक होते हैं, इन सब विषयों में आचार्य कथन ही प्रमाण कहा जा सकता है, दूसरा कारण नहीं कह सकते। इति ।।५१।।

एवं कल्पगत कालात् तात्कालिकानयनमुक्त्वा इदानीं कलिगतकालात् दर्शयति आर्याषट्केन

कलिगतशुद्धिः प्राग्वत्-शुक्राद्योऽब्दाधिपोऽब्दभगणवधात् ।
क्षितिजस्य खत्रयाष्टरससप्तवसुखाग्निवेद ४३०८७६८०००युतात् ।।५२।।
बुधशीघ्रस्य खखाम्बररसनन्दाष्टाष्टवसुयमोदधिभिः ४२८८८९६००० ।
खचतुष्टययमशरगुणशशित्रिवेदैः ४३१३५२००००सुरेन्द्रगुरोः ।।५३।।
भार्गवशीघ्रस्याम्बरखखाष्टवेदाब्धिखाग्निकृतैः ४३०४४८००० ।
भास्करसुतस्य खत्रयरविगुणशरखदहनसमुद्रैः ४३०५३१२००० ।।५४।।
खचतुष्टयपक्षेन्दुगुणगुणनवभि ९३३१२००००० रर्कमन्दस्य ।
इन्दोः खत्रययमशरनवपञ्चव्योमशरचन्द्रैः १५०५९५२००० ।।५५।।
खत्रययमनवपञ्चाष्टरामधृतिभिः १८३८५९२००० शशाङ्कपातस्य ।
कल्पगतभगणघातात्कुजादिमन्दोच्चपातानाम् ।।५६।।
भगणादिकल्पवर्षैर्लब्धं रविमण्डलान्तिका मध्याः ।
मेषादिद्युगणफलाधिका भवन्तीष्टदिनमध्याः ।।५७।।

वा. भा.—कलियुगादेरारभ्य यो गतः कालोऽभीष्टरविमण्डलान्ते सकले गतास्तस्मात् शुद्धिः प्राग्वद्यथा-कल्पगतात्तद्वदित्यर्थः। एतदुक्तं भवति। यथा कल्पगताब्दा गुणिता रूपाष्टजिनैरित्यादिना दिनांशा अवमानि अवमांशा कल्पगताब्ददिनयुतेः। सूर्याद्योऽब्दाधिपतिद्विगुणाब्दयोगादधिमांशाः शेषास्तिथयः शुद्धिदिनानीति प्रागानीतं तद्वत्कलिगताब्दैरथानेयम्। किन्तु अत्रायं विशेषः कलिगतदिनयुते शुक्राद्योऽब्दपतिर्भवति यतो गुरुदिवसान्ते द्वापरयुगं परिसमाप्तं शुक्रदिनादौ कलियुगं प्रवृत्तं रविचन्द्रौ तत्र

द्वापरान्ते निःशेषावभूताधिमासावमा अपि निःशेषा अभूवन् । तत्रैव काले चैत्रादिः स एव ततः प्रभृति शकान्ते ये गता अब्दा गोगैकगुणाः तेष्वभीष्टशककालगतवर्षाणि दत्वा राशिर्यो भवति । तेन कलिगताब्दराशिनैव कर्म्म कर्त्तव्यम् । तत्र दिनांशा अवमांशाश्च कल्पाब्दकृतानां तुल्या एवं भवन्ति कलिगताब्ददिनयुतैः सप्तहृतायाः शेषशुक्राद्योऽब्दपतिरियान्विशेषः। भौमादिग्रहमन्दशीघ्रपातास्तत्र निःशेषा नाभूवन्। अतस्तेषां द्वापरान्ते कल्पगताब्दभगणा वधे कलाहृते भगणशुद्धशेषा ये तैरधिकाः कलिगताब्दस्वभगणवधादानयने आचार्येणैव निबद्धम् । अब्दभगणावधिरूपे क्षितिजस्य खत्रयाष्टरससप्तवसुखाग्निवेदयुतादित्याभिरार्यष्टाभिः तद्यथा द्वापरान्ते भगणशुद्धशेषं कुजस्य ४३०८७६८००० अथ बुधशीघ्रस्यास्य ४२८८८९६००जीवस्य ४३१३५२००००शुक्रशीघ्रस्य ४३०४४८००० अथ शनेः ४३०५३१२००० अथ रविमन्दस्य ९३३१२००००चन्द्रमन्दस्य १५०५९५२३००० । चन्द्रपातस्य १८३८१५०००० शेषाणां पुनः कुजादिमन्दपातानामानयनं कल्पगताब्दैरेव कार्यम् । यतस्तेषां बहुभिरपि वर्षैरन्तरं न भवति । फलानयनेऽतो ग्रन्थगौरवभयान्न पठितास्तेषां द्वापरान्तभगणशेषशुद्धशेषानां कलिगताब्दस्वभगणवधात् स्वक्षेपकयुतात्कल्परविवर्षैर्यल्लब्धं भगणादि फलम् । पृथक्-पृथक् तेन रविमण्डलान्तिका ग्रहा मध्या भवन्ति शुद्धावमशेषादिकं सर्वमुक्तवत् कृत्वा ततश्चैत्राद्याः तिथयः शुद्धिविहीना इत्यादिना रविमेषादिकोऽहर्गणः कार्यः । तत इष्टदिने मेषाद्यहर्गणाद्यत्फलं द्युगणात् सप्तत्यंशमेकादशलिप्तांश भौम इत्यादिना ग्रन्थेनागच्छति तेन स्वेन फलेनाधिकाः सन्तः इष्टदिनमध्ये भवन्तीतिप्रागेवोक्तत्वात् गतार्थमिति वासनाप्यत्र प्रागेवोक्तेति ।

वि. भा.—प्राग्वत् (पूर्ववत्) कलिगतशुद्धिः साध्याऽर्थात्पूर्वं यथा कल्पगतवर्षेभ्यः शुद्धिरानीता तथैव कलिगतवर्षेभ्यः साध्या तत्र शुक्राद्यो वारोऽब्दाधिपोऽर्थात्कलियुगादौ शुक्रवारसद्भावाद् वर्षपतिः शुक्रवाराद् भवति । उपरिलिखितश्लोकेषु पठिताङ्का मङ्गलादिग्रहाणां (मङ्गलगुरुशनीनां) रविचन्द्रयोर्मन्दोच्चयोः, बुधशुक्रयोः शीघ्रोच्चयोश्चन्द्रपातस्य च क्षेपसंज्ञकाः स्युः । अब्दभगणवधात् (कलिगतवर्षाणां ग्रहभगणानां च घातात्) पाठपठितस्वस्वक्षेपयुतात्कल्पवर्षैर्भक्ताद्यद् भगणादिलब्धं भवेत्ते रविमण्डलान्तिका (रविवर्षान्तकालिकाः) मध्यमग्रहा भवेयुस्ते मेषादिद्युगणफलाधिकाः (लघ्वहर्गणोत्पन्नग्रहैर्युताः) सन्तोऽभीष्टदिने मध्यग्रहा भवेयुरिति ॥ ५२-५३-५४-५५-५६-५७ ॥

अत्रोपपत्तिः

रविवर्षान्ते ग्रहानयनार्थमनुपातः क्रियते, यदि कल्पवर्षैः कल्पग्रहभगणा लभ्यन्ते तदा कल्पगतवर्षैः किं समागच्छतीष्टवर्षान्ते भगणादिग्रहस्तत्स्वरूपम् $=\frac{\text{कल्पग्रहभगण} \times \text{कल्पगतवर्ष}}{\text{कल्पवर्ष}}$ अत्राचार्येण कल्पगतवर्षाणां खण्डद्वयं (कल्पादितः

कल्यादिपर्यन्तमेकं, कल्यादित इष्टवर्षपर्यन्तं द्वितीयम्) कृत तदा तदुत्थापनेन

$$\frac{\text{कल्पग्रहभगण (कल्यादितः कल्यादिपर्यन्तवर्ष + कल्यादितो गतवर्षाणि)}}{\text{कल्पवर्ष}}$$

$$= \frac{\text{कल्पग्रभ} \times \text{कल्यादितः कल्यादिपर्यन्तवर्ष}}{\text{कवर्ष}} + \frac{\text{कल्पग्रभ} \times \text{कल्यादितो गतवर्षाणि}}{\text{कवर्ष}}$$

= इष्टवर्षान्ते भगणादिग्र । अत्र प्रथमखण्डे यद्भगणशेषमानं तस्य क्षेपसंज्ञा कृताऽऽचार्येणेत्येतावताऽऽचार्योक्तमुपपन्नम् सिद्धान्तशेखरे श्रीपतिना प्रथमखण्डजनितफलस्यैव ग्रहध्रुवसंज्ञा कृता, यथा तदुक्तं, यातवर्षखगपर्ययाहते कल्पवर्षविहृते ग्रहध्रुवाः । ते भवन्ति रविमण्डलान्तिका इति ॥५२-५३-५४-५५-५६-५७॥

अब कलिगतवर्ष ही से शुद्धि आदि के आनयन के लिए विशेष बात और रविवर्षान्तिकालिक ग्रहानयन के लिये प्रकारान्तर को कहते हैं

हि. भा.—पूर्ववत् कलिगत शुद्धि साधन करना अर्थात् पहले कल्पगत वर्षों से जिस तरह शुद्धि लायी गई है उसी तरह कलिगत वर्षों से साधन करना, किन्तु कलि के आदि में शुक्रवार था इसलिये वर्षपति की गणना शुक्रवार से होती है । श्लोकों में जो पठिताङ्क हैं वे मङ्गल, बृहस्पति, शनैश्चर इन ग्रहों के, रवि और चन्द्र के मन्दोच्चों के, बुध और शुक्र के शीघ्रोच्चों के तथा चन्द्रपात के क्षेपसंज्ञक हैं, कलिगत वर्षों के और ग्रह भगणों के घात में पाठपठित अपने-अपने क्षेप जोड़कर कल्पवर्ष से भाग देने से जो भगणादि लब्धिप्रमाण आता है वे रविमण्डलान्तिक (रविवर्षान्तिकालिक) मध्यम ग्रह होते हैं उनमें मेषादि द्युगण फल (लघ्वहर्गणोत्पन्नग्रह) को जोड़ने से अभीष्ट वर्षान्त में मध्यम ग्रह होते हैं इति ॥ ५२,५३,५४,५५,५६,५७ ॥

उपपत्ति

रविवर्षान्त में ग्रहानयन के लिये अनुपात करते हैं, यदि कल्पवर्ष में कल्प ग्रह भगण पाते हैं तो कल्पगतवर्ष में क्या इस अनुपात से अभीष्ट वर्षान्त में भगणादि मध्यमग्रह आते हैं ।

$\frac{\text{कल्पग्रहभ} \times \text{कल्पगतवर्ष}}{\text{कल्पवर्ष}}$ = अभीष्टवर्षान्त में भगणादिग्र, यहाँ आचार्य ने कल्पगतवर्ष के दो खण्ड 'कल्पादि से कल्यादि तक प्रथम खण्ड, और कल्यादि से इष्टवर्षान्त तक द्वितीय खण्ड' किये हैं, तब इनसे कल्पगतवर्ष के उत्थापन करने से

$\frac{\text{कग्रभ} \times \text{कल्पादि से कल्यादितकवर्ष}}{\text{कल्पवर्ष}} + \frac{\text{कग्रभ} \times \text{कलिगतवर्ष}}{\text{कल्पवर्ष}}$ = अभीष्टवर्षान्त में भगणादिग्र,

यहाँ प्रथम खण्ड में जो भगण शेष रहता है उसी का नाम आचार्य ने क्षेप रक्खा है । इससे आचार्योक्त उपपन्न हुआ । पूर्वोक्त प्रथमखण्डागतग्रहों को सिद्धान्तशेखर में श्रीपति 'यातवर्षखगपर्ययाहते कल्पवर्षविहृते ग्रहध्रुवाः । ते भवन्ति रविमण्डलान्तिकाः' इससे ग्रह ध्रुवा कहते हैं इति ॥ ५२-५३-५४-५५-५६-५७ ॥

इदानीं चैत्रसितादिना सावनेनाखण्डेनाहर्गणेन ग्रहानयनचिकीर्षुरादौ तावच्चैत्राद्यर्कोदययोरन्तरपरिज्ञानार्थमार्यामाह

शुद्धीशवधे शुद्धेऽवमशेषात्सावनद्युगणसिद्धिः ।
व्येकावमं गृहीत्वा गुणखमुनियुतान्न शुद्धिश्चेत् ।।५८।।

वा. भा.—शुद्धेरीशानां च वधः शुद्धीशवधस्तस्मिन् शुद्धे सति कुत इत्याह, अवमे यद्यपि सामान्येनावमशेषग्रहणं तथापि रविमण्डलान्तावमशेषात् अवमांशेभ्यो यमनवरसगुणितेभ्यो विकृतेभ्यः स्वच्छेदेन यत्फलं भवति, तस्मादित्यर्थः । एवं कृते शेषं यत्सावनद्युगणशुद्धिश्चैत्रादावमशेषं भवतीत्यर्थः अथ । रविमण्डलान्तावमशेषादेकादशगुणशुद्धिर्न शुध्यति, तदा व्येकावमं गृहीत्वा गुणखमुनियुतात्पूर्वमेवावमानि यान्यतीतानि । नवाग्निसप्तनगैः कल्पगताब्दान् संगुणय्य खखरसनवभिर्विभज्य तेभ्यो रूपमेकं विशोधयेद्रविमण्डलान्तावमशेषं च गुणखमुनियुक्तं कृत्वा ततः शुद्धीशवधं विशोध्य चैत्राद्यवमशेषं भवति, तत्रेयं वासना रविमण्डलान्ताद्वैपरीत्येन चैत्रादर्कोदयेऽवमशेषं क्रियते तत्र शुद्धिरेव चैत्रादर्कोदयरविमण्डलान्तरं भूः । तत एकैकस्मिन्सावनदिने चन्द्रदिनेन सहान्तरमेकादशसंख्यमवमशेषमतः शुद्धतुल्यैःसावनदिनै शुद्ध एकादशगुणायां तुल्यमवशेषं भवति । अतो रविमण्डलान्तावमशेषाद्विशोध्य शेषं चैत्राद्यर्कोदयेऽवमशेषं भवति सैव सावनद्युगणसिद्धिर्भवति । यस्मात् तत्र दिने तावदेवान्तरं चैत्राद्यर्कोदययोरथैकादशगुणशुद्धिर्न शुद्धयति । रविमण्डलान्तावमशेषात्तदा चैत्रादिरविमण्डलान्तयोरंतरं एवोनरात्रयातो ज्ञेयोऽतः पुनरथावमगणादवम संगृहीत्वा रविमण्डलान्तिके त्रिखमुनिसंख्यं योज्यते । यस्मात् त्रिखमुनिसंख्येऽवमशेषेणोनरात्रो भवति । अत उक्तमेकावमं गृहीत्वा गुणखमुनियुतान्न शुध्यति वोदितः किन्त्वत्र तद्द्विगुणाब्दयोगादिति क्रियमाणे शुद्धिरथैकोना भवति, सात्रैकादशगुण विशोध्यते, इत्युपपन्नम् ।। ५८ ।।

वि. भा.—शुद्धेः (पूर्वपूरिभाषितायाः) ईशानां (एकादशानां) च गुणनफलेऽवमशेषात् (रविवर्षान्ते साधितावमशेषात्) ६९२ गुणितादेभिः (९६००) भक्ताच्छुद्धे 'हृतास्त्रिखागैः फलावमविहीना' इत्यादिना चैत्रादौ सावनाहर्गणसिद्धिर्भवति, यदि शुद्धेरेकादशस्य च गुणनफलस्यावमशेषाच्छोधनं न भवेत्तदा रविवर्षान्ते कल्पतो यान्यवमानि तान्येकरहितानि गृहीत्वा ७०३ युतादवमशेषात्तद्गुणनफलं शोध्यमिति ।। ५८ ।।

अत्रोपपत्तिः

चैत्रादितिथिः =० तदा विपरीतशोधनेन चैत्रादिगति—शुद्धि=शुद्धि—तदा

'अवमांशेभ्यो यमनवरसगुणितेभ्य इत्याद्याचार्योक्त्या' ऽवमशेषस्वरूपम् $\frac{\text{६९२ वक्षयशे}}{\text{९६००}}$

७०३

-११ शु = इष्टक्षयशेष । यदि ११ शु $> \frac{६९२ \text{ वक्षयशे}}{९६००}$ तदाऽवमशेषप्रमाणात्मकं भवेत्तदा लब्धिः = — इष्टक्षयशे, धनात्मकार्थमेकयोजनेन

$$१ + \frac{\frac{६९२ \text{ वक्षशे}}{९६००} - ११ \text{ शु}}{७०३} = \frac{\frac{७०३ + ६९२ \text{ वक्षयशे}}{९६००} - ११ \text{ शु}}{७०३} = \text{चैत्रादावमशेषमा-}$$

नम् । यदिचैत्रशुक्लादौ रविवर्षान्तात्पूर्वमेव भवेत्तदा विलोमाहर्गणो भवति लल्लाचार्यादिभिरयमेव चैत्रादावृणाहर्गणः कथ्यत इति । सिद्धान्तशेखरे 'शुद्धिमेव पृथगीश्वराहतां शोधयेदवमशेषकान्निजादित्यादिना' ऽयमेव ब्रह्मगुप्तोक्तप्रकारः श्रीपतिना लिखितो विवेचकैर्ज्ञेय इति ॥ ५८ ॥

अब रविवर्षान्त और चैत्रादि के मध्य में कितने सावनदिन हैं उनका साधन करते हैं

हि. भा.—अवमशेष रविवर्षान्त में जो क्षयशेष है उसको ६९२ इससे गुणाकर अपने हर (९६००) से भाग देने से जो फल होता है, में पूर्वकथित शुद्धि और ग्यारह के घात (गुणनफल) को घटा देने से सावनाहर्गण की शुद्धि होती है अर्थात् "हृतास्त्रिखागैः फलावमविहीना इत्यादि" आचार्योक्त प्रकार से चैत्रादि में सावनाहर्गण की सिद्धि होती है । यदि अवमशेष में शुद्धि और ग्यारह की घात न घटे तब रविवर्षान्त में कल्प से जितने अवम हों उनमें एक घटाकर अवमशेष में ७०३ जोड़कर जो हो उसमें उस घात (गुणनफल) को घटा देना चाहिये इति ॥५८॥

उपपत्ति

चैत्रादितिथि = ० तब विपरीत शोधन से चैत्रादिगति—शुद्धि = ०—शुद्धि = — शुद्धि, तब 'अवमांशेभ्यो यमनवरसगुणितेभ्य इत्यादि आचार्योक्त प्रकार से' अवमशेष-स्वरूप = $\frac{\frac{६९२ \text{ वक्षयशे}}{९६००}}{७०३} - ११$ शुद्धि, यदि ११ शुद्धि $> \frac{६९२ \text{ वक्षयशे}}{९६००}$ तब अवमशेष प्रमाण ऋणात्मक होता है, तब लब्धि = — इष्टक्षयशे = — अवमशे, धनात्मक के लिये एक जोड़ने से

$$१ + \frac{\frac{६९२ \text{ वक्षयशे}}{९६००} - ११ \text{ शुद्धि}}{७०३} = \frac{\frac{६९२ \text{ वक्षयशे}}{९} - ११ \text{ शुद्धि} + ७०३}{७०३} = \text{चैत्रादि में}$$

अवमशे, यदि चैत्र शुक्लादि रविवर्षान्त से पहले हो तब विलोमाहर्गण होता है, इसी को लल्लाचार्य आदि आचार्य चैत्रादि में ऋणाहर्गण कहते हैं । सिद्धान्तशेखर में श्रीपति 'शुद्धिमेव पृथगीश्वराहतां शोधयेदवमशेषकान्निजात् इत्यादि' से ब्रह्मगुप्तोक्त प्रकार ही कहते हैं इसको विवेचक लोग समझें इति ॥५८॥

अत्र विशेषविचारः

चैत्रामान्ततो वर्षान्ताव्यवहितपूर्वतिथ्यन्तावधि निरवयवा अधितिथयः इत्येकं खण्डम्। तिथ्यन्तात्सूर्योदयावधि वर्षान्तीयावमघटिका द्वितीयखण्डम्। एवं सूर्योदयाद्वर्षान्तावधि वर्षान्तीयदिनादिघटिका इति तृतीयं खण्डमिति। खण्डत्रय-योगे चैत्रसितादितो वर्षान्तावधि अधिशेषदिनानि सावयवानि। तत्रावमशेषं विशोध्य शेषस्या अति+दिनादिशे स्य शुद्धिसंज्ञा कृता ग्रन्थकृता। इयमेव शुद्धिर्भास्कराचार्यस्यापि।

अथ लघ्वहर्गणावगमे मध्यमार्कसञ्चारवशाद्वर्षान्तस्य ज्ञानाभावात् चैत्रामान्ततोऽभीष्टदैवसिकतिथ्यन्तावधितिथयो गृह्यन्ते। तत्र चैत्रामान्तवर्षान्तरे यदोष्टतिथ्यन्तं मन्यते तत्रेष्टतिथिभ्यः शुद्धेरधिकत्वात् "चैत्रसिताद्यास्तिथयः शुद्धिविहीनाः पृथक्गुणा रुद्रै" रित्यादिविधानेनावमानयने विप्रतिपत्तिः संपद्येत। शुद्धेः ऋणगतत्वसिद्धेः। अतस्तदानयनार्थमन्यथा यतते।

तथाहि। लघ्वहर्गणानयनेह्याचार्यकृतावमशेषस्वरूपम्

$$= \frac{११ (\text{इति} - \text{शु}) + \frac{६९२ \text{ वक्षशे}}{९६००}}{७०३} \quad \ldots\ldots\ldots\ldots (१)$$

अत्र शु < इति कल्प्यते

$\therefore$ इति — शु = — शेषम्

$$\therefore (१) \text{ समीकरणस्वरूपम्} = \frac{\frac{६९२ \text{ वक्षशे}}{९६००} - ११ \text{ शेष}}{७०३}$$

अत्रापि यदि $\frac{६९२ \text{ वक्षशे}}{९६००} < ११$ शे।

तदाऽ $\frac{६९२ \text{ वक्षशे}}{९६००} - ११$ शे स्याघ्यणंगतत्वात् तथा लब्धिरूपाल्पत्वाच्च तत्र रूपं प्रक्षिप्य धनात्मकमवममानं विहितमाचार्येण।

$$\therefore \text{धनावममानम्} = १ + \frac{\frac{६९२ \text{ वक्षशे}}{९६००} - ११ \text{ शे}}{७०३}$$

$$= \frac{७०३ + \frac{६९२ \text{ वक्षशे}}{९६००} - ११ \text{ शे}}{७०३}$$

अत्राचार्यमतेन चैत्रामान्तेऽवमशेषमानं समागतम् शुद्धीशवध इत्युक्तत्वात्। इष्टतिथिमानस्य शून्यत्वेनावगमाच्च।

अत्र प्रागानीतेन समीकरणेनार्शान् वर्षान्तकालिकावमशेषमानं ६९२ एभिः संगुण्य ९६०० एभिर्विभज्य फलं त्रिशून्यमप्तसंख्यायां संयोज्य हारेणानेन ७०३ नेन हृते सत्यवमानमहर्गणोपयुक्तं भवेदिति ग्रन्थकाराः प्रोचुः। तथासति दिनमेकमधिकं गृहीतं भवेत्।

तथाहि। कल्प्यते ११ शु $> \frac{\text{६९२ वक्षशे}}{\text{९६००}}$

$$\text{तदाऽवमदिनमानम्} = \frac{\text{११ शु} - \frac{\text{६९२ वक्षशे}}{\text{९६००}}}{\text{७०३}}$$ इत्येव भवितुं युज्यते।

परमिहाचार्येण

$$\frac{\text{७०३} + \frac{\text{६९२ वक्षशे}}{\text{९६००}} - \text{११ शु}}{\text{७०३}}$$ इदमवमानं स्वीकृतम्।

द्वयोरन्तरेण—

$$\frac{\text{७०३} + \frac{\text{६९२ वक्षशे}}{\text{९६००}} - \text{११ शु}}{\text{७०३}} - \frac{\text{११ शु} - \frac{\text{६९२ वक्षशे}}{\text{९६००}}}{\text{७०३}}$$

$= \text{अन्तर} = \frac{\text{७०३}}{\text{७०३}} = \text{१}$ अत आचार्येणैकमधिकमवमदिनमानं गृहीतम्। तदर्थं "व्येकावमं गृहीत्वे" ति ग्रन्थकाराः प्रोचुः।

एतेनायमर्थः पर्यवसितो भवति यल्लघ्वहर्गणानयने साधिताद $\frac{\text{६९२ वक्षशे}}{\text{९६००}}$ स्मादवमशेषाद्यत्र शुद्धीशवधोऽधिकः स्यात्तत्रावमशेषं त्रिखागमिते संयोज्य तत्रैव शुद्धीशवधः शोधनीयः। ततो भागहारेण विभज्यावमशेषं साधनीयम्। तथा कृते सति रूपसमं दिनमन्तरमापद्यते। तदर्थमाचार्येण व्येकमवमं गृहीतमिति सुष्ठुतरम्।

अत्रैव सिद्धान्तशेखरकारा अपि

"शुद्धिमेव पृथगीश्वराहृतां
शोधयेदवमशेषकान्निजात् ।
चेन्न शुध्यति च सत्रिखाचलात्
शोध्यमेकमपि शुद्धितो दिनम्"

इति प्राहुः। तत्रैव व्याख्यायां मक्किभट्टः। चेन्न शुद्धयतीति—एकादशगुणा शुद्धिरवशेषान्न शुद्धयति चेत् तर्हि सत्रिखाचलादवमशेषाच्छोधयेत्। अवमशेषे त्रिखाचलं संयोज्य पश्चाच्छुद्धिं शोधयेदिति यावत्। यदा त्रिखशैलयोजनेन शोधनं क्रियते तदा विशेषमाहशोध्यमिति। शुद्धितोऽप्येकं दिनं शोधयेत्। अत्र शुद्धिशब्देनावमदिनान्युच्यन्ते। एतदुक्तं भवति। कल्पगतानब्दान् कलिगतान् वा नवगुणादिनगैः संगुण्य खखर्तुनवभि विभज्य लब्धेभ्यो रूपमेकं विशोधयेत्। तदुक्तं ब्रह्मगुप्तेन "व्येकावमं गृहीत्वेति" इति सर्वं चर्वितचर्वणमेव।

भास्कराचार्यास्तु चैत्रादितिथिभ्योऽधिकायां शुद्धौ तिथिषु शुद्धिर्न शुद्धयत्यतः प्राक् चैत्रामान्ततोऽभीष्टदैवसिकदिनावधि तिथयो ग्राह्याः। तत्रैव प्राक् वर्षजातां शुद्धिं विशोध्याहर्गणः साधनीयः। तद्वशेन ये ग्रहाः सिद्धयन्ति तेऽपि प्राग्वर्षान्तकालिकध्रुवेषु क्षेप्या भवन्तीति प्राहुः।

अत्रैव लल्लाचार्येण विपरीतशोधनेनर्णाहर्गणमानीतम्। तद्वाक्यं शिष्यधीवृद्धिदे।

यावन्न मेषं व्रजति प्रभाकरस्तावन्न पूर्वध्रुवकान् परित्यजेत्
चैत्रे प्रविष्टेऽपि विलोमकर्म वा शुद्धया विजह्यादगते क्रियं रवौ।

भास्वानृणाहर्गणतश्च सिद्धः पात्यो भचक्रात्स्वफलानि चैवम्।
स्वस्वध्रुवादप्यथखेचराणां शोध्यानि यत्नात् प्रवदन्ति सन्तः॥ इति।

इदानीं चैत्रादावब्दाधिपपरिज्ञानार्थं तत्रैव सर्वग्रहणमर्कोदयकाले
मध्यमानयनं चार्ययाह

चैत्रसिताद्योऽब्दपतिः शुद्धयूनाया दिनाब्दरूपयुतेः।
तद्द्युगणाद्दिनवारः शुद्धयूना मध्यमाः प्राग्वत्॥५६॥

वा. भा.—चैत्रसिताब्दपतिः स कथं भवतीत्याह। शुद्ध्यूनायाः कस्याः दिनाब्दरूपयुतेः एतदुक्तं भवति कल्पगताब्ददिनयुतेः सरूपायाः शुद्धिदिनानि

सकलानि संशोध्य शेषस्य सप्तभिर्भागेहृते नोऽवशेषांकसमोऽर्कादिश्चैत्रादौ वाराधिपतिर्भवति। यदि सविकलाशुद्धिः अथ शुद्धौ भाविकलं नास्ति तदाब्ददिनयुतौ रूपं न देयम्। अथवा कलिगताब्दे शुक्राद्योऽब्दपतिः कार्यः तथापि स एव भवति तद्युगणाद्दिनवारः शुद्ध्यूना मध्यमा प्राग्वत्। ततश्चैत्रसितादेर्यो द्युगणः क्रियते, तस्य तदादिका वा गणना कार्या। शुद्ध्यूनाश्च मध्यमा रविमण्डलान्तिकाः कृताः चैत्रादावर्कोदये मध्यमाः भवन्ति। अथ प्राग्वत् कार्याः। अयमर्थः शुद्धितोऽहर्गणं परिकल्प्य ततो द्विगुणात् सप्तत्र्यंशं स्वनवार्कांशाधिकमित्यादिना रवेरेकादशघ्निप्तांशा भौम इत्यादिना भौमादीनाञ्च यत्फलं भवति, तेन स्वफलेनोना रविमंडलान्तिकाः कार्याः कृतश्चैत्राद्यर्कोदये लंकायां मध्यमो भवति। एवं चैत्रादौ मध्यमाः सर्व एव ग्रहमन्दपाताः कार्याः। अवमशेषाद्याधिमत्यादिकञ्च संलिख्य वर्षोपयोगी स्थापयेत्। तत इष्टदिने चैत्रसिताद्यस्तिथयः पृथग्गुणा रुद्रैरित्यादिना योऽहर्गणो भवति स खण्डो भवति स्वावमशेषसहितः ततो द्युगणात्सप्तत्र्यंशमित्यादिना ग्रन्थेन प्राग्वत्, सर्वेषां ग्रहशीघ्रमन्दपातानां फलान्यानीय चैत्राद्यौदयिकेषु संयोज्येष्टदिने मध्या भवन्ति, लंकार्कोदये ग्रहर्गणस्य सप्तहृतस्य शेषांकसमग्रहो द्वितीयो ग्रहः। स तत्र दिने वाराधिपतिर्भवति यतो भुक्ता वारा अहर्गणे भवन्ति, तत्रैवं वासना कल्पगताब्दा दिनयुतौ वारगणस्तिष्ठति, वारश्चैककुसावनदिवसे न भवति शुद्धेर्रा सावनदिवसात्मिका अतः शुद्धिरब्ददिनयुतेर्विशोधयेत् तावता वाराश्चैत्रादेरतीतस्य रूपञ्च शुद्धेः सकलत्वाद्दीयते। ततः सप्तहृतशेषश्चैत्रादौ वाराधिपतिर्भवति। चैत्रादिकाहर्गणस्य तदादिका वारग्रहणमपि युज्यत एव शुद्धीनाञ्च रविमण्डलांतिकाश्चैत्रादौ भवन्ति, रव्युदये यस्माद्यथाहर्गणेन ग्रहा अग्रतो नीयन्ते। एवं पश्चादपि तुल्यत्वात् त्रैराशिकस्य शुद्धिश्चाहर्गणः एवं यतस्तस्मादुपपन्नम् ॥५९॥

वि. भा.—पूर्वसाधितदिनाद्यस्य कल्पगतवर्षाणां रूपस्य च युतेः शुद्धिरहितायाश्चैत्रसिताद्यो वर्षपतिः साध्योऽर्थाच्छुद्धिरहिताया दिनाद्यकल्पगतवर्षरूपसंयुतेर्यच्छेषं तत्सप्तभिर्भक्तं तदा चैत्रादौ रव्यादिवारो भवेत्ततश्चैत्रादितो योऽहर्गणो भवति तत्र चैत्रादिवाराद्दिनवारो ज्ञातव्यस्ततः साधिता ग्रहा शुद्धिदिनोत्पन्नैर्ग्रहै रहितास्तदा सौरवर्षान्तात्पूर्ववन्मध्यमग्रहा भवन्ति, यदि कोऽपीष्टवर्षे चैत्रादितोऽहर्गणज्ञानं ततो ग्रहान् ततश्च सौरवर्षान्तमध्यमग्रहान् ज्ञातुमिष्यति तदा तेनोपरिलिखितप्रकारेण तत्साधनं कार्यमिति ॥ ५९ ॥

अत्रोपपत्तिः

रविवर्षान्तामान्तयोर्मध्यवर्त्तिन्यस्तिथयोऽधिशेषतिथयस्ततो वर्षान्तक्षयशेषघटिकाः शोध्याः शेषस्य शुद्धिसंज्ञा सैव वर्षान्तामान्तयोर्मध्ये सावनदिनसंख्या। रविवर्षान्तामान्तयोरंतरे सावनदिनानि = शुद्धिः कल्पादित इष्टसौरवर्षान्तं यावत्सावनदिनानि = ३६५ गव + दिनादि, ततः कल्पादित इष्टसौरवर्षान्तं

यावत्सावनदि—शुद्धि=३६५ गव+दिनादि—शुद्धि=चैत्रादौ सावनदिनानि, एतानि सप्तभिर्भक्तानि वर्तमानवारार्थं रूपयोजितानि तदा चैत्रसिताद्वारः= गव+दिनादि–शुद्धि+१ एतावताऽऽचार्योक्तमुपपद्यते । सिद्धान्ततत्त्वविवेके कमलाकरेण लघ्वहर्गणानयने वारगणनार्थ विशेषः प्रतिपादितोस्तीति ॥५९॥

अब चैत्रादि से अहर्गणानयन करके मध्यग्रहानयन को कहते हैं

हि. भा.—पूर्वसाधित दिनादि—कल्पगतवर्ष और रूप (एक) इन सबों के योग में शुद्धि को घटाकर जो हो उस पर से चैत्रसितादिवर्षपति साधन करना, अर्थात् दिनाद्य-कल्पगतवर्ष और रूप इन सबों के योग में शुद्धि को घटाकर जो शेष बचे उसको सात से भाग देने से चैत्रादि में रव्यादिवार होते हैं। चैत्रादि से जो अहर्गण होता है उसमें चैत्रादिवार से दिनवार समझना चाहिए, उससे जो ग्रह होते हैं उसमें शुद्धिदिनोत्पन्नग्रह को घटाने से सौरवर्षान्त से पूर्ववत् मध्यम ग्रह होते हैं ॥५९॥

उपपत्ति

सौरवर्षान्त और अमान्त के मध्य में जो तिथि है वह अधिशेष तिथि है, उसमें वर्षान्तक्षयशेष घटी को घटाने से जो शेष रहता है उसका नाम शुद्धि है, वही वर्षान्त और अमान्त के मध्य में सावनदिन है, रविवर्षान्त और अमान्त के मध्य में सावन दिन=शुद्धि, कल्पादि से इष्टसौरवर्षान्तपर्यन्त सावनदिन=३६५ गव+दिनादि,

अतः कल्पादि से इष्टसौरवर्षान्तपर्यन्तसावनदि-शुद्धि=३६५ गव+ दिनादि—शुद्धि=चैत्रादि में सावनदिन इसको सात से भाग देना और वर्तमान वार के लिये रूप जोड़ देना तब चैत्रसितादि से वार होते हैं, चैत्रसितादि से वार=गव+ दिनादि—शुद्धि+१ इससे आचार्योक्त उपपन्न हुआ । कमलाकर ने सिद्धान्ततत्त्वविवेक में लघ्वहर्गणानयन में वार गणना के लिये बहुत विशेष विचार किया है, कभी-कभी बिना रूप जोड़ने से भी चैत्रादि में वार होते हैं, वर्तमान वारज्ञानार्थ अहर्गण में सैक और निरेक किया जाता है जिसको भास्कराचार्य ने भी सिद्धान्तशिरोमणि में 'अभीष्ट वारार्थमहर्गणश्चेत्' इत्यादि से कहा है इति ॥५९॥

इदानीं बीजकर्माह

खखखार्कहृताब्देभ्यो गतगम्याल्पाः खशून्ययमलहृताः ।
लब्धं त्रिसायकहतं कलाभिरूनौ सदाऽर्केन्दू ॥ ६० ॥

शशिवत् जीवे द्विहतं चन्द्रोच्चे तिथिहतं तु सितशीघ्रे ।
द्वीषु ५२ हतं च बुधोच्चे द्वि २ कु १ वेद ४ हतं च पातकुजशनिषु ॥६१॥

वा. भा.—अनयोः श्लोकयोर्वासनाभाष्यं नास्ति ।

वि. भा.—द्वादशसहस्र १२००० भक्तेभ्यो गतवर्षे - (कल्पगतवर्षे) भ्यो-ये लब्धास्ते गताः, गता हारा - (१२०००) त्पतितास्तदा गम्याः (एष्याः) स्युरे-तयोर्मध्ये येऽल्पास्ते द्विशत्या २०० भक्ता यल्लब्धं तत्त्रिभिः, पञ्चभिर्गुणितं कलात्मकफलैः सदा क्रमेण रविचन्द्रौ हीनौ कार्यौ, जीवे (बृहस्पतौ) चन्द्रवत्फलं देयमर्थाच्चन्द्रे यत्कलात्मकं फलमृणं तदेव बृहस्पतावप्यृणं कार्यम् । तदेव 'खशू-न्ययमल २०० हृता इत्यनेनानीतं' फलं द्विहतं (द्वाभ्यां गुणितं) चन्द्रमन्दोच्चे हीनं कार्यं तदेव फलं पञ्चदशभिर्गुणितं सद्यद्भवेत्तच्छुक्रशीघ्रोच्चे हीनं कार्यम् । तदेव फलं द्विपञ्चाशता ५२ गुणितं यद्भवेत्तद्बुधशीघ्रोच्चे ऋणं कार्यं तथा तदेव पूर्वफलं द्वि २ कु १ वेद ४ गुणितं गुणनफलं क्रमेण पातमङ्गलशनिषु ऋणं कार्यम् । 'द्वीपुहतं च बुधोच्चे द्विकुवेदहतमित्यनेन' यादृशो हि (ऋणात्मकरूपः) संस्का-रोऽभिहितो ब्रह्मगुप्तेन तद्विपरीत (धनात्मक) संस्कारः "इन्दुना दस्रबाणैः कराभ्यां कृतैरित्यादिना" सिद्धान्तशिरोमणौ भास्कराचार्येणाभिहित इति ॥६०-६१ ।

अत्रोपपत्तिः

इष्टग्रहभगणगुणादित्यादिब्रह्मगुप्तोक्तेन, द्युचरचक्रहतो दिनसंचय इत्यादि-भास्करोक्तेन वाऽऽनीतक्रान्तिवृत्तीयमध्यमग्रहतः स्फुटक्रियाकरणेन वास्तव-स्फुटग्रहो नायाति, परन्त्वस्मिन् मध्यमग्रहे बीजकर्मजनितफलसंस्कारे कृते यो मध्यमग्रहस्तस्मात्स्फुटक्रियाकरणेन वास्तवस्फुटग्रह आयातीत्यागमवादिनो वदन्ति नात्र वस्तुतः प्रामाण्यम् । तत्रोपपत्त्याऽऽनयनार्हः कतिचिद्दिनैरुपलब्धभूतः पदार्थो बीजशब्दवाच्यस्तत्कर्म बीजकर्म इति, अथ तत्तत्पदार्थस्य सृष्ट्यादित आरभ्य षट्-सहस्र ६००० वर्षपर्यन्तं वृद्धिस्ततोऽग्रे षट्सहस्रवर्षपर्यन्तं ह्रास इत्यत्रागम एव प्रमाणम् । तेन सृष्ट्यादितः षट्सहस्रवर्षान्ते परमवृद्धिः । द्वादशसहस्रवर्षान्ते परमह्रास इति फलितम् । एवं प्रतिद्वादशसहस्रवर्षे भवति, तेनेष्टकाले गता ये कतिचित्सौराब्दास्ते द्वादशसहस्रभक्ताः (प्रतिद्वादशसहस्रवर्षान्ते तत्प्रलयत्वात्) शेषादनुपातेन फलमानीय मध्यमग्रहे संस्कृते सति स्फुटक्रियाकरणार्हो मध्यग्रहो भविष्यतीति । अथ यदि शेष $<$ ६००० वर्ष तदा वृद्धयभिमुखफलम्, यदि च शेष $>$ ६००० वर्ष तदा ह्रासोन्मुखफलम् । यदा शेष $<$ ६००० वर्ष तदा शेष $<$ १२००० − शेष = शेष$'$, परं द्वाभ्यामपि शेषाभ्यामनुपातेन फलमेककाली-नमेवातोऽङ्कलाघवार्थमत्रा 'शे' स्मादेवानुपातकरणं युक्तम् । यदा च शे $>$ ६००० वर्ष तदा शे $>$ १२००० − शेष = शेष$'$ परन्त्वत्रापि द्वाभ्यामपि शेषाभ्यां फलमेककालीनमेवाऽत्राङ्कलाघवार्थमस्मादेवानुपातकरणं युक्तमतोऽनुपातः—

$$\frac{\text{परमोपचयफल} \times \text{शेष}}{६०००} = \frac{\frac{\text{परमोपचयफल}}{३०} \times \text{शेष}}{२००} = \text{फल},$$ अत्र रव्यादीनां ग्रहाणां

पातादीनां च परमबीजफलं त्रिशता भक्तं सत्क्रमेण ३, ५, ५, १५, २, १, ५२, २, ४ भवन्ति, तत्रानुपातागतफलमेतद्यदि रविचन्द्रबृहस्पतिचन्द्रोच्चादिषु ऋणं क्रियेत तदा स्फुटक्रियाकरणयोग्यो मध्यमग्रहः स्यादित्यत्रागम एव प्रमाणम्, एवं शे, मस्मादपि तथैवानुपातो यतो द्वादशसहस्रवर्षान्ताद् विलोमक्रमेणायं कालः, तत्र फलं वृद्धयुन्मुखमेव यतो द्वादशसहस्रवर्षान्ते फलस्य परमह्रासस्तत्कालाद् विलोमक्रमेण फलसत्ताक्रमेणाधिका एवातोऽनुपातेनोभयत्र फलसाम्यमेवात:

$$\frac{\text{परमबृफल} + \text{शेष}'}{६०००} = \text{फल} = \frac{\frac{\text{पबृफ}}{३०} \times \text{शेष}'}{२०००}$$ इतोऽग्रे पूर्ववदत्र वर्षशब्देन सर्वत्र

सौरवर्षमेव ग्राह्यमिति, भास्कराचार्येण सिद्धान्तशिरोमणौ भानुचन्द्रेज्यशुक्रेन्दुतुङ्गेष्वनुपातागतफलमृणं तथा भौमसौम्येन्दुपातार्किषु धनमभिहितं, परं ब्रह्मगुप्तेन सर्वत्रानुपातागतफलमृणमेव कार्यमिति कथितं कमलाकरेण सिद्धान्ततत्त्वविवेके बीजकर्मसंस्कारस्य खण्डनमेव कृतं किमत्र युक्तमितिनिर्णायकयुक्त्यभावात्किमपि वक्तुं न शक्नोम्यहमिति ॥ ६०-६१ ॥

अब बीज कर्म कहते हैं

हि. भा.—कल्पगत वर्ष में बारह हजार (१२०००) से भाग देने से जो लब्धि होती है वह गत है, उसको हर १२००० में घटाने से जो शेष रहता है वह गम्य है, इन दोनों में जो अल्प हो उसे दो सौ से भाग देने से जो लब्धफल हो उसे तीन और पाँच से गुणाने से जो कलात्मक फल हो उनको क्रम से रवि और चन्द्र में ऋण करना, चन्द्र में जो कलात्मक फल ऋण किया गया है वही बृहस्पति में भी ऋण करना चाहिये। उसी फल को दो से गुणाकर चन्द्रमन्दोच्च में ऋण कर देना चाहिये, उसी फल को पन्द्रह से गुणा कर जो हो उसे शुक्र के शीघ्रोच्च में ऋण करना। उसी फल को बावन ५२ से गुणाकर जो हो उसे बुधशीघ्रोच्च में ऋण करना चाहिये। उसी फल को दो, एक और चार से पृथक्-पृथक् गुणा करके जो हो उन्हें क्रम से पात, मङ्गल और शनि में ऋण करना चाहिये ।।६०-६१।।

उपपत्ति

'इष्टग्रहभगणगुणात्' इत्यादि ब्रह्मगुप्तोक्तप्रकार से या 'द्युचरचक्रहतो दिनसंचयः इत्यादि' भास्करोक्तप्रकार से साधित क्रान्तिवृत्तीय मध्यम ग्रह से स्फुट क्रिया करने से वास्तव स्फुट ग्रह नहीं आते हैं, लेकिन इस मध्यम ग्रह में बीजकर्म जनित फल को संस्कार करने से जो मध्यम ग्रह होते हैं उससे स्फुट क्रिया करने से वास्तव स्फुटग्रह आते हैं, यह बात आगमवादी लोग कहते हैं। वस्तुतः इसमें कुछ प्रामाणिकता नहीं है।

उपपत्ति से आनयन योग्य कितने दिनों में उपलब्ध भूत पदार्थ बीज शब्द से कहा जाता है उसका कर्म बीजकर्म कहलाता है, उन २ पदार्थों की सृष्ट्यादि से लेकर छः हजार वर्ष पर्यन्त वृद्धि होती है उससे आगे छः हजार वर्ष पर्यन्त ह्रास होता है इसमें आगम ही प्रमाण है, इसलिये सृष्ट्यादि से छः हजार वर्षान्त में परमवृद्धि होती है, बारह हजार वर्षान्त में परम ह्रास होता है यह निर्गलितार्थ हुआ; इस तरह प्रत्येक बारह हजार वर्ष में होता है, इसलिये इष्ट काल में जो गत सौर वर्ष हो उसे बारह हजार से भाग देने से जो शेष रहे उस पर से अनुपात द्वारा फल लेकर मध्यम ग्रह में संस्कार करने से स्फुट क्रिया करण योग्य मध्यम ग्रह होंगें, यदि शेष $<$ ६००० वर्ष तब फल वृद्ध्यभिमुख होता है, यदि शेष $>$ ६००० वर्ष तब फल ह्रासोन्मुख होता है। यदि शेष $<$ ६००० वर्ष तब शेष $<$ १२०००—शेष=शेष' लेकिन दोनों शेषों के अनुपात से फल एक ही होता है इसलिये अङ्कलाघव के लिये यहां 'शे' इसी से अनुपात करना ठीक है। यदि शे $>$ ६००० वर्ष तब शे $>$ १२०००—शेष=शेष' यहां भी दोनों शेषों से फल एककालीन ही होता है, यहाँ अङ्क लाघव के लिये शे इसी से अनुपात करना ठीक है, इसलिये अनुपात करते हैं

$$\frac{\text{परमोपचयफल} \times \text{शेष}}{\text{६०००}} = \frac{\frac{\text{परमोपचयफल}}{\text{३०}} \times \text{शेष}}{\text{२००}} = \text{फल}$$

यहां रवि आदि ग्रहों के और पातादियों के परम बीज फलों को तीस से भाग देने से क्रम से ३,५,५,१५,२,१,५२,२,४ होते हैं, यहाँ अनुपातागत फलों को यदि रवि, चन्द्र, बृहस्पति, चन्द्रमन्दोच्चादि में ऋण करते हैं तब स्फुट क्रियाकरण योग्य मध्यम ग्रह होते हैं, इसमें आगम ही प्रमाण है।

इस तरह शे' इससे भी उसी तरह अनुपात होता है क्योंकि बारह हजार वर्षान्त से विलोम क्रम से यह काल होता है वहाँ फल वृद्धि के तरफ होता है, क्योंकि बारह हजार वर्षान्त में फल का परमह्रास होता है, उस काल से विलोम क्रम से फल की सत्ता क्रम से अधिक ही होती है, इसलिये अनुपात से दोनों जगह फल की तुल्यता ही होती है, इसलिये

$$\frac{\text{परमवृफल} \times \text{शेष}'}{\text{६०००}} = \text{फल} = \frac{\frac{\text{पवृफ}}{\text{३०}} \times \text{शेष}'}{\text{२००}}$$

इससे आगे पूर्ववत् होता है, यहाँ वर्षशब्द से सौरवर्ष ही ग्रहण करना चाहिये। भास्कराचार्य सिद्धान्तशिरोमणि में रवि, चन्द्र, बृहस्पति, शुक्रशीघ्रोच्च, चन्द्रमन्दोच्चों में अनुपातागत फलों को ऋण कहते हैं तथा मङ्गल बुध, चन्द्र, पात, शनि इनमें अनुपातागत फल को धन कहते हैं, ब्रह्मगुप्त सबों में अनुपातागत फलों को ऋण ही कहते हैं, सिद्धान्ततत्त्वविवेक में कमलाकर ने बीज कर्म संस्कार का खण्डन किया है। इनमें क्या ठीक है, इस विषय में प्रबल युक्ति नहीं मिलती है, इसलिये इस विषय में हम कुछ नहीं कह सकते ॥६०-६१॥

इदानीं चन्द्रमन्दोच्चपातयोरार्यभटोक्त्या दूषणमाह

अकृतार्यभटः शीघ्रगमिन्दूच्चं पातमल्पगं स्वगतेः ।
तिथ्यन्तग्रहणानां घुणाक्षरं तस्य संवादः ॥ ६२ ॥

वा. भा.—स्पष्टार्थेयमार्या अकृतार्यभटः । शीघ्रगामित्वादुच्चं पातमल्पगं स्वगतेः । तिथ्यन्तग्रहणानां घुणाक्षरं तस्य, इयं वासना चन्द्रमन्दस्य यत्र ब्राह्मसिद्धान्ते भगणः वसुशरवसुपंचखचन्द्रवसुवसुसमुद्रो ४८८१०५८५८ एतेभ्यरार्यभटोक्ता भगणाः सहस्रघ्नाः बहवोऽतो गम्यतेऽधिका मन्दगतिस्तस्य ब्राह्मोक्तगतेः यतो दशगीतिकासु उक्तं चन्द्रोच्चजस्त्रिघेति—४८८२१९ एते भगणाः सहस्रघ्ना जाता अधिका ब्रह्मभगणेभ्यः ४८८२१९००० तस्मादुपपन्नं शीघ्रगामीन्दूच्चपातब्रह्मभगणेभ्यश्चोना आर्यभटस्तस्य पात ब्रह्मभगणोऽतः कल्पगतस्तस्य तद्यथा ब्रह्मपातभगणाः वसुरसरुद्रेन्दुगुणद्वित्रियमा २३२३१११६८ दशगीतिकासु उक्तञ्च पातविलोम इति चतुर्युगस्य सहस्रघ्नाश्च जाता २३२२११६००० एते ब्रह्मभगणेभ्यरूनास्तस्मादुपपन्नपातमल्पगं स्वगतेः । यत एवातस्तस्यास्फुटत्वात्तिथ्यन्तग्रहाणां घुणाक्षरवत्संवादो युज्यते, इति स्वकृता या मध्यगतेः प्रशंसार्थमार्यामाह ॥६२॥

वि. भा.—आर्यभटश्चन्द्रमन्दोच्चं स्वगतेः (मत्कथितचन्द्रमन्दोच्चगतेः) शीघ्रमर्थान्मत्कथितचन्द्रमन्दोच्चगतेः स्वो (आर्यभट) क्त तद्गतिमधिकां कृतवान् तथा पातं (चन्द्रपातं), अल्पगं (अल्पगतिं) कृतवान्, तस्य (आर्यभटस्य) तिथ्यन्तग्रहणानां मध्ये यदि मया सह कदाचित् संवादो (ऐक्यं) भवेत्तद्घुणाक्षरं बोध्यम् । मदुक्तेन तिथ्यन्तादिना यदि कदाचिदार्यभटोक्तानां तिथ्यन्तादीनामैक्यं भवेत्तदा तद्घुणाक्षरन्यायभवं बोध्यम् । चन्द्रमन्दोच्चभगणा आर्यभटोक्ताः कल्पे=४८८२१९००० मन्मते कल्पे चन्द्रमन्दोच्चभगणाः=४८८१०५८५८<४८८२१९००० तथा कल्पे आर्यभटोक्ताश्चन्द्रपातभगणाः=२३२२२६००० मन्मते कल्पे चन्द्रपातभगणाः=२३२३१११६८>२३२२२६००० अतो मदुक्तचन्द्रमन्दोच्चपातगतिभ्यामार्यभटोक्ततद्गत्योरधिकत्वाल्पत्वाच्च तन्मतं न समीचीनमित्याचार्यः (ब्रह्मगुप्तः) कथयति, ब्रह्मगुप्तमनसीत्थं धारणाऽस्ति यन्मदुक्तमेव कल्पचन्द्रमन्दोच्चभगणमानं कल्पचन्द्रपातभगणमानं च युक्तियुक्तं मदुक्तेन सहाऽर्यभटोक्तस्य पार्थक्यमस्ति तेन तन्मतं न समीचीनमिति, ब्रह्मगुप्तकथनमिदं तथ्यमतथ्यं वेति परीक्षणार्थं गणितमेव शरणमिति ॥६२॥

अब आर्यभटोक्त चन्द्रोच्च और चन्द्रपात के दोष को कहते हैं

हि. भा.—आर्यभट ने मेरी चन्द्रमन्दोच्चगति से चन्द्रमन्दोच्च को शीघ्रगति किया है अर्थात् मेरी चन्द्रमन्दोच्च गति से अपनी (आर्यभटीय) चन्द्रमन्दोच्चगति को अधिक

किया है और मेरी चन्द्रपातगति से अपनी चन्द्रपातगति को अल्प किया है, इसलिये तिथ्यन्त और ग्रहणों में यदि मेरे मत के साथ आर्यभट मत का ऐक्य (एकता) हो तो उसको (मतैक्य को) घुणाक्षर समझना चाहिए अर्थात् काठ को घुण (कीड़ा विशेष) के खाने से कभी-कभी अक्षर का आकार बन जाता है तो उससे यह नहीं समझा जाता है कि घुण ने अपनी बुद्धि से अक्षर बनाया है, उसी तरह मतैक्य के सम्बन्ध में भी समझना चाहिये।

कल्प में आर्यभटोक्त चन्द्रमन्दोच्चभगण=४८८२१९०००, मेरे मत से कल्प में चन्द्रमन्दोच्चभगण=४८८१०५८५८<४८८२१९००० तथा कल्प में आर्यभटोक्त चन्द्रपातभगण=२३२२२६०००, मेरे मत से कल्पचन्द्रपातभगण=२३२३१११६८> २३२२२६००० इसलिये मेरी चन्द्रमन्दोच्चगति और पातगति से आर्यभटोक्त उनकी गति अधिक और अल्प होने के कारण आर्यभट का मत ठीक नहीं है यह ब्रह्मगुप्त कहते हैं, ब्रह्मगुप्त अपने मत को बिलकुल ठीक समझ कर अपने मत से आर्यभट मत के पृथक् होने के कारण उसका खण्डन करते हैं, ब्रह्मगुप्त का कथन ठीक है या नहीं इसके लिये गणित ही शरण है इति ॥६२॥

इदानीं स्वकृताया मध्यगतेः प्रशंसार्थमाह

मध्यगतिज्ञं वीक्ष्य श्रीषेणार्यभटविष्णुचन्द्रज्ञाः ।
सदसि न भवन्त्यभिमुखाः सिंहं दृष्ट्वा यथा हरिणाः ॥६३॥

वि. भा.—मध्यगतिज्ञं (मध्यग्रहानयनवेत्तारं) वीक्ष्य (दृष्ट्वा) श्रीषेणार्यभटविष्णुचन्द्रोक्तानां मध्यग्रहानयनानां ज्ञातारः सदसि (सभायां) अभिमुखा (संमुखाः) न भवन्ति, यथा सिंहं दृष्ट्वा हरिणास्तदभिमुखा न भवन्तीत्यनेन ब्रह्मगुप्तेन स्वकीयमध्यग्रहानयनस्य वास्तवत्वं श्रीषेणार्यभटादीनामाचार्याणां मध्यमग्रहानयनस्यावास्तवत्वं कथ्यतेऽर्थादेतद्व्याजेन स्वप्रशंसा क्रियत इति ॥ ६२ ॥

अब अपनी प्रशंसा को कहते हैं

हि. भा.—हमारे मध्यग्रहानयन के समझने वाले को देखकर श्रीषेण-आर्यभट-विष्णु-चन्द्र इन आचार्योक्त मध्यग्रहानयन को समझने वाले सभा में उनके (हमारे मध्यग्रहानयन को समझने वालों के) सम्मुख नहीं होते हैं जैसे सिंह को देखकर हरिण उसके सम्मुख नहीं होता है। इससे आचार्य (ब्रह्मगुप्त) अपने मध्यग्रहानयन के वास्तवत्व और श्रीषेण-आर्यभट आदि आचार्योक्त मध्यग्रहानयन के अवास्तवत्व को कहते हैं अर्थात् इस व्याज से अपनी प्रशंसा करते हैं इति ॥ ६३ ॥

इदानीं मध्यमाधिकारोपसंहारमाह

युगभगणमानयाताहर्गणदिनवारमध्यमाद्येषु ।
मध्यमगतिस्त्रिषष्ट्यचार्याणां प्रथमः कृतोऽध्यायः ॥ ६४ ॥

वा. भा—युगादिष्वर्थेषु द्विषष्ट्याचार्याणां मध्यगत्याख्यो मध्ययोनि बद्ध इति।

इति ब्राह्मसिद्धान्ते वासनाभाष्ये मध्यगत्याख्यो ग्रन्थशतैः सप्तभिः सार्धैर्व्याख्यातम् ।

इति ब्राह्मसिद्धान्तवासनाभाष्ये मध्यगत्याख्यो मध्ययोनि बद्ध इति ।

वि. भा.—ग्रहादीनां युगे कियन्ति भगणमानानि गताहर्गणमानानि यानि, दिनवारादेर्य विचाराः, मध्यमग्रहादिसाधनानि यानि, एतदाद्येषु विषयेषु आर्याणां (आर्याछन्दसां) त्रिषष्टया (त्रिषष्टिप्रमिताऽऽर्याछन्दसा) प्रथमो मध्यगतिरध्यायः (मध्यगतिनामकः प्रथमोऽध्यायः) मया कृतोऽर्थान्मध्यगतिनामकेऽध्याये कियन्तो विषयाः सन्ति तेषामुल्लेखः कृत इति ॥ ६४ ॥

इति ब्राह्मस्फुटसिद्धान्ते मध्यमाधिकारः प्रथमः ॥

अब मध्यमाधिकार के उपसंहार को कहते हैं

हि. भा.—ग्रहादियों के युग में जो भगणमान है, गताहर्गणमान जो है, दिनवारादि के जो विचार हैं, और मध्यम ग्रहादि साधन जो है एतदादिक विषयों में तिरसठ आर्याछन्दों के (तिरसठ आर्याछन्द श्लोक द्वारा) मध्यगति नाम का प्रथम अध्याय किया गया अर्थात् मध्यगति नामक अध्याय में कितने विषय हैं उनका उल्लेख किया गया इति ॥६४॥

इति ब्राह्मस्फुटसिद्धान्त में मध्यमाधिकार (प्रथम अधिकार) समाप्त हुआ ॥



ब्राह्मस्फुटसिद्धान्तः

स्पष्टाधिकारः

ब्राह्मस्फुट-सिद्धान्तः

स्पष्टाधिकारः

तत्रादौ स्फुटीकरणस्य प्रयोजनमाह

यस्मान्न मध्यतुल्यः प्रतिदिवसं दृश्यते ग्रहो भगणे।
तस्माद् दृक्तुल्यकरं वक्ष्ये मध्यस्फुटीकरणम् ॥१॥

वा. भा.—अथ स्फुटगत्यध्यायो व्याख्यायते । तत्रारम्भप्रयोजनमाह । यस्मान्मध्यग्रहेण तुल्यः दृग्विषये ग्रहो न दृश्यते भगणे नक्षत्रचक्र प्रतिदिवसं दिवसे-दिवसे तस्मात् स्फुटोकरणं वक्ष्ये । मध्यस्य कीदृगित्याह दृक्तुल्यकरमभिप्रायो-मध्यमो ग्रहः कक्षामण्डले परिकल्पते । न च कक्षामण्डले पारमार्थिको ग्रहः प्रति-मण्डले मध्यभुक्त्या भ्रमति । यस्माद् दृश्यते कक्षामण्डलेऽतोऽहं दृक्स्फुटीकरणं वक्ष्ये येन प्रतिमण्डलस्थो ग्रहः कक्षामण्डले दृक्तुल्यो दृश्यते इत्यर्थः, एतत्सर्वं कक्षामण्डलं प्रतिमण्डलनीचोच्चवृत्तादीनि विन्यस्य गोले छेदके च प्रदर्शयेत् । मया च पूर्वमेव गोलाध्याये प्रदर्शितमिति ।

वि. भा.—यस्मात्कारणात् प्रतिदिवसं (प्रतिदिनं) भगणे (क्रान्तिवृत्ते) ग्रहः (पारमार्थिकः स्फुटो वा ग्रहः) मध्यतुल्यो (मध्यमेन ग्रहेण समः) न दृश्यते (नावलोक्यते), तस्मात्कारणात् दृक्समकारकं स्फुटीकरणं वक्ष्ये, अत्रैतदुक्तं भवति मध्यमो ग्रहः कक्षावृत्ते परिकल्पितः, नहि कक्षावृत्ते पारमार्थिको ग्रहः प्रतिवृत्ते मध्यगत्या भ्रमति किन्तु स्पष्टगत्या प्रतिवृत्ते परिभ्रमन् कक्षावृत्ते दृश्यते, अतो येन गणितेव कक्षावृत्ते प्रतिवृत्तस्थो ग्रहो दृक्समो भवेत्तादृशं स्फुटीकरणमहं वक्ष्ये इति ॥१॥

हि. भा.—जिस कारण से प्रत्येक दिन क्रान्तिवृत्त में स्पष्ट ग्रह मध्यम ग्रह के बरा-बर नहीं देखे जाते हैं उस कारण से दृक्तुल्य (दृग्गणितैक्य) कारक स्पष्टीकरण को मैं (ब्रह्मगुप्त) कहता हूं, यहाँ यह कहा जाता है कि कक्षावृत्त में मध्यम ग्रह परिकल्पित है, प्रतिवृत्त में स्पष्टगति से भ्रमण करते हुए ग्रह कक्षावृत्त में देखे जाते हैं इसलिए जिस गणित से कक्षावृत्त में प्रतिवृत्तस्थित ग्रह दृक्सम होते हैं उस स्पष्टीकरण को मैं कहता हूं ॥१॥

इदानीं स्पष्टीकरणादिसर्वग्रहगणितानां ज्यागणिताऽधीनत्वात्प्रथममर्ध-ज्यामुक्त्वोत्क्रमज्यामाह

अर्धज्या मनुयमला मुनियमवेदा वसुज्वलनषट्काः ।
रसकृतवसवः शशिपञ्चखेन्दवश्चन्द्रशरसूर्याः ॥२॥

षडुदधिमनवो भूताग्निरसशशाङ्का मुनीन्दुवसुचन्द्राः ।
इन्दुनवनन्दचन्द्रा रसतिथियमला रवित्रियमाः ॥३॥
छिद्रेषु जिनाः कृतनवपञ्चयमा नन्दचन्द्रमुनिपक्षाः ।
दन्ताष्टयमा गुणरामनवयमाः शशियमखरामाः ॥४॥
ऋतुनवखगुणा नवशरचन्द्रगुणाः सप्तशून्ययमदहनाः ।
द्विजिनगुणास्त्रिरसरदाः खसप्तयमवन्ह्यो व्यस्ताः ॥५॥
मुनयोऽष्टयमास्त्रिरसा रुद्रशशाङ्काः समुद्रमुनिचन्द्राः ।
नववेदयमा मुनिगुणहुताशना वसुगुणसमुद्राः ॥६॥
भूमीन्द्रियेषवो रसनगर्तवश्चन्द्रशीतकरवसवः ।
शरवसुनन्दाः सागररुद्रशशाङ्का नवाङ्कार्काः ॥७॥
त्रिविषयवेदशशाङ्काः पञ्चाग्निरसेन्दवोऽब्धियमधृतयः ।
अतिधृतिखयमा नवशशियमपक्षाः सागरद्विजिनाः ॥८॥
रदरसयमला गुणवेदवसुयमाः षट्कविषयशून्यगुणाः ।
खमुनिरदा व्यासार्धं नवरदचन्द्रा जिनांशज्या ॥९॥

(२, ३, ४, ५, ६, ७, ८, ९) श्लोकानां कृते

वा. भा.—अत्र अङ्कन्यास एव व्याख्यानम् । अर्धज्यकास्ता इति तद्यथा । मनुयमला २१४। एतत् प्रथमज्यार्धम् । मुनियमवेदा ४२७ द्वितीयम् । वसुज्वलनषट्काः ६३८ तृतीयम् । रसकृतवसवः ८४६ चतुर्थम् । शशिपञ्चखेन्दवः १०५१ पञ्चमम् । चन्द्रशरसूर्या १२५१ षट्कम् । षट्उदधिमनवः १४४६ सप्तमम् । भूताग्निरसशशांकाः १६३५ अष्टमम् । मुनीन्दुवसुचन्द्राः १८१७ नवमम् । इन्दुनवनन्दचन्द्राः १९९१ दशमम् । रसतिथियमला २१५६ एकादशमम् । रविविंत्रियमा २३१२ द्वादशम्ः छिद्रेषुजिना २४५९ त्रयोदशम् । कृतनवपञ्चयमाः २५९४ चतुर्दशम् । नन्दचन्द्रमुनिपक्षाः २७१९। पञ्चदशमम् । दन्ताष्टयमाः २८३२ षोड़शम् । गुणरामनवयमाः २९३३ सप्तदशमम् शशियमखरामाः ३०२१ अष्टादशम् । ऋतुनवखगुणाः ३०९६ एकोनविंशम् । नवशरचन्द्रगुणाः ३१५९ विंशतिः । सप्तशून्यदन्ताः ३२०७ एकविंशम् । द्विजनगुणाः ३२४२ द्वाविंशतिः । त्रिरसरदाः ३२६३ त्रयोविंशतिः । खसप्तयमदहनाः ३२७० चतुर्विंशतिः अर्धज्या प्रथमं ज्यार्धमुत्क्रमेण मुनयः अष्टयमाः २८ द्वितीयः, त्रिरसाः ६३ तृतीयम् । रुद्रशशांकाः १११ चतुर्थम्, समुद्रमुनिचन्द्राः १७४ पञ्चमम् । नववेदयमाः २४९ षष्ठः, मुनिगुणहुताशाः ३३७ सप्तमम्, वसुगुणसमुद्राः ४३८ अष्टमम् । रूपेन्द्रियेषवः ५५१ नवमम् । रसनगर्त्तवः ६७६ दशमम् । चन्द्रशशिवसवः ८११ एकादशम् । शरवसुनन्दाः ९८५ द्वादशम् । सागररुद्रशशांकाः १११४ त्रयोदशम् । नवाङ्कार्काः १२९९ चतुर्दशम् । त्रिविषयवेदशशांका १४५३ पञ्चदशम् । पञ्चत्रि-

रसेन्दवः १६३५ षोडशम्, अब्धियमधृतयः १८२४ सप्तदशमम्। अतिधृतिखयमाः २०१९ अष्टादशम्। नवशशियमपक्षाः २२१९ एकोनविंशतिः। सागरद्विजिना २४२४ विंशतिः। रदरसयमलाः २६३२ एकविंशतिः। गुणवेदवसुयमाः २८४३ द्वाविंशतिः। षट्विषयशून्यगुणाः ३०५६ त्रयोविंशतिः। खमुनिरदा ३२७९ चतुर्विंशति, व्यासार्धं चैतदेव चकारोऽत्र द्रष्टव्यः। नवरदचन्द्राः १३२९ एतावती जिनांशज्य क्रमेणेति वाक्यशेषः। अयमर्थः भागचतुर्विंशतिज्याक्रमेण क्रियते सा नवरदचन्द्रसंख्या भवति। परमक्रान्तिज्या प्रदर्शनार्थमेव चतुर्विंशतिग्रहणम्। यतश्चतुर्विंशतिज्या पराक्रान्तिरतोऽनया नवरदचन्द्रसंख्यया ज्यया त्रैराशिकेनेष्टदिने क्रान्तिज्यासाधन वक्ष्यति चाचार्यः। आसामार्याष्टानां वासना गोलाध्याये पूर्वमेव अस्माभिः प्रदर्शितेति।

वि. भा.—वृत्तचतुर्थांशे मनुयमला मुनियमवेदा इत्याद्यर्धज्याश्चतुर्विंशतिसंख्यकाः सन्ति याश्चाधोलिखिताः स्युः। व्यस्ता (उत्क्रमज्या) इत्यस्याग्रे सम्बन्धः।

चतुर्विंशतिरर्धज्याः (क्रमज्याः)

२१४, ४२७, ६३८, ८४६, १०५१, १२५१, १४४६, १६३५, १८१७, १९९१, २१५६, २३१२, २४५९, २५९४, २७१९, २८३२, २९३३, ३०२१, ३०९६, ३१५९, ३२०७, ३२४२, ३२६३, ३२७०।

वि. भा.—वृत्तचतुर्थांशे मुनयोऽष्टमा इत्यादि चतुर्विंशतिसंख्यका उत्क्रमज्याः सन्ति याश्चाधोलिखिताः स्युः—

७, २८, ६३, १११, १७४, २४९, ३३७, ४३८, ५५१, ६७६, ८११, ९८५, १११४, १२९९, १४५३, १६३५, १८२४, २०१९, २२१९, २४२४, २६३२, २८४३, ३०५६, ३२७०।

नवरदचन्द्राः=१३२९=जिनांशज्या (जिनांशानां चतुर्विंशतिसंख्यकांशानां परमक्रान्त्यंशानां ज्या) अस्या बहुषु स्थलेषूपयोगित्वात्संख्याः पठिता इति॥३-९॥

अत्रोपपत्तिः

वृत्तपरिधि ३६० चतुर्थांशे ९० चतुर्विंशतिसंख्यकाः क्रमज्या उत्क्रमज्याश्च '$\frac{९० \times ६०}{२४}$=२२५'=प्रथमचापम्, २२५', २२५'×२, २२५×३ ········ २४×२२५' चापानां, ज्योत्पत्तिविधिना ३२७० मितत्रिज्यायामाचार्येणाऽऽनीय पठिताः। यथा ३४३८ त्रिज्यायां भास्करमतेन स्वल्पान्तरात् २२५=प्रथमज्या, ततोऽनुपातो यदि

३४३८ त्रिज्यायां २२५ तुल्या प्रथमज्या लभ्यते तदा ३२७० त्रिज्यायां किमित्यनुपातेनाऽऽगच्छत्याचार्योक्तप्रथमज्या $= \frac{२२५ \times ३२७०}{३४३८}$ हरभाज्यौ नवभिरपवर्तितौ तदा

$\frac{२५ \times ३२७०}{३८२} = \frac{२५ \times १६३५}{१९१} = \frac{४०८७५}{१९१} = २१४\frac{१}{१९१} = २१४ =$ आचार्योक्तप्रथमज्या स्वल्पान्तरात्, एवमेवान्याः क्रमज्या उत्क्रमज्याश्चाऽऽयान्तीति । एवं पठितज्याभिर्ज्यासाधनविधिना चतुर्विंशत्यंशानां ज्या साध्या सा चै १३२९ तन्मिता भवतीयमेव परमक्रान्तिज्येति । सिद्धान्तशिरोमणेष्टिप्पण्यां संशोधकेन पठितज्यास्विष्टज्याज्ञानात्तत्पूर्वाग्रिमज्ययो (पृष्ठज्याऽग्रज्ययोः) र्घातानयनं कृत्वा तत्र पृष्ठज्या भक्तेऽग्रज्या भवेदग्रज्याभक्ते पृष्ठज्या भवेदिति प्रदर्शितम् । यथा यथेष्टचापम् = इ ; प्रथमचापम् = प्र, तदा ज्या (इ − प्र) = पृष्ठज्या, ज्या (इ + प्र) = अग्रज्या ।

अनयोर्घातः

ज्या (इ—प्र) × ज्या (इ + प्र) = पृष्ठज्या × अग्रज्या, चापयोरिष्टयोरित्यादिना,

$$\frac{(ज्याइ \times कोज्याप्र - ज्याप्र \times कोज्याइ)}{त्रि} \times$$

$$\frac{(ज्याइ \times कोज्याप्र + ज्याप्र \times कोज्याइ)}{त्रि}$$ योगान्तरघातस्य वर्गान्तरसमत्वात् ।

$$\frac{ज्या^२इ \times कोज्या^२प्र - ज्या^२प्र \times कोज्या^२इ}{त्रि^२} =$$

$$\frac{ज्या^२इ\ (त्रि^२ - ज्या^२प्र) - ज्या^२प्र\ (त्रि^२ - ज्या^२इ)}{त्रि^२}$$

$$= \frac{ज्या^२इ \times त्रि^२ - ज्या^२इ \times ज्या^२प्र - ज्या^२प्र \times त्रि^२ + ज्या^२प्र \times ज्या^२इ}{त्रि^२} =$$

$$\frac{ज्या^२इ \times त्रि^२ - ज्या^२प्र \times त्रि^२}{त्रि^२}$$

$= \frac{त्रि^२\ (ज्या^२इ - ज्या^२प्र)}{त्रि^२} =$ ज्या^{२}इ — ज्या^{२}प्र, ३४३८ त्रिज्यायां स्वल्पान्तरात्

ज्या^{२}प्र = ५०५६० ततः ज्या^{२}इ — ५०५६० = पृष्ठज्या × अग्रज्या $\therefore \frac{ज्या^२इ - ५०५६०}{पृष्ठज्या}$

= अग्रज्या, वा $\frac{ज्या^२इ - ५०५६०}{अग्रज्या}$ = पृष्ठज्या, एतेन 'ज्यावर्गात्खरसाक्षाभ्रवाणोनादित्यादि' संशोधकोक्तमुपपन्नम् । ज्या^{२}इ — ज्या^{२}प्र = पृष्ठज्या × अग्रज्या, अत्राऽऽचा-

योक्तज्या^{2}प्र वशेन तत्पृष्ठज्याऽग्रज्ययोर्घातज्ञानं भवेत्तत्र पृष्ठज्याभक्तेऽग्रज्या भवेद-ग्रज्याभक्ते पृष्ठज्या भवेदिति ।

एतस्य प्रकारस्य खण्डनं म. म. सुधाकरद्विवेदिनैवं क्रियते यथा ज्या (इ—प्र) × ज्या (इ+प्र) = पृष्ठज्या + अग्रज्या, अत्र यदि इष्टचापम् = प्रथम-चापम् ।

तदा ज्या (इ—प्र) × ज्या (इ+प्र) = ज्या^{2}इ—ज्या^{2}प्र = पृष्ठज्या × अग्रज्या = ० × अग्रज्या

$\therefore \frac{\text{ज्या}^2\text{इ}-\text{ज्या}^2\text{प्र}}{0}$ = अनन्त = अग्रज्या, तदेष्टचापसमे प्रथमचापेऽग्रज्या-मानमनन्तसमं । संशोधकप्रकारेण समागच्छत्यतस्तन्मतं न युक्तमिति ।

परं सुधाकरद्विवेदिखण्डनं न युक्तं, संशोधकप्रकारः समीचीन एवेति प्रदर्श्यते ।

ज्या^{2}इ — ज्या^{2}प्र = पृष्ठज्या × अग्रज्या, यदि इष्टचा = प्रथमचा तदा ज्या (इ—प्र) = पृष्ठज्या = ० ,

$\therefore$ ज्या^{2}इ—ज्या^{2}प्र = ० × अग्रज्या वर्गान्तरस्य योगान्तरघातसमत्वात् ।

(ज्याइ — ज्याप्र) (ज्याइ + ज्याप्र) = ० × (ज्याइ + ज्याप्र) = ० × अग्रज्या,

$\therefore \frac{0\times(\text{ज्याइ}+\text{ज्याप्र})}{0}$ = ज्याइ + ज्याप्र = अग्रज्या, इतिलुप्तभिन्नसमी-करणेनाग्रज्यामानं समीचीनमेवागतमेतेनसंशोधकप्रकारस्य समाधानं जातमिति ।

म. म. सुधाकरद्विवेदिमहानुभावै रग्रज्यापृष्ठज्ययोर्योगवशात्तज्ज्ञानं कृतं यथा इष्टचापम् = इ । प्रथमचापम् = प्र । ज्या (इ—प्र) = पृष्ठज्या, ज्या (इ+प्र) = अग्रज्या ततः ज्या (इ—प्र) + ज्या (इ+प्र) = पृष्ठज्या + अग्रज्या, चापयोरिष्टयोरित्यादिना

$$\frac{\text{ज्याइ}\times\text{कोज्याप्र}-\text{ज्याप्र}\times\text{कोज्याइ}}{\text{त्रि}}+\frac{\text{ज्याइ}\times\text{कोज्याप्र}+\text{ज्याप्र}\times\text{कोज्याइ}}{\text{त्रि}}=$$

$$\text{पृज्या}+\text{अग्रज्या}=\frac{2\,\text{ज्याइ}\times\text{कोज्याप्र}}{\text{त्रि}}=\frac{2\,\text{ज्याइ}(\text{त्रि}-\text{ज्याउप्र})}{\text{त्रि}}=$$

$$2\,\text{ज्याइ}-\frac{2\,\text{ज्याइ}\times\text{ज्याउप्र}}{\text{त्रि}}=2\left(\text{ज्याइ}-\frac{\text{ज्याइ}\times\text{ज्याउप्र}}{\text{त्रि}}\right)=2$$

$$\frac{\left(\text{ज्याइ} - \frac{\text{ज्याइ}}{\text{त्रि}}\right)^2}{\text{ज्याउप्र}} \left(\text{ज्याइ} - \frac{\text{ज्याइ}}{४६७}\right) = \text{पृज्या} + \text{अग्रज्या},\ \text{अत्र त्रि} = ३४३८,$$

अत्र पृष्ठज्याशोधनेनाग्रज्या भवेदग्रज्याशोधनेन च पृष्ठज्या भवेदेतेन तदीय-सूत्रमवतरति ।

जीवा स्वसप्तारिघुगांशहीना द्विघ्नी च पूर्वज्यकया विहीना ।
स्यादग्रजीवा वृहतीति सर्वा आसन्नजीवा द्वयतो भवन्ति ।।

अस्याऽऽचार्यस्य मते त्रिज्या = ३२७०,एतत्त्रिज्यावशेनापि प्रथमोत्क्रमज्या = ३४३८ त्रिज्योत्पन्नप्रथमोत्क्रमज्या = ७, अतः पूर्वोक्तसूत्रेणाऽऽचार्योक्तज्यासु कयापीष्टज्यया तत्पूर्वाग्रिमज्ययोर्योगज्ञानं भवेदेवेति ।।३-९।।

अब स्पष्टीकरणादि सब ग्रहगणितों के ज्यागणित के अधीन होने के कारण पहले अर्धज्या को कह कर उत्क्रमज्या को कहते हैं

हि. भा.—वृत्त परिधि के चतुर्थांश में २२५′, २×२२५′, ३×२२५′········· चापों की चौबीस क्रमज्यायें और उत्क्रमज्यायें हैं जो संस्कृत विज्ञान भाष्य में लिखी गई हैं, उन्हीं को यहाँ भी देखिए। चौबीस अंश की ज्या परमक्रान्तिज्या है, इसकी उपयोगिता बहुत स्थानों में होने के कारण उसकी संख्या १३२९ पठित की गई है इति ।। ३-९।।

उपपत्ति

वृत्त परिध्यंश ३६० के चतुर्थांश ९०° में चौबीस संख्यक क्रमज्यायें और उत्क्रमज्यायें

$$\left(\frac{९० \times ६०}{२४} = २२५' = \text{प्रथमचाप } २२५',\ २ \times २२५',\ ३ \times २२५' \cdots\cdots २४ \times २२५'\right)$$

चापों की ज्योत्पत्तिविधि से ३२७० तुल्य त्रिज्या में आचार्य ने लाकर पाठ किया है, जैसे भास्कराचार्य के मत में ३४३८ त्रिज्या में स्वल्पान्तर से प्रथमज्या = २२५, तब अनुपात करते हैं यदि ३४३८ तुल्य त्रिज्या में २२५ तुल्य प्रथमज्या पाते हैं तो ३२७० त्रिज्या में क्या, इस अनुपात से आचार्योक्त प्रथमज्या आती है,

$\frac{२२५ \times ३२७०}{३४३८}$ = आचार्योक्त प्रथमज्या, यहां हर और भाज्य में ९ इससे अपवर्त्तन करने से

$\frac{२५ \times ३२७०}{३८२} = \frac{२५ \times १६३५}{१९१} = \frac{४०८७५}{१९१} = २१४ \frac{१}{१९१}$ = २१४ स्वल्पान्तर से आचार्योक्त

प्रथमज्या, इसी तरह अवशिष्ट (द्वितीयादि) क्रमज्यायें और उत्क्रमज्यायें आती हैं, पठित-ज्याओं से ज्यासाधन विधि से चौबीस अंश परमक्रान्त्यंश की ज्या साधन करने से १३२९ एतत्तुल्य होती है। सिद्धान्तशिरोमणि की टिप्पणी में संशोधक 'पठितज्याओं में स्फुटता नहीं

से उससे पूर्व और अग्रिम (पृष्ठज्या और अग्रज्या) ज्याओं के घातानयन करके उस घात में पृष्ठज्या से भाग देने से अग्रिमज्या होती है और अग्रज्या से भाग देने से पृष्ठज्या होती है, दिखलाते हैं जैसे इष्टचाप=इ, प्रथमचाप=प्र, ज्या (इ—प्र)=पृष्ठज्या ज्या (इ+प्र)= अग्रज्या, दोनों के घात करने से ज्या (इ—प्र) × ज्या (इ+प्र)=पृष्ठज्या × अग्रज्या

चापयोरिष्टयोर्दोर्ज्ये मिथः कोटिज्यकाहते इत्यादि से

$$\frac{(\text{ज्याइ}\times\text{कोज्याप्र}-\text{ज्याप्र}\times\text{कोज्याइ})}{\text{त्रि}}\times\frac{(\text{ज्याइ}\times\text{कोज्याप्र}+\text{ज्याप्र}\times\text{कोज्याइ})}{\text{त्रि}}$$ योगान्तर

घात वर्गान्तर के बराबर होता है, इस नियम से $\frac{\text{ज्या}^2\text{इ}\times\text{कोज्या}^2\text{प्र}-\text{ज्या}^2\text{प्र}\times\text{कोज्या}^2\text{इ}}{\text{त्रि}^2}=$

$$\frac{\text{ज्या}^2\text{इ}\ (\text{त्रि}^2-\text{ज्या}^2\text{प्र})-\text{ज्या}^2\text{प्र}\ (\text{त्रि}^2-\text{ज्या}^2\text{इ})}{\text{त्रि}^2}=$$

$$\frac{\text{ज्या}^2\text{इ}\times\text{त्रि}^2-\text{ज्या}^2\text{इ}\times\text{ज्या}^2\text{प्र}-\text{ज्या}^2\text{प्र}\times\text{त्रि}^2+\text{ज्या}^2\text{प्र}\times\text{ज्या}^2\text{इ}}{\text{त्रि}^2}=$$

$$\frac{\text{ज्या}^2\text{इ}\times\text{त्रि}^2-\text{ज्या}^2\text{प्र}\times\text{त्रि}^2}{\text{त्रि}^2}=\frac{\text{त्रि}^2(\text{ज्या}^2\text{इ}-\text{ज्या}^2\text{प्र})}{\text{त्रि}^2}=\text{ज्या}^2\text{इ}-\text{ज्या}^2\text{प्र}=\text{पृष्ठज्या}\times$$

अग्रज्या, ३४३८ त्रिज्या में स्वल्पान्तर से $\text{ज्या}^2\text{प्र}=५०५६०$ $\therefore$ $\text{ज्या}^2\text{इ}-५०५६०=$ पृष्ठज्या × अग्रज्या इसलिए $\frac{\text{ज्या}^2\text{इ}-५०५६०}{\text{पृष्ठज्या}}=\text{अग्रज्या}$, वा $\frac{\text{ज्या}^2\text{इ}-५०५६०}{\text{अग्रज्या}}=\text{पृष्ठज्या}$, इस से 'ज्यावर्गात्खरमाक्षाभ्रबाणोनात् इत्यादि' संशोधकोक्त उपपन्न हुआ।

यहां आचार्योक्त प्रथमज्या वश से पृष्ठज्या और अग्रज्या के घात से पूर्ववत् पृष्ठज्या और अग्रज्या का ज्ञान हो जायगा। संशोधकोक्त प्रकार का खण्डन किसी ने अधोलिखित युक्ति से किया है, ज्या(इ—प्र) × ज्या (इ+प्र) = पृष्ठज्या × अग्रज्या = $\text{ज्या}^2\text{इ}-\text{ज्या}^2\text{प्र}$; यहाँ यदि इष्टचा=प्र वा तब $\text{ज्या}^2\text{इ}-\text{ज्या}^2\text{प्र}=० \times \text{अग्रज्या}$ $\therefore$ $\frac{\text{ज्या}^2\text{इ}-\text{ज्या}^2\text{प्र}}{०}=\text{अग्रज्या}=$ अनन्त; परन्तु इष्टचाप और प्रथमचाप के बराबर रहने से अग्रज्यामान अनन्त के बराबर नहीं होना चाहिए इसलिए यह प्रकार ठीक नहीं है। लेकिन यहाँ किसी ने जो खण्डन किया है वह ठीक नहीं है, संशोधकोक्त प्रकार ठीक ही है जैसे:—

$\text{ज्या}^2\text{इ}-\text{ज्या}^2\text{प्र}$=पृष्ठज्या × अग्रज्या, यदि इष्टचाप=प्रथमचाप तब ज्या (इ—प्र)=०=पृष्ठज्या, इसलिए $\text{ज्या}^2\text{इ}-\text{ज्या}^2\text{प्र}=० \times$ अग्रज्या, परन्तु वर्गान्तर योगान्तर घात के बराबर होता है।

अतः (ज्याइ—ज्याप्र) (ज्याइ+ज्याप्र) = ० × (ज्याइ + ज्याप्र) = ० × अग्रज्या

$\therefore$ $\frac{० \times (\text{ज्याइ} + \text{ज्याप्र})}{०}$ = अग्रज्या = ज्याइ + ज्याप्र = अग्रज्या, लुप्तभिन्नसमीकरण से अग्रज्या का मान समीचीन ही आता है, अतः संशोधकोक्त प्रकार समीचीन ही है, यह सिद्ध हुआ।

यहां म.म. सुधाकर द्विवेदी जी ने अग्रज्या और पृष्ठज्या के योग के सम्बन्ध से अग्रज्या के ज्ञानार्थ विधि दिखलायी है, जैसे इष्टचाप = इ। प्रथमचाप = प्र, ज्या (इ—प्र) = पृष्ठज्या ज्या (इ + प्र) = अग्रज्या तब ज्या (इ—प्र) + ज्या (इ + प्र) = पृष्ठज्या + अग्रज्या, चापयोरिष्टयोर्दोर्ज्ये मिथःकोटिज्यकाहते इत्यादि से $\frac{\text{ज्याइ} \times \text{कोज्याप्र} - \text{ज्याप्र} \times \text{कोज्याइ}}{\text{त्रि}}$ +

$$\frac{\text{ज्याइ} \times \text{कोज्याप्र} + \text{ज्याप्र} \times \text{कोज्याइ}}{\text{त्रि}} = \frac{२\ \text{ज्याइ} \times \text{कोज्याप्र}}{\text{त्रि}}$$

$$= \frac{२\ \text{ज्याइ}(\text{त्रि} - \text{ज्याउप्र})}{\text{त्रि}} = २\ \text{ज्याइ} - \frac{२\text{ज्याइ} \times \text{ज्याउप्र}}{\text{त्रि}} = २\left(\text{ज्याइ} - \frac{\text{ज्याइ} \times \text{ज्याउप्र}}{\text{त्रि}}\right)$$

$$= २\left(\text{ज्याइ} - \frac{\text{ज्याइ}}{\frac{\text{त्रि}}{\text{ज्याउप्र}}}\right) = २\left(\text{ज्याइ} - \frac{\text{ज्याइ}}{\frac{३४३८}{७}}\right)$$

$$= २\left(\text{ज्याइ} - \frac{\text{ज्याइ}}{४६७}\right) = \text{पृष्ठज्या} + \text{अग्रज्या},\ \text{अतः}\ २\left(\text{ज्याइ} - \frac{\text{ज्याइ}}{४६७}\right) - \text{पृष्ठज्या} =$$

अग्रज्या।

इससे द्विवेदी जी का सूत्र 'जीवा स्वसप्तारियुगांशहीना इत्यादि' जो संस्कृतोपपत्ति में लिखा गया है, उपपन्न हुआ। आचार्य (ब्रह्मगुप्त) के मत में त्रिज्या = ३२७०, इस त्रिज्या से भी प्रथमोत्क्रमज्या = ७ अतः पूर्वोक्त सूत्र से इनकी पठित ज्याओं में किसी इष्टज्या से अग्रज्या का ज्ञान पूर्ववत् होता है, इति ॥३-९॥

केषाञ्चिन्मतं तत्प्रकारश्च

"पृष्ठज्या यत्र शून्या प्रथमगुणसमाऽभीष्टचापज्यका स्यादग्रज्या नैव सिद्ध्यत्युदितगणिततस्तत्र संशोधकस्य। शून्यत्वादिष्टज्याप्रथमगुणवियोगैक्यघातस्य तस्मात् दुष्टोऽयं तत्प्रकारो गणितमतिमता वेदितव्यो बुधैरि" ति केनाप्युक्तवचसा दुष्टोऽयं प्रकार इत्यधिक्षिपति कश्चित्।

वस्तुतो विचार्यमाणे यत्र भिन्ने भाज्यभाजकगताव्यक्तराशेर्यस्मिन्कस्मिन्नपि

व्यक्तमाने तन्मूल्यं शून्यसमं भवेत्तल्लुप्तसंज्ञकभिन्नमिति नवीनाः प्रवदन्ति। तत्र लुप्तभिन्ना$\div$दस्मात्प्रकृतराशिज्ञानं कथं स्यादिति समालोच्यते।

अथ लुप्तभिन्नस्य भाज्यभाजकावव्यक्तस्य व्यक्तपदे शून्यसमौ भवेतां तत्र व्यक्ताव्यक्तयोरन्तरेण वा तत्सजातीयेन केनाप्यङ्केन तौ भाज्यभाजकाववश्यमेव निःशेषं भजेताम्। अन्यथा तत्र लुप्तभिन्नत्वं न स्थास्यतीत्युच्चगणितेन स्फुटमेव विदाम्। अतोऽत्रानया दिशा संशोधकप्रकारः परीक्ष्यते, तथाहि संशोधकप्रकारेण—

$$\text{अग्रज्या} \times \text{पृष्ठज्या} = \text{ज्या}^2\text{इ} - \text{ज्या}^2\text{प्र}$$

$$\therefore \quad \text{अग्रज्या} = \frac{\text{ज्या}^2\text{इ} - \text{ज्या}^2\text{प्र}}{\text{पृष्ठज्या}}$$

$$= \frac{(\text{ज्याइ} - \text{ज्याप्र})\ (\text{ज्याइ} + \text{ज्याप्र})}{\text{ज्या}\ (\text{इ} - \text{प्र})} \ldots\ldots (१)$$

इदमेव तावद्वास्तवभिन्नस्वरूपम्।

तत्र यदि ज्याइ=ज्याप्र।

वा इ=प्र कल्प्येत चेत् तदा

(१) समीकरणस्वरूपम्= $\div$ अतो लुप्तभिन्नत्वं जातम्।

अतो लुप्तभिन्नसिद्धान्तेन (१) समीकरणे भाज्यभाजकौ ज्या (इ—प्र) अनेन निःशेषं भवत एव।

$$\text{तदर्थं} \quad \text{ज्याइ} - \text{ज्याप्र} = \frac{२\ \text{कोज्या}\tfrac{१}{२}\ (\text{इ} + \text{प्र}),\ \text{ज्या}\tfrac{१}{२}(\text{इ} - \text{प्र})}{\text{त्रि}}$$

$$\text{एवं} \quad \text{ज्याइ} + \text{ज्याप्र} = \frac{२\ \text{ज्या}\tfrac{१}{२}\ (\text{इ} + \text{प्र}),\ \text{कोज्या}\tfrac{१}{२}\ (\text{इ} - \text{प्र})}{\text{त्रि},}$$

$$\text{द्वयोर्घातः} \quad = \text{ज्या}\ (\text{इ} + \text{प्र})\ \text{ज्या}\ (\text{इ} - \text{प्र})$$

$$\text{अतो वास्तवभिन्नः} = \frac{\text{ज्या}\ (\text{इ} + \text{प्र})\ \text{ज्या}\ (\text{इ} - \text{प्र})}{\text{ज्या}\ (\text{इ} - \text{प्र})} = \text{ज्या}\ (\text{इ} + \text{प्र})$$

एतेनाग्रजीवा वास्तवैव सिद्ध्यतीति। अतोऽधिक्षेपो न युक्त इति। संशोधक. प्रकारस्य वास्तवत्वं न हीयते, किन्तु स्थास्यत्येव।

इदानीं चापज्यानयनमाह

लिप्तास्तत्त्वयमहृता लब्धज्या ज्यान्तराहताच्छेषात् ।
तिथिकृतिहृतात्फलयुता लब्धज्या ज्याग्रहणमेवम् ॥१०॥

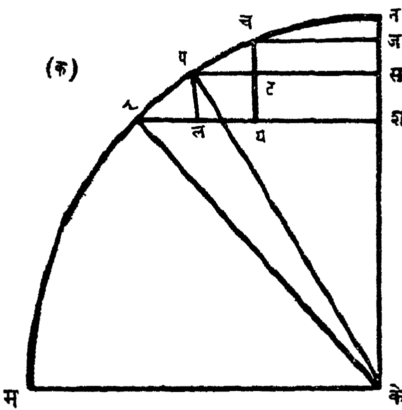
वा. भा.—इदानीं इष्टस्य धनुषो ज्याकरणायार्यामाह । इष्टचापस्य यस्य ज्याकर्त्तुमिष्यते तत्सम्बन्धिन्यो लिप्ता गृह्यन्ते, तेनायमर्थः । लिप्तास्तत्त्वयमहृताः कार्यास्ततो लब्धांकसमसंख्या ज्या स्थापयितव्या ज्यान्तरहृताच्छेषात् । इति लब्धज्यायाः तदग्रतो वर्त्तमानज्यायाश्च यदन्तरं तज्ज्यान्तरं तेन हताच्छेषात् । प्रथममेव तत्त्वयमैर्यद्भागे हृते यदवशेषं तच्छेषमुच्यते । तस्मात् तिथिकृतिहृतादिति, तत् यमैरेव हृतादित्यर्थः । ततो यदवाप्तं फलं तेन युता लब्धज्या कार्या । एवं ज्याग्रहणमिष्टचापोत्क्रमोत्क्रमज्यामयीत्यर्थः । एतदुक्तं भवति वक्ष्यमाणविधिना ज्याकेन्द्रं कार्यम् । तल्लिप्तादिकेन्द्रं कृत्वा तत्त्वयमैर्विभजेत् । लब्धांकसमां ज्यां स्थापयेत् । मनुयमला मुनियमवेदा इत्यादिगणनया यदि क्रमेण ज्याग्रहणमथोत्क्रमेण तथा मुनयोऽष्टयमा इत्यादिकया गणनया ज्यां स्थापयेत् । शेषं विकलसंज्ञं भवति । ततो लब्धज्याया पुरतः स्थितया सहान्तरे कृते यदवशिष्यते । समगुणकारो भवति, तेन विकलं संगुण्य तत्त्वयमैर्विभजेत् । लब्धं लिप्तादिः पूर्वस्थापितज्यायां संयोज्य ज्या भवति क्रमोत्क्रमेण च ज्याग्रहणमेवं कार्यं । अत्रेयं वासना गोलाध्याये प्रदर्शितविधिना वृत्तक्षेत्रं दिगङ्कितं राश्यष्टांशेष्टकानित्यादिनोक्तवत् परिलिख्य प्रदर्शयेत् । तत्र खखषडिन्दुघनसंख्यापरिणाहे षण्णवतिहृते तत्त्वयमा भवन्ति । अतएवेष्टचापलिप्तानां तत्त्वयमा भागहारः । तस्मात्तत्त्वयमसंख्ये चापखण्डलके ज्यारेखा स्थिता, यावद्गुणश्च तत्त्वयमा लिप्ताभ्यो विशोध्यन्ते । तावत् संस्थज्या तासां शुद्धलिप्तानां ततो भवति ततः शुद्धलिप्ताभिः त्रैराशिकं यदि तत्त्वयमसंख्याभिर्लिप्ताभिर्लब्धाः भुक्तज्यायोज्यज्ययोरन्तरतुल्यं ज्याखण्डलकं भवति, तदाभिरिष्टलिप्ताभिः किमिति लब्धफलेनोपचीयते । पूर्वलब्धा ज्या यतः तद्रेखाक्रान्तं चापखण्डमतिक्रम्य पुरतः स्थितो ग्रहादिकस्तदवधिज्यया वास्माकं प्रयोजनमुपपन्नं ज्याग्रहणमेवेति ।

वि. भा.—यासां लिप्तानां (कलानां) ज्याः साध्यास्तास्तत्त्वयमहृता (२२५ एभिर्भाज्याः) लब्धज्या (लब्धसंख्यकगतज्या बोध्याः), शेषात् ज्यान्तराहतात् (गतैष्यज्ययोरन्तरगुणितात्) तिथि १५ कृतिहृतात् (२२५ एभिर्भक्तात्) यत्फलं (लब्धं) तेन युता लब्धज्या (गतज्या) कार्याः, एवं कृते ज्याग्रहणं (इष्टज्यामानं) भवेदिति ॥१०॥

अत्रोपपत्तिः

वृत्तपादे २२५′, २×२२५′, ३×२२५′……………………२४×२२५′ चतुर्विंशतिसंख्यका ज्याः पूर्वं पठिताः सन्ति, पदादिबिन्दुतो यदि द्वयोरुक्तयोश्चापयो-

मध्ये इष्टचापाग्रं भवेत्तदा पदादिबिन्दुत इष्टचापाग्रं यावदिष्टचापकला यास्तास्तत्त्वाश्वि २२५ भिर्भाज्यास्तदा या लब्धिस्तत्संख्यका गतज्या भवेयुः, शेषचापादनुपातो 'यदितत्त्वाश्वि २२५ भिर्गतैष्यज्ययोरन्तरं लभ्यते तदा शेषचापेन किमिति, लब्धिः शेषचापसम्बन्धिनी ज्यावृद्धिरेतया युता गतज्येष्टा भवतीति परं शेषचापसम्बन्धिज्यावृद्ध्यर्थं यो ह्यनुपातः कृतः स च न समीचीनः कथमित्युच्यते ।



के=वृत्तकेन्द्रम् । नम=वृत्तपादः =९०, चज=गतज्या, रश=एष्यज्या, नप=इष्टचापम्, पस=इष्टज्या, चर =२२५, रय=एज्या—गतज्या, चप=शेषचापम् । पट=शेषचापसम्बन्धिनी ज्यावृद्धिः।<केरन=९०,<केपन=९० रकेशकोणः> पकेसकोणात् ∴ केरश कोण < केपस कोण तेन चरय कोण >चपट कोण अतः चरय, चपट त्रिभुजयोर्विजातीयत्वा—

$$\frac{(\text{एज्या—गज्या}) \times \text{शेषचा}}{२२५}$$

देतादृशोऽनुपातो न भवितुमर्हत्यत आचार्योक्तमिष्टचापज्यानयनं न युक्तियुक्तमिति सिद्धम् । परमिष्टज्यानयनार्थं सूर्यसिद्धान्तकारसिद्धान्तशेखरकारप्रभृतिभिः प्राचीनाचार्यैर्भास्करप्रभृतिभिस्तदर्वाचीनैश्चायमेव विधिर्गृहीत ॥१०॥

अब इष्टचाप के ज्यानयन को कहते हैं

हि. भा.—जिन कलाओं का ज्या साधन करना हो उन चाप कलाओं को दो सौ पच्चीस २२५ से भाग देने से जो लब्धि होती है तत्संख्यक गतज्या होती है, शेषचाप का गतज्या और एष्यज्या के अन्तर से गुणा कर दो सौ पच्चीस से भाग देने से जो लब्धि होती है उसको गतज्या में जोड़ने से इष्टज्या होती है इति ॥१०॥

उपपत्ति

वृत्त के चतुर्थांश ९० में पदादि बिन्दु से २२५′ कला वृद्धि करके चापों की चौबीस संख्यक ज्या पहले पठित की गई है । यदि उन दो चापों के मध्य में इष्टचापाग्र हो अर्थात् उन दो ज्याओं के बीच में इष्टज्या हो तब उसका ज्ञान कैसे होगा तदर्थं विचार करते हैं, इष्टचाप कला को दो सौ पच्चीस २२५ से भाग देने से जो लब्धि होती है तत्संख्यक गतज्या समझनी चाहिए। शेष चाप से अनुपात करते हैं यदि दो सौ पच्चीस २२५ में गतज्या और एष्यज्या का अन्तर पाते हैं तो शेष चाप में क्या इससे लब्धि शेषचाप सम्बन्धिनी ज्यावृद्धि

होती है, इसको गतज्या में जोड़ने से इष्टज्या होती है। लेकिन शेष-चाप-सम्बन्धिनी ज्यावृद्धि के लिए जो अनुपात किया गया है सो ठीक नहीं है, इसके लिए विचार करते हैं।

यहाँ संस्कृतोपपत्तिस्थ (क) क्षेत्र को देखिये। के=वृत्तकेन्द्र, नम चाप=वृत्तपाद =९०, चज=गतज्या, रश=एष्यज्या, नप=इष्टचाप, पस=इष्टज्या, चर=२२५, रय =एज्या—गतज्या, चप=शेषचाप, पट=शेषचापसम्बन्धिनी ज्यावृद्धि < केरन=९०, < केपन=९०, रकेश कोण > पकेस ∴ केरश कोण < केपस कोण ∴ चरय कोण > चपट कोण इसलिए चरय, चपट दोनों त्रिभुजों के विजातीयत्व के कारण $\frac{(\text{एज्या—गज्या})\ \text{शेचा}}{२२५}$ यह अनुपात ठीक नहीं कहा जा सकता है इसलिए आचार्योक्त इष्टचापज्यानयन युक्तियुक्त नहीं है, यह सिद्ध हुआ। लेकिन इष्टज्यानयन के लिए सूर्य सिद्धान्तकार प्रभृति प्राचीनाचार्य और भास्करप्रभृति उनसे अर्वाचीन आचार्य इसी (आचार्योक्त) विधि को अपनाये हुये हैं इति ॥१०॥

इदानीं ज्यातश्चापानयनमाह

ज्यां प्रोह्य शेषगुणितास्तत्त्वयमा ज्यान्तरोद्धृता लब्धम्।
क्षेप्यं विशुद्धजीवासंख्या तिथिकृतिवधे चापम् ॥११॥

वा. भा.—इदानीमिष्टज्यायाश्चापकरणार्थमार्यामाह। इष्टज्यायाः यस्याः चापं कर्त्तुमिष्यते। तस्या ज्यां प्रयोज्य इष्टज्यातो या ज्या ज्ञातसंख्या विशुध्यति तां विशोध्य यच्छेषं तेन गुणिताः तत्त्वयमा ज्यान्तरोद्धृताः कार्याः यल्लब्धं तत्तत्र क्षेप्यं क्वेत्याह, विशुद्धजीवा संख्यातिथिकृतिवधेः, एवं कृते चापं कृत्वा ज्यातो भवति। क्रमोत्क्रमाभ्यां अपि अयमर्थः यस्याः ज्यायाः चापं क्रियते। ततो मनुयमला इत्यादिकानां ज्यानां मध्याद्याजीवा विशुध्यति तां विशोध्य शेषं विकलं भवति, तत्त्वयमैः संगुण्य शुद्धजीवयोरन्तरेण विभजेत्। यल्लब्धं तच्चापखण्डके क्षेप्यं स्थापयेत्, ततो यावत्संख्या ज्या विशुध्यति तावत्संख्यागुणैस्तत्त्वयमैर्युक्तं तत्क्षेप्यं कार्यम्। एवं कृते इष्टज्यायाश्चापं कृतं भवति क्रमेण। अथोत्क्रमेण क्रियते तत्रेष्टज्यातो मुनयो यमादिकानामुक्तज्यानां मध्या या जीवा विशुध्यति तां विशोध्य शेषगुणितास्तत्त्वयमाः कार्यास्ततः शुद्धाशुद्धज्यान्तरेण विभज्य चापखण्डं कृत्वा तच्छुद्धजीवा संख्या तत्त्वयमवधे क्षिपेदेवमुत्क्रमज्याभिश्चापं कृतं भवति। वासना चात्र प्रागाचार्योक्तवैपरीत्ये योज्या यस्माद्यया वासनया चापात् ज्याकरणं तथैव विपरीतं, ज्यातश्चापकरणमाचार्येणोपनिबद्धं तथा युञ्ज्यादिति।

वि. भा.—इष्टज्यातो या ज्या विशुद्ध्यन्ति ताः शोध्याः, ज्याशेषगुणिता-

स्तत्त्वयमा २२५ गतैष्या ज्यान्तरभक्ता लब्धं यत्संख्यका जीवा विशुद्धास्तासां पञ्च-दशवर्गाणां २२५ च घाते योज्यं तदेष्टचापं भवेदिति ॥११॥

अत्रोपपत्तिः

इष्टज्यातो यत्संख्यका ज्या विशुद्धयन्ति ताः शोध्याः शेषा(गतज्येष्टज्ययोरन्तरात्)दनुपातो 'यदि गतैष्यज्यान्तरेण २२५ तत्तुल्यं चापं लभ्यते तदा गतज्येष्ट-ज्ययोरन्तरेण किमिति' यल्लब्धं तद्विशुद्धज्यासंख्यागुणिततत्त्वाश्वि २२५ मिते योज्यं तदेष्टचापं भवेदित्येतदर्थमिष्टज्यानयने लिखितं क्षेत्रं विलोक्यमित्यत्राप्यनुपातेऽप्य-नौचित्यं पूर्ववदेव बोध्यमिति ॥११॥

अब ज्या से चापानयन करते हैं

हि. भा.—इष्टज्या में जितनी ज्यायें घटें उनको घटा देना, ज्याशेष और दो सौ पच्चीस २२५ के घात में गतज्या और एष्यज्या के अन्तर से भाग देने से जो लब्धि हो उसका विशुद्धज्या संख्यागुणित दो सौ पच्चीस २२५ में जोड़ने से इष्टचाप होता है, इति ॥११॥

उपपत्ति

इष्टज्या में जितनी ज्यायें घटें घटा देना, शेष (गतज्या और इष्टज्या के अन्तर) से अनुपात 'यदि गतज्या और एष्यज्या के अन्तर में दो सौ पच्चीस २२५ चाप पाते हैं तो गतज्या और इष्टज्या के अन्तर में क्या' से जो लब्धि आती है उसको विशुद्धज्या गुणित दो सौ पच्चीस २२५ में जोड़ने से इष्टज्या होती है। इसके लिये इष्टज्यानयन में लिखे हुए क्षेत्र को देखना चाहिये। यहाँ भी अनुपात में अशुद्धता पूर्ववत् समझनी चाहिये, इति ॥११॥

अत्र विशेषो विचारः

भास्कराचार्यास्तु प्राचीनोक्तदिशा ज्यानयनं ३४३८ त्रिज्यायां विहितवन्तः। किन्तु खार्कव्यासार्धवृत्ते दशभिरंशैर्ज्या विधाय तदन्तरेण वृत्तपादे नवलघुज्याखण्डानि प्रोचुः। तत्राभीष्टज्यानयने यथोक्तदिशा त्रैराशिकक्रियया जीवायां महत्स्थौल्यमापद्यते तदर्थं स्फुटभोग्यखण्डानयनं विहितं भास्कराचार्यैः।

तद्यथा। कल्प्यतेऽभीष्टचापम्=चा, यस्य जीवा साधनीया। दशभक्तचापं गतसंज्ञकम्=गशेषम्= शे. प्रथमचापम् प्र।

अत्र $\quad$ ग—प्र=पूर्वचापम्, ग+प्र=अग्रचापम्

$$\therefore \text{ पूर्वज्या} = \frac{\text{ज्याग. कोज्याप्र—कोज्याग. ज्याप्र}}{\text{त्रि}} = \text{ज्यापू.}$$

$$\text{अग्रज्या} = \frac{\text{ज्याग. कोज्याप्र} + \text{कोज्याग. ज्याप्र}}{\text{त्रि}} = \text{ज्याग्र}$$

अत्र पूर्वज्यकायाः गतज्यकायां विशोधनेन गतखण्डं तथा अग्रज्यकायां गतज्यां विशोध्य भोग्यखण्डं भवतीत्यतः ।

$$\text{गतखण्डम्} = \text{गखं} = \frac{\text{ज्याग (त्रि—कोज्याप्र)} + \text{कोज्याग. ज्याप्र}}{\text{त्रि}}$$

$$\text{एवं भोग्यखण्डम्} = \text{भोखं} = \frac{\text{कोज्या. ज्याप्र—ज्याग(त्रि—कोज्याप्र)}}{\text{त्रि.}}$$

गतैष्यखण्डयोर्योगान्तराभ्याम्—

$$\text{गखं} + \text{भोखं} = \frac{\text{२ कोज्याग. ज्याप्र}}{\text{त्रि}}$$

$$\therefore \frac{\text{गखं} + \text{भोखं}}{\text{२}} = \frac{\text{कोज्याग. ज्याप्र}}{\text{त्रि}} \qquad \ldots\ldots\ldots(\text{१})$$

$$\text{एवं} \quad \frac{\text{गखं—भोखं}}{\text{२}} = \frac{\text{ज्याग (त्रि—कोज्याप्र)}}{\text{त्रि}}$$

$$= \frac{\text{ज्याग. उज्याप्र}}{\text{त्रि}} \qquad \ldots\ldots\ldots(\text{२})$$

अथ ग+शे=इष्टचापम्=चा ।

$$\therefore \quad \text{ज्याचा} = \frac{\text{ज्याग. कोज्याशे} + \text{कोज्याग. ज्याशे}}{\text{त्रि}}$$

अत्र शेषचापस्य दशभिरंशै रल्पत्वत:

$$\text{ज्याशे} = \frac{\text{ज्याप्र. शे}}{\text{१०}}, \therefore \text{ज्या}^{\text{२}}\text{शे} = \frac{\text{ज्या}^{\text{२}}\text{प्र. शे}^{\text{२}}}{\text{१०२}}$$

$$\therefore \text{कोज्या}^{\text{२}}\text{शे} = \text{त्रि}^{\text{२}} - \frac{\text{ज्या}^{\text{२}}\text{प्र. शे}^{\text{२}}}{\text{१०२}}$$

मूलेनासन्नमानेन—

$$\text{कोज्याशे} = \text{त्रि} - \frac{\text{ज्या}^{\text{२}}\text{प्र. शे}^{\text{२}}}{\text{त्रि. १०२}}$$ स्वल्पान्तरादग्रिमावयवत्यागात् ।

यदि शे=प्र=१०

$$\text{कोज्याप्र}=\text{त्रि}-\frac{\text{ज्या}^{\text{२}}\text{प्र}}{\text{त्रि}}$$

$$\therefore \quad \frac{\text{ज्या}^{\text{२}}\text{प्र}}{\text{त्रि}}=\text{त्रि}-\text{कोज्याप्र}=\text{प्रथमोत्क्रमज्या}=\text{उज्याप्र}$$

$$\therefore \quad \text{कोज्याशे}=\text{त्रि}-\frac{\text{उज्याप्र}\cdot\text{शे}^{\text{२}}}{\text{१०}^{\text{२}}}$$

$$\therefore \quad \frac{\text{उज्याप्र}.\ \text{शे}^{\text{२}}}{\text{१०}^{\text{२}}}=\text{त्रि}-\text{कोज्याशे}=\text{उज्याशे}$$

अथ पूर्वानीतचापज्यायां गतज्याया विशोधनेन

$$\text{ज्यान्तरम्}=\frac{\text{कोज्याग}.\ \text{ज्याशे}}{\text{त्रि}} \therefore \frac{\text{ज्याग}.\ (\text{त्रि}-\text{कोज्याशे})}{\text{त्रि}}$$

$$=\frac{\text{कोज्याग}.\ \text{ज्याप्र}.\text{शे}}{\text{त्रि}\times\text{१०}} \therefore \frac{\text{ज्याग}.\ \text{उज्याप्र}.\ \text{शे}^{\text{२}}}{\text{त्रि}.\ \text{१०}^{\text{२}}}$$

$$=\frac{\text{कोज्याग}\cdot\text{ज्याप्र}}{\text{त्रि}}\cdot\frac{\text{शे}}{\text{१०}} \therefore \frac{\text{ज्याग}\cdot\text{उज्याप्र}}{\text{त्रि}\cdot}\cdot\frac{\text{शे}^{\text{२}}}{\text{१०}^{\text{२}}}$$

अत्र (१) (२) समीकरणाभ्यामुत्थापनेन—

$$\text{ज्यान्तरम्}=\frac{\text{गखं}+\text{भोखं}}{\text{२}}\cdot\frac{\text{शे}}{\text{१०}}-\frac{\text{गखं}-\text{भोखं}}{\text{२}}\cdot\frac{\text{शे}^{\text{२}}}{\text{१०}^{\text{२}}}$$

$$=\frac{\text{शे}}{\text{१०}}\left(\frac{\text{गखं}+\text{भोखं}}{\text{२}}-\frac{(\text{गखं}-\text{भोखं})\text{शे}}{\text{२०}}\right)$$

अत्र कोष्ठकान्तर्गतखण्डं यदि भोग्यखण्डं मन्यते तर्हि प्रागुक्तानुपातेन वास्तवमेव ज्यान्तरं समागच्छतीति ∴ "यातैष्ययोः खण्डकयोर्विशेषःशेषांशनिघ्नो नखहृदित्यादि" भास्करोक्तं समीचीनमेव स्यात् व्यर्थं दुराग्रहेण प्रखण्डितं कमलाकरेण ।

इदानीं मन्दशीघ्रकेन्द्रयोः केन्द्रभुजकोटिज्ययोश्च परिभाषामाह

मध्याद्विशोध्य मन्दं शीघ्रात्संशोध्य मध्यमं केन्द्रम् ।
अयुजि गतयेययोर्युजि पदेऽन्यथा बाहुकोटिज्ये ॥६२॥

वा. भा.—इदानीं मन्दशीघ्रकर्मणोः केन्द्रकरणायार्यार्धेनाह। अत्र करणागतो देशान्तरफलेन संस्कृतो मध्य उच्यते। मन्दस्फुटञ्च मध्यं भौमादीनां तेनायमर्थः मध्याद्विशोध्य मन्दं मध्याद् ग्रहात्स्वमन्दोच्चं विशोध्य केन्द्रं भवति। शीघ्रोच्चात् संशोध्य मध्यमं मन्दफलं स्फुटं शीघ्रकेन्द्रं भवति। केन्द्रशब्देन मध्यमुच्यते। तेन कक्षामण्डले प्रथमं केन्द्रं मन्दनीचोच्चवृत्तमध्यं द्वितीयं केन्द्रं शीघ्रनीचोच्चवृत्तमध्यं यथा न्यस्तेषु कक्षामण्डलप्रतिमण्डलादिषु कक्षामण्डले मध्यग्रहा चिन्हेत्। तत्प्रदेशे नीचोच्चवृत्तं मध्ये कृत्वा प्रदर्शयेत् तद्यथा मेषादेः प्रभृति। कक्षामण्डले यावतो राशिभागादयो भुक्ताः ग्रहास्तेभ्यः स्वमन्दोच्चभुक्ताः राशिभागादीन्विशोध्य शोधयेत् राशिभागादयस्तावद्भिर्मन्दोच्चभागावधेस्तन्मन्दोच्चनीचवृत्तमध्यं वर्त्तते। अत एव तदन्तरकराश्यादिकं केन्द्रं मध्यमुच्यते। स च रेखातस्तावत्प्रदेशे केन्द्रस्याग्रतो गतत्वात्। स्वमन्दोच्चात् शीघ्रगतिर्यतोऽतो ग्रहात् मन्दोच्चं विशोध्यतेऽधिकभुक्तिपरिज्ञानाय स्वशीघ्रोच्चान्मन्दो ग्रहः अतएव शीघ्रात् ग्रहो विशोध्यते, तदन्तरपरिज्ञानाय कियति दूरे राशिभागाधिके ग्रहोऽवलंबित इति। यावति च प्रदेशे राशिभागादिके स्वशीघ्रोच्चरेखातो ग्रहपश्चादवलम्बितः कक्षामण्डले तावति दूरे शीघ्रनीचोच्चवृत्तमध्ये वर्त्तते। अतएव तदन्तरकं शीघ्रकेन्द्रमुच्यते।

इदानीं द्वितीयार्यार्धेन तत एव केन्द्रात् भुजकोटिज्ययोः करणमाह। अयुजिगतये अयुजिपदेऽन्यथा बाहुकोटिज्ये।

अयुजि विषमपदस्थे केन्द्रे यथासंख्यगतये ययोर्बाहुकोटिज्ये कार्ये, युजिपदे समपदस्थे केन्द्रेऽन्यथा येयगतयोर्बाहुकोटिज्ये कार्ये इत्यर्थः। एतदुक्तं भवति। मध्यकर्मणि मध्यग्रहात् स्वमन्दोच्चं विशोध्य केन्द्रं कार्यम्। तद्यदि प्रथमे पदे भवति तदा केन्द्रेण यद्राश्यादिकं भुक्तं तल्लिप्तापि केन्द्रं कृत्वा तत्त्वयमसंख्याभागहारेण मनुयमला इत्यादौ ज्यार्धे या ज्या भवति सा भुजज्येत्युच्यते। अथ द्वितीये पदे केन्द्रे तदा द्वितीयपदस्य यत्केन्द्रं भुक्तं तेन या ज्या क्रियते सा कोटिज्या तस्य द्वितीयपदस्य यच्छेषं तेन या ज्या क्रियते सा भुजज्या एवं तृतीय पदस्थे केन्द्रे प्रथमपदवत्। चतुर्थपदस्थे केन्द्रे द्वितीयपदवद्भुजकोटिज्याकरणम्। अथ शीघ्रकर्मणि स्वशीघ्रान्मन्दफलस्फुटं ग्रहं विशोध्य केन्द्रं कार्यम्। तस्मान्मन्दकर्म्मवद्भुजकोटिज्याकरणं योज्यमिति। अत्र गोलाध्यायोक्तविधिना कक्षामण्डलादीनि विन्यस्य गोले वासनां प्रदर्शयेत्। तद्यथा प्रतिमण्डलपरिधेर्यत्र प्रदेशे नीचोच्चवृत्तेन सह संपातस्तत्र स्फुटग्रहः। तत्रसूत्रैकस्याग्रं बद्ध्वा स्वोच्चशलाकातः

द्वितीयस्यां दिशि तावत्येव प्रतिमण्डलपरिधेः भागे बध्नीयात् । तदर्धभुजज्या तस्य सूत्रस्य स्वोच्चशलाकया सह यत्र संपातस्तस्य प्रदेशस्य प्रतिमण्डलमध्यस्योच्चान्तरं कोटिज्या तद् दक्षिणोत्तरज्या भुजज्योच्यते । अतएव प्रतिमण्डले प्रथमप्रदेशोच्च-शलाकासंपाताद्यद्ग्रहेण भुक्तं तस्य भुजज्या यच्च पदशेषं तस्य कोटिज्या द्वितीये पदे वाधोगा कोटिज्या, पार्श्वस्था भुजज्या तस्मात्तत्र प्रतिमण्डलार्धचक्रादधिकं यद्भुक्तं तस्य भुजज्या पार्श्वस्था भवति । शेषस्याधोगा कोटिज्या भवति, द्वितीयपद-वासनायां एवं चतुर्थसिदात् यच्छेषं तस्य पार्श्वस्था भुक्तस्य कोटिज्यार्धचक्रे स्थिता, प्रथमपदवासनयैव प्रदर्शयेत् ॥१२॥

वि. भा.—मध्यमग्रहान्मन्दोच्चं विशोध्य शेषं मन्दकेन्द्रम् । शीघ्रोच्चान्मध्यम-(मन्दस्पष्ट) ग्रहं विशोध्य शेषं शीघ्रकेन्द्रम् । अयुजि (विषम) पदे गतयेययोः (गतगम्ययोः) चापयोर्बाहुकोटिज्ये (भुजकोटिज्ये) साध्ये, अर्थात् गताद् भुजज्या, गम्यात्कोटिज्या साध्या, युजि (समे) पदेऽतोऽन्यथाऽर्थाद् गम्याद् भुजज्या, गतात्को-टिज्या साध्येति ॥१२॥

अत्रोपपत्तिः

अथ भूकेन्द्रान्मन्दप्रतिवृत्तस्य शीघ्रप्रतिवृत्तस्य च यो हि दूरतरप्रदेशोऽर्थादु-च्चरेखा (वर्धितभूकेन्द्रग्रहगोलकेन्द्रगतरेखा) मन्दप्रतिवृत्तसम्पातस्तथोच्चरेखाशीघ्र-प्रतिवृत्तसम्पातश्च मन्दोच्चं शीघ्रोच्चं चेति, मन्दप्रतिवृत्ते यत्र गणितागतो मध्यमग्रहोऽस्ति भूकेन्द्रात्तद्गता रेखा शीघ्रप्रतिवृत्ते यत्र लगति तत्र मन्दस्पष्टग्रहः । मन्दोच्चान्मध्यमग्रहावधिमन्दप्रतिवृत्ते मन्दकेन्द्रसंज्ञकम् । शीघ्रोचचान्मन्दस्पष्ट-ग्रहावधिशीघ्रप्रतिवृत्ते शीघ्रकेन्द्रसंज्ञकम् । मध्यमग्रहगतितो मन्दोच्चगतेरल्पत्वात् मध्यमग्र—मन्दोच्च=मन्दकेन्द्रम्, तथा शीघ्रोच्चगतेर्मन्दस्पष्टग्रहगतेरल्पत्वात् शीघ्रोच—मन्दस्पग्र=शीघ्रकेन्द्रम् । ग्रहगोलकेन्द्राढुच्चरेखोपरि लम्बरेखा कार्या तदैताभ्यां रेखाभ्यां मन्दप्रतिवृत्तस्य समानि चत्वारि खण्डानि नवत्यंशमितानि भव-न्ति, उच्चरेखातः (उच्चबिन्दुतो वा) सव्यक्रमेण चत्वारि पदानि कल्प्यानि, प्रथमपदे मन्दप्रतिवृत्ते यत्र ग्रहस्तस्योच्चरेखायाश्चान्तरं भुजज्या । ग्रहात्तिर्यग्रेखो (मन्दगोल-केन्द्रादुच्चरेखोपरिलम्बरेखा) परिलम्बरेखा भुजकोटिज्या, यथा-यथा ग्रहो पदान्ता-भिमुखं गच्छेत्तथा तथा भुजज्योपचीयते, भुजकोटिज्या चापचीयते, पदान्ते भुजज्या परमा त्रिज्या समा भुजकोटिज्यायाश्चाभावः ततोऽग्रे द्वितीयपदे ग्रहो यथा-यथाऽग्रतो गच्छति तथा-तथा भुजज्याऽपचीयते, भुजकोटिज्योपचीयते द्वितीयपदान्ते भुजज्याऽ-भावः, भुजकोटिज्या च परमा त्रिज्या समा भवत्यतोऽयुजि गतयेययोर्युजि पदेऽन्यथा बाहुकोटिज्ये इत्याऽचार्योक्तं युक्तियुक्तं संगच्छते तृतीये चतुर्थे पदेऽप्येवमेव विचारः कार्यः । सूर्यसिद्धान्ते 'ग्रहं संशोध्य मन्दोच्चात्तथा शीघ्राद्विशोध्य चेत्यादिना, मध्यम-

मन्दोच्चाद्विशोध्य शेषं मन्दकेन्द्रं कथ्यते भगवता सूर्यांशपुरुषेण, अन्यत्सर्वमाचार्योक्तवदेवास्ति सिद्धान्तशेखरे श्रीपतिना सिद्धान्तशिरोमणौ भास्कराचार्येण चाऽऽचार्योक्तमेव कथ्यत इति ॥१२॥

अब मन्दकेन्द्र और शीघ्रकेन्द्र की तथा केन्द्रज्या-और
केन्द्र कोटिज्या की परिभाषा कहते हैं

हि. भा.—मध्यमग्रह में मन्दोच्च को घटाने से शेष मन्दकेन्द्र होता है, शीघ्रोच्च में मन्द स्पष्ट ग्रह को घटाने से शेष शीघ्र केन्द्र होता है, विषम पद में गत चाप की ज्या भुजज्या कहलाती है, गम्य (एष्य) चाप की ज्या कोटिज्या कहलाती है, सम पद में इसके विपरीत अर्थात् गम्यचापज्या भुजज्या और गतचापज्या कोटिज्या होती है इति ॥१२॥

उपपत्ति

भूकेन्द्र से मन्द प्रतिवृत्त और शीघ्र प्रतिवृत्त का जो दूरतर प्रदेश (अर्थात् उच्चरेखा और वर्धित भूकेन्द्र ग्रहगोलकेन्द्रगतरेखा के योग बिन्दु) हैं वे क्रमशः मन्दोच्च और शीघ्रोच्च कहलाते हैं, मन्द प्रतिवृत्त में गणितागत मध्यम ग्रह जहाँ है भूकेन्द्र से तद्गत रेखा शीघ्र-प्रतिवृत्त में जहाँ लगती है वही मन्दस्पष्ट ग्रह है, मन्दोच्च से मध्यमग्रहपर्यन्त मन्द प्रति-वृत्तीय चाप मन्दकेन्द्र है, शीघ्रोच्च से मन्दस्पष्टग्रहपर्यन्त शीघ्र प्रतिवृत्तीय चाप शीघ्र-केन्द्र है, मन्दोच्च की गति मध्यमग्रह गति से अल्प होने के कारण मध्यमग्र—मन्दोच्च= मन्दकेन्द्र, तथा मन्दस्पष्टग्रह की गति से शीघ्रोच्च गति के अधिक होने के कारण शीघ्रोच्च —मन्दस्पष्टग्र=शीघ्रकेन्द्र, ग्रहगोल केन्द्र से उच्चरेखा के ऊपर लम्बरेखा करने से उच्च-रेखा और लम्ब रेखा से मन्द प्रतिवृत्त के समान चार खण्ड (नवत्यंश के बराबर) होते हैं, मन्दोच्च से सव्य क्रम से चार पद कल्पना करना।

प्रथम पद में मन्द प्रतिवृत्त में जहाँ ग्रह है उसका और उच्चरेखा का लम्बरूप अन्तर भुजज्या है, ग्रह से तिर्यक् रेखा (मन्दगोल केन्द्र से उच्चरेखा के ऊपर लम्ब रेखा) के ऊपर लम्बरेखा कोटिज्या है, ग्रह ज्यों-ज्यों पदान्ताभिमुख जाते हैं त्यों-त्यों भुजज्या उपचीयमान होती है और कोटिज्या अपचीयमान होती है, पदान्त में भुजज्या परम (त्रिज्यातुल्य) होती है और कोटिज्या का अभाव होता है, उससे आगे द्वितीय पद में ग्रह ज्यों-ज्यों आगे जाते हैं त्यों-त्यों भुजज्या अपचीयमान होती है और कोटिज्या उपचीयमान होती है, पदान्त में भुजज्या का अभाव होता है और कोटिज्या परम (त्रिज्या तुल्य) होती है इसलिए "अयुजि गतयेययोर्युजिपदेऽन्यथा बाहुकोटिज्ये" यह आचार्योक्त युक्तियुक्त है, इसी तरह तृतीय पद और चतुर्थ पद में भी विचार करना चाहिए, सूर्य सिद्धान्त में 'ग्रहं संशोध्य मन्दोच्चात्तथा शीघ्राद् विशोध्य च' इत्यादि से मन्दोच्च ही में मध्यम ग्रह को घटाकर शेष को मन्द केन्द्र कहते हैं, और सब कुछ आचार्योक्तवत् ही है, सिद्धान्तशेखर में श्रीपति और सिद्धान्तशिरोमणि में भास्कराचार्य भी आचार्योक्त ही को कहते हैं इति ॥१२॥

इदानीं स्पष्टपरिध्यानयनमाह

त्रिज्याहृता भुजज्या युगयुक्परिधिद्वयान्तरगुणाप्त्या ।
युग्मान्तपरिधिरधिको हीने हीनोऽधिके स्पष्टः ॥१३॥

वा. भा.—इदानीं शुक्रमन्दशीघ्रकर्मणोः परिधिसंस्कारार्थमार्यामाह । मन्दोच्चनीचवृत्तस्य परिधिभागाः सितस्य विषमान्ते नवचेत्यादिना ये परिधयः पठिताः मन्दपरिधिप्रथमपदान्ते तृतीयपदान्ते च नवरसयमाः, द्वितीयचतुर्थपदान्तयोरष्टभागाः द्वितीयपदान्ते चतुर्थपदान्ते चैकादशभागाः शीघ्रपरिधिप्रथमतृतीयपदान्तयोरग्निरसयमा भागा । एवं स्थिते चाभ्यन्तरे परिधेः साधनायेदमार्यसूत्रं त्रैराशिकात्मकं तद्यथा त्रिज्याहृता कासौ भुजज्या किं भूता, युगयुक्परिधिद्वयान्तरगुणा च शीघ्रकर्मणोरपि ततोऽवाप्तिः तया वाप्त्याधिको युग्मान्तरपरिधिः कर्त्तव्यः । यदि विषमान्तरपरिधेरूनः । अथ युग्मान्तरपरिधिरधिकस्तदा भागावाप्त्या हीनः कार्यः स मन्दनीचोच्चवृत्तस्य शीघ्रनीचोच्चवृत्तस्य च परिधिः स्फुटो भवति तेन वक्ष्यमाणविधिना फलानयनम् । अत्र मन्दप्रतिमण्डलोच्चप्रदेशे नीचोच्चवृत्तस्यैकादशकः परिधिः तत्क्रमेणोपचीयते । यावत्प्रथमं पदान्तं तत्र नवपरिधिः । तथा तत्र फलोपलब्धैस्ततः परं पुनरप्यपचीयते । यावत्प्रतिमण्डलार्धचक्रं तत्रैकादशको मन्दनीचोच्चपरिधिरुच्चप्रदेशवत्तत्रापि तथैव फलोपलब्धेः प्रथमद्वितीयपदयोस्त्रिचतुर्थपदे व्याख्याते । अथवान्तरे त्रैराशिकं यदि भुजज्या त्रिज्या यत्र तत्र परिध्यन्तरं द्वौ यत्र चेष्टौ भुजज्या तत्र किमिति लब्धेन युग्मान्तपरिधिरपचीयते । क्रमेण विषमान्तेन भविष्यन्ति । एवं शेषपदेषु मन्दकर्मणि योज्यं । शीघ्रकर्मणि परिधिसंस्कारो विपरीतः वासनावैपरीत्यात् तत्र यदि भुजज्यया त्रिज्यया तुल्यया पंचभागाः परिधिरन्तरं तदेष्टभुजज्यया किमिति फलेनोपचीयते । युग्मान्तरं परिधिर्यत्रोपचयक्रमेण विषमान्तेऽग्निरसयमलसंख्यो भविष्यति, तथा स्थिते एतत् गोले छेद्यके वा प्रदर्शयेत् । एवं शुक्रस्य मन्दनीचोच्चवृत्तशीघ्रनीचोच्चवृत्तयो परिधी संस्कार्यौ बुधगुरुशनीनां वक्ष्यमाणं यथा पठिता एवं परिधयः स्फुटाः मन्दशीघ्रयोरपि कुजस्यापि मन्दपरिधिर्यथा पठिता तच्छीघ्रपरिधेरपि संस्कारं वक्ष्यति शीघ्रस्फुटपरिधिनाप्तभागोना वेदजिनाः अंशोना इति स तथा एव स्फुटो भवति । इदानीं इष्टस्फुटः परिधिनाप्ता भागोना वेदजिना अंशौ, पूर्वानीतभुजकोटिभ्यां च भूमध्यप्रतिमण्डलस्थपारमार्थिक ग्रहान्तरकरणभुजकोटिज्ये क्रियेते तत्करणमार्ययाह ।

वि. भा.—भुजज्या (केन्द्रज्या) युगयुक्परिधिद्वयान्तरगुणा (समविषमपदान्तपरिध्योरन्तरेण गुणा) त्रिज्याहृता (त्रिज्याभक्ता) आप्त्या (लब्ध्या) युग्मान्तपरिधिः (समपदान्तपरिधिः) अधिकः कार्यो विषमपदान्तपरिधेः समपदान्तपरिधिमानेऽल्पे सति अधिके (विषमपदान्तपरिधेः समपदान्तपरिधिमानेऽधिके) लब्ध्या समपदान्तपरिधिर्हीनः कार्यस्तदा स्पष्टः परिधिर्भवेदिति ॥१३॥

अत्रोपपत्तिः

यदि त्रिज्यातुल्यया केन्द्रभुजज्यया समविषमपदान्तपरिध्योरन्तरं लभ्यते तदेष्टकेन्द्रभुजज्यया किमित्यनुपातेनागतं फलं (इष्टपरिध्यन्तरं) विषमपदान्तपरिधेः समपदान्तपरिधिमानस्याल्पत्वे समपदान्तीयपरिधिमाने योज्यं, विषमपदान्तपरिधेः समपदान्तपरिधिमानस्याधिक्ये समपदान्तीयपरिधिमाने वियोज्यं तदेष्टपरिधिः स्पष्टो भवेत् । सूर्यसिद्धान्तकारेण 'ओजयुग्मान्तरगुणा भुजज्या त्रिज्ययोद्धृतेत्यादिना' श्रीपतिना 'ओजयुक्परिधिजान्तरनिघ्नी दोर्ज्यकेत्यादिना' प्याचार्योक्तानुरूपमेव कथ्यत इति ॥१३॥

अब स्पष्टपरिध्यानयन को कहते हैं

हि. भा.—केन्द्रज्या को समपदान्तीय परिधि और विषमपदान्तीय परिधि के अन्तर से गुणाकर त्रिज्या से भाग देने से जो फल होता है उसको समपदान्तीय परिधि में जोड़ देना (यदि विषम पदान्त परिधि से समपदान्त परिधि अल्प हो तब), यदि विषम पदान्त परिधि से समपदान्त परिधि अधिक हो तब घटा देने से स्पष्ट परिधि होती है इति ॥१३॥

उपपत्तिः

यदि त्रिज्या तुल्य केन्द्र भुजज्या में सम-विषम पदान्तीय परिध्यन्तर पाते हैं तो इष्ट-केन्द्र भुजज्या में क्या इस अनुपात से जो फल आता है उसको विषम-पदान्त परिधि से सम-पदान्त परिधि के अल्प रहने से समपदान्तपरिधि में जोड़ने से इष्ट स्थानीय परिधि (स्पष्टपरिधि) होती है, विषम पदान्त परिधि से समपदान्त परिधि के अधिक रहने से समपदान्त परिधि में घटाने से स्पष्ट परिधि होती है । सूर्य सिद्धान्तकार 'ओजयुग्मान्तरगुणा भुजज्या त्रिज्ययोद्धृता इत्यादि से' तथा श्रीपति 'ओजयुक् परिधिजान्तरनिघ्नी' इत्यादि से आचार्योक्तानुसार ही कहते हैं । इति ॥१३॥

इदानीं भुजफलकोटिफलसाधनं स्पष्टां कोटिञ्चाह

तद्गुणिते ज्ये भांशैर्हृते फले कोटिफलयुता त्रिज्या ।
आद्यन्तयोर्विहीना पदयोर्द्वितृतीययोः कोटिः ॥१४॥

वा. भा.—तदितिनीचोच्चवृत्तस्फुटपरिधेः परामर्शः, स्वमन्दस्फुटपरिधिना स्वशीघ्रस्फुटपरिधिना वा गुणिते ये भुजकोटिज्ये, इत्यर्थः । भांशैर्हृते षष्टिशतत्रय-भक्ते फले यथा भुजकोटिज्ययोर्भवतः एतदुक्तं भवति, यानन्तरानीता भुजज्या मन्द-कर्मणि तां मन्दपरिधिना गुणयेत् । शीघ्रकर्मणि शीघ्रपरिधिना, तत् षष्टिशतत्रयेण विभजेत् । ततो लब्धं यत्फलं तत्कोटिफलमुच्यते । ततः कोटिफलयुतत्रिज्या कर्त्तव्या एवं कृता त्रिज्या प्रतिमण्डलप्राप्तिकर्णस्य कोटिर्भवति । भुजफलमेव भुजज्या । अत्र वासना पूर्वंन्यस्तेषु कक्षाप्रतिमण्डलादिषु प्रदर्श्या तद्यथा यत्र प्रदेशे कक्षामण्डले मध्यमो

ग्रहस्तत्र नीचोच्चवृत्तमध्यं विन्यस्य शीघ्रनीचोच्चवृत्तस्य मध्यचक्रस्फुटगतप्रदेशे कक्षामण्डले विन्यस्य गोलविधिना ततस्त्रैराशिकं यदि भागषष्टिशतत्रयेण परिधेरेतावती भुजज्या तदस्य नीचोच्चवृत्तभागपरिधेः कियतीति फलं नीचोच्चवृत्तस्य भुजो भवति। यद्भुजफलमुच्यते। अतः पुनरपि यदि षष्टिशतत्रयपरिधेरेतावती कोटिज्या तत् नीचोच्चवृत्तपरिधेः कियतीति फलं नीचोच्चवृत्तस्य कोटिः यत्कोटिफलमभिधीयते भवद्भिः नीचोच्चवृत्तमध्यञ्च सर्वदा भूमध्यात् व्यासार्धतुल्यान्तरे स्थितः। यतस्तत्कक्षामण्डलं न त्यजति। नीचोच्चवृत्तकोटिश्च प्रथमचतुष्टयो केन्द्रपदयोरुपरि भवति। द्वितृतीययोरधस्थस्तन्मध्यादत आद्यन्तयोः केन्द्रपदयोर्नीचोच्चवृत्तकोट्या व्यासार्धमधिकं प्रतिमण्डलप्राप्तिकरणस्य कोटिर्भवति यतः कक्षामण्डलादुपरिग्रहस्तदास्थितो द्वितृतीययोः नूनं नीचोच्चवृत्तकोट्यैव व्यासार्धप्रतिमण्डलप्रापिकर्णस्य कोटिर्भवति यस्मात्कक्षामण्डलादधो वर्त्तते गृहीतभुजज्यातो पुनः नीचोच्चवृत्तभुजज्ये वा यतो नीचवृत्तशलाकाग्रहयोस्तदेवान्तरमतएव तदप्युपपन्नमिति ॥१४॥

वि. भा.—ज्ये (केन्द्रभुजकोटिज्ये) तद्गुणिते (तेन स्पष्टपरिधिना गुणिते) भांशै ३६० र्भक्ते तदा फले (भुजफलकोटिफले) भवतः। आद्यन्तयोः पदयोः (प्रथमचतुर्थयोः पदयोरर्थान्मकरादिकेन्द्रे) त्रिज्या कोटिफलेन युता कार्या, द्वितृतीययोः पदयोः (कर्क्यादिकेन्द्रे) त्रिज्याकोटिफलेन विहीना कार्या तदा कोटिः (स्पष्टा कोटिः) भवेदिति ॥१४॥

अत्रोपपत्तिः

भू=भूकेन्द्रम्। भूबिन्दुतस्त्रिज्याव्यासार्धेन वृत्तं कार्यं तत्कक्षावृत्तम्। न बिन्दुतोऽपि तत्त्रिज्या व्यासार्धेनैव वृत्तं कार्यं तन्मन्दप्रतिवृत्तम्। न=मन्दगोलकेन्द्रम्। भून=मन्दान्त्यफलज्या, ऊर्ध्वाधररतिर्यग्रेखे कार्ये, उ=प्रतिवृत्ते उच्चस्थानम्। उ=कक्षावृत्ते उच्चस्थानम्। ग्र=मन्दप्रतिवृत्ते मध्यमग्रहः। म=कक्षावृत्ते मध्यम ग्रहः। वर्धितभूमरेखोपरि ग्रबिन्दुतो लम्बः=ग्रल=भुजफलम् मल=कोटिफलम्। ग्रम=मन्दान्त्यफलज्या=रच=भून, भूम=त्रिज्या, ग्रश=मन्दकेन्द्रज्या, ग्रच=मन्दकेन्द्रकोटिज्या,=मर तदा भूमर, मग्रल

त्रिभुजयोः साजात्यादनुपातः $= \frac{\text{भूर} \times \text{ग्रम}}{\text{भूम}} = \frac{\text{मन्दकेन्द्रज्या} \times \text{मन्दान्त्यफलज्या}}{\text{त्रि}} =$

ग्रल $=$ मन्दभुजफलम् $= \frac{\text{मन्दकेज्या} \times \text{मन्दपरिधि}}{३६०}$

यतः $\frac{\text{मन्दान्त्यफलज्या}}{\text{त्रि}} = \frac{\text{मन्दपरिधि}}{३६०}$, म बिन्दुं केन्द्रं मत्वा मग्र. मन्दान्त्यफलज्या-व्यासार्धेन यद् वृत्तं तन्मन्दनीचोच्चवृत्तं स एव मन्दपरिधिः तथा $\frac{\text{मर} \times \text{ग्रम}}{\text{भूम}} =$ लम $=$

$\frac{\text{मन्दकेकोज्या} \times \text{मन्दान्त्यफलज्या}}{\text{त्रि}} = \frac{\text{मन्दकेकोज्या} \times \text{मन्दपरिधि}}{३६०} =$

मन्दकोटिफलम् । एवं शीघ्रकेन्द्रज्यादिवशेन शीघ्रभुजफलकोटिफले भवतः। उज $=$ प्रथमपदम्, जय $=$ द्वितीयपदम् । यप $=$ तृतीयपदम् । उप $=$ चतुर्थपदम् । जउप $=$ मकरादिकेन्द्रम् । जयप $=$ कर्क्यादिकेन्द्रम् । भूम $+$ लम $=$ त्रि $+$ मन्दकोटिफल $=$ भूल $=$ मन्दनीचोच्चवृत्तीयस्पष्टा कोटिः। एवं चतुर्थपदेऽपि भवति, द्वितीयतृतीयपदयोः त्रि $-$ मन्दकोटिफ $=$ मन्दनीचोच्चवृत्तीय स्पष्टा कोटिरिति भुजफलकोटिफलस्वरूपविन्यासेनैव तत्र स्फुटं भवत्येतावताऽऽचार्योक्तं सम्यगुपपद्यत इति ॥१४॥

अब भुजफल और कोटिफल के साधन तथा स्पष्टा कोटि को कहते हैं

हि. भा.—केन्द्रज्या और केन्द्र कोटिज्या को स्पष्ट परिधि से गुणा कर भांश ३६० से भाग देने से भुजफल और कोटिफल होता है। प्रथम पद और चतुर्थ पद (मकरादि केन्द्र) में त्रिज्या में कोटिफल को जोड़ने से स्पष्टा कोटि होती है, द्वितीय पद और तृतीय पद (कर्क्यादि केन्द्र) में त्रिज्या में कोटिफल को घटाने से स्पष्टा कोटि होती है। यहां मन्दकेन्द्रज्या, मन्दकेन्द्र कोटिज्या, और मन्द परिधि के सम्बन्ध से मन्दभुजफल और मन्द कोटिफल होता है, तथा शीघ्रकेन्द्रज्या, शीघ्रकेन्द्र कोटिज्या और शीघ्रपरिधि के सम्बन्ध से शीघ्र भुजफल और शीघ्रकोटिफल होता है इति ॥१४॥

उपपत्ति

यहाँ संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये। भू $=$ भूकेन्द्र, भू बिन्दु से त्रिज्या व्यासार्ध से वृत्त कक्षावृत्त होता है, न $=$ ग्रहगोलकेन्द्र, न बिन्दु से उसी त्रिज्या व्यासार्ध से जो वृत्त होता है वह प्रतिवृत्त है, भून, $=$ अन्त्यफलज्या भू, न बिन्दुओं से ऊर्ध्वाधर रेखा और तिर्यग्रेखायें कीजिये। उ $=$ प्रतिवृत्त में उच्चस्थान । उ $=$ कक्षावृत्त में उच्चस्थान । ग्र $=$ प्रतिवृत्त में मध्यमग्रह । म $=$ कक्षावृत्त में मध्यमग्रह । वर्धित भूम रेखा के ऊपर ग्र बिन्दु से लम्ब $=$ ग्रल $=$ भुजफल, मल $=$ कोटिफल, ग्रम $=$ अन्त्यफलज्या, $=$ रच $=$ भून, भूम $=$ त्रिज्या, ग्रश $=$ केन्द्रज्या $=$ भूर, ग्रच $=$ केन्द्रकोटिज्या $=$ मर भूमर, मग्रल दोनों त्रिभुज सजातीय हैं

इसलिए अनुपात करते हैं $\frac{\text{भूर} \times \text{ग्रम}}{\text{भूम}} = \frac{\text{केन्द्रज्या} \times \text{अन्त्यफज्या}}{\text{त्रि}}$ = ग्रल = भुजफल

$= \frac{\text{केन्द्रज्या} \times \text{परिधि}}{३६०}$ क्योंकि $\frac{\text{अन्त्यफलज्या}}{\text{त्रि}} = \frac{\text{परिधि}}{३६०}$, म बिन्दु को केन्द्र मानकर 'मग्र' अन्त्यफलज्या व्यासार्ध से जो वृत्त बनता है वही नीचोच्चवृत्त है उसी को स्पष्ट परिधि कहते हैं।
तथा $\frac{\text{मर} \times \text{ग्रम}}{\text{भूम}} = \frac{\text{केन्द्रकोज्या} \times \text{अन्त्यफज्या}}{\text{त्रि}}$ = लम = $\frac{\text{केन्द्रकोज्या} \times \text{परिधि}}{३६०}$ = कोटिफल, उज = प्रथमपद, जय = द्वितीयपद, यप = तृतीयपद, उप = चतुर्थपद, जउप = मकरादिकेन्द्र, जयप = कर्क्यादिकेन्द्र, भूम + लम = भूल = त्रि + कोटिफल = नीचोच्चवृत्तीय स्पष्टा कोटि, इसी तरह चतुर्थ पद में भी होता है, द्वितीय और तृतीय पद में त्रि — कोटिफल = नीचोच्चवृत्तीय स्पष्टा कोटि यह भुजफल और कोटिफल फलस्वरूप के विन्यास ही से स्पष्ट होता है, इससे आचार्योक्त उपपन्न होता है, सिद्धान्तशिरोमणि में भास्कराचार्य 'स्वेनाहते परिधिना' इत्यादि से, तथा त्रिज्या तथा कोटिफलेन युक्ता हीना च इससे इसी विषय को कहते हैं। सिद्धान्तशेखर में भी 'स्फुटनिजपरिणाहक्षुण्ण दोःकोटिजीवे' इत्यादि से आचार्योक्त के अनुरूप ही कहा गया है इति ॥१४॥

इदानीं त्रिभिः श्लोकैः कर्णानयनं प्रकारान्तरेण भुजफलानयनं पूर्वानीत-
फलस्यर्णत्वं धनत्वं, मन्दफलं शीघ्रफलञ्च कथयति

तद्भुजफलकृतियोगान्मूलं कर्णः पदेष्वयुग्युक्षु ।
स्वपरिधिगुणा क्रमोत्क्रमजीवा भांशैर्हृता मन्दे ॥१५॥

क्षयधनधनक्षयास्तत्फलानि शीघ्रेऽन्यथा धनं धनयोः ।
ऋणमृणयोर्योगोऽन्तरमृणधनयोस्तुल्ययोः शून्यम् ॥१६॥

तच्चापं मन्दफलं फलयोगान्तरवशात् धनमृणं वा ।
शीघ्रफलं तद्गुणिताद् व्यासार्धात्कर्णलब्धधनुः ॥ १७ ॥

वा. भा.—(१५, १६, १७ श्लोकानां कृते) इदानीं प्रतिमण्डलप्रापिकर्णस्यानयनमार्ययाह तदित्यनेन स्फुटकोटिभुजज्यातः पुनर्नीचोच्चवृत्तभुजज्येव। यतो नीचउच्चशलाकाग्रहयोस्तदेवांतरमत एतदप्युपपन्नमिति। भुजफलञ्च नीचोच्चवृत्तभुजज्योच्यते। तेनायमर्थः स्फुटकोटेः कृतिः कार्या, भुजफलस्य च तयोर्योगस्तस्मात्फलं यत्तद् भूमध्यप्रतिमण्डलस्थग्रहान्तरं कर्णः, स एवोच्यते, भुजकोटिकृतियोगपदं भवतीति किमत्रोच्यते यतः कोटिज्यातुल्यं फलं समचतुरस्रक्षेत्रस्य यत्फलं यच्च बाहुज्यातुल्यस्य समचतुरस्रस्य तयोर्फलयोरैक्यं। यत्तत्तुल्यफलं कर्णतुल्यसमचतुरस्रक्षेत्रस्य भवत्यत उपपन्नं पदेष्वयुग्युक्ष्विति। उत्तरोत्तरं सम्बद्धं भविष्यति। बासना चात्र यथा गोले स्थिते छेद्यके च प्रदर्शयेत्। तद्यथा नीचोच्चवृत्तशलाकानु-

सारेण कोटिज्या सर्वत्र भवति। कोट्यग्रग्रहान्तरभुजफलतुल्यभुजज्यया ग्रहाच्च भूमध्यं यावत्कर्ण इति।

अत्र केन्द्रे प्रथमतृतीये अयुक्पदे द्वितुर्थे युक्पदे तेषु तेषु अयुग्युक्पदेषु स्वपरिधिगुणा के तानित्याह क्रमोत्क्रमजीवा यथासंख्यं विषमसमपदेष्टभांशैर्हताः षष्टिशतत्रयभक्ताः सन्तो मंदे मन्दकर्मणि क्षयधनधनक्षयाः भवन्ति। तासां फलानि तत्फलानि तानि शीघ्रेन्यथेति। शीघ्रकर्मणि तु पुनः अन्यथा वैपरीत्येन भवति। धनक्षयक्षयधनानीति यावती ततो धनं भवति। धनयोर्यथामंमनमृणमृणयोश्च तयोरन्तरमृणधनयोः कार्यम्। यदधिकं तत् ग्राह्यमित्यर्थः यत्फलं भवति तुल्यपक्षे तयोः धनयोः शून्यफलाभावो भवतीत्यर्थः तस्यैवंविधस्य भुजफलस्य चापं तच्चापं मन्दफलं भवति। शीघ्रफलं तु पुनः तद्गुणितव्यासार्धान्कर्णलब्धधनुः तेन भुजफलेन व्यासार्धं निहत्य स्फुटकर्णेन विभजेत्। यतो यल्लब्धं तच्चापं कृत्वा शीघ्रफलं भवतीत्यर्थः।

तस्यैवंविधस्य भुजफलस्य एतदुक्तं भवति। मन्दकर्मणि शीघ्रकर्मणि वा यदि केन्द्रं प्रथमे पदे भवति, केन्द्रेण यद्भुक्तं तस्य क्रमज्या ग्राह्या सा भुजज्या भवति, तां स्वपरिधिहतां भांशैर्विभज्य ग्रहस्य भुजफलं भवति। द्वितीयपदे पुनर्यदि द्वितीयपदस्य भुक्तं तस्योत्क्रमज्या ग्राह्याः ततः प्रथमपदे परमभुजज्यां त्रिज्यातुल्यां ग्रहस्वमन्दपरिधिना स्वशीघ्रपरिधिना वा सगुणषष्टिशतत्रयेण विभजेत्। लब्धं ग्रहस्य परमं भुजफलम्। ततो द्वितीयपदात् क्रमज्यां स्वपरिधिना निहत्य भांशैर्विभज्य यल्लब्धं तद्ग्रहस्य परमं फलं ज्यातो विशोध्य शेषं ग्रहस्य भुजफलं भवति। यस्मादुक्तमन्तरमृणधनयोरिति, अथ तृतीये पदे केन्द्रं तदा पदभुक्तस्य क्रमज्यां कृत्वा स्वपरिधिना संगुण्य भांशैर्विभज्य लब्धं द्वितीयपदोत्पन्नपरमज्याफले योजयेत्। यत उक्तं धनं धनयोग इति। ततस्तस्माद्योगात्प्रथमपदोत्पन्नं परमभुजफलं विशोध्य शोधग्रहस्य भुजफलं भवति। अथ चतुर्थे पदे केन्द्रं भवति। तदा परमभुक्तस्योत्क्रमज्या स्वपरिधिहता भांशैर्विभजेत्। यल्लब्धं तत् प्रथमपदोत्पन्नग्रहपरमभुजज्याफले संयोजयेत्। यत उक्तमृणमृणयोर्योग इति, द्वितीयपदोत्पन्नयोः परमभुजफलयोर्धनात्मकयोर्योगस्तस्माद्दृणयोगं विशोध्य ग्रहस्य भुजफलं भवति। मन्दकर्मणि प्रथमो ज्योत्पन्नं भुजफलं क्षयो भवति। द्वितीयपदे उत्क्रमज्योत्पन्नं धनं भवति। तृतीयपदे क्रमज्योत्पन्नं धनमेव, चतुर्थपदे उत्क्रमज्योत्पन्नमृणम्भवति तत्फलानि शीघ्रमन्यथेति प्रथमपदे धनं द्वितीये क्षयं, तृतीये क्षयं, चतुर्थे धनमित्यर्थः। अत्र धनर्णविवक्षायां प्रतिमण्डलपदानि गृह्यन्ते। प्रथमं पदं राशित्रयस्य स्वपरमफलाधिकं तदेवार्धचक्राद्विशोध्य शेषं द्वितीयपदप्रमाणं प्रथमप्रमाणं चतुर्थपदं। द्वितीयप्रमाणं तृतीयपदं यस्मात्स्फुटगत्युत्तरे वक्ष्यत्याचार्यः एवं प्रतिमण्डलपदमाद्यं गृहत्रयं सान्यधनुरतोन्यादित्यादिना ग्रन्थेन तत उक्तवद्धनं धनयोः ऋणं ऋणयोर्योगोत्तरमृणधनयोरिति कृत्वा ग्रहभुजफलं कार्यम्। तुल्ययोस्तु पुनस्तयोः शून्यं भवतीति किमत्रोच्यते। एवं यथासम्भवं भुजफलमुत्पाद्य तस्य चापं

कृत्वा तन्मदकर्मणि फलं भवति। तस्य फलयोगान्तरवशाद्यदधिकं धनमृणं वा तद् भवतीत्यर्थः। शीघ्रकर्मणि तु पुनस्तद्गुणितात् व्यासार्धात्तेन भुजफलेन व्यासार्धं ताडयित्वा स्वकर्णेन यल्लभ्यते, तस्य चापं फलं भवति। तदपि फलयोगान्तर-वशादेव धनमृणं वा कार्यम्। इतिवाक्यशेषः अत्र वासना तद्यथोक्तवत्। कक्षा-मण्डलादीनि च विन्यस्य केन्द्रं यदा शून्यं भवति तदोच्चरेखायामेव ग्रह स्थितो भवति। तत्र भुजाभावः ततः प्रतिमण्डलोच्चरेखातः क्रमेण ग्रहे विप्रकृष्टते प्रति-मंडलपरिधिं कृत्वा यत्र ग्रह स्थितो भवति तस्य प्रदेशस्योच्चरेखायाश्च यदन्तरं स भुजः असौ प्रथमपदे भुक्तस्य क्रमज्या भवति। तावदुपचीयते यावत्पदांतं तत्र त्रिज्या तुल्या भवति। ततो द्वितीयपदे भुक्तस्य क्रमज्या तावत् ग्रहेण भुक्तं तस्योत्क्रमज्या। तयापचिता त्रिज्या भुजज्या भवति। तस्मात् पुनारेखायाः सन्निकर्षो ग्रहो भवति। उत्क्रमज्याक्रमेण तावद्यावदर्धचक्रं तत्र नीचरेखायामेव ग्रहस्तस्मात्तयापि भुजज्या भवति। तृतीयपदे प्रथमपदवत् विप्रकर्षो ग्रहस्य योज्यश्चतुर्थपदे द्वितीयपदवत् सन्नि-कर्षो योज्यः, एवं व्यासार्धतुल्ये प्रतिमण्डले स्वनीचोच्चवृत्तेप्येकमतस्त्रैराशिकेन तद् भुजज्यानयनं चतुर्षु पदेषु, प्रदर्शितमाचार्येण, पदेष्वयुग्युक्स्वपरिधिगुणाः क्रमोत्क्रम-जीवा भांशैः हृता इति तद्यथा भांशः षष्टिशतत्रयपरिणाहस्येयं भुजज्या,तत्स्वोच्चनीच-परिणाहस्य कियतीति फलं स्वोच्चनीचोच्चवृत्तभुजज्यया,प्रथमतृतीयपदयोः द्विचतुर्थ-पदयोस्तु पुनरनेनैव त्रैराशिकेन नीचोच्चवृत्तभुजज्याज्ञापनाय सिद्धिः ततः क्षय-धनकल्पना मन्दोच्चरेखातः कक्षामंडले यावति प्रदेशे राशिभागादिकमध्ये ग्रहस्तत्र मन्दनीचोच्चवृत्तमध्यं विन्यसेत्ततो मन्दोच्चरेखातो यावति प्रदेशकक्षामंडले ततएव प्रतिमण्डलनीचोच्चवृत्तपरिध्योः संपातस्तत्र पारमार्थिको ग्रहस्तस्मात् भूमध्यं याव-त्सूत्रं नीयते तत्कक्षामण्डलस्थमध्यग्रहात् पश्चिमे नयति यत्र सूत्रेण सह कक्षामण्ड-लस्य संपातस्तत्रस्थितं ग्रहं भूस्थो द्रष्टा पश्यति। अतस्तदनन्तरफलेन नापचीयमानः प्रतिमण्डलस्योपरिस्थितत्वान्मन्दफलं प्रथमे प्रतिमण्डलप्रदेशे क्षयो भवतीत्युपपन्नम्। द्वितीयपदे पुनरधः प्रतिमण्डलस्योपरिस्थितत्वादुपरि कक्षामण्डलं तत्रानेनोपचयविधिना यत्सूत्रं नीयते तत्प्रथमपदोत्पन्नस्यापचयस्यापचयमुत्क्रमेण धनमुदेति अतो यावदेवा-पचयस्यापचयस्तावदेव धनमुच्यते। द्वितीये प्रतिमण्डलपदेपि तदप्युपपन्नं तृतीयपदेऽपि कक्षामण्डलस्योपरिस्थितत्वाद्यावद् भूमध्याद्यत्सूत्रं पूर्ववत् प्रतिमण्डलस्थग्रहमध्येन कक्षामण्डलेन नीयते। तावत् कक्षामण्डले मध्यग्रहचिह्नितप्रदेशात्तत्पूर्वेण भवति। तत्रस्थं ग्रहं पश्यति भूस्थो द्रष्टा ततस्तदनंतरफलेनोपचीयते ग्रहः सोऽत्रापि उपपन्नः यथा द्वितीयपदे क्रमेणापचितमपचयफलम्। एवं चतुर्थपदोत्क्रमेणापचीयते धनफल-मतस्तदपचयो यावानुत्क्रमेण तावदृणं चतुर्थपद इत्युच्यते तदप्युपपन्नं प्रतिमण्डल-स्योपरिस्थितत्वादेवं स्थितानां मन्दफलानां यथासम्भवं योगान्तरं वा ग्रहफलं भवति एवं मन्दनीचोच्चवृत्तभुजज्येव ग्रहफलं। येन कारणेन स्फुटकोटिकर्णेन कृते स्फुट-कर्णोत्पन्नभुजकोटिफलस्य च कक्षामण्डलपरिणाहाय त्रैराशिकं न कृतं तत्र गोला-ध्याये कारणमाचार्येण प्रदर्शितम्। त्रिज्याभक्तकर्ण इत्यादिकया तया अस्माभि-रुपरि तत्रैव परिहृतमिति शीघ्रकर्मणि धनक्षयोत्पत्तिः स्वशीघ्रप्रतिमण्डले स्वरेखातः

कक्षामण्डले यावति प्रदेशे पश्चादवलम्बितो मन्दस्फुटो ग्रहस्तत्र शीघ्रनीचोच्चवृत्तं विधाय प्रदर्शयेत्। तत उच्चरेखातो मध्यमग्रहो यावत्कक्षामण्डले यावतो राशिभागादयस्तावन्त एव प्रतिमण्डलशीघ्रनीचोच्चवृत्तयोः संपातं यावत्प्रतिमण्डलोच्चरेखा तस्य एव तत्र शीघ्रफलस्फुटो ग्रहस्तस्मात् भूमध्यं प्रति यत्सूत्रं नीयते तत्र कक्षामण्डलस्थमन्दस्फुटग्रहात् पूर्वेण नीयात्। अतस्तदन्तरेणोपचीयते मन्दस्फुटो ग्रहः स कक्षामण्डले स्फुटो भवति तस्मादुपपन्नम्। प्रथमपदे धनमथद्वितीयपदे प्रथमपदोत्पन्नं धनं भुक्तं ज्याक्रमेणापचीयते स एवापचयो द्वितीये पदे भवतीत्युपपन्नम्। कक्षामण्डलस्योपरिस्थितत्वात् मन्दोच्चग्रहस्य स्वशीघ्रात् एवं तृतीयपदे क्षयोपचयौ योज्यौ चतुर्थे क्षयोपचयोत्क्रमज्याक्रमेण धनमुपपद्यते। इत्यादि स्वधिया योज्यम्। एतदार्द्धद्वयसार्धं फलोत्पन्नावुपचयापचया वासना प्रदर्शनार्थं न फलानयनार्थं, यदा फलानयनार्थं स्यात्तच्छुक्रस्य प्रथमपदान्तं मन्दपरिधिना नवकेन यत्फलमानीयते। यच्च द्वितीयपदांतपरिधिना एकादश तयोः ऋणधनयोः कथं तुल्यत्वं स्यात्। अतुल्यत्वे तु केन्द्रे चक्रावस्थोपि फलसम्भवः स्यात्। नवैव चक्रं योज्यम्। शीघ्रपरिध्योरप्येवमेव योज्यम्। आर्यभटस्य विषमेऽन्योन्यो युग्मे परिधिर्गुणकः क्रमोत्क्रमजानाम्, चक्रार्धे फलनाशो भवति न यस्मादसत्तदपि शेषाणामन्तरा ग्रहाणामेकत्वात्परिधेः फलानयनेऽपि न दोष इति। अथवा शुक्रस्यापि विषमपदादावेकादशकः परिधिः तदन्तरमेव नवक एवं समपदादौ नव तदन्ते चैकादशपरिधिरेवान्तरे त्रिज्याहृता भुजज्येत्यादिकर्मणा वासनामानात् फलनाशोऽपि चक्रार्धे उपपद्यते इति।

वि. भा.—तद्भुजफलकृतियोगात् (तस्याःपूर्वानीतस्फुटकोटेर्भुजफलस्य च वर्गयोगात्) मूलं तदा कर्णो भवेत्। अयुग्युक्षु विषमसमपदेषु क्रमशः क्रमोत्क्रमजीवा (केन्द्रज्या, केन्द्रोत्क्रमज्या च) स्वपरिधिगुणा, भांशै ३६० भंज्या तदोत्क्रमज्यातो यत्फलं तत्परमे भुजफले हीनं कार्यं तदा वास्तवं भुजफलं भवेदित्यध्याहार्यम्, मन्दे इत्यस्याग्रिमश्लोकेन सम्बन्ध इति॥ १५॥

अत्रोपपत्तिः

१४तम श्लोकस्य संस्कृतोपपत्तिस्थक्षेत्रे भूग्र=कर्णः=$\sqrt{\text{ग्रल}^2+\text{भूल}^2}$=$\sqrt{\text{भुजफल}^2+\text{नाचाच्चवृस्पष्टको}^2}$, प्रथमपदे गतकेन्द्रांशानां ज्या स्वपरिधिगुणा भांशै ३६० भंज्या तदा पूर्वोक्तप्रकारागतं भुजफलमेव भवेत्। द्वितीयपदे एष्यांशानां ज्या गतोत्क्रमज्योनत्रिज्यातुल्या तदा पूर्ववदेव भुजफलम्

$=\frac{\text{परिधि (त्रि—गतकेन्द्रांशोत्क्रमज्या)}}{३६०}$, $\therefore$ परमभुजफल

$-\frac{\text{परिधि (त्रि—गकेउज्या)}}{३६०}$ अर्थात्समपदे केन्द्रांशोत्क्रमज्यातो यत्फलं समागच्छेत्तेन हीनं परमं भुजफलं वास्तवं भुजफलं भवेत्। विषमपदे (प्रथमपदे तृतीयपदे च)

$\frac{\text{केन्द्रज्या} \times \text{परिधि}}{३६०}$ = भुजफलम्, पदान्ते केन्द्रज्यायाः परमत्वात्तत्र भुजफलस्यापि परमत्वं भवेत्। समपदे (द्वितीयपदे, चतुर्थपदे च), परम भुजफल $-\frac{\text{केउत्क्रमज्या} \times \text{परिधि}}{३६०}$ = वास्तवभुजफल, पदान्ते भुजफलं शून्यं, अत्रोत्क्रमज्या-गतं फलं परमे भुजफले ऋणं कार्यमिति चतुर्वेदाचार्यमतानुकूलोऽध्याहार इत्या-चार्यसूत्रतो नाऽऽयातीति बोध्यं विज्ञैरिति ।। १५ ।।

अब कर्णानयन को तथा प्रकारान्तर से भुजफलानयन को भी कहते हैं

हि. भा.—पूर्वानीतस्फुटकोटि और भुजफल के वर्गयोग का मूल लेने से कर्ण होता है। विषम पदों में केन्द्रज्या को स्पष्ट परिधि से गुणा कर भांश ३६ से भुजफल होता है, समपदों में केन्द्रांशोत्क्रमज्या को स्पष्ट परिधि से गुणा कर भांश ३६० से भाग देने से जो फल हो उसको परमभुजफल में घटाने से वास्तव भुजफल होता है, यह अध्याहार करना चाहिये श्लोक में 'मन्दे' शब्द का सम्बन्ध अगले श्लोक के साथ है इति ।।१५।।

उपपत्ति

१४ वें श्लोक का संस्कृतोपपत्तिस्थ क्षेत्र देखिये, भूग्र = कर्ण = $\sqrt{\text{ग्रल}^2 + \text{भूल}^2}$ = $\sqrt{\text{भुजफ}^2 + \text{नीचोच्चवृत्तीय स्पको}^2}$ प्रथम पद में गत केन्द्रांशज्या को स्पष्ट परिधि से गुणाकर भांश ३६० से भाग देने से पूर्व प्रकारागत ही भुजफल होता है। द्वितीय पद में एष्यांशज्या गतोत्क्रमज्योन त्रिज्या के बराबर होती है तब उससे पूर्ववत् भुजफल = $\frac{\text{परिधि}\ (\text{त्रि} - \text{गतकेन्द्रांशोत्क्रमज्या})}{\text{त्रि}}$, अतः परम भुजफल—

$\frac{\text{परिधि}\ (\text{त्रि} - \text{गतकेन्द्रांशोत्क्रमज्या})}{\text{त्रि}}$ = वास्तव भुजफल अर्थात् सम पदों में केन्द्रांशोत्क्रमज्या से जो फल आवे उसको परमभुजफल में घटाने से वास्तव भुजफल होता है, विषमपद (प्रथम पद, तृतीय पद) में $\frac{\text{केज्या} \times \text{परिधि}}{३६०}$ = भुजफल; पदान्त में केन्द्रज्या परमत्व के कारण परमभुजफल होता है, समपदों (द्वितीय पद चतुर्थ पद) में परम भुजफल— $\frac{\text{के उत्क्रमज्या} \times \text{परिधि}}{३६०}$ = वास्तव भुफल; पदान्त में भुजफल शून्य होता है, यहाँ उत्क्रमज्या से आये हुये फल को ऋण करना चाहिये, यह चतुर्वेदाचार्य के मतानुकूल अध्याहार करना होता है, ये बातें आचार्य (ब्रह्मगुप्त) के सूत्र से नहीं आती हैं, यह समझना चाहिये इति ।। १५ ।।

वि. भा.—मन्दे (मन्दकर्मणि) पदक्रमेण पूर्वानीतफलानि क्षयधनधन-क्षयाः स्युः । शीघ्रे (शीघ्रकर्मणि) ऽन्यथाऽर्थात् धनक्षयक्षयधनानि स्युः । ततो धनयोर्योगो धनम्, ऋणयोर्योगश्च ऋणम्, ऋणधनयोरन्तरं संस्कारवशेन धनर्णं भवति, तुल्ययोः ऋणधनयोर्वशतो भुजफलं शून्यं भवतीति ॥ १६ ॥

अत्रोपपत्तिः

प्रथमद्वितीयपदयोर्मेषादिकेन्द्रम्, मन्दोच्चान्नीचपर्यन्तं स्थिते मध्यग्रहे मन्दोच्च-मध्यग्रहान्तररूपस्य मन्दकेन्द्रस्य मेषादिषड्भान्तर्गतत्वान्मन्दफलेन भुजफलचापसमेन हीनो मध्यग्रहो मन्दस्पष्टग्रहो भवेत् । तृतीयचतुर्थपदयोश्च तुलादिकेन्द्रम्, नीचान्म-न्दोच्चावधिवर्त्तमाने मध्यग्रहे मन्दकेन्द्रस्य (मन्दोच्चमध्यग्रहान्तररूपस्य) तुलादि-राशिषट्कान्तरे स्थितत्वान्मन्दफलेन युक्तो मध्यग्रहो मन्दस्पष्टग्रहो भवेदतो मन्दकर्मणि प्रथमपदे द्वितीयपदे च भुजफलचापमृणं तृतीयपदे चतुर्थपदे च भुजफलचापं धनं यतस्तत एव धनमन्दफलोत्पत्तिर्भवति, । द्वितीयपदे पूर्वागतं

भुजफलम् $=$ परमभुफ $-\dfrac{\text{परिधि} \times \text{केउज्या}}{३६०}$, धनर्णयोर्विलोमेन—परमभुजफल $+$

$\dfrac{\text{परिधि} \times \text{केउज्या}}{३६०}$, चतुर्थपदे पूर्वागतं भुजफलं धनात्मकम् $=$ परमभुफ$-$

$\dfrac{\text{परिधि} \times \text{केउज्या}}{३६०}$, मेषादिकेन्द्रत्वात्प्रथमे पदे ऋणं, तुलादिकेन्द्रत्वात्तृतीये पदे

धनम् । एवं पदक्रमेण मन्दकर्मणि फलानि क्षयधनधनक्षयाख्यानि भवन्ति, शीघ्रकर्मणि मध्यग्रहः शीघ्रोच्चाल्पगतित्वेन पृष्ठतोऽवलम्बते प्रतिवृत्ते, तस्मा-च्छीघ्रोच्चान्नीचं यावद् ग्रहोच्चान्तररूपस्य शीघ्रकेन्द्रस्य मेषादिषड्भ्यन्तर्गतत्वाच्छी घ्रफलं धनात्मकं जायते, नीचादुच्चं यावच्छीघ्रकेन्द्रस्य तुलादिराशिषट्कान्तर्गत-त्वाच्छीघ्रफलमृणात्मकं जायते तेनैव कारणेन शीघ्रकर्मणि भुजफलमन्यथा साध्यत इति, सिद्धान्तशेखरे श्रीपतिना ।

'ऋणं क्रमादुत्क्रमतो धनज्या पुनः क्रमात् स्वं क्षय उत्क्रमाच्च ।
क्रमोत्क्रमाभ्यां हि पदक्रमेण प्रसाध्य जीवां फलमानयेद्वा ॥

युतिः स्वयोः स्वं क्षययोः क्षयश्च धनर्णयोरन्तरतोऽधिकं यत् ।
समानयोः स्वक्षययोश्च शून्यमृणं धनं शीघ्रफलेऽन्यथा स्यात् ॥

श्लोकाभ्यां ब्रह्मगुप्तोक्त 'तद्भुजफलकृतियोगान्मूलं कर्णः पदेष्वित्यादेः क्षयधनधनक्षयास्तत्फलानीत्यादि' श्लोकद्वयस्य पुनरुक्तीकरणमेव कृतमिति विवेचकैर्विवेचनीयम् ॥ १६ ॥

अब पूर्वानीत फल के ऋणत्व और धनत्व को उससे संस्कार वश भुजफल को कहते हैं

हि. भा.—मन्दकर्म में पदक्रम से पूर्वानीत फल ऋण, धन, धन, ऋण होते हैं, शीघ्र कर्म में इससे भिन्न होता है अर्थात् पद क्रम से धन, ऋण, ऋण, धन होते हैं, इस कारण से धन, धन का योग धन होता है, ऋण, ऋण का योग ऋण होता है, और धन, ऋण का अन्तर संस्कार वश से भुजफल धनात्मक और ऋणात्मक होता है, धन और ऋण के तुल्यत्व से भुजफलाभाव (शून्य) होता है इति ।। १६ ।।

उपपत्ति

प्रथम पद और द्वितीय पद मेषादि केन्द्र है, तथा तृतीय पद और चतुर्थ पद तुलादि केन्द्र है, मन्द कर्म में भुजफल के चाप के बराबर मन्द फल मेषादि केन्द्र में ऋण होता है और तुलादि केन्द्र में धन होता है, इसलिये प्रथम पद और द्वितीय पद में भुजफल ऋण होता है, तृतीय पद में और चतुर्थ पद में भुजफल धन होता है क्योंकि उससे मन्द फल धनात्मक उत्पन्न होते हैं, द्वितीय पद में पूर्वागत भुजफल $=$ परम भुजफल $- \frac{\text{परिधि} \times \text{केउज्या}}{३६०}$, धन और ऋण के विलोम से—परम भुजफल $+ \frac{\text{परिधि} \times \text{केउज्या}}{३६०}$, इसी तरह चतुर्थ पद में पूर्वागत भुजफल $=$ परमभुफ $- \frac{\text{परिधि} \times \text{केउज्या}}{३६०}$ धनात्मक, मेषादि केन्द्र में प्रथम पद के होने के कारण प्रथम पद में भुजफल ऋण तथा तुलादि केन्द्र में तृतीय पद के होने के कारण वहां धन होता है, इस तरह पद क्रम से मन्द कर्म में फल ऋण, धन, धन, ऋण होते हैं, शीघ्र कर्म से इससे विलोम होता है क्योंकि शीघ्रकर्म में मेषादिकेन्द्र में शीघ्रफलधन होता है और तुलादिकेन्द्र में ऋण होता है इसी हेतु से वहाँ भुजफल भिन्न होता है, सिद्धान्त-शेखर में श्रीपति 'ऋणं क्रमादित्यादि, युतिः स्वयोः स्वं 'क्षययोः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोकद्वय से आचार्योक्त 'तद्भुजफलकृतियोगात्' इत्यादि, 'क्षयधनधनक्षयास्तत्फलानि' इत्यादि श्लोकद्वय का पुनरुक्तीकरण ही किया है इति ।। १६ ।।

वि. भा.—(तच्चापं मन्दभुजफलस्य चापं) मन्दफलं पूर्वसाधितफलयोर्योगान्तरवशात् धनं वा ऋणं भवति । तद्गुणितात् (पूर्वागतशीघ्रभुजफलेन गुणितात्) व्यासार्धात् (त्रिज्यातः) कर्ण (शीघ्रकर्ण) भक्ताद्यल्लब्धं तस्य धनुः (चापं) शीघ्रफलं भवतीति ।।१७।।

अत्रोपपत्तिः

तात्कालिककर्णाग्रीयमन्दभुजफलचापं मन्दफलं न भवितुमर्हति, पठितमन्दकर्णाग्रीयभुजफलस्य चापं मन्दफलं भवति कथमित्युच्यते ।

उ=मन्दोच्चम् । ग्र=मन्दप्रतिवृत्ते ग्रहः । भू=भूकेन्द्रम् । ज=ग्रहगोलकेन्द्रम् । भूज=मन्दान्त्यफलज्या । ग्रन=तात्कालिकान्त्यफलज्या=तच=भूज । भूग्र=तात्कालिकमन्दकर्णः । ग्रर=मन्दभुजफलम् । प बिन्दुतो भूर रेखायाः समान्तरा पग्र रेखा कार्या, प बिन्दुत एव ग्रन रेखायाः समान्तरा पश रेखा कार्या. भूग्र रेखा कार्या । पय=मन्दफलज्या, अथ भूग्रन, भूपश त्रिभुजयोः साजात्यात्

$$\frac{\text{ग्रन} \times \text{भूप}}{\text{भूग्र}} = \frac{\text{तात्कालिकान्त्यफज्या} \times \text{त्रि}}{\text{तात्कालिकमन्दकर्ण}} = \text{पश} = \text{पठितान्त्यफलज्या} = \text{ग्रन},$$

अतोभूग्र=पठितमन्दकर्णः । ग्रग=पठितमन्दकर्णाग्रीयभुजफलम्=पद=मंफलज्या ग्रर > पय वा तात्कालिकमन्दकर्णाग्रीयभुजफल > मन्दफलज्या अत एव मन्दभुजफलचापं मन्दफलं न भवितुमर्हति, किन्तु पठितमन्दकर्णाग्रीयमन्दभुजफलचापं मन्दफलं भवितुमर्हत्यत आचार्योक्त 'तच्चापं मन्दफलं' मिदं न युक्तम् । सिद्धान्तशेखरे श्रीपत्यु 'दोः फलस्य च धनुः कलादिकं जायते मृदुफल नभःसदाम्' क्तमिदं 'मृदुदोः फलस्य चापं बुधा मन्दफलं वदन्ति' भास्करोक्तमिदं चाऽऽचार्योक्तानुरूपमेव । एवं $\frac{\text{शीघ्रभुजफल} \times \text{त्रि}}{\text{शीघ्रकर्ण}} =$ शीघ्रफलज्या, एतच्चापं शीघ्रफलं भवेत् । श्रीपतिना 'दोः फलत्रिगुणयोरभिघातात्कर्णलब्धधनुराशुफलं स्यात्' ऽप्यनेनाऽऽचार्योक्तानुरूपमेव कथ्यत इति ।।१७।।

अब मन्दफल और शीघ्रफल कहते हैं

हि. भा.—मन्द भुजफल का मन्दफल होता है, यह पूर्वसाधित फलद्वय के योग और अन्तर वश से धन वा ऋण होता है. पूर्वागत शीघ्रभुजफल को त्रिज्या से गुणा कर शीघ्र कर्ण से भाग देने से जो लब्धि होती है उसका शीघ्रफल होता है ।। १७ ।।

उपपत्ति

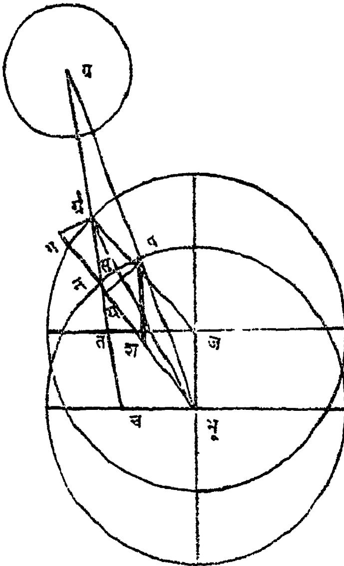
यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । तात्कालिक मन्दकर्णाग्रीय भुजफल का चाप मन्दफल नहीं होता है, किन्तु पठित मन्दकर्णाग्रीय भुजफल का चाप मन्दफल होता है इसके लिये अधोलिखित युक्ति है । उ=मन्दोच्च, ग्र=मन्दप्रतिवृत्त में ग्रह, भू=भूकेन्द्र, ज=ग्रहगोलकेन्द्र, भूज=मन्दान्त्यफलज्या, ग्रन=तात्कालिकमन्दान्त्यफज्या=तच=भूज, भूग्र=तात्कालिकमन्दकर्ण, ग्रर=मन्दभुजफल, प बिन्दु से भूर रेखा की समान्तरा रेखा पग्र, प बिन्दु से ग्रन रेखा की समान्तरा पश रेखा कीजिये, भूग्र रेखा कीजिये पय=मन्दफलज्या, भूग्रन, भूपश दोनों त्रिभुज सजातीय हैं इसलिये अनुपात करते हैं । $\frac{\text{ग्रन} \times \text{भूप}}{\text{भूग्र}} = \text{पश} = \frac{\text{तात्कालिकमन्दान्त्यफलज्या} \times \text{त्रि}}{\text{तात्कालिकमन्दकर्ण}} = \text{पठितमन्दान्त्यफलज्या} =$

ग्रन, अतः भूग्र = पठितमन्दकर्ण, ग्रग = पठितमन्दकर्णाग्रीयभुजफल = पय = मन्दफलज्या, ग्रर > पय वा तात्कालिकमन्दकर्णाग्रीय भुजफल > मन्दफलज्या इसलिये तात्कालिक मन्दकर्णाग्रीय भुजफल का चाप मन्दफल नहीं हो सकता है किन्तु पठितमन्दकर्णाग्रीय भुजफल का चाप मन्दफल के बराबर सिद्ध हुआ इसलिये 'तच्चापं मन्दफलं' यह आचार्योक्त ठीक नहीं है, सिद्धान्तशेखर में 'दोः फलस्य च धनुः कलादिकं इत्यादि' श्रीपत्युक्ति तथा 'मृदुदोः फलस्य चापं बुधा मन्दफलं वदन्ति' यह भास्करोक्ति आचार्योक्तानुरूप ही है,

$\frac{\text{शीघ्रभुजफल} \times \text{त्रि}}{\text{शीघ्रकर्ण}}$ = शीघ्रफलज्या; इसका चाप शीघ्रफल होता है, 'दोः फलत्रिगुणयोरभिघातात्' इत्यादि श्रीपत्युक्ति आचार्योक्त 'तद् गुणिताद् व्यासार्धात्कर्णलब्धधनु.' के अनुरूप ही है इति ।। १७ ।।

अत्र विशेषविचारः

यथा-यथा कर्णो वर्धते तथा-तथाऽन्त्यफलज्यापि वर्धिता भवतीति मन्यते ब्रह्मगुप्तः। अतोऽभीष्टकाले पारमार्थिको ग्रहः प्रतिवृत्ते ग्र स्थाने न वर्तते, किन्तु ग्र स्थाने तिष्ठति। अतो वास्तवान्त्यफलज्या = ग्रन। अतो भू स्थानात् भूग्र व्यासार्धेन यो गोलस्तत्रैव प्रतिमण्डले ग्रहभ्रमणं भवतीति ब्रह्मगुप्तमतं साध्विति स्थापयन्ति भास्कराचार्याः। तदर्थमेव मन्दश्रुतिर्द्राक्श्रुतिवत्प्रसाध्येत्यादि-वक्ष्यमाणविधिना भूग्र कलाकर्णमानं साधितं भास्करेण इत्यनया कल्पनया भुजफलचापसमं मन्दफलं भवति। अपूर्वेयं कल्पना ब्रह्मगुप्तस्य।



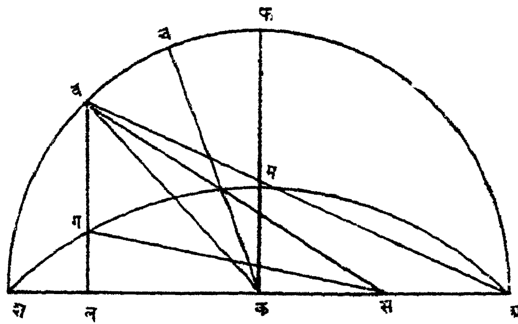
अथ नवीनानां मतेन सहेदं ब्रह्मगुप्तमतं समन्वेति। तदर्थं विदां विनोदाय नवीनमतं प्रतिपाद्यते।

तथाहि उपरि तनक्षेत्रदर्शनेन ग्रन पठितान्त्यफलज्या तद्वशेन गन कोटिफलम्। ततः स्पष्टाकोटिः = भूग। ग्रग = भुजफलम्। ततः कर्णः = भूग्र, तद्वशेन कक्षामण्डले स स्थानं एव स्फुटो ग्रहो भवितुमर्हति। किन्तु ब्रह्मगुप्तेन मन्दकर्मणि क्षेत्रभङ्ग्या साधितरविचन्द्राभ्यां वैषम्यं समुपलभ्य प स्थाने स्फुटो दृष्टः। तथा सति भूग्र तात्कालिककर्णानुपातेन साधितं फलं ग्रग भुजफलचापरूपं जायते।

अतो भास्कराचार्येणेह ब्रह्मगुप्तमतमेव समर्थितम्। मृदुदोः फलस्य चापं बुधाः मन्दफलं वदन्तीति प्राहुः भास्कराचार्याः। श्रीपत्यादयोऽप्येवमेव प्रोचुः।

नव्यास्तु वर्तुलाभासपिण्डे ग्रहान् परिभ्राम्य दीर्घवृत्तस्यैकस्यां नाभौ सूर्यं मत्वा तत्परितो दीर्घवर्तुले ग्रहो भ्रमतीति स्वीकृत्य सूर्यकेन्द्राद्ग्रहावधि मन्दकर्णस्तुल्यकाले समं क्षेत्रफलं समुत्पादयतीति केप्लरसिद्धान्तानुसारेण ग्रहाणां मन्दफलं साधयन्तीत्याहुः।

दीर्घवृत्तश्रेढीप्रकारेण फलानयनं नवीनमते



अत्र ब्रह्मगुप्तमतं नवीनगणितेन परीक्ष्यते। तथाहि कल्प्यते अश व्यासोपरि अगश भ्रमणेन दीर्घवृत्तखण्डम्। अश व्यासोपरि अपवश सहायकवृत्तार्धम्।

स=दीर्घवृत्तनाभिर्यत्र सूर्यः।

अ=नीचस्थानम्।

अक=महद्व्यासार्धम्=अ

कम=लघुव्यासार्धम्=क

क=दीर्घवृत्तकेन्द्रम्।

सहायकवृत्ते च स्थाने मध्यमो ग्रहः।

दीर्घवृत्ते ग स्थाने ग्रहः।

सहायकवृत्ते व स्थाने ग सम्बन्धी यो ग्रहः।

< अकच=मध्यमकेन्द्रम्=के।

< अकग=स्फुटकेन्द्रम्=ष.

< अकव=सहायककेन्द्रम्=के,

अथ अ स्थानात् ग स्थानं यावत् ग्रहगमनकालः=का,। एवं दीर्घमण्डलभ्रमणकालः=का.

अतः केप्लर द्वितीयसिद्धान्तेन

$$\frac{\text{का}_1}{\text{का}} = \frac{\text{क्षेफ असग}}{\text{दीवृफ}}.$$

अत्र मध्यममानेनैकस्मिन् दिने मन्दकेन्द्रगतिमानं न प्रकल्प्य ततोऽनुपातः। यदि भगणभोगकालेन भगणभागा लभ्यन्ते तदैकदिनेन किम्।

जातमेकस्मिन् दिने मध्यकेन्द्रमानम् $= \frac{2\pi}{\text{का}} = \text{न}$।

(अत्र π=रूपव्यासार्धेऽर्धपरिधिमानम्),

$$\therefore \text{का} = \frac{2\pi}{\text{न}}.$$

$$\therefore \frac{\text{का}_1 \cdot \text{न}}{2\pi} = \frac{\text{क्षेफ असग}}{\text{दीवृफ}}.$$

अत्र दीवृफ$=\pi \cdot$ अ$\cdot$ क$\cdot$

$$\therefore \frac{\text{का}_1 \cdot \text{न}}{2\pi} = \frac{\text{क्षेफ असग}}{\pi \cdot \text{अ} \cdot \text{क}}.$$

$$\therefore \text{का}_1 \cdot \text{न} = \frac{2 \cdot \text{क्षेफ} \cdot \text{असग}}{\text{अ} \cdot \text{क}}.$$

अत्र का$_1$ समे काले का$_1 \cdot$ न इदं मन्दकेन्द्रमानं भवति। अतः मन्दकेन्द्रम्=

$$\frac{2\,\text{क्षेफ} \cdot \text{असग}}{\text{अ} \cdot \text{क}} = \text{म}।$$

अथ दीर्घवृत्तसिद्धान्तेन—

$$\frac{\text{गल}}{\text{वल}} = \frac{\text{क}}{\text{अ}}.$$

परं च $\frac{\text{गल}}{\text{वल}} = \frac{\text{फ अलग}}{\text{फ अलव}}.$

$$\therefore \frac{\text{फ अलग}}{\text{फ अलव}} = \frac{\text{क}}{\text{अ}}.$$

$$\therefore \text{फ अलग} = \text{फ अलव} \cdot \frac{\text{क}}{\text{अ}}.$$

परं च फ अलव$=\triangle$अकव$+\triangle$लकव$\cdot$

$$\therefore \text{फ अलग} = \frac{\text{क}}{\text{अ}} (\triangle\text{अकव} + \triangle\text{लकव})$$

$$=\frac{\text{क}}{\text{अ}}\left(\frac{\text{के}_1\cdot\text{अ}^2}{2}+\frac{\text{ज्याके}_1\cdot\text{अ}\cdot\text{लक}}{2}\right)$$

$$=\frac{\text{क}\cdot\text{अ}}{2}\left(\text{के}_1+\frac{\text{ज्याके}_1\,\text{लक}}{\text{अ}}\right)$$

$$=\frac{\text{क}\cdot\text{अ}}{2}\left(\text{के}_1+\text{ज्याके}_1\cdot\text{कोज्याके}_1\right)$$

एवं $\triangle\,\text{सलग}=\frac{\text{सल}\cdot\text{गल}}{2}$

$$=\frac{\text{सल}\cdot\text{वल}\cdot\text{क}}{2\cdot\text{अ}}$$

$$=\frac{\text{अ}\cdot\text{क}}{2}\cdot\frac{\text{सल}\cdot\text{वल}}{\text{अ}\cdot\text{अ}}$$

$$=\frac{\text{अ}\cdot\text{क}}{2}\cdot\frac{(\text{लक}+\text{सक})\,\text{वल}}{\text{अ}\cdot\text{अ}}$$

$$=\frac{\text{अ}\cdot\text{क}}{2}\cdot\frac{\text{लक}\cdot\text{वल}}{\text{अ}\cdot\text{अ}}+\frac{\text{सक}\cdot\text{वल}}{\text{अ}^2}$$

$$=\frac{\text{अ}\cdot\text{क}}{2}\left(\text{कोज्याके}_1\cdot\text{ज्याके}_1+\text{इ}-\text{ज्याके}_1\right)$$

अनयोरन्तरेण—

$$\triangle\,\text{असग}=\frac{\text{अ}\cdot\text{क}}{2}\left(\text{के}_1-\text{इ}\cdot\text{ज्याके}_1\right)$$

$$\therefore\quad \text{म}=\text{के}_1-\text{इ}\cdot\text{ज्याके}_1 \quad\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (1)$$

एतेन च्युतिकेन्द्रमुखेन मध्यमकेन्द्रमानं सिद्धयति अतः परं स्फुटकेन्द्रद्वारा तन्मानमन्विष्यते।

अथ दीर्घवृत्तसिद्धान्तेन—

$$\text{मक}\cdot\text{कोज्याष}=\text{अ}\cdot\text{कोज्याके}_1-\text{इ}\;\text{अ}\cdot$$

एवं $\text{मक}\cdot\text{ज्याष}=\text{क}\cdot\text{ज्याके}_1$

वर्गयोर्योगेन—

$$\text{मक}^2\cdot\text{कोज्या}^2\text{ष}=\text{अ}^2\cdot\text{कोज्या}^2\text{के}_1-2\,\text{अ}\cdot\text{कोज्याके}_1\cdot\text{इ}\cdot\text{अ}+\text{इ}^2\cdot\text{अ}^2$$

एवं मक^{२}· ज्या^{२}ष=क^{२}· ज्या^{२}के$_{१}$

योगेन—

मक^{२}=अ^{२}· कोज्या^{२}के$_{१}$—२ अ· कोज्याके$_{१}$· इ· अ+इ^{२}· अ^{२}+ ज्या^{२}के$_{१}$· क^{२}

=अ^{२}· कोज्या^{२}के$_{१}$—२ अ· कोज्याके$_{१}$· इ· अ+इ^{२}· अ^{२}+ अ^{२} (१—इ^{२})· ज्या^{२}के$_{१}$

=अ^{२}· कोज्या^{२}के$_{१}$—२ अ· कोज्याके$_{१}$· इ· अ+अ^{२} इ^{२}+ (१—इ^{२}) ज्या^{२}के$_{१}$

=अ^{२} (कोज्या^{२}के$_{१}$—२ कोज्याके$_{१}$· इ+इ^{२}—इ^{२}· ज्या^{२}के$_{१}$ +ज्या^{२}के$_{१}$)

=अ^{२} (कोज्या^{२} के$_{१}$+ज्या^{२}के$_{१}$—२ कोज्याके · इ+इ^{२}· कोज्या^{२}के$_{१}$)

=अ^{२} (१—इ· कोज्याके$_{१}$)^{२}

मूलेन—

मक=अ (१—इ· कोज्याके$_{१}$)························(२)

अथ त्रिकोणगणितेन—

२ ज्या^{२} $\frac{१}{२}$ ष=१—कोज्याष

∴ २ मक· ज्या^{२} $\frac{१}{२}$ ष=मक (१—कोज्याष)

=मक—मक· कोज्याष

=अ (१—इ· कोज्याके$_{१}$)—(अ· कोज्याके$_{१}$ —इ ·अ)

=अ (१—इ· कोज्याके$_{१}$)—(अ· कोज्याके$_{१}$—इ· अ)

=अ १—इ· कोज्याके$_{१}$—(कोज्याके$_{१}$—इ)

=अ {१—इ· कोज्याके$_{१}$—कोज्याके$_{१}$ +इ}

एवं २ कोज्या^{२} $\frac{१}{२}$ष· मक=मक (१+कोज्याष)

=अ (१—इ· कोज्याके$_{१}$+कोज्याके$_{१}$—इ)

∴ $\frac{\text{ज्या}^{२}\frac{१}{२}\text{ ष}}{\text{कोज्या}^{२}\frac{१}{२}\text{ ष}}$ = $\frac{(\text{१—इ· कोज्याके}_{१}\text{—कोज्याके}_{१}\text{+इ})}{\text{१—इ· कोज्याके}_{१}\text{+कोज्याके}_{१}\text{—इ·}}$

= $\frac{(\text{१+इ}) (\text{१—कोज्या के}_{१})}{(\text{१—इ}) (\text{१+कोज्या के}_{१})}$

$$\therefore \text{स्प}^2\tfrac{1}{2}\,\text{ष} = \frac{1+\text{इ}}{1-\text{इ}}\cdot\text{स्प}^2\tfrac{1}{2}\,\text{के}_1,$$

$$\therefore \text{स्प}\tfrac{1}{2}\,\text{ष} = \sqrt{\frac{1+\text{इ}}{1-\text{इ}}}\cdot\text{स्प}\tfrac{1}{2}\,\text{के}_1, \quad \cdots\cdots\cdots (3)$$

एतेन च्युतिकेन्द्रमुखेन स्फुटकेन्द्रमानं सिद्धयति । पूर्वं तु (१) समीकरणेनापि च्युतिकेन्द्रमुखेन मध्यमकेन्द्रमानं सिद्धम् । अथेदानीं मध्यमस्फुटयोः सम्बन्धो गवेषणीयः ।

अत्र यदि $\text{इ}=\text{ज्यास}$, $\text{ष}=\text{य}$, $\text{के}_1=\text{र}$,

$$\text{तर्हि } \frac{1+\text{इ}}{1-\text{इ}} = \frac{1+\text{ज्यास}}{1-\text{ज्यास}} = \frac{1+2\,\text{कोज्या}\tfrac{1}{2}\text{स}\cdot\text{ज्या}\tfrac{1}{2}\text{स}}{1-2\,\text{कोज्या}\tfrac{1}{2}\text{स}\cdot\text{ज्या}\tfrac{1}{2}\text{स}}$$

$$= \frac{\text{कोज्या}^2\tfrac{1}{2}\text{स}+\text{ज्या}^2\tfrac{1}{2}\text{स}+2\,\text{कोज्या}\tfrac{1}{2}\text{स}\cdot\text{ज्या}\tfrac{1}{2}\text{स}}{\text{कोज्या}^2\tfrac{1}{2}\text{स}+\text{ज्या}^2\tfrac{1}{2}\text{स}-2\,\text{कोज्या}\tfrac{1}{2}\text{स}\cdot\text{ज्या}\tfrac{1}{2}\text{स}}$$

$$= \frac{(\text{कोज्या}\tfrac{1}{2}\text{स}+\text{ज्या}\tfrac{1}{2}\text{स})^2}{(\text{कोज्या}\tfrac{1}{2}\text{स}-\text{ज्या}\tfrac{1}{2}\text{स})^2}$$

$$= \frac{(1+\text{स्प}\tfrac{1}{2}\text{स})^2}{(1-\text{स्प}\tfrac{1}{2}\text{स})^2} \therefore \sqrt{\frac{1+\text{इ}}{1-\text{इ}}} = \frac{1+\text{स्प}\tfrac{1}{2}\text{स}}{1-\text{स्प}\tfrac{1}{2}\text{स}}.$$

$$\therefore \text{स्प}\tfrac{1}{2}\text{ष} = \text{स्प}\tfrac{1}{2}\text{के}_1\sqrt{\frac{1+\text{इ}}{1-\text{इ}}}$$

$$\therefore \text{स्प}\tfrac{1}{2}\text{य} = \frac{1+\text{स्प}\tfrac{1}{2}\text{स}}{1-\text{स्प}\tfrac{1}{2}\text{स}}\cdot\text{स्प}\tfrac{1}{2}\text{र}\cdot$$

अथ त्रिकोणमित्या—

$$\text{स्प}\,\tfrac{1}{2}\,\text{ष} = \frac{\text{इ}^{i\text{य}/2}+\text{इ}^{-i\text{य}/2}}{\text{इ}^{i\text{य}/2}-\text{इ}^{-i\text{य}/2}}$$

$$\text{एवं}\quad \text{स्प}\,\tfrac{1}{2}\,\text{र} = \frac{\text{इ}^{i\text{र}/2}+\text{इ}^{-i\text{र}/2}}{\text{इ}^{i\text{र}/2}-\text{इ}^{-i\text{र}/2}}$$

योगान्तरनिष्पत्त्या—

$$\text{इ}^{i\text{य}} = \text{इ}^{i\text{र}}\cdot\frac{1+\text{३}^{-i\text{र}^{i}}\cdot\text{स्प}\tfrac{1}{2}\text{स}}{1-\text{३}^{i\text{र}}\cdot\text{स्प}\tfrac{1}{2}\text{स}}$$

पक्षयोर्लघुरिक्थेन—

$$य = र + २ \left(स्प \tfrac{१}{२} स \cdot ज्या र + \tfrac{१}{२} स्प^{२} \tfrac{१}{२} स ज्या २ र + \cdots\cdots \right)$$

एवमेव $इ = ज्या स$ ।

$$\therefore \quad स्प \tfrac{१}{२} स = \frac{\sqrt{१ - इ^{२}}}{इ}$$

$$= \frac{इ}{२} + \frac{इ^{२}}{८} + \cdots\cdots\cdots$$

अत उत्थापनेन—

$$य = र + \left(इ + \frac{इ^{२}}{४} \right) ज्या र + \frac{इ^{२}}{४} ज्या २ र + \cdots\cdots$$

वा $$ष = के_{२} + \left(इ + \frac{इ^{२}}{४} \right) ज्या के_{१} + \frac{इ^{२}}{४} ज्या २ के_{१} + \cdots\cdots$$

अत्र (१) समीकरणेन—

$$म = के_{१} - इ ज्या के_{१}$$

यद्यत्र प्रथमवारं दक्षिणपक्षस्थखण्डं त्यज्यते तदा $म = के_{१}$ तत उत्थापनेन—

$$के_{१} = म + इ \cdot ज्या म \cdot$$

अनेन (४) समीकरणमुत्थाप्य जातम्

$$ष = म + इ \cdot ज्या म + \left(इ + \frac{इ^{२}}{४} \right) ज्या (म + इ \cdot ज्या म)$$

$$= म + इ \cdot ज्या म + इ \cdot ज्या (म + इ \cdot ज्या म) + \cdots\cdots$$

$$= म + २ \; इ \cdot ज्या म + \cdots\cdots$$

$\therefore ष - म = २ इ \cdot ज्या म$ अन्यपदत्यागात् ।

अत्र म मध्यमकेन्द्रं, ष स्फुटकेन्द्रं, मध्यस्फुटकेन्द्रान्तरं मन्दफलं भवत्यतः

मन्दफलम् $= २ इ \cdot ज्या म \cdot$ यद्यत्र $२ इ =$ अन्त्यफलज्या, तथा $त्रि = १$, तदा ब्रह्मगुप्तोक्तं मृदुदोः फलचापरूपं मन्दफलं नवीनमतेनापि सिद्धम् । अत्रान्त्यफलज्या $= २ इ \cdot$ एतदर्थमन्यः प्रकारो द्रष्टव्यः तत्त्वग्रे वक्ष्ये ।

अत्रैव केचन नवीनास्तु अन्यथैव क्षेत्रभङ्गीं प्रदर्श्य चन्द्रार्कयोर्मन्दफलं प्रसाध्य प्राचीनमतं समर्थयन्ति।

तद्यथा

अथ E भुवो मध्यम्।

C=ग्रहगोलकेन्द्रम्।

EC=मन्दान्त्यफलज्या=p.

m=प्रतिवृत्ते मध्यमः

S=कक्षामण्डले सूर्यः स्पष्टः

Em=त्रिज्या=अ।

$\angle$mES=मन्दफलम्=E कल्प्यते।

SH लम्बः =Em रेखोपरि कृतः।

$\therefore$ स्प $\angle$ SEH$=\frac{SH}{EH}=$ $\angle$mES.

$\angle$EmS=मन्दकेन्द्रम्=म.

स्प $\angle$ mES$=\frac{\text{p. Sin म}}{\text{अ—कोज्याम· p.}}$

$\therefore$ E$=\frac{\text{P}}{\text{अ}}$. ज्याम$+\frac{\text{p}^2}{\text{२अ}^2}$.ज्या २ म+..........

परमिह दीर्घवृत्तीयसिद्धान्तेन—

E$=\left(\text{२ इ}-\frac{\text{इ}^3}{\text{४}}\right)$ ज्याम$+\frac{\text{५}}{\text{४}}$इ^2. ज्या २म+

$\frac{१३ इ^{३}}{१२}$. ज्या ३ म + ...

अतोऽत्र गोउफ्रउमहाशयेन $\frac{p}{अ}$ = २ इ — $\frac{इ^{३}}{४}$ प्रकल्पितम्, तत्र इ अस्य अत्यल्पत्वात् $\frac{इ^{३}}{४}$ त्यज्यते तदा $\frac{p}{अ}$ = २ इ.

∴ E = २ इ. ज्याम = $\frac{p}{अ}$. ज्याम.

अतोऽत्रापि ब्रह्मगुप्तमतेन—

मन्दफज्या = $\frac{ज्याअ. ज्याम}{अ}$

अथवा = २ इ. ज्याम., त्रि = १

२ इ = ज्यापरमफलम् ।

इदानीं रविचन्द्रयोः स्फुटत्वार्थमाह

देशान्तरे खमध्ये भुजफलचापे भुजान्तरे च कृते ।
उन्मण्डलेऽर्कचन्द्रौ स्पष्टौ रविचरदले क्षितिजे ।। १८ ।।

वा. भा.—इदानीं वा देशान्तरादिभिः संस्कारैः स्वदेशे यादृशौ रविचन्द्रौ भवतः यत्र प्रदेशे तत्प्रतिपादनायार्यामाह । लङ्कार्कोदयकालिकौ यौ रविचन्द्रौ मध्यौ तौ देशान्तरे कृते कर्मणि स्वदेशे मध्यौ भवतः यस्माल्लंकासमयाम्योत्तररेखातः प्राक् पश्चाद्वा स्वदेशेनैव भवितव्यम् । तत्र च प्रथमं पश्चाद्वार्कोदयो भवति । रेखार्कोदयादित्यत उपपन्नं भुजफलचापे भुजान्तरे च कृते, उन्मण्डलकेऽर्कचन्द्राविति भुजफलचापे स्वफलचापे स्वफले कृतेरपि स्फुटौ भवतः यस्मात् प्रतिमण्डलस्थौ स्वफलेनोपचितावपचितौ च कक्षामण्डले दृग्गतौ भवतः स्पष्टावपि तावेवाभिधीयेते । किन्तून्मण्डलसन्निधौ भवतः यस्मान्मध्यमरवेरुदयकालिकः सावनोऽहर्गणस्तस्माद्भुजान्तरे कृते उन्मण्डले स्पष्टौ भवतः यतो मध्यस्फुटरव्युदययोरन्तराद् भुजान्तरोत्पत्तिरुन्मण्डलञ्च निरक्षदेशक्षितिजमुच्यते । तस्मादुपपन्नम् ।

रविचरदले क्षितिज इतिस्वसम्बन्धी यच्चरार्धं तस्मिन् कृते सति क्षितिजस्थे रवौ रविचन्द्रौ स्पष्टौ भवतः । यस्मात्स्वदेशे क्षितिजोन्मण्डलयोरन्तरं यच्चरदलं स्वाहोरात्रार्धवृत्ते तस्मादेतदप्युपपन्नम् । सर्वं गोले प्रदर्शयेत् । अत्रार्धार्या रविचन्द्रयोर्ग्रहणग्रहोपलक्षणार्था । तेनान्येऽपि ग्रहाः देशान्तरे कृते स्वदेशे मध्या भवन्ति, मन्दशीघ्रभुजफलचापद्वये भुजान्तरे च कृते उन्मण्डले

स्पष्टा भवन्ति । रविचरदले च यथासंभवं कृतेऽर्कोदयकालिका भवन्ति। यद्यर्कसावनेनानीताः अथान्यग्रहमद्युनाहर्गणेनानीतास्तदा तत्सर्वं हि चरदले कृते तस्यैव ग्रहस्योदयकालिका भवन्तीति रव्यादयोऽथनक्षत्रसावनेनानीतास्ते चरदलं विना चोनाधिका भवन्तीति यदुक्तं रविचरदले कृते क्षितिजे रविचन्द्रौ भवतस्तल्लंकार्कोदयास्तमयिकावेव देशान्तरकृतौ नान्याविव्यत आर्यार्द्धेनाह ॥१८॥

वि. भा.—खमध्ये (खस्वस्तिके) ऽर्थात्स्फुटदिनार्धकाले यद्यर्कचन्द्रौ स्पष्टावपेक्षितौ तदा मध्यमरवौ चन्द्रे च भुजफलचापे (मन्दफले), भुजान्तरे च कृतेऽर्थात्संस्कृते सत्युन्मण्डले तौ स्फुटौ भवतः, तत्र रविचरदले (रविचरार्धे) संस्कृते सति क्षितिजे (स्वक्षितिजे) स्फुटौ रविचन्द्रौ भवेतामिति ॥१८॥

अत्रोपपत्तिः

यतो लङ्का याम्योत्तररेखातः पूर्वं पश्चाद्वा स्वदेशोऽतो देशान्तरसंस्कृतौ लङ्कार्कोदयकालिकौ रविचन्द्रौ स्वदेशमध्यमौ भवेताम् तत्र रेखार्कोदयात्प्रथमं पश्चाद्वा रव्युदयो भवति, तथा मन्दफलभुजान्तरयोः संस्करणेन स्वनिरक्षक्षितिजे रविचन्द्रौ स्फुटौ भवतस्तत्र रविचरार्धफलसंस्करणेन स्वक्षितिजे तौ स्फुटौ भवेतामिति । सिद्धान्तशेखरे श्रीपतिना 'अध्वकर्मणि कृते स्वमध्यमौ दोः फले रविफले इत्यादिना' ऽऽचार्योक्तानुरूपमेव रविचन्द्रयोः स्पष्टीकरणं प्रदर्शितमस्ति, भास्करतः प्राचीना आचार्याः स्वदेशोदयकालिकग्रहज्ञानार्थं पूर्वप्रतिपादितानि देशान्तरादित्रीण्येव कर्माणि कृतवन्तः, भास्करेणैकमपूर्वमुदयान्तरसंज्ञकं कर्म प्रतिपाद्य 'लङ्कायां भास्करोदये मध्याः' इति ब्रह्मगुप्तोक्तं तिरस्कृत्य 'यतोऽन्तरं तच्चलमल्पकं चे' त्यादिना पुनः समाधानं कृतमिति ॥ १८ ॥

अब रवि और चन्द्र के स्फुटत्व के लिये कहते हैं

हि. भा.—स्फुटदिनार्धकाल में यदि स्पष्टरवि और स्पष्ट चन्द्र अपेक्षित हों तो मध्यमरवि में और मध्यमचन्द्र में मन्दफल, भुजान्तर और देशान्तर इन तीनों कर्मों के संस्कार करने से उन्मण्डल में अर्थात् स्वनिरक्षक्षितिज में वे दोनों (रवि और चन्द्र) स्पष्ट होते हैं उनमें रविचरार्धफल संस्कार करने से स्वक्षितिज में स्पष्टरवि और स्पष्ट चन्द्र होते हैं इति ॥ १८ ॥

उपपत्ति

लङ्का याम्योत्तररेखा से स्वदेश पूर्व वा पश्चिम में है इसलिये लङ्कार्कोदयकालिक रवि और चन्द्र में देशान्तर संस्कार करने से स्वदेश में वे दोनों होते हैं, वहाँ रेखार्कोदय से पहले या पीछे रवि का उदय होता है, मन्दफल और भुजान्तर का संस्कार करने से स्वनिरक्षक्षितिज में स्पष्टरवि और स्पष्टचन्द्र होते हैं, उनमें रविचरार्ध का संस्कार करने से

स्वक्षितिज में स्पष्टरवि और स्पष्टचन्द्र होते हैं, सिद्धान्तशेखर में श्रीपति ने 'अध्वकर्मणि कृते स्वमध्यमौ' इत्यादि से आचार्योक्तानुरूप ही रवि और चन्द्र का स्पष्टीकरण किया है। भास्कराचार्य से प्राचीन आचार्यों ने स्वदेशोदयकालिक ग्रहज्ञान के लिये पूर्व प्रतिपादित देशान्तर आदि तीन ही कर्म किये हैं, भास्कराचार्य ने एक अपूर्व उदयान्तर संज्ञक कर्म कह कर 'लङ्कायां भास्करोदये मध्याः' इस ब्रह्मगुप्त कथन का अनादर कर 'यतोऽन्तरं तच्चलमल्पकं च' इससे पुनः उनके मत का समाधान किया है इति ॥१८॥

इदानीमार्यभटोक्तं स्फुटीकरणं न युक्तमित्याह

अर्कोदयास्तमययोर्विना चरार्धेन रात्रिदिनदलयोः।
न स्फुटमार्यभटोक्तं स्पष्टीकरणं स्फुटोक्तिरतः॥ १९ ॥

वा. भा.—लङ्कार्कोदयकालिकौ स्पष्टौ देशान्तरफलसंस्कृतौ चरदलेन यदा संस्क्रियेते तदा स्वदेशे प्राक् क्षितिजस्थे रवौ तात्कालिकौ भवतः। अथास्तमयिकौ यथोक्तौ तदपि रविचरदलकर्मणि कृते परक्षितिजस्थे रवौ तात्कालिकौ भवतः, सर्वं ग्रहाणां योज्यम्। विना चरार्धेन रात्रिदिनदलयोः यस्माद्याम्योत्तरमण्डलं चरदलवशान्न भिद्यते महत्याप्यक्षोन्नत्या सर्वमेतत् गोले प्रदर्शयेत्। इष्टकालिकास्तु ग्रहाश्चरदलकर्म विनापि स्फुटा भवन्तीति यस्मात् स्वदेशार्कोदयादस्तमयाद्वा स कालः कलित इति, आर्यभटोक्तं स्पष्टीकरणं स्फुटोक्तिरतः स्पष्टार्थमिदमार्याधंम्।

वि. भा.—चरसंस्कारेण विनाऽर्धरात्रे दिनार्धे च रविचन्द्रौ स्फुटौ भवतः, आर्यभटकथितं स्पष्टीकरणं न स्फुटमतोऽस्मात्कारणात्स्फुटीकरणकथनं युक्तमस्तीत्याचार्येण स्वकीयस्पष्टीकरणकथने कारणं प्रतिपाद्यते ॥१९॥

अत्रोपपत्तिः

स्वदेशनिरक्षदेशयोर्दिनार्धं रात्र्यर्धं चैककालावच्छेदेनैव भवत्यतस्तत्र चरार्धसंस्कारस्याऽवश्यकता न भवतीति ॥१९॥

अब आर्यभटोक्त स्फुटीकरण ठीक नहीं है इसको कहते हैं

हि. भा.—चर संस्कार के विना अर्धरात्रि में और दिनार्ध में रवि और चन्द्र स्फुट होते हैं, आर्यभट का कहा हुआ स्पष्टीकरण स्फुट नहीं है। स्पष्टीकरण का कहना ठीक है इससे आचार्य अपने स्पष्टीकरण कथन में कारण कहते हैं, इति. ॥१९॥

उपपत्ति

स्वदेश में और निरक्ष देश में दिनार्ध और रात्र्यर्ध एक ही समय में होता है

इसलिये वहां चरार्ध संस्कार का अभाव होता है अर्थात् चरार्ध संस्कार की आवश्यकता नहीं होती है इति. ॥१९॥

इदानीं रविचन्द्रयोः स्पष्टीकरणार्थं मन्दपरिध्यंशानाह

सूर्यस्य मनुद्वितयं त्र्यंशोनं दिनदले नतस्य प्राक् ।
तिथिघटिकाभिस्त्र्यंशाधिकोनमूनाधिकं पश्चात् ॥२०॥
द्युदले जिनलिप्तोनं दशनद्वितयं द्विशरकलोनं प्राक् ।
पश्चात् युतोनमिन्दोः सूर्य इव ऋणे धने परिधिः ॥२१॥

वा. भा.—इदानीं स्फुटीकरणं विवक्षुरादौ तावद्रविचन्द्रयोः दिनदलेनार्धरात्रोदयास्तमयेषु मन्दनीचोच्चवृत्तस्य परिधिप्रमाणान्यार्याद्वयेनाह—

ऋणधनपरिध्यंशा इति सर्वत्र सम्बद्धो भवति । नायमर्थः सूर्यस्य मनुद्वितयं त्रिशोनमृणधनपरिध्यंशाः द्युदले स्वमध्याह्ने एतदुक्तं भवति । मध्याह्ने रविमंदोच्चनीचवृत्तस्य परिधेस्त्रयोदशभागाः चत्वारिंशच्च लिप्ताःऋणकेन्द्रे धनकेन्द्रे च नतस्य प्राक्तिथिघटिकाभिरंशाधिकोनामिति स्वमध्याह्नात् पञ्चदशघटिकाभिर्यदि प्राग्नतोनो रविः स्वोन्मण्डलस्थित इत्यर्थः, तदा मुनिद्वितयमंशोनं यदुक्तं ऋणधनपरिध्यंशा द्युदलं तदेव त्रिशाधिकोनं सत् यथासंख्यमृणधनपरिध्योरंशा भवन्ति। उन्मण्डलस्थस्य रवेर्ऋणपरिधिञ्च दशधनपरिधिस्त्रयोदश सन्ति भागा इत्यर्थः। ऊनाधिकस्वमध्यान्हात् पश्चात्कपालेन तस्य तिथिघटिकाभिरेव स्वास्तोन्मण्डलस्थितस्येत्यर्थः ।

तदेव त्रिशोनं मनुद्वितयं त्र्यंशोनयुतं कृत्वा तत्रर्णधनपरिध्योरंशो यथासंख्यं भवति । ऋणपरिधिस्त्रयोदश सन्ति भागाः धनपरिधिश्चतुर्दशभागाः इत्यर्थः स्वार्धरात्रेऽपि द्युदलपरिधेस्तुल्या परिधिरिति चन्द्रस्यापि द्युदलं स्वमध्याह्ने जिनलिप्तोनं दशनद्वितयमिति चतुर्विशतिलिप्तानामूनः । द्वात्रिंशद्भागाः स्वमन्दोच्चनीचवृत्तस्य ऋणधनकेन्द्रयोर्द्वयोरपि स्थितस्य परिधिर्भवति, द्विशरकलोनं प्रागिति नतस्य तिथिघटिकाभिरिति सूर्यवद्योज्यन्ते, न द्वात्रिंशद्भागा जिनलिप्तोनाद्वा पंचदशहीना लिप्तानां स्वोन्मण्डलस्थस्य चन्द्रमस ऋणधनकेन्द्रयोस्तन्मदोच्चपरिधयो भवन्ति । प्राक्पश्चाद्युतोनमिति पश्चात्पुनर्नते चन्द्रमसि घटिकाभिः स्वस्वोन्मण्डलस्येत्यर्थस्तदेव दशनद्वितयंशा भवन्ति, अतोऽपि स्वमध्यजिनलिप्तोनं द्वापञ्चाशद्धीना लिप्तानां स्वोन्मण्डलस्थस्य चन्द्रमस ऋणधनकेन्द्रयोस्तन्मन्दोच्चपरिधिभागा भवन्ति । प्राक् पश्चात् पुनर्नते चन्द्रमसि तिथिघटिकाभिः स्वास्तोन्मण्डलस्येत्यर्थः तदेव दशनद्वितयं जिनलिप्तोनं द्वापञ्चाशत्कलानां युतमूनं कृत्वा यथासंख्यं ऋणधनपरिध्योरंशाः भवन्ति ।

अत्रापि स्वमध्याह्नात् परिधिरेव स्वार्धरात्रपरिधिर्याम्योत्तरमण्डलस्यैक-

त्वात्तद्यथा सूर्यस्य ऋणकेन्द्रयोः द्युकलेऽर्धरात्रे च परिधिः १३।४० स्वोन्मण्डले परिधिः १४ तत्रैव धनपरिधिः १३०२०। स्वास्तोन्मण्डले ऋणपरिधिः १३।२० तत्रैव धनपरिधिः १४ चन्द्रस्य स्वमध्याह्नार्धरात्रयोर्ऋणधनयोरपि परिधिः ३१३६ स्वोदयोन्मण्डले ऋणधनयोः परिधिः ३०४४ अस्तोन्मण्डलऋणपरिधिः ३२०२८ तत्रैव धनपरिधिः ३०४४ तत्र परिधेरूनाधिकत्वे उपलब्धिरेव वासना परमफल-वशाद्यतो नीचोच्चवृत्तस्य महत्त्वाल्पत्वे भवति यादृगुदये फले न तादृग् मध्याह्ने नवास्तमये इष्टभूगोलोपरिस्थितत्वादित्येतद्गोले प्रदर्शयेत्। एवं द्युदलादिषु पञ्चदशघटिकान्तरितेषु कालेषु रविचन्द्रयोर्मन्दोच्चनीचवृत्तमध्यस्य स्फुटपरिधि-रुक्तो वान्तरे यथास्फुटो भवति तथार्ययाह।

वि. भा.—मनुद्वितयं त्र्यंशोनं कार्यमर्थाच्चतुर्दशांशाः स्थानद्वये भागत्र्यंशेन रहितास्तदा ऋणे वा धने मन्दफले सूर्यस्य, दिनदले (मध्याह्ने) मन्दपरिध्यंशा भवन्ति, ऋणे धने वा मन्दफले दिनार्धात् प्राक्कपाले पञ्चदशघटीभिर्नतस्य सूर्यस्य दिनार्धपरिधिमानं क्रमेण भागत्र्यंशेनाधिकमूनं कार्यम्, दिनार्धात्पश्चिमकपाले पञ्चदशघटीभिर्नतस्य सूर्यस्य ऋणे धने वा मन्दफले दिनार्धपरिधिमानं क्रमेण भागत्र्यंशेनोनाधिकं कार्यं तदा प्राक्पश्चादुन्मण्डलस्थे सूर्ये तन्मन्दपरिध्यंशा भवन्ति। चन्द्रस्य ऋणे धने वा मन्दफले दशनद्वितयं जिनलिप्तोनं कार्यमर्थात्स्थानद्वये द्वात्रिंशदंशाश्चतुर्विंशतिकलाभिर्हीनास्तदा मध्यान्हे तन्मन्दपरिध्यंशा भवन्ति। सूर्य इव प्राक्कपाले पश्चिमकपाले च पञ्चदशघटीभिर्नतस्य चन्द्रस्य ऋणे मन्दफले मध्यान्हे परिधिमानं द्विशर ५२ कलोनं धने मन्दफले ताभिरेव घटीभिः प्राक्पश्चान्न-तस्य चन्द्रस्य मध्यान्हपरिधिमानं द्विशर ५२ कलाभिः क्रमेण युतोनं कार्यं तदा प्राक्-पश्चादुन्मण्डलस्थे चन्द्रे तन्मन्दपरिध्यंशा भवन्ति यथा—

रवेर्ऋणे मन्दफले	धने मन्दफले
मध्यान्हे मन्दपरिधिः=१३°।४०′	मध्यान्हे परिधिः=१३°।४०′
प्रागुन्मण्डलस्थे सूर्ये=१४°।०	प्रागुन्मण्डलस्थे सूर्ये=१३°।२०′
पश्चिमोन्मण्डलस्थे सूर्ये=१३°।२०′	पश्चिमोन्मण्डलस्थे सूर्ये=५४°।०′
चन्द्रस्य ऋणमन्दफले	धने मन्दफले
मध्यान्हे मन्दपरिधिः=३१°।३६′	मध्यान्हे मन्दपरिधिः=३१°।३६′
प्रागुन्मण्डलस्थे चन्द्रे=३०°।४४′	प्रागुन्मण्डलस्थे चन्द्रे=३०°।४४′
पश्चिमोन्मण्डलस्थे चन्द्रे=३२°।२८′	पश्चिमोन्मण्डलस्थे चन्द्रे=३०°।४४′

आर्यभटमतेन रवेर्मन्दपरिधिः=१३°।३०′, चन्द्रस्य मन्दपरिधिः=३१°।३०′,

एतयोर्ब्रह्मगुप्तार्यभटपठितपरिध्योर्दर्शनेन किञ्चिदन्तरं पतति, सूर्यसिद्धान्ते त्वे 'रवेर्मन्दपरिध्यंशा मनवः शीतगो रदाः, युग्मान्ते विषमान्ते च नखलिप्तोनिता-स्तयोः' वमस्ति, भिन्नभिन्नमन्दपरिध्यंशदर्शनेन ज्ञायते यन्मन्दान्त्यफलज्या सर्वदा न

स्थिरा यतो मध्यग्रहान्मन्दान्त्यफलज्याव्यासार्धवृत्तमेव मन्दपरिधिः, यस्याचार्यस्य समये या मन्दान्त्यफलज्योपलब्धा तदनुसारमेव मन्दपरिधिमानं स्वस्वसिद्धान्ते लिखितं तैरिति ॥२०-२१॥

अत्रोपपत्तिः

उपपत्तिसम्बन्धे चतुर्वेदाचार्येण 'अत्रोपलब्धिरेव वासनेत्यभिहितम्' भास्कराचार्येणाप्येतदनुकरणमेव कृतमिति ॥२०-२१॥

अब रवि और चन्द्र के स्पष्टीकरण के लिए मन्द परिध्यंशों को कहते हैं

हि. भा.—चौदह अंश में दो स्थानों में एक अंश के तृतीयांश (बीसकला) को घटाने से सूर्य के ऋणमन्द फल में वा धनमन्द फल में मध्यान्ह काल में मन्द परिध्यंश होता है, ऋणमन्दफल में वा धनमन्दफल में दिनार्ध से पूर्वकपाल में पञ्चदश १५ घटी कर के नत सूर्य के मध्यान्ह मन्दपरिधिमान में क्रम से एक अंश के तृतीयांश (२० कला) को युत और हीन करना चाहिए, दिनार्ध से पश्चिम कपाल में ऋणमन्दफल में और धनमन्दफल में मध्यान्ह परिधिमान में बीसकला को क्रम से हीन और युत करना तब पूर्व और पश्चिम उन्मण्डलस्थ सूर्य का मन्द परिध्यंश होता है। चन्द्र के ऋण या धन मन्दफल रहने पर बत्तीस ३२ में दो स्थानों में चौबीस २४ कला को घटा देना तब मध्यान्ह में उनके मन्द परिध्यंश होते हैं। सूर्य ही की तरह पूर्वकपाल में और पश्चिमकपाल में पञ्चदश १५ घटी करके नत चन्द्र के ऋणमन्दफल में मध्यान्ह परिधिमान में बावन ५२ कला घटा देना, धनमन्दफल में पञ्चदश घटी करके नतचन्द्र के मध्यान्ह परिधिमान में ५२ कला को क्रम से युत और हीन करना तब पूर्व और पश्चात् उन्मण्डलस्थ चन्द्र के मन्द परिध्यंश होता है। यथा.

रवि के ऋण मन्दफल में	धन मन्दफल में
मध्यान्ह में मन्द परिधि=१३°।४०′	मध्याह्न में मन्दपरिधि=१३°।४०′
प्राक् उन्मण्डलस्थ सूर्य में=१४°।०′	प्राक् उन्मण्डलस्थ सूर्य में=१३°।२०′
पश्चात् उन्मण्डलस्थ सूर्य में=१३°।२०′	पश्चात् उन्मण्डलस्थ सूर्य में=१४°।०′

चन्द्र के ऋण मन्दफल में	धन मन्दफल में
मध्याह्नमन्दपरिधि=३१°।३६′	मध्याह्नमन्दपरिधि=३१°।३६′
प्राक् उन्मण्डलस्थ चन्द्र में=३०°।४४′	प्राक् उन्मण्डलस्थ चन्द्र में=३०°।४४
पश्चात् उन्मण्डलस्थ चन्द्र में=३२°।२८′	पश्चात् उन्मण्डलस्थ चन्द्र में=३०°।४४

आर्यभट के मत से रवि की मन्द परिधि=१३°।३०′, चन्द्र की मन्द परिधि=३१°।३०′ ब्रह्मगुप्त पठित परिधिमान को और आर्यभट पठित परिधिमान को देखने से दोनों में कुछ अन्तर पड़ता है, सूर्यसिद्धान्त में—

'रवेर्मन्दपरिध्यंशा मनवः शीतगो रदाः युग्मान्ते। विषमान्ते च नखलिप्तोनितास्तयोः'

इस तरह है, भिन्न-भिन्न परिध्यंश देखने से मालूम होता है कि ग्रहों की मन्दान्त्य फलज्यायें सदा स्थिर नहीं हैं क्योंकि मध्यम ग्रह को केन्द्र मान कर मन्दान्त्य फलज्या व्यासार्ध से जो वृत्त बनता है वह मन्दनीचोच्चवृत्त परिधि है, जिन जिन आचार्य को जितनी-जितनी मन्दान्त्य फलज्या उपलब्ध हुई उसी के अनुसार मन्द परिधिमान अपने-अपने सिद्धान्त में भिन्न-भिन्न लिखे हैं इति ॥२०-२१॥

उपपत्ति

इसके विषय में चतुर्वेदाचार्य ने 'इस में उपलब्धि ही उपपत्ति है, कहा है' भास्कराचार्य ने भी इन्हीं का अनुकरण किया है इति॥२०-२१॥

इदानीमिष्टे नते स्फुटपरिध्यानयनमाह

तद्द्युदलपरिध्यन्तरगुणा हृता त्रिज्यया च नतजीवा ।
ऊने धनमृणमधिके दिनार्धपरिधौ स्फुटः परिधिः ॥ २२ ॥

वा. भा.—तदित्यनेनौदयिकस्यास्तमयिकस्य चोन्मण्डलपरिधेः परामर्शस्तस्य द्युदलपरिधेश्च यदन्तरं तत् द्युदलपरिध्यन्तरं तेन गुणा खनवजीवाहृता त्रिज्यया कार्या, एतदुक्तं भवति खे सदा परिध्यन्तरं विंशतिलिप्तास्ताभिस्त्रैराशिकं यदि त्रिज्यातुल्यया नतोत्क्रमज्यया स्वमध्याह्नेऽत्र रवौ प्राक् पश्चाद्वा परिध्यन्तमेतत्तदिष्टकालिकया नतोत्क्रमज्यया कः नते स्वमध्याह्नात् एव किमिति लब्धं यत्र फलं धनमृणं वा दिनार्धपरिधौ कार्यमनेन परिधिना सह दिनार्धपरिधेरन्तरे कृते तस्मादूने दिनार्धपरिधौ धनमधिके ऋणं कार्यम् । यस्मात् प्रतिक्षणमुपचीयतेऽपचीयते वा दिनपरिधिः, एवं कृते स्वमन्दोच्चनीचवृत्तस्य तत्र प्रदेशे स्फुटः परिधिर्भवति चन्द्रस्यापि स्वपरिध्यन्तरेण लिप्तानां द्वापञ्चाशता स्वमध्याह्नादिष्टकालनतोत्क्रमज्या च स्वमध्यपरिधिसंस्कृतः स्फुटो भवति । प्रागपरकपालयोरर्धरात्राच्च नतज्यां गृहीत्वा स्वार्धरात्रपरिधिः संस्कृत इष्टकाले स्वमन्दोच्चनीचवृत्तस्य स्फुटो भवत्यतएव पञ्चदशेभ्यो घटिकाभ्योऽधिको नतः कालः त्रिंशतो विशोध्य शेषास्ते गृह्यन्ते, यस्मादुन्मण्डलमत्रावधिः परमोपचयापचययोः अतएव यत्र षट्षष्टिरक्षांशास्तत्र रविमिथुनान्तार्को द्युदलपरिधेस्तुल्यस्तात्कालिकपरिधिरित्यादिकं गोले स्वाहोरात्रवृत्ते प्रदर्शयेत् सर्वत्र स्फुटपरिधिना च फलानयनं प्राग्वदिति ॥२२॥

वि. भा.—नतजीवा (इष्टनतकालज्या) तद्द्युदलपरिध्यन्तरगुणा (तच्छब्देनौदयिकस्यास्तमयिकस्य वोन्मण्डलपरिधेर्वा ग्रहणं तस्य दिनार्धपरिधेश्च यदन्तरं तेन गुणा) त्रिज्यया भक्ता लब्धं फलं दिनार्धपरिधौ धनमृणं वा कार्यं येन परिधिना सह दिनार्धपरिधेरन्तरं तस्मादूने दिनार्धपरिधौ धनमधिके ऋणं विधेयं तदाऽभीष्टस्थानीयः स्फुटः परिधिर्भवेदिति ॥ २२ ॥

अत्रोपपत्तिः

ये किल पूर्वं मन्दनीचोच्चवृत्तपरिधयः पठितास्ते दिनार्धकाल एव, ऋणे धने च फले प्राक्पश्चिमोन्मण्डलस्थे रवौ चन्द्रे च ये परिधयस्तयोः (रविचन्द्रयोः), स्वस्वदिनार्धपठितपरिधिना सहैतत्परिधेर्यदन्तरं तद्वशादनुपाते-'यदि त्रिज्यातुल्यया नतकालज्ययेदं परिध्यन्तरं लभ्यते तदेष्टनतकालज्यया किमिति' नानेनेष्टपरिध्यन्तरं समागच्छति, पठितपरिधौ-(दिनार्धपरिधौ) वेतदृणं धनं कार्यं तदेष्टस्थानीयः स्फुटः परिधिर्भवेदेवेति, सिद्धान्तशेखरे श्रीपतिना 'तद्दिनार्धपरिधिद्वयान्तरेणाहृता स्वनतशिञ्जिनीहृता। त्रिज्ययाऽथपरिधौ दिनार्धजे हीनके स्वमधिके त्वृणं स्फुटम्' अनेनाऽऽचार्योक्तानुरूपमेव कथितमिति ॥ २२ ॥

अब इष्टनतकाल में स्फुट परिध्यानयन को कहते हैं

हि. भा.—इष्टनतज्या को प्राक् पश्चिम उन्मण्डल में रवि और चन्द्र के रहने से जो परिधि पहले कही गयी है पठित परिधि (दिनार्ध परिधि) के साथ उसका जो अन्तर है उससे गुणा कर त्रिज्या से भाग देकर जो फल हो उसको दिनार्ध परिधि में ऋण वा धन करना (जिस परिधि के साथ दिनार्ध परिधि का अन्तर करते हैं उस परिधि से दिनार्ध परिधि ऊन हो तब दिनार्ध परिधि में जोड़ना, दिनार्ध परिधि के अधिक रहने से दिनार्ध परिधि में पूर्वागत फल को ऋण करना) तब इष्टस्थानीय स्फुट परिधि होती है इति ॥२२॥

उपपत्ति

पहले जो मन्दनीचोच्चवृत्त परिधि पठित है वह दिनार्ध काल ही में, ऋण फल में और धन फल में प्राक् उन्मण्डल में और पश्चिमोन्मण्डल में रवि और चन्द्र के रहने से जो परिधि होती है उसको दिनार्ध पठित परिधि के साथ जो अन्तर होता है उसके वश से 'यदि त्रिज्यातुल्य नतकालज्या में यह परिध्यन्तर पाते हैं तो इष्टनतकालज्या में क्या' इस अनुपात से इष्टपरिध्यन्तर आता है, दिनार्ध परिधि (पठित परिधि) में इसको ऋण और धन करने से इष्टस्थानीय स्फुट परिधि होती है, सिद्धान्तशेखर में 'तद्दिनार्धपरिधिद्वयान्तरेणाहृता' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्तानुरूप ही कहा है इति ॥ २२॥

इदानीं मन्दफलस्य धनत्वमृणत्वञ्चाह

भुजफलचापं केन्द्रे षड्राश्यूने रवावृणं मध्ये ।
स्वभुजफलचापमेवं षड्राश्यधिके धनं भवति ॥२३॥

वा. भा.—इदानीं स्वमन्दोच्चनीचस्फुटपरिधिना आगतस्य फलस्य धनर्णप्रदर्शयन्नाह । मध्ये रवौ स्वकर्मोद्भवं भुजफलचापं प्रागेव प्रदर्शितम् । यत्तदृणं भवति, षड्राश्यूने स्वमन्दकेन्द्रे यस्मात् प्रथमकेन्द्रपदे फलमृणं

भवति। ततो द्वितीयपदोत्क्रमधनफलेनापचीयमानक्षयं यावत्। यावत्तावदर्धचक्रमत उक्तं षड्राश्यूने केन्द्रे स्वमृणमिति। अधिके तु पुनः केन्द्रेऽर्धचक्रवत् फलं धनं भवतीत्यनुक्तमपि ज्ञायते। ततस्तृतीयपदफलं धनम्। तच्चतुर्थपदोत्क्रमक्षयफलेनापचीयमानमपि चक्रं यावदतिरिच्यते। चन्द्रस्य तु पुनः षड्राश्यधिके केन्द्रे धनं भवति, वा तदूनं क्षयः स्वभुजफलचापं रविवासनयैव विस्तरेण पूर्वमेव क्षयधनोपपत्तौ प्रदर्शितेति, रविचन्द्रवन्नार्थेयं ग्रहोपलक्षणार्था तेनान्येषामपि ग्रहाणां मन्दकर्मैव योज्यमिति।

वि. भा.—मन्दकेन्द्रे राशिषट्काल्पे भुजफलचापं (मन्दफलं) मध्ये रवावृणं भवति, एवं राशिषट्काधिके मन्दकेन्द्रे स्वभुजफलचापं (रविमन्दफलं) मध्ये रवौ धनं भवतीति ॥२३॥

अत्रोपपत्तिः

रविमन्दोच्चस्थानान्नीचपर्यन्तं स्थिते मध्यमरवौ तन्मन्दकेन्द्रस्य (रविमन्दोच्चमध्यमरवेरन्तररूपस्य) मेषादिराशिषट्कान्तर्गतत्वान्मन्दफलेन (मध्यमस्पष्टरव्योरन्तरेण) हीनो मध्यमरविः स्पष्टरविर्भवेत्। नीचादुच्चपर्यन्तं स्थिते मध्यमरवौ तत्केन्द्रस्य तुलादिराशिषट्कान्तरे विद्यमानत्वान्मन्दफलेन युक्तो मध्यमरविः स्फुटरविर्भवत्यतः सिद्धं यन्मेषादिकेन्द्रे मन्दफलमृणं तुलादिकेन्द्रे च मन्दफलं धनं भवत्यतः श्लोके षड्राश्यूने केन्द्रे (मेषादिकेन्द्रे) षड्राश्यधिके केन्द्रे (तुलादिकेन्द्रे) व्याख्येयः, सिद्धान्तशिरोमणौ भास्करेण 'तुलाजादिकेन्द्रे फलं स्वर्णमेवं मृदुज्ञेयमिति' आचार्योक्तानुरूपमेव कथ्यत इति ॥२३॥

अब मन्दफल के धनत्व और ऋणत्व को कहते हैं

हि. भा.—छः राशि से अल्प मन्द केन्द्र (अर्थात् मेषादि केन्द्र) में मन्दफल को मध्यमरवि में घटा देने से स्पष्ट रवि होते हैं। इसी तरह छः राशि से अधिक मन्द केन्द्र (अर्थात् तुलादि केन्द्र) में मध्यमरवि में मन्दफल को जोड़ने से स्पष्टरवि होते हैं इति ॥ २३ ॥

उपपत्ति

मन्दोच्च स्थान से नीच पर्यन्त मध्यमरवि के रहने से रवि मन्दकेन्द्र (मन्दोच्च और मध्यमरवि के अन्तर) के मेषादि छः राशि के अन्तर्गत होने के कारण रविमन्दफल को मध्यमरवि में घटाने से स्पष्टरवि होते हैं। नीच से उच्च पर्यन्त मध्यमरवि के रहने से रविमन्द केन्द्र के तुलादि छः राशि के अन्तर्गत होने के कारण रविमन्द फल को मध्यमरवि में जोड़ने से स्पष्टरवि होते हैं इससे सिद्ध होता है कि मेषादि केन्द्र में मन्दफल ऋण होता है और तुलादि केन्द्र में मन्दफल धन होता है, सिद्धान्तशिरोमणि में

भास्कराचार्य भी 'तुलाजादिकेन्द्रे फलं स्वर्णमेवं मृदुज्ञेयं' इससे आचार्योक्तानुरूप ही कहते हैं इति ॥ २३ ॥

इदानीं रविचन्द्रयोः स्पष्टीकरणे विशेषमाह

देशान्तराद्यमेवं स्पष्टीकरणं दिनार्धपरिधिभ्याम् ।
कृत्वा तत्तिथ्यन्तस्फुटपरिधिभ्यां स्फुटावसकृत् ॥२४॥

वा. भा.—इदानीमसकृत्कर्मप्रदर्शनार्थमार्यामाह । देशान्तराद्यं यदुक्तं तदेव-मेव कृत्वा स्पष्टीकरणं तु पुनः प्रथमदिनार्धपरिधिभ्यां कृत्वा रविचन्द्रयोस्ततस्ताभ्यां तिथ्यन्तः साध्यते । तत्र तिथ्यन्ते स्वपरिधेः स्फुटीकृत्वा ताभ्यां पुनरसकृत् स्पष्टी-कार्यौ । एवं तावद्यावदवशेषौ भवतः । तौ च कक्षामण्डलगौ भवत इत्यर्थः । अत्रोपपत्तिस्तात्कालिकेन परिधिना फलानयनं युज्यते । न तावत्तिथ्यन्तो ज्ञायते ततो दिनार्धपरिधिनैव स्फुटौ कृत्वा तिथ्यन्तः साध्यः । ततो ज्ञातो तात्का-लिकेन परिधिना स्फुटीक्रियते, यतो नीचोच्चवृत्तपरिधिः प्रदक्षिणयाऽन्यद्देशे भवति । असकृत्कर्मवासना यथान्यस्तेषु कक्षामण्डलादिषु प्रदर्श्या तद्यथा कक्षा-मंडले मध्यग्रहचिन्हिते प्रदेशे यदा नीचोच्चवृत्तमध्यं क्रियते तदान्या नीचोच्चवृत्त-भुजज्या भवति । यदा स्फुटग्रहप्रदेशे क्रियते तदान्यतो नीचोच्चवृत्तं पूरयति । तस्मात् प्रतिमण्डलस्थग्रहपरिज्ञानाय, प्रथममध्यमेनैवं ग्रहाणां फलानयनम् । ततो ज्ञात्वा प्रतिमण्डलस्थग्रहे तत्समसूत्रकक्षामण्डलस्थग्रहेणासकृत् यत्फलमागच्छति तन्मध्यस्फुटग्रहयोरन्तरं स्पष्टफलमपि तदेवाभिधीयते उपपन्नमिति ।

वि. भा.—रविचन्द्रयोर्दिनार्धपरिधिभ्यां देशान्तरादिस्फुटीकरणं कृत्वा ताभ्यां स्पष्टरविचन्द्राभ्यां ग्रहणे तिथ्यन्तः साध्यः, तत्तिथ्यन्तकालिकाभ्यां चन्द्रार्कयोः स्फुटपरिधिभ्यां स्फुटौ रविचन्द्रौ साध्यौ, ताभ्यां स्फुटरविचन्द्राभ्यां पुनस्तिथ्यन्तः साध्यः, पुनः स्पष्टपरिधिभ्यां स्फुटौ रविचन्द्रौ साध्यावेवमसकृत्करणेन ग्रहणोपयुक्तौ स्पष्टरविचन्द्रौ भवेतामित्याचार्याभिप्रायो भास्कराचार्येण अस्फुटी-कृतोऽतएव सिद्धान्तशिरोमणौ 'मुहुः स्फुटाऽतो ग्रहणे रवीन्द्वोस्तिथिस्त्विदं जिष्णु-सुतो जगाद' भास्करेण कथ्यत इति ॥ २४ ॥

अत्रोपपत्तिः

आचार्योक्तं नतकर्म सकृत्प्रकारेणापि भवितुमर्हति । यथा गणितागत-तिथ्यन्तकालासकृत्प्रकारसाधितनतकर्मसंस्कृतरविचन्द्रोत्पन्नतिथ्यन्तकालयोरन्तर्गत-घटीमानम्=य, एतत्सम्बन्धिनतोंऽशाः=६य, गणितागततिथ्यन्तकाले रविनत-कालांशा=न, अनयोः संस्कारेण वास्तवनतकालांशाः=न± ६य, ततोऽनुपातो यदि घटीषष्ट्या रविचन्द्रयोर्गत्यन्तरकला लभ्यन्ते तदा 'य' घटीभिः काः समागता

'य' घटीषु रविचन्द्रान्तरकलाः $=\frac{\text{य (चंगक—रगक)}}{६०}=\text{य}\times\text{ग}$

$\frac{\text{चंगक—रगक}}{६०}$ = ग· 'तिथ्यन्तनाडीनतबाहुमौर्व्यो' इत्यादि

भास्करोक्तप्रकारेण सूर्यस्य नतकर्म = $\frac{\text{रफ} \times \text{ज्या (न} \pm \text{६य)}}{४९२०}$ = रफ$_1$ × ज्या

(न ± ६य) अत्र $\frac{\text{रफ}}{४९२०}$ = रफ$_1$ तथा चन्द्रस्य नतकर्म = $\frac{\text{चंफ} \times \text{ज्या (न} \pm \text{६य)}}{४३७५}$

= चंफ$_1$ × ज्या (न ± ६य) अत्र $\frac{\text{चंफ}}{४३७५}$ = चंफ$_1$

अनयोः संस्कारः पूर्वसाधितान्तरेण तुल्यो भवेदन्यथा गणितागतयोर्नतकर्मसंस्कृतयोश्च रविचन्द्रयोः 'य' घटयन्तरे कथं समानमन्तरमुत्पद्येत। ततः ग × य = चंफ$_1$ × ज्या (न ± ६य) — रफ$_1$ × ज्या (न ± ६य)

= (चंफ$_1$ — रफ$_1$) × ज्या (न ± ६य), अतः $\frac{\text{ग}}{\text{चंफ}_1 \text{—रफ}}$ = $\frac{\text{ज्या (न} \pm \text{६य)}}{\text{य}}$ =

पर: = प, ततोऽनुपातो यदि दशानामंशानां ज्या = २१ तदै '६य' तत्तुल्यांशानां का जाता

ज्या६ य = $\frac{२१ \times ६ \text{ य}}{\text{य}}$, एवमेव $\frac{२१ \times ३ \text{ य}}{१०}$ = ज्या३ य = $\sqrt{\frac{\text{त्रि} \times \text{उज्या६ य}}{२}}$ =

$\sqrt{६० \times \text{उज्या६ य}}$ अतो विलोमेन $\frac{२१^2 \times ३^2 \times \text{य}^2}{१२^2 \times ६०}$ = उज्या ६य, तथा चापयोरिष्टयोरित्यादिना.

ज्या (न ± ६ य) = $\frac{\text{ज्यान} \times \text{कोज्या६ य} \pm \text{कोज्यान} \times \text{ज्या६ य}}{\text{त्रि}}$ = ज्यान—

$\frac{\text{ज्यान} \times \text{उज्या६ य}}{\text{त्रि}} \pm \frac{\text{कोज्यान} \times \text{ज्या६ य}}{\text{त्रि}}$ = ज्यान — $\frac{\text{ज्यान} \times २१^2 \times ३^2 \times \text{य}^2}{१०^2 \times ६० \times १२०}$

$\pm \frac{\text{कोज्यान} \times २१ \times ६ \text{ य}}{१० \times १२०}$

= ज्यान — $\frac{\text{ज्यान} \times \text{य}^2}{(\frac{२००}{२१})^2 \times २} \pm \frac{\text{कोज्यान} \times \text{य}}{\frac{२००}{२१}}$ = ज्यान — $\frac{\text{ज्यान} \times \text{य}^2}{२ \text{ हा}^2} \pm$

$\frac{\text{कोज्यान} \times \text{य}}{\text{हा}}$ अथ $\frac{\text{ज्या (न} \pm \text{६ य)}}{\text{य}}$ = प = $\frac{\text{ज्यान}}{\text{य}} - \frac{\text{ज्यान} \times \text{य}}{२ \text{ हा}^2} \pm \frac{\text{कोज्यान}}{\text{हा}}$

पक्षौ 'हा' गुणितौ तदा प × हा = ध्रुवः = ध्रु$_0$ = $\frac{\text{ज्यान} \times \text{हा}}{\text{य}} - \frac{\text{ज्यान} \times \text{य}}{२ \text{ हा}} \pm$

कोज्यान,पक्षयोः समशोधनेन तथा ज्यान भक्तेन च $\frac{\text{ध्रु} \mp \text{कोज्यान}}{\text{ज्यान}} = \frac{\text{हा}}{\text{य}} - \frac{\text{य}}{\text{२ हा}}$

छेदगमेन $\text{२ हा}^2 - \text{य}^2 = \pm \text{अ} \times \text{हा} \times \text{य} \times \text{२}$ अत्र $\frac{\text{ध्रु} + \text{कोज्यान}}{\text{ज्यान}} = \pm \text{अ} =$ अन्यः समशोधनेन.

$\text{य}^2 \pm \text{२ अ} \times \text{हा} \times \text{य} = \text{२ हा}^2$ ततो वर्गपूर्त्तिकरणेन $\text{य}^2 \pm \text{२ अ} \times \text{हा} \times \text{य} + \text{अ}^2 \times \text{हा}^2 = \text{२हा}^2 + \text{अ}^2 \times \text{हा}^2 = \text{हा}^2 (\text{अ}^2 + \text{२})$

$$\text{मूलेन य} \pm \text{अ} \times \text{हा} = \text{हा}\sqrt{\text{अ}^2 + \text{२}}$$

$$\therefore \text{य} = \text{हा} \left(\sqrt{\text{अ}^2 + \text{२}} \mp \text{अ}\right)$$

एतेन म.म.पण्डितसुधाकरद्विवेदिनः सूत्राण्यवतरन्ति--

गत्यन्तरकलाः षष्टिभक्ता गत्यन्तरं भवेत्, ।
फललिप्ताः स्वहाराप्ता रवीन्द्वोश्च फलं क्रमात् ॥
गत्यन्तरं फलवियोगहृतं विधोः प्राक्,
स्वे तत्फलेऽन्यसमये युतिहृत् पराख्यम् ।
खाभ्राश्विनो विधुकरैर्विहृता हरस्तन्निघ्नं,
परेण भवति ध्रुवसंज्ञकं तत् ॥
स्वीय ध्रुवो नतजकोटिगुणेन हीनो,
मौर्व्या नतासु भवया विहृतोऽपरोऽस्य ।
वर्गात्पदं करयुतादपरो नितं तद्धारघ्न-
मेवमिह दण्डमुखं विधोः प्राक् ॥
अस्वे फले रविफलात् स्वफलस्य बाल्ये,
हीनान्यथा च सहिते ष्टफलेन नूनम् ।
तिथ्यन्तदण्डमितिरत्र भवेत्स्फुटा सा,
प्राक् चेद्विधोर्धनफलाल्पमथात्र सौरम् ॥
तर्हि ध्रुवात् सनतकोटिगुणादिहान्यः,
साध्यो विदा गणितगोलविदा मुदैव ।
श्री ब्रह्मगुप्तनतकर्म भवेत् सुसूक्ष्ममेत्रं,
सकृत् सकलसज्जनरञ्जनार्थम् ॥

उदयान्तरभुजान्तरादिसंस्करणेन यो हि स्पष्टग्रहः समागच्छति वस्तुतो नहि स्पष्टग्रह इति ब्रह्मगुप्तोक्तनतकर्मपादानेन तत्साधनकर्तुर्भास्कराचार्यस्य वेदा-

दपि ज्ञायते, सर्वे आकाशस्था ग्रहादयो भूवायुगोले परिणता अस्माकं प्रत्यक्षीभूताः स्पष्टा भवन्ति, तेन स्पष्टीकरणेन ये स्पष्टग्रहाः समागच्छन्ति तेषु यावता संस्कारेण भूवायुगोलपरिणताः स्पष्टग्रहा भवेयुस्तस्यैव नाम नतकर्म; ब्रह्मगुप्ततः प्राचीनाः सूर्यसिद्धान्तकाराऽऽर्यभटप्रभृतिभिरेतत्सम्बन्धे स्वस्वसिद्धान्तेन किमपि लिखितवन्तः। मन्मते नतकर्मसंस्कारस्यातीवाऽऽवश्यकता प्रतीयते, विषयेऽस्मिन् सारासारविचारदक्षा ज्यौतिषिका भृशं विचारयन्त्विति ॥२४॥

अब रवि और चन्द्र के स्पष्टीकरण के सम्बन्ध में विशेष कहते हैं।

हि. भा.—रवि और चन्द्र का दिनार्ध परिधियों से देशान्तरादि द्वारा स्फुटीकरण कर के उन स्पष्टरवि और स्पष्टचन्द्र से ग्रहण में तिथ्यन्त साधन करना,उस तिथ्यन्त कालिक रवि और चन्द्र के स्पष्ट परिधियों से स्पष्ट रवि और स्पष्ट चन्द्र साधन करना, उन स्पष्ट रवि और स्पष्ट चन्द्र से पुनः तिथ्यन्त साधन करना, पुनः स्पष्ट परिधियों से स्पष्टरवि और स्पष्ट चन्द्र साधन करना, इस तरह वार-वार करने से ग्रहण के लिये उपयुक्त स्पष्ट रवि और स्पष्ट चन्द्र होते हैं, आचार्य जी के इस अभिप्राय का भास्कराचार्य ने विशदरूप से प्रतिपादन किया है इसीलिये सिद्धान्त शिरोमणि में 'मुहुः स्फुटाऽतो ग्रहणे रवीन्द्वोस्तिथिस्त्विदं जिष्णुसुतो जगाद' भास्कराचार्य कहते हैं ॥२४॥

उपपत्ति

आचार्योक्त नतकर्म सकृत्प्रकार से भी हो सकता है जैसे गणितागत तिथ्यन्त काल और असकृत्प्रकार से साधित नत कर्म संस्कृत रवि और चन्द्र से उत्पन्न तिथ्यन्त काल के अन्तर घट्यात्मक मान मानते हैं (य) एतत्सम्बन्धि अंश $=६$ य, गणितागत तिथ्यन्त काल में रवि के नत कालांश $=$ न, इन दोनों के संस्कार करने से वास्तवनतकालांश $=$ न$\pm$६य, तब अनुपात करते हैं, यदि साठ घटी में रवि और चन्द्र की गत्यन्तर कला पाते हैं तो (य) घटी में क्या इस से य घटी में रवि और चन्द्र की अन्तर कला आती है,

$\frac{\text{य (चंगक—रगक)}}{६०} = \text{य} \times \text{ग}$, यहां $\frac{\text{चंगक—रगक}}{६०} = \text{ग}$. । 'तिथ्यन्तनाडीनतबाहुमौर्व्या इत्यादि' भास्करोक्तप्रकार से सूर्य के नतकर्म $= \frac{\text{रफ} \times \text{ज्या (न}\pm\text{६य)}}{४६२०} = \text{रफ}_१ \times \text{ज्या}$ (न$\pm$६य), यहाँ $\frac{\text{रफ}}{४६२०} = \text{रफ}_१$ तथा चन्द्र के नतकर्म $= \frac{\text{चंफ} \times \text{ज्या (न}\pm\text{६य)}}{४३७५}$ $= \text{चंफ}_१ \times \text{ज्या}$ (न$\pm$६य), यहां $\frac{\text{चंफ}}{४३७५} = \text{चंफ}_१$ इन दोनों का संस्कार पूर्व साधित अन्तर के बराबर होता है अन्यथा गणितागत रवि और चन्द्र के अन्तर और नतकर्म संस्कृत रवि और चन्द्र के अन्तर य घटयन्तर में कैसे समान अन्तर को बनायेगा, अतः ग$\times$य चंफ$_१$ $\times$ज्या

$(न\pm ६य) - {}_{१}रफ \times ज्या\,(न\pm ६य) = (चंफ_{१} - रफ_{१}) \times ज्या(न\pm ६य)$ इसलिये $\frac{ग}{चंफ_{१} - रफ_{१}}$

$= \frac{ज्या\,(न\pm ६य)}{य} = पर = प$, तब अनुपात करते हैं यदि दश अंश की ज्या = २१ पाते

हैं तो '६ य' एतत्तुल्य अंश की क्या आ गयी '६य' इसकी ज्या, ज्या $६य = \frac{२१ \times ६य}{१०}$,

इसी तरह $\frac{२१ \times ३य}{१०} = ज्या\ ३य = \sqrt{\frac{त्रि \times उज्या\ ६य}{२}} = \sqrt{६० \times उज्या\ ६य}$ इसके

विलोम से $\frac{२१^{२} \times ३^{२} \times य^{२}}{१०^{२} \times ६०} = उज्या\ ६य$; चापयोरिष्टयोरित्यादि से ज्या $(न\pm ६य)$

$$= \frac{ज्यान \times कोज्या\ ६य}{त्रि} \pm \frac{कोज्यान \times ज्या\ ६य}{त्रि} = ज्यान - \frac{ज्यान \times उज्या\ ६य}{त्रि}$$

$$\pm \frac{कोज्यान \times ज्या\ ६य}{त्रि} = ज्यान - \frac{ज्यान \times २१^{२} \times ३^{२} \times य^{२}}{१०^{२} \times ६० \times १२०} \pm \frac{कोज्यान \times २१ \times ६य}{१० \times १२०}$$

$$= ज्यान - \frac{ज्यान \times य^{२}}{\left(\frac{२००}{२१}\right)^{२} \times २} \pm \frac{कोज्यान \times य}{\frac{२००}{२१}} = ज्यान - \frac{ज्यान \times य^{२}}{२\ हा} \pm \frac{कोज्यान \times य}{हा.},$$

$\frac{ज्या\ (न\pm ६य)}{य} = पर = प = \frac{ज्यान}{य} - \frac{ज्यान \times य}{२\ हा^{२}} \pm \frac{कोज्यान}{हा}$ दोनों पक्षों को हा गुणने से

$प \times हा = ध्रुव = ध्रु = \frac{ज्यान \times हा}{य} - \frac{ज्यान \times य}{२\ हा} \pm कोज्यान$ दोनों पक्षों में समशोधन

करने से तथा ज्यान से भाग देने से $\frac{ध्रु \mp कोज्यान}{ज्यान} = \frac{हा}{य} - \frac{य}{२\ हा}$ छेदगम से $२\ हा^{२} - य^{२}$

$= \pm अ \times हा \times य \times २$। यहां $\frac{ध्रु \mp कोज्यान}{ज्यान} = अन्य = \pm अ$ समशोधनकरने से $य^{२} \pm २अ \times$

$हा \times य = २\ हा^{२}$ वर्ग पूर्तिकरने से $य^{२} \pm २अ \times हा \times य + अ^{२} \times हा^{२} = २\ हा^{२} + अ^{२} \times हा^{२}$
$= हा^{२}\ (अ^{२} + २)$ मूल लेने से $य \pm अ \times हा = हा\ \sqrt{अ^{२} + २}$ ∴ $य = हा$
$(\sqrt{अ^{२} + २} \mp अ)$

इससे म. म. सुधाकर द्विवेदी जी के सूत्र उपपन्न होते हैं जो कि संस्कृतोपपत्ति में लिखे हुये हैं। उदयान्तर भुजान्तरादि संस्कार से जो स्पष्टग्रह होते हैं वे वस्तुतः स्पष्टग्रह नहीं होते हैं यह विषय ब्रह्मगुप्त के नतकर्म कहने से तथा नतकर्म साधन-

कारक भास्कराचार्य के लेख से मालूम होता है, आकाशस्थ ग्रहादि भूवायु गोल में परिणत होकर हम लोगों को प्रत्यक्षीभूत (स्पष्ट) होते हैं, इसलिये स्पष्टीकरण से जो स्पष्टग्रह आते हैं उनमें जितना संस्कार करने से भूवायु गोल परिणत स्पष्टग्रह हो उसी को नतकर्म कहना उचित है, ब्रह्मगुप्त से प्राचीन सूर्यसिद्धान्तकार, आर्यभट प्रभृति ने इसके विषय में अपने-अपने सिद्धान्त में कुछ नहीं लिखा है। मेरे मत में नतकर्म संस्कार की अतीव आवश्यकता है, इस विषय के उपर विज्ञ ज्यौतिषिक लोग विचार करें इति ॥ २४ ॥

इदानीं ग्रहणे सूर्याचन्द्रमसोर्नतकालमाह

प्राक् पश्चाद्वा याभिर्घटिकाभिर्दिनदलान्नतः सूर्यः ।
तिथ्यन्ते तद्विहितं त्रिंशद्घटिकावशेषाभिः ॥ २५ ॥
विपरीतमर्धरात्राच्चन्द्रग्रहणे शशी रविग्रहणे ।
सूर्यो यतो नतस्ताभिरेव घटिकाभिरिन्दुरपि ॥ २६ ॥

वा. भा.—पूर्वेण परेण वा स्वदिनार्धाद्यावतीभिर्घटिकाभिर्नतः सूर्यः तिथ्यन्ते पौर्णमास्यन्ते ताभिः रहितास्तद्रहिताश्च तास्त्रिंशद्घटिकाश्च तद्रहित-त्रिंशद्घटिका ताभ्यो या अवशेषाः ताभिर्घटिकाभिश्चन्द्रग्रहणे शशी नतो भवति, विपरीतमर्धरात्राद्यदि रविः स्वदिनार्धपूर्वनतस्तदा चन्द्रो रविसम्बन्धिनोऽर्धरात्राद् परेण रविः पश्चाच्चन्द्रः पूर्वेणातः तुल्यो नतकालः, एकैव नतज्या स्वपरिधे. संस्कारार्थं चन्द्रग्रहणे कार्येत्यर्थः । रविग्रहणे पुनः सूर्यो यतः पूर्वेण परेण वा नतो यावतीभिर्घटिकाभिरमावस्यान्ते ततएवैतावतीभिरेव घटिकाभिश्चन्द्रो नतो भवत्यतोऽत्रापि नतकालस्तुल्य एव । तस्मादेकैव नतज्या परिध्योः संस्कारार्थं कार्येत्यत्र वासनागोले प्रदर्श्य स्वाहोरात्रवृत्तयोः स्वदिनार्धाद् याम्योत्तरमण्डल-स्वाहोरात्रवृत्तसंपातात्प्रभृति रविरर्धरात्रं यावत् पुनरपि स्वाहोरात्रयाम्योत्तर-संपातं यावद्यदा नतो भवति । तदा त्रिंशद्घटिकानतः सूर्यो भवति । चन्द्रश्च तदा स्वमध्याह्नात् याम्योत्तरमण्डलस्वाहोरात्रमण्डलयोः संपातो भवति । तत्र च त्रिंशद्घटिकाभ्योऽवशेषाः घटिकाः सूर्यनतो नास्त्यतो नताभावश्चन्द्रस्य रवेश्चार्धरात्रे नताभावोऽनुक्त एव ज्ञायते । स्वदिनार्धापेक्षया त्रिंशद्घटिकाभिर्नतः, इत्युच्यते । यदा तु पुनरर्धरात्रे रविः पश्चिमतो भवति । तदा चन्द्रोऽपि स्वमध्या-ह्नात्पूर्वेण तावत्येव प्रदेशे स्वाहोरात्रवृत्ते भवति । तुल्याभिरेव घटिकाभिः, तिथ्यन्ते चायं नियमो यस्मादर्धचक्रान्तरितौ तदा रविचन्द्रौ भवतोऽन्यत्र काले ऽन्यदर्धरात्रं रवेरन्यदिनार्धशशिनः तस्मादुक्तं तिथ्यन्तमिति । यदा रविः पूर्वेण स्वार्धरात्राद् भवति तदा स्वदिनदलाच्चन्द्रः पश्चिमतो भवति । तावतीभिरेव घटिकाभिरर्धचक्रान्तरितो यतः पौर्णमास्यन्ते अतः सर्वमुपपन्नम् । शशि-ग्रहणे रविग्रहणे च तयोर्लब्धे पृथक्कले एव स्वफलविकलानामागतानां धन-कलानां फलविकला चासुरेकत्र स्थितेः । मूर्खोऽपि जानाति एकएव नतकालो भवति । तस्मादत्राप्युपपन्नम् । यथा स्वे स्वाहोरात्रवृत्ते प्रदर्शयेदिति ।

वि. भा.—चन्द्रग्रहणे तिथ्यन्ते (पूर्णान्तकाले) दिनदलात् (मध्याह्न-कालात्) प्राक्पश्चाद्वा याभिर्घटिकाभिः (यन्मिताभिर्घटीभिः) सूर्यो नतो भवति तत्सूर्यस्य नतकालमानं विहितं भवति । त्रिंशद्घटिकावशेषाभिस्ताभिर्घटिकाभि-र्विपरीतं (विलोमं) अर्धरात्रात् शशी (चन्द्रः) नतो भवति, अर्थाद्याभि-र्घटिकाभिस्तिथ्यन्ते रविर्नतस्ताभ्यस्त्रिंशद्घटिका विशोध्यावशिष्टं चन्द्रस्यार्धरात्रा-द्विपरीतं नतं भवति यदि रवेः प्राक् तदा चन्द्रस्य पश्चात् यदि रवेः पश्चात्तदा चन्द्रस्य प्रागर्धरात्रान्नतं भवति । रविग्रहणे याभिर्घटिकाभिः सूर्यो नतो भवति ताभिरेव घटिकाभिश्चन्द्रोऽपि तस्मिन्नेव कपाले नतो भवतीति ॥२५-२६॥

अत्रोपपत्तिः

पूर्णान्तकाले चन्द्रग्रहणं भवति, पूर्णान्ते च रविचन्द्रौ षड्भान्तरितौ भवतोऽत ऊर्ध्वयाम्योत्तरवृत्ताद्याभिर्घटीभिर्नतो रविस्त्रिंशता रहिताभिस्ता-भिर्घटीभिर्विपरीतकपाले चन्द्रो नतो भवति, सूर्यग्रहणे सूर्याचन्द्रमसावेकराश्याद्य-वयवे स्थितौ भवतस्तेनैककपाले तुल्या एव नतघटिका भवन्तीति सर्वं ज्योतिर्विदा-मतिरोहितमेवेति सिद्धान्तशेखरे 'प्राक् पश्चाद्वा दिवसशकलाद्याभिरर्को घटीभि-स्तिथ्यन्ते स्यान्नत उडुपतिस्ताभिरेवार्धरात्रात् । व्यस्तं चन्द्रग्रहणसमये वाऽभ्रराम ३० च्युताभिः सूर्यग्रासे रविरिव विधुः स्यान्नतः प्राक्प्रतीच्योः श्रीपत्युक्तमिदमा-चार्योक्तानुरूपमेवेति गणकैर्विभाव्यम् ॥२५-२६॥

अब ग्रहण में सूर्य और चन्द्र के नतकाल को कहते हैं

हि. भा.—चन्द्रग्रहण में पूर्णान्तकाल में मध्याह्नकाल से पहले या पीछे जितनी घटी में रवि नत होता है वह सूर्य का नतकाल मान कथित है, तीस ३० में उस घटिका को घटाने से जो शेष रहता है उतनी ही संख्या करके चन्द्रनत होता है, किन्तु अर्धरात्र से विलोम अर्थात् तिथ्यन्त में जितनी घटी में रवि नत होता है उनमें तीस ३० घटी को घटाकर जो शेष रहता है वह चन्द्र का नत होता है, यदि रवि का प्राक्नत है तो चन्द्र का पश्चिमनत, यदि रवि का पश्चिमनत है तो चन्द्र का प्राक्नत अर्धरात्र से होता है, सूर्यग्रहण में रवि जितनी घटी करके नत रहता है उतनी ही घटी करके उसी काल में चन्द्र भी नत होता है इति ॥२५-२६॥

उपपत्ति

चन्द्रग्रहण पूर्णान्तकाल में होता है । पूर्णान्तकाल में रवि से चन्द्र छः राशि के अन्तर पर रहता है इसलिये ऊर्ध्वयाम्योत्तरवृत्त से जितनी घटी करके रविनत रहता है, उन घटी में तीस को घटा करके जो शेष रहता है उतनी घटी करके विपरीत कपाल में चन्द्रनत होता है । सूर्यग्रहण में सूर्य और चन्द्र एक ही राश्याद्यवयव में रहते हैं इसलिये एक कपाल में दोनों की तुल्य ही नत घटी होती है, सिद्धान्तशेखर में श्रीपति ने आचार्योक्तानु-रूप ही कहा है । उनके पद्य संस्कृतोपपत्ति में देखिये इति ॥२५-२६॥

इदानीं प्रकारान्तरेण नतकर्माह

दिनदलपरिधिस्फुटतिथिनतकेन्द्रज्यावधो गुणोऽर्केन्द्वोः ।

इन्द्वतिधृति १९१ भिर्नवनववेदै ४९९ र्व्यासार्धकृति१०६९२९०० भक्तः ॥२७॥

फलविकला वा सूर्ये प्रागृणमसकृन्नते धनं पश्चात् ।

केन्द्रफलमृणं चन्द्रेऽन्यथा धनं प्रागृणे स्पष्टौ ॥२८॥

वा. भा.—दिनदले यौ परिधी रविचंद्रयोरुक्तौ ताभ्यां यौ स्फुटौ ताभ्यां या तिथिस्तिथ्यन्त इत्यर्थः । तस्यास्तिथेर्यो नतः कालस्तस्य योत्क्रमज्या दिनदल-परिधिस्फुटतिथिः, नतज्या तस्याः तात्कालिककेन्द्रज्यायाश्च वधः केन्द्रसम्बन्धे यथासंख्यमिच्छति, इन्द्वतिधृतिगुणको यो नवनववेदैश्च पृथक् तदुभयतोपि व्यासार्ध-कृतिभक्तः कार्यः फलविकलात् पृथक् एतदुक्तं भवति । स्वमध्याल्पपरिधिना प्रथमचन्द्रार्कौ स्फुटौ कृत्वा ततस्ताभ्यां तिथ्यन्तं साधयेत् । तत्र तिथ्यन्ते स्वदिन-दलादर्वाक् पुनरनयोर्वा यावत्यो नतघटिकाः तासां प्राणीकृतानामुत्क्रमज्या ग्राह्याः, यत्र पञ्चदशघटिका नतघटिका भवन्ति तदा त्रिंशतो विशोध्य शेषा नता स्वार्धरात्रात् परिकल्प्यास्तासामुक्तवज्ज्या कार्या सा नतज्या भवति । ततस्ति-थ्यन्ते मध्यौ रविचन्द्रौ स्वोच्चसहितौ कृत्वा तद् दिवार्धपरिधिभ्यामेव स्फुटीकार्यौ तयोः स्फुटीक्रियमाणे ये केन्द्रे भवतस्ताभ्यां ज्ये ग्राह्ये । ततो रविकेन्द्रज्या नतजीवया गुणात् पुनरिद्वतिधृतिभिर्गुणयेत् ततो व्यासार्धकृत्या विभजेत् । लब्धं फलं विकला एवं चन्द्रकेन्द्रज्या नतज्याहतान्नवनववेदैर्गुणयेत् । ततस्त्रिज्या कृत्या विभजेत् । फलं विकलाः एवं ततः स्वकेन्द्रज्याकरणे यज्ज्यांतरप्रभवाद् गुणकारः तेन स्वकेन्द्र-भुक्तिं संगुण्य तत्त्वयमैर्विभजेत् । फलं स्वकेन्द्रभुक्तिर्भवति । ततः केन्द्रभुक्तिज्ये पृथक् द्वेऽपि नतज्याहते स्वगुणकारगुणिते कृत्वा त्रिज्या कृत्या विभजेत् । लब्धे पृथक्कले विकलात्मके एव स्वफलविकलानामागतानां धनकलानां फलविकला सूर्ये प्रागृणमसकृन्नते धनं पश्चात् । वा शब्दोऽत्रचन्द्रार्कयोः स्फुटीकरणप्रकाराय । तेनायमर्थः प्राग्नते सूर्ये फलविकला ऋणं भवति । पश्चान्नते धनं प्राक्कपाले नते रवावृणम् । अपरकपालस्थे धनमित्यर्थश्चन्द्रे तु पुनर्यदिकेन्द्रफलमृणं कृतं तदन्यथा प्राग्धनमपरकपालस्थे क्षय इत्यर्थः । स्वफलविकलाः । अथ चन्द्रकेन्द्रफलं धनं कृतं । तर्कफलं विकला वा ऋणं भवति । सर्वथा कपालनिरपेक्षायां एवं कृते कर्मणि स्पष्टौ भवतः । एतच्च कर्म्मासकृत्कर्तव्यम् । तत्करणे स्फुटाभ्यां तिथ्यन्तः पुनर्साध्यः तिथ्यन्ते पुनः एतदेव कर्म तावद्यावद् विशेषो भवतः । अत्रोपपत्तिः—तद्यथा सर्वदा स्वे परिध्यंतरं लिप्ता विंशति(२०) एताभिः परमभुजज्या त्रिज्या तुल्या संगुणिता (६५४००)अतो भगणं भगणांशैर्भागे हृते लब्धं विकला(१८१)अंशा वापि विकला १९१० एतावद्रवेः परमं फलान्तरं चंद्रस्यापि परिध्यन्तरं द्वापंचाशल्लिप्ता ५२, एताभिर्व्यासार्धतुल्या परमभुजज्या गुणिता जाता १७८००४० अतो भगणां-

शैर्हृते लब्धं विकला: ४७२ आसां धनुर्नवनववेदा: ४९९ एतावच्चन्द्रस्य परमं फलान्तरमेतच्च तदा संभवति, यदा रविचन्द्रयोरुन्मण्डलस्थयोः स्वकेन्द्रज्या त्रिज्या तुल्या भवति। नतज्या च त्रिज्यातुल्यैव। अतस्त्रैराशिका कल्पना वाचार्येण कृता। यदि त्रिज्या तुल्यैव, यदा स्वकेन्द्रनतज्ये भवतः तदा रवेर्गुद्वतिधृतितुल्य-विकलाः फलान्तरं भवति। यदा पुनरिष्टकालनतज्या स्वकेन्द्रज्ये इष्टप्रामाणिके तदा कियत् फलांतरमिति फलं विकला चन्द्रस्यापि नतकेन्द्रज्याद्वये त्रिज्याकृति तुल्यच्छेदे नवनववेदसंख्या विकला भवन्ति। फले तावत्, इष्टनतकेन्द्रज्ययोर्वधेन किमिति फलं विकला भवन्ति। केन्द्रभुजज्ययोरप्येवमेव तस्मादुपपन्नम्। तद्विकला रूपफलं प्राक्कपालस्थे सूर्ये विशोधयेत्। यस्मात्तात्कालिकपरिधिदिनार्धपरिधेः-कोऽत्र फलं विशोध्यते। यतः प्रागृणमल्पं कृते तिष्ठति तदापचीयते येन तात्कालिक-परिधिना स्फुटो रविर्भवति। क्षयकेन्द्रधनकेन्द्रेऽप्यूना युतोदिनार्धपरिधेस्तत्परिधि-रूनोऽतोऽधिकं धनकृते तिष्ठति। विशोध्यते पश्चात् कपालवैपरीत्येन रवेर्यतो धनं क्रियते चन्द्रस्यापि ऋणं केन्द्रमन्यथा प्राक्काले दिनार्धपरिधेरूनस्तात्कालिकः परिधिरतोऽधिकमृणं कृतं तिष्ठति पुनः दीयते। अपरकपाले वैपरीत्येन धने हीन इति। यतः प्राक्कपाले दिनार्धपरिधेरूनस्तात्कालिकपरिधिरतोऽधिकं धनं कृतं तिष्ठति तद्विशोध्यते। तस्मात्सर्वमुपपन्नम्। प्रागुक्तं भुजफलचापे भुजान्तरे कृते ग्रहे उन्मण्डले स्पष्टो भवति ॥२७-२८॥

वि. भा.—दिनदलपरिधिभ्यां यौ स्फुटरविचन्द्रौ ताभ्यां या तिथिः (तिथ्यन्तः) तत्र यो नतः (नतकालः) तस्य केन्द्रस्य च ज्ययोर्वधः (घातः) कार्यः स च यदि रवेस्तदै १९१ भिर्गुणितः, यदि चन्द्रस्य तदै ४९९ भिर्गुणितस्त्रिज्या-वर्ग १०६९२६०० भक्तः फलं विकला भवन्ति, एतत्फलं प्राक्नते सूर्ये ऋणं पश्चान्नते धनं कार्यम्। चन्द्रे तत्पूर्वागतं विकलात्मकं प्राक्कपाले मन्दफले ऋणात्मके धनं कार्यमन्यथा प्राक्पश्चिमे ऋणमेव कार्यमेवमसकृत्कार्यं तदा वा स्फुटौ रविचन्द्रौ भवतः, पूर्वं 'तद्द्युदलपरिध्यन्तरगुणा' इत्यादिना नतकर्मानीतमधुना पुनस्तत्सा-धितमतो 'वा' शब्दः प्रयुक्त इति ॥ २७-२८ ॥

अत्रोपपत्तिः

दिनार्धपरिधिना पूर्वप्रकारेण मन्दफलकला $=\frac{२२५ \text{ दिप}\cdot\text{ज्याके}}{२१४\times ३६०}$, अत्र दिप

$=$दिनार्धपरिधिः ज्याके$=$मन्दकेन्द्रज्या. विकलात्मककरणेन $\frac{२२५\cdot\text{दिप}\cdot\text{ज्याके}\times ६०}{२१४\times ३६०}$,

रविपरिध्यन्तरम् $=\frac{\text{ज्यान}}{३\ \text{त्रि}\cdot}$ ततोऽनुपातो यदि दिनार्धपरिधिना मन्दफल-

विकला लभ्यन्ते तदाऽऽनीतपरिध्यन्तरेण किं समागच्छति रविपरिध्यन्तर-

सम्बन्धिनी फलविकला $= \frac{६० \text{ दिप} \cdot २२५ \cdot \text{ज्याके} \cdot \text{ज्यान}}{३ \times २१४ \times ३६० \times \text{त्रि} \times \text{दिप}} =$

$= \frac{२० \times २२५ \text{ ज्याके} \cdot \text{ज्यान} \cdot \text{त्रि}}{२१४ \times ३६० \times \text{त्रि}^२} = \frac{२२ \times ३२७० \text{ ज्याके} \cdot \text{ज्यान}}{१८ \times २१४ \times \text{त्रि}^२}$

$= \frac{२५ \times १६३५ \text{ ज्याके} \cdot \text{ज्यान}}{२१४ \times \text{त्रि}^२} = \frac{४०८७५}{२१४} \times \frac{\text{ज्याके} \cdot \text{ज्यान}}{\text{त्रि}^२} = \frac{१९१ \text{ ज्याके} \cdot \text{ज्यान}}{\text{त्रि}^२}$

एवमेव चन्द्रपरिध्यन्तरवशेन तद्गुणाकाङ्क्षा उत्पद्यन्ते, सिद्धान्तशेखरे 'तत्तिथ्यन्तनतोद्भवोत्क्रमगुणः क्षुण्णः स्वकेन्द्रज्यया, गोऽक्षाभ्रेन्दुरसै ६१०५९ रवेः शररसाग्न्यब्ध्यश्विभिः २४३६५ शीतगोः। भक्तोऽथक्रमशो भवन्ति विकलास्ताः प्रागृणं स्वं रवौ पश्चाच्छीतकरेऽन्यथा क्षयफले हानिर्धनं चासकृत्' ऽनेन श्लोकेन श्रीपतिनाऽऽचार्योक्तानुरूप कथितः। केवलमाचार्येण ३२७० मिता त्रिज्या गृहीता, श्रीपतिना च ३४१५ मिता त्रिज्या गृहीता, तज्जन्यो भाज्यभाजकयोः स्वल्पभेदः समुचित एव, आचार्योक्तनतज्यास्थाने श्रीपतिना नतोत्क्रमज्या गृहीताऽत्रकारणं लल्लाचार्यानुयायिचतुर्वेदाचार्यव्याख्यानमेवेति ॥२७-२८॥

अब प्रकारान्तर से नतकर्म को कहते हैं

हि. भा.—पहले दिनदल (दिनार्ध) परिधियों से जो स्पष्टरवि और स्पष्टचन्द्र साधित हैं उनसे जो तिथ्यन्त हैं तात्कालिक नतज्या और केन्द्रज्या के घात करना, यदि वह रवि का है (अर्थात् रवि की नतज्या और रवि की केन्द्रज्या का घात है) तब उसको १९१ इससे गुणाकर त्रिज्यावर्ग १०६९२९०० से भाग देना, यदि वह घात चन्द्र का है (अर्थात् चन्द्रनतकालज्या और चन्द्रकेन्द्रज्या का घात है) तब उसको ४९९ इससे गुणाकर त्रिज्यावर्ग १०,६९,२९०० से भाग देना, दोनों स्थानों में जो विकलात्मक फल होता है पूर्वनत में सूर्य में ऋण करना, पश्चिम नत में सूर्य में धन करना, चन्द्र में प्राक् कपाल में ऋणात्मक मन्दफल रहने पर उस पूर्वागत केन्द्रफल को धन करना, अन्यथा प्राक् कपाल और पश्चिम कपाल में ऋण ही करना चाहिये, इस तरह असकृत्कर्म करने से स्फुटरवि और स्फुटचन्द्र होते हैं। पहले 'तद्द्युदलपरिध्यन्तरगुणा' इत्यादि से नतकर्म साधित है, यहां पुनः उसका साधन किया गया है इसलिये 'वा' शब्द का प्रयोग किया गया है इति ॥ २७-२८ ॥

उपपत्ति

दिनार्धपरिधि से पूर्व प्रकार से मन्दफलकला $= \frac{२२५ \times \text{दिप} \times \text{ज्याके}}{२१४ \times ३६०}$ विकलात्मक करने से $\frac{२२५ \text{ दिप} \times \text{ज्याके} \times ६०}{२१४ \times ३६०}$, रवि के परिध्यन्तर $= \frac{\text{ज्यान}}{३ \text{ त्रि}}$ तब अनुपात करते हैं यदि दिनार्ध परिधि में पूर्वागत मन्दफल विकला पाते हैं तो आनीत (लाये हुये)

परिध्यन्तर में क्या इस अनुपात से रवि की परिध्यन्तर सम्बन्धिनी फल विकला

$$=\frac{\text{६० दिप}\times\text{२२५ ज्याके.ज्यान}}{\text{३}\times\text{२१४}\times\text{३६०}\times\text{त्रि}\times\text{दिप}}=\frac{\text{२०}\times\text{२२५ ज्याके त्रि. ज्यान}}{\text{२१४}\times\text{३६०}\times\text{त्रि}^2}$$

$$=\frac{\text{२२५}\times\text{३२७० ज्याके· ज्यान}}{\text{१८}\times\text{२१४}\times\text{त्रि}^2}=\frac{\text{२५}\times\text{१६३५ ज्याके·ज्यान}}{\text{२१४}\times\text{त्रि}^2}=\frac{\text{४०८७५}}{\text{२१४}}$$

$$\times\frac{\text{ज्याके·ज्यान}}{\text{त्रि}^2}=\frac{\text{१९१ ज्याके·ज्यान}}{\text{त्रि}^2}$$, इसी तरह चन्द्र परिध्यन्तर से चन्द्र के गुणाङ्क आते हैं इति। सिद्धान्तशेखर में 'तत्तिथ्यन्तनतोद्भवोत्क्रमगुण: इत्यादि' संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति आचार्योक्तानुरूप ही कहते हैं, केवल आचार्य ने ३२७० एतत्तुल्य त्रिज्या ग्रहण किया है और श्रीपति ने ३४१५ त्रिज्याग्रहण किया है, तज्जन्य भाज्य और भाजक में थोड़ा अन्तर होना उचित ही है, आचार्योक्तनतज्या के स्थान में श्रीपति ने नतोत्क्रमज्या को ग्रहण किया है। इसका कारण केवल लल्लाचार्यानुयायिचतुर्वेदाचार्य का व्याख्यान ही है ॥२७-२८॥

इदानीं भुजान्तरकर्म स्पष्टगतिं चाह

अर्कफलभुक्तिघाताद् भगणकलाप्तं भुजान्तरं रविवत् ।
स्फुटभुक्तिरतीतैष्यग्रहान्तरं वर्त्तमानेऽह्नि ॥ २९ ॥

वा. भा.—इष्टग्रहभुक्तिं कर्मफलेन संगुण्य भगणकलाभिर्विभजेत्। लब्धा भुजान्तराख्यं फलं तद्ग्रहे रविवद्धनमृणं वा कार्यं। यदि स्फुटभुक्तानीतं तत् स्फुटग्रहे मध्यभुक्तानीतं तन्मध्ये रवेर्भुजान्तरं कार्यं ग्रहवत्। यतो मध्यमार्कोदयकालिकाः स्पष्टग्रहा आगता भवन्ति। स्वफलेन ते च स्फुटार्कोदयकालिकाः क्रियन्ते। अर्कफलेन च त्रैराशिकाद्यस्मान्मध्यस्फुटार्कयोरन्तरं तत्कालमतः त्रैराशिककल्पना। तद्यथा यावत् स खषड्गुनसंख्याश्चक्रलिप्ता उदयं यान्ति। तावद् ग्रहः स्वभुक्तिं यदि भुंक्ते, तदर्कफललिप्तोदयेन किमिति स्वभुजान्तरं द्वितीयमार्यार्धमाह। स्फुटभुक्तिरतीतैव यद् ग्रहान्तरं वर्तमानेऽह्नि इष्टग्रहस्योक्तवत् स्फुटीकरणं कृत्वेष्टदिने तद्वदतीतदिनेव। तयोः स्फुटग्रहयोर्यदन्तरं सा ग्रहस्य स्फुटभुक्तिरेकदैवसिकी वर्तमाने दिने भवति।

अथवा आगामिदिने स्फुटं ग्रहं कृत्वा तेन सहान्तरं यद्वर्तमानदिने स्फुटग्रहस्य तुल्यकालस्य सा स्फुटभुक्तिर्भवत्यतश्च व्यवहारार्थमुच्यते। अन्यथा स्फुटभुक्तिः परमार्थतया न शक्यते वक्तुं प्रतिक्षणमन्यथात्वात् स्फुटभुक्तिर्यतः प्रतिमण्डलस्य कक्षामण्डलेन सहान्तरं स्वल्पक्षेत्रभागेप्यन्यथा भवति। यथास्थितेषु कक्षामण्डलादिषु प्रदर्शयेदिति ॥२९॥

वि. भा.– अर्कफलभुक्तिघातात् (रविमन्दफलग्रहगत्योर्वधात्) भगण-कलाभिर्भक्तात्प्राप्तं फलं भुजान्तरं (भुजान्तरकलाः) रविवत् ग्रहेषु संस्कार्यमर्था-दागतं फलमतो ऋणं धनं क्रियते यतो मध्यमार्कोदयात् प्राक् स्फुटार्कोदयः स्यादृणे तत्फले स्वे यतोऽनन्तरम्, अतीतैष्यग्रहान्तरं (दिनान्तरस्पष्टग्रहान्तरं) वर्त्तमानेऽह्नि (वर्त्तमानदिने) स्फुटभुक्तिर्भवत्यर्थादद्यतनश्वस्तनस्फुटग्रहयोरन्तरमेव तत्समयान्तरे स्फुटगतिर्भवतीति ॥२९॥

अत्रोपपत्तिः

मध्यमार्कोदयकालीना ग्रहा येन कर्मणा स्फुटार्कोदयकालीना भवन्ति तदेव भुजान्तरकर्म, अहर्गणेन समानीता ग्रहा आचार्यमतेन लङ्कायां सूर्योदये मध्या भवन्त्यर्थान्मध्यमार्कोदयकालीनाः समागच्छन्ति, अपेक्षितास्तु स्फुटार्कोदय-कालीनाः, मध्यमार्कस्फुटार्कयोरन्तरं रविमन्दफलकला, एतत्समा एव रविमन्द-फलोत्पन्नासवः स्वीकृता आचार्येण ततोऽनुपातो यद्यहोरात्रासुभिर्ग्रहगतिकला लभ्यन्ते तदा रविमन्दफलकलासुभिः किं जाता रविमन्दफलकलासुसम्बन्धिनी

ग्रहगतिः $=\frac{\text{ग्रग} \times \text{रविमन्दफलकलासु}}{\text{अहोरात्रासु}}$, मन्दफले ऋणे मध्यमार्कोदयात्प्रागेव

स्फुटार्कोदयोऽतो समागतया रविमन्दफलकलासुसम्बन्धिन्या गत्या हीनो मध्यमार्कः स्फुटार्कोदये स्फुटार्को भवेत् । एवं तया गत्या हीना ग्रहाः स्फुटार्कोदयकालीना भवन्ति, धनात्मके रविमन्दफले मध्यमार्कोदयात्पश्चात्स्फुटार्कोदयो भवति तेन चालन-फलेन युतो मध्यमार्कः स्फुटार्कोदये स्फुटार्को भवेत्, ग्रहा अपि चालनफलेन युता सन्तः स्फुटार्कोदये भवन्ति, अत्र स्थौल्यं स्पष्टमेवास्ति, रविमन्दफलकला रवि-मन्दफलास्वोः समत्वस्वीकारात् । तथा च रविमन्दफलासुसम्बन्धिन्या गत्या संस्कृतो मध्यमार्कोदयकालिकग्रहो नहि वस्तुतः स्फुटार्कोदयकालिको भवितुमर्हति (मन्दफलासुमध्येऽपि ग्रहस्य कापि गतिर्भवेत्तद्ग्रहणमत्र न क्रियतेऽतस्तज्जन्य-विकारसद्भावात्) वास्तवभुजान्तरज्ञानार्थं स एव विधिराश्रयणीयो यश्च पूर्वं वास्तवोदयान्तरज्ञानार्थं प्रदर्शितोऽस्ति तत्र प्राचीनोक्तोदयान्तरस्थाने प्राचीन-भुजान्तरग्रहणं कर्त्तव्यमन्यत्सर्वं समानमेवेति । आचार्योक्तपद्ये भगणकलाशब्देना-होरात्रासवो बोध्या इति, कस्याप्याचार्यस्य भुजान्तरकर्मसाधनं समीचीनं नास्ति पूर्वप्रदर्शितयुक्त्यैव स्फुटमिति ॥ २९ ॥

अब भुजान्तरकर्म को और स्पष्ट गति को कहते हैं

हि. भा.—रवि के मन्दफल और ग्रहगति के घात में भगणकला से भाग देने से जो फल होता है, वह भुजान्तर कला है, ग्रह में उसको रवि की तरह संस्कार करना अर्थात् ऋणात्मक रविमन्दफल में मध्यमार्कोदय से स्फुटार्कोदय पहले होता है इसलिये

मध्यमार्कोदयकालिक ग्रह में भुजान्तर फल को ऋण करने से स्फुटार्कोदयकालिक ग्रह होते हैं, धनात्मक रविमन्दफल से मध्यमार्कोदय से स्फुटार्कोदय पीछे होता है इसलिये मध्यमार्कोदय कालिक ग्रह में भुजान्तर फल को धन करने से स्पष्टार्कोदयकालिक ग्रह होते हैं, और गतदिन के ग्रह और एष्य दिन के ग्रह के अन्तर (दिनान्तर स्पष्ट ग्रहान्तर) वर्तमान दिन में स्पष्टगति होती है अर्थात् अद्यतन (आज के) स्पष्टग्रह और श्वस्तन (कल के) स्पष्टग्रह का अन्तर स्पष्टगति होती है, यहाँ भगण कलाबद्ध से अहोरात्रासु समझना चाहिये इति ।। २९ ।।

उपपत्ति

मध्यमार्कोदयकालिक ग्रह में जितना संस्कार करने से स्फुटार्कोदयकालिक ग्रह होते हैं उसी को भुजान्तरकर्म कहते हैं । अहर्गण से साधित ग्रह आचार्य के मत से लङ्का सूर्योदय काल में मध्यम होते है, अर्थात् मध्यमार्कोदयकालीन होते हैं, स्फुटार्कोदय कालीन ग्रह अपेक्षित हैं, मध्यमार्क और स्फुटार्क का अन्तर रविमन्दफल कला है, इसके बराबर ही रविमन्दफलोत्पन्नासु आचार्य ने स्वीकार किये हैं, अब अनुपात करते हैं यदि अहोरात्रासु में ग्रहगति कला पाते हैं तो रविमन्दफलासु में क्या इस अनुपात से रविमन्दफलासुसम्बन्धिनी ग्रहगति आती है, मन्दफल ऋण रहने से मध्यमार्कोदय से पहले ही स्फुटार्कोदय होता है इसलिये अनुपातागत रविमन्दफलासुसम्बन्धिनी गति को मध्यमार्क में घटाने से स्फुटार्कोदय काल में स्फुटार्क होते हैं । इसी तरह उस गति को ग्रह में घटाने से स्फुटार्कोदयकालिक ग्रह होते हैं । धनात्मक रविमन्दफल में मध्यमार्कोदय से स्फुटार्कोदय पीछे होता है इसलिये पूर्वानीत चालनफल को मध्यमार्क में जोड़ने से स्फुटार्कोदयकालिक स्फुटार्क होते हैं, ग्रह में चालनफल को जोड़ने से स्पष्टार्कोदयकालिक ग्रह होते हैं, यहां स्थूलता स्पष्ट ही है क्योंकि रविमन्दफलकला के बराबर ही रविमन्दफलासु को आचार्य ने स्वीकार किया है । दूसरी त्रुटि इसमें यह है कि मध्यमार्कोदयकालिक ग्रह में पूर्वानुपातागत रविमन्दफलासुसम्बन्धिनी गति का संस्कार करने से स्फुटार्कोदयकालिक ग्रह नहीं हो सकते हैं क्योंकि रविमन्दफलासु के अन्तर्गत भी ग्रह की कुछ गति होगी उसका ग्रहण आचार्य ने नहीं किया है वास्तव भुजान्तर ज्ञान के लिये उसी विधि का आश्रयण करना चाहिये जो कि पहले वास्तवउदयान्तर ज्ञानार्थ दिखलायी गई है, वास्तव उदयान्तर साधन में प्राचीनोदयान्तर के स्थान पर प्राचीन भुजान्तर लेना चाहिये और सब विषय बराबर ही है, सूर्यसिद्धान्तकारादि किसी भी आचार्य के भुजान्तरकर्मसाधन ठीक नहीं है. पहले लिखी हुई युक्ति ही से स्पष्ट है इति ।। २९ ।।

इदानीं नतकर्मवशेन रविचन्द्रयोर्गतिफलमाह

क्षयधनहानिधनानि प्राक् पश्चादन्यथा रवेरिन्दोः ।
प्राग्वत् पश्चात्स्वगतौ धनक्षयक्षयधनानि प्राक् ।। ३० ।।

वा. भा.—इदानीं परिध्यन्तरोत्पन्नस्य केन्द्रफलभुक्तिफलस्य धनक्षयप्रतिपा-

दनार्थमार्यामाह। केन्द्रफलभुक्तिज्यानतज्ययोर्वधाद्रवेरिद्वतिधृतिगुणाच्छशिनो नवनववेदगुणा व्यासार्धकृत्या यत्फलं लब्धं तत्स्वभुक्तौ कदा धनं कदार्णं वा क्रियते तन्न ज्ञायते तदर्थमियमार्या। तद्यथा पूर्वकपाले क्षयः प्रथमे केन्द्रपदे द्वितीये धनं तृतीये हानिश्चतुर्थे धनं रविस्फुटभुक्तौ यस्माद्दिनार्धपरिधिना भुक्तफलमानीतं प्राग्दिनार्धपरिधेश्चाधिकस्तात्कालिकोऽत्र परिधिरतोऽल्पमृणं कृतमासीदधुना फलान्तरं विशोध्यते। प्रथमे पदे द्वितीये तु पुनर्भुक्तौ धनं कृतमासीत्तदपि दिनार्धपरिधिना ततश्च तात्कालिकपरिधिरधिकोऽतोऽल्पं धनं कृतमासीत्तद्दिनार्धपरिधिना धनं परिधिश्च तृतीयपदे सदोनो दिनार्धपरिधेरतोऽधिकं धनं तिष्ठति तद्विशोध्यते। चतुर्थपदे भुक्तावृणं कृतमासीत्। दिनार्धपरिधिना ततश्च तात्कालिकपरिधिरल्पः षड्राश्यधिकत्वात् केन्द्रस्यातोऽधिकमृणं प्राक्कृतं तत् पुनर्दीयते फलान्तरमेव पूर्वकपाले रवेः पश्चाद्यथा रवेः प्राक्कपाले धनर्णकल्पनैव चन्द्रस्यापरकपाले यदि स्यादपरकपाले चन्द्रस्य ऋणपरिधिः को भवति दिनार्धपरिधेर्यतोऽधिकमपि ऋणं कर्तुं युज्यते येन तात्कालिकपरिधिना संस्कृता भवति स्फुटभुक्तिः, द्वितीयपदे धनं यतो द्वितीयपदे भुक्तौ धनं कृतमासीत्तदधिकं कर्तुं युज्यतेऽधिकत्वात्तात्कालिकपरिधेस्तृतीयपदे भुक्तौ धनं कृतमासीद्दिनार्धपरिधिना। ततश्च धनपरिधिरूनस्तात्कालिकोऽतो बहुधनं कृतं तिष्ठति तत्पुनर्विशोध्यते फलान्तरं चतुर्थपदं चंद्रभुक्तावृणं कृतमासीत्, दिनार्धपरिधिना, ततस्तात्कालिकपरिधिनातः ऋणं बहुकृतमासीत्तत्पुनर्दीयते, फलान्तरमेवं। स्वकेन्द्रपदवशेन प्राक्कपाले तु पुनश्चन्द्रस्फुटभुक्तौ धनक्षयक्षयधनानि स्वकेन्द्रपदेषु यतः शशिनः ऋणं परिधिरूनो दिनार्धपरिधेः फलं च दिनार्धपरिधिना यदानीतं तद्भुक्तेर्विशोधितं तत्पुनर्दीयते उपपन्नं प्रथमे पदे धनं द्वितीये पदेऽपि दिनार्धपरिधिना धनं कृतमासीत्तदधिकं यस्मात् तात्कालिकः परिधिरूनोऽतो यदधिकः ॥३०॥

वि. भा.—दिनदलपरिधिस्फुटतिथिनतकेन्द्रज्येत्यादिना यद्विकलात्मकफलमानीतं तद्गतौ कदा धनं कदा क्षय इत्येतदर्थं कथ्यते, प्राक्कपाले रवेः केन्द्रवशेन तानि फलानि क्षयधनहानिधनानि स्वगतौ (पूर्वसाधितरविमन्दस्फुटगतौ) भवन्त्यर्थात्प्रथमे केन्द्रपदे क्षयः, द्वितीये केन्द्रपदे धनं, तृतीये हानिः (क्षयः) चतुर्थे धनं स्फुटगताविरयर्थः। पश्चात्कपाले चान्यथाऽर्थात् धनक्षयधनक्षयात्मकानि स्युः,इन्दोः (चन्द्रस्य) पश्चात्कपाले प्राग्वत् (पूर्ववत्) अर्थात् क्षयधनहानिधनानि भवन्ति, प्राक्कपाले धनक्षयक्षयधनानि भवन्ति चन्द्रमन्दस्पष्टगताविति ॥ ३० ॥

अत्रोपपत्तिः

प्रथमपदे तृतीयपदे च केन्द्रज्योपचीयते, द्वितीयपदे चतुर्थपदे चापचीयते, रवेः प्राक्कपाले नतकम ऋणं पश्चिमकपाले च धनं भवति, अतः प्रथमपदे तृतीयपदे च ऋणफलस्योपचयान्नतकर्मान्तरमृणं द्वितीयपदे चतुर्थपदे च ऋणफलस्यापचयान्नत-

कर्मान्तरं धनं भवति, पश्चिमकपाले नतकर्मणो धनत्वाद्विलोमं भवति। चन्द्रस्य पश्चिमकपाले मन्दफले ऋणे धने च नतकर्म ऋणमेव भवत्यतः केन्द्रपदवशात् क्षयधनह्रासधनानि फलानि जायन्ते, पूर्वकपाले प्रथमपदे ऋणात्मके मन्दफले केन्द्रज्याया उपचयत्वान्नतकर्मणो धनत्वाच्च नतकर्मान्तरं धनं भवति, द्वितीयपदे केन्द्रज्याया अपचयत्वान्नतकर्मान्तरमृणं, तृतीयपदे मन्दफलं धनं नतकर्म ऋणं केन्द्रज्यायाश्चोपचयोऽतो नतकर्मान्तरमृणम्, चतुर्थे पदे केन्द्रज्याया अपचयत्वान्नत-कर्मणश्च क्षयत्वान्नतकर्मान्तरं धनं भवतीति। दिनान्तरस्पष्टग्रहान्तरं स्पष्टा गति-र्भवतीति नियमाद् गतदिननतकाल एव द्वितीयदिनेऽपि नतकालस्तेन केन्द्रज्या एवोपचयापचयवशान्नतकर्मान्तररूपद्वितीयगतिफलस्य धनर्णत्वं समुचित-मेवेति. ॥ ३० ॥

अब नत कर्मवश से रवि और चन्द्र के गतिफल को कहते हैं

हि. भा.—दिनदलपरिधिस्फुटतिथिनतकेन्द्रज्या इत्यादि मे अद्यतन और श्वस्तन फल विकलाओं के अन्तर (विकलात्मक अन्तर) पूर्वकपाल में पूर्वसाधितरविमन्दस्पष्ट गति में रवि के केन्द्रपदवश से ऋण, धन, ऋण, धन होता है। पश्चिम कपाल में विलोम होता है अर्थात् धन, ऋण, धन, ऋण, चन्द्र के पश्चिम कपाल में पूर्ववत् होता है अर्थात् ऋण, धन, ऋण, धन, और पूर्व कपाल में चन्द्रमन्दस्पष्टगति में वे ही धन, ऋण, ऋण, धन होते हैं ॥३०॥

उपपत्ति

प्रथम पद में और तृतीय पद में केन्द्रज्या उपचीयमान रहती है और द्वितीय पद में तथा चतुर्थ पद में अपचीयमान रहती है; रवि के पूर्व कपाल में नतकर्म ऋण और पश्चिम कपाल में धन होता है इसलिये प्रथम पद में और तृतीय पद में ऋणफल के उपचय के कारण नतकर्मान्तर ऋण होता है। द्वितीय और चतुर्थ पद में ऋण फल के अपचयत्व के कारण नतकर्मान्तर धन होता है, पश्चिम कपाल में नतकर्म के धनत्व के कारण विलोम (उल्टा) होता है, चन्द्र के पश्चिम कपाल में मन्द फल के ऋण या धन रहने पर नतकर्म ऋण ही होता है। इसलिए केन्द्रपदवश से फल ऋण, धन, ऋण, धन होता है। द्वितीय पद में केन्द्रज्या के अपचयत्व के कारण नतकर्मान्तर ऋण होता है। तृतीय पद में मन्दफल धन, नतकर्म ऋण, केन्द्रज्या का अपचय रहता है। इसलिये नतकर्मान्तर ऋण होता है, चतुर्थ पद में केन्द्रज्या के अपचयत्व से और नतकर्म के क्षयत्व के कारण नतकर्मान्तर धन होता है। अद्यतन (आज के) श्वस्तन (कल के) स्पष्टग्रहों का अन्तर स्पष्ट गति है। इस नियम से गत-दिन का नतकाल ही द्वितीय दिन में भी नतकाल होता है इसलिये केन्द्रज्या ही के उपचय और अपचय वश से नत कर्मान्तर रूप द्वितीय गति फल का धनत्व और ऋणत्व उचित ही है इति ॥३०॥

इदानीमाचार्यः स्वप्रशंसामाह

ब्रह्मोक्तमध्यरविशशितदुच्चतत्परिधिभिः स्फुटीकरणम् ।
कृत्वैवं स्पष्टतिथिर्दूरभ्रष्टान्यतन्त्रोक्तैः ॥३१॥

वा. भा.—श्लोकस्यास्य वासनाभाष्यं नोपलभ्यते ।

वि. भा.—ब्रह्मोक्त (ब्रह्मगुप्तकथित) मध्यरविचन्द्रतन्मन्दोच्चतत्परिधिभिः स्फुटीकरणं कृत्वा स्पष्टतिथिः साध्या यतोऽन्यतन्त्रोक्तैः (अन्येषामार्यभटादीनां तन्त्रेषु ये कथिता मध्यरविशशिपरिध्यादयस्तैः) स्पष्टतिथिर्दूरभ्रष्टा भवत्यर्थादत्यन्तनिषिद्धा भवत्येतावताऽऽचार्येण कथ्यते यन्मत्कथितस्पष्टीकरणसामग्रीभिरेव रविचन्द्रयोः स्पष्टीकरणं युक्तियुक्तं, ताभ्यां स्पष्टीकृताभ्यामेव रविचन्द्राभ्यां साधिता स्पष्टा तिथिः समीचीना भवति, आर्यभटादिकथितस्पष्टरविचन्द्रसामग्रीभिर्वस्तुतः स्पष्टौ रविचन्द्रौ न भवतोऽतस्ताभ्यां साधिता तिथिः स्पष्टा न भवतीति ॥३१॥

अब आचार्य अपनी प्रशंसा कहते हैं

हि. भा.—ब्रह्म (ब्रह्मगुप्त) कथित मध्यमरवि, मध्यमचन्द्र, उनके मन्दोच्च और उनकी मन्द परिधि इन सबों से रवि और चन्द्र के स्पष्टीकरण करके स्पष्ट तिथि का साधन करना चाहिये, क्योंकि आर्यभटादि अन्य आचार्यों के तन्त्रों में कथित मध्यमरवि, मध्यमचन्द्र और उनकी मन्द परिधियों से साधित स्पष्टतिथि वस्तुतः स्पष्टतिथि नहीं होती है इससे आचार्य कहते हैं कि मेरी स्पष्टीकरण सामग्रियों से ही रवि और चन्द्र का स्पष्टीकरण युक्तियुक्त होता है, उन स्पष्टीकृत रवि और चन्द्र से साधित स्पष्टतिथि यथार्थ स्पष्टतिथि होती है, आर्यभटादि आचार्यों से कथित स्पष्टरवि और स्पष्टचन्द्र की सामग्रियों से वस्तुतः स्पष्टरवि और स्पष्टचन्द्र ठीक नहीं होते हैं इसलिये उन रवि और चन्द्र से साधित स्पष्ट तिथि ठीक स्पष्ट तिथि नहीं होती है इति ॥३१ ॥

इदानीं व्यवहारोपयुक्तरविचन्द्रयोः स्पष्टीकरणमाह

स्वदिनार्धपरिधिभुजफलचापं मध्यार्कचन्द्रयोः कृत्वा ।
पूर्ववदन्यत् स्पष्टं संव्यवहारार्थमेवं वा ॥३२॥

वा. भा.—अस्य श्लोकस्य वासनाभाष्यं नास्ति ।

वि. भा.—स्वदिनार्धपरिधिना पूर्वकथितविधिना यद्भुजफलचापं (मन्दफलं) तन्मध्यमरविचन्द्रयोः संस्कृत्य अन्यद्देशान्तरादिसंस्कारं पूर्ववत् कृत्वैवं वा संव्यवहारार्थं स्पष्टीकरणं विधेयम् । नतकर्मसंस्कारं विनैवाऽऽचार्येणेदं स्पष्टीकरणं स्थूलं व्यवहारोपयोगिकथितम् । भास्कराचार्येण रविचन्द्रयोः स्थूलमेवेदं स्पष्टी-

करणं सर्वकर्मोपयुक्तं सूक्ष्मत्वेन स्वीकृतम्। 'मुहुः स्फुटाऽतो ग्रहणे रवीन्द्वोरित्यादिना' भास्करेण यदाचार्यमतं वर्णितं वस्तुतस्तत्तन्मतं नास्तीति विज्ञैर्बोध्यमिति ॥३२॥

अब व्यवहारोपयोगी रवि और चन्द्र के स्पष्टीकरण को कहते हैं

हि. भा.—स्वदिनार्धपरिधि से पूर्वकथित विधि के अनुसार जो मन्दभुजफल होता है उसके चाप (मन्दफल) को मध्यमरवि और मध्यमचन्द्र में संस्कार करके अन्य देशान्तरादि संस्कारों को पूर्ववत् करके व्यवहार के लिये वा इस तरह स्पष्टीकरण करना चाहिए। बिना नतकर्म संस्कार के आचार्य इस व्यवहारोपयोगी स्थूल स्पष्टीकरण को कहते हैं। 'भास्कराचार्य ने रवि और चन्द्र के इस स्थूल स्पष्टीकरण को ही सूक्ष्म सब कर्मों के लिये उपयुक्त स्वीकार किया है, 'मुहुः स्फुटाऽतो ग्रहणे रवीन्द्वोः इत्यादि से' भास्कराचार्य ने आचार्यमत का भिन्न तरह प्रतिपादन किया है इति ॥३२॥

इदानीं मङ्गलादिग्रहस्पष्टीकरणे कारणमाह

आर्यभटस्याज्ञानान्मध्यममन्दोच्चशीघ्रपरिधीनाम्।
अस्पष्टा भौमाद्याः स्पष्टा ब्राह्मोक्तमध्योच्चैः ॥३३॥

वा. भा.—नास्ति वासनाभाष्यमस्य श्लोकस्य।

वि. भा.— आर्यभटस्य मध्यममन्दोच्चशीघ्रपरिधीनामज्ञानात्कारणात्, भौमाद्या (मङ्गलादिकाः) ग्रहाः अस्पष्टा भवन्त्यतो ब्राह्मो (ब्रह्मगुप्तो) क्तमध्योच्चैर्भौमाद्याः स्पष्टाः कार्या अर्थादार्यभटस्य वास्तवमध्यममन्दोच्चादीनामज्ञानात्तन्मतेन भौमादिग्रहस्पष्टीकरणं न युक्तमतो मदुक्तवास्तवमन्दोच्चाद्यैस्तत्स्पष्टीकरणं विधेयमित्याचार्याभिप्राय इति ॥३३॥

अब मङ्गलादि ग्रहों के स्पष्टीकरण में कारण कहते हैं

हि. भा.—आर्यभट को वास्तव मध्यममन्दोच्च-शीघ्र परिधियों का ज्ञान नहीं था इसलिये भौमादि (मङ्गल आदि) ग्रह उनके मत से स्पष्ट नहीं होते हैं। ब्राह्मो (ब्रह्मगुप्तो) क्त मन्दोच्चादि से वे स्पष्ट होते हैं, आचार्य के कहने का तात्पर्य यह है कि आर्यभट को मध्यम मन्दोच्च शीघ्र परिधियों का ज्ञान नहीं था इसलिये हमारे मन्दोच्चादि से कुजादि ग्रहों के स्पष्टीकरण करने से वे ठीक स्पष्ट होते हैं इति. ॥३३॥

इदानीं मङ्गलादिग्रहाणां मन्दशीघ्रपरिध्यंशान् स्फुटीकरणञ्चाह

मन्दोच्चनीचवृत्तस्य परिधिभागाः सितस्य विषमान्ते।
नवयुग्मान्ते रुद्राः ११ शीघ्रौजान्तेऽग्निरसयमलाः २६३ ॥३४॥

युग्मान्तेऽष्टशरयमा २५८ मन्दफलान्मध्यमः स्फुटो मध्यः ।
शीघ्रफलात् स्पष्टोऽसकृदेवं स्वफलैर्ज्ञ गुरुसौराः ॥३५॥

बुधमन्दपरिधिभागा वसुरामा ३८ सुरगुरोस्त्रयस्त्रिंशत् ।
रविजस्य शून्यरामाज्ञशीघ्रपरिधिर्द्विगुणचन्द्राः १३२ ॥३६॥

देवगुरोरष्टरसा ६८ भास्करपुत्रस्य शरगुणाः ३५ स्पष्टाः ।
कुजशीघ्रकेन्द्रपदगतये याल्पज्या त्रिभागोनैः ॥३७॥

सप्तभिरंशै ६।४० र्गुणिता दलाढचराशिज्ययाप्तांशैः ।
अधिकोनः कुजमन्दो मृगकर्क्यादौ स्फुटो भवति ॥३८॥

तत्स्फुटपरिधिः खनगाः ७० शीघ्रस्फुटपरिधिराप्तभागोनाः ।
वेदजिनास्त्र्यंशोनाः २४३।४० स्पष्टीकरणं कुजस्यैवम् ॥३९॥

मन्दफलं मध्येऽर्धं तच्छीघ्रफलस्य मध्यमे सकले ।
मध्येऽसकृत् क्षितिसुतः स्पष्टो भुक्तिः स्फुटा ग्रहवत् ॥४०॥

वा. भा.—मन्दोच्चनीचवृत्तस्य गोलाध्याये प्रदर्शितस्य शीघ्रोच्चनीचवृत्तस्य ये परिधिभागाः स्वकक्षा षष्टिशतत्रयकल्पना या स्वपरमफलवशादुपलब्धाः ते तु नीचोच्चवृत्तस्य परिधिभागा उच्यन्ते। सर्वेषां ग्रहाणां सितस्य वद्यथा विषमपदान्ते प्रथमतृतीययोः पदयोरन्तरेत्यर्थस्तत्र नवभागा मन्दनीचोच्चवृत्तस्य परिधियुग्मान्ते रुद्राः द्विचतुर्थयोरन्ते चैकादशभागाः, अन्तरे च त्रैराशिकमाचार्येण प्रागुक्तमेव, शीघ्रनीचोच्चवृत्तस्यौजान्ते प्रथमतृतीयपदान्ते रसयमलाः, युग्मान्ते द्विचतुर्थपदान्तेऽष्टशरयमाः अवान्तरे वापि त्रैराशिकम्। प्राग्वन्मन्दफलान्मध्यमस्फुटो मध्य इति करणागतो देशान्तरभुजान्तचरदलैः कृतैः मध्ये यः स्वदेशौदयिकः स्वमन्दफलेन स्फुटो मध्ये भवति। यतो मध्ये मन्दफलोच्चनीचवृत्तमध्यमः स्वशीघ्रनीचोच्चवृत्तमध्यमतएव शीघ्रफलेन मध्यमः स्फुटो भवति। यतस्तु परिधौ स्फुटो ग्रहः कक्षामण्डल एव दृश्यते अतस्तदुपलब्धये कर्म क्रियते शुक्रस्य तद्यथेष्टकेन्द्रे खस्वस्तिकेऽभीष्टकालिकं शुक्रं संस्थाप्य तस्मात्स्वमन्दोच्चं विशोध्य केन्द्रं भवति। ततः केन्द्राद् भुजज्योक्तवत्कार्या ततः त्रिज्याहृता भुजज्येत्यादिना स्फुटमन्दपरिधिः कार्यः तेन भुजज्यां संगुण्य षष्टिशतत्रयेण विभजेत्। लब्धस्य चापं मन्दफलं भवति। षड्राश्यूने केन्द्रे तात्कालिकमध्ये क्षयः षड्राश्यधिके केन्द्रे धनमेव मध्यमो भवति। योऽस्माभिर्मन्दस्फुट इत्युच्यते। ततस्तं मध्यमं स्वशीघ्रात्तात्कालिकाद्विशोध्य शीघ्रकेन्द्रं भवति। तस्मादुक्तवद्भुजकोटिज्ये कार्ये तास्त्रिज्याहृता भुजज्येत्यादिना शीघ्रपरिधिस्फुटः कार्यः तेन भुजकोटिज्ये संगुण्य भांशैर्विभजेत् लब्धे भुजकोटिफले पृथग्भवतस्ततः कोटिफलयुतात् त्रिज्यापदयोराद्यंतयोर्विहीना द्वितीयतृतीययोरिति स्फुटकोटिः कार्या ततः तद्भुजफलकृतियोगात्पदं स्फुटकर्णः कार्यः। ततस्तद्गुणितात् व्यासार्धात् लब्धकर्णधनुरिति शीघ्रफलं कृत्वा तन्मन्दस्फुटे शुक्रे षड्राश्यूने

शीघ्रकेन्द्रे धनं कार्यमधिके ऋणमेवं मन्दशीघ्रकर्मद्वयस्फुटः शुक्रो भवति। ततस्तं मध्यं परिकल्प्य तस्मात् स्वमन्दोच्चं विशोध्य मन्दफलमानयेत्तत्कारणागते मध्ये धनं ऋणं वा कृत्वा मन्दस्फुटो मध्यमः कार्यः। तदा शीघ्रं विशोध्योक्तवच्छीघ्रफलमानयेत्तदनन्तरं मन्दस्फुटे धनं ऋणं वा कृत्वा स्फुटः शुक्रो भवति। एवं तावद्यावदविशेषः स्फुटो भवति। किन्त्वत्र प्रतिकर्मपरिधेः स्फुटोकरणं कार्यम्। एवं स्वफलैर्ज्ञगुरुसौरा इति। एवमनेनैव प्रकारेण बुधवृहस्पतिशनैश्चरा स्फुटाः कार्या असकृत् किन्तु स्वमंदशीघ्रपरिधिभिस्तेषां स्फुटीकरणं प्रागेव प्रदर्शितम्।

बुधमन्दनीचोच्चवृत्तस्य परिधिभागाः वसुरामा ३८। सुरगुरोर्मन्दपरिधिभागास्त्रयस्त्रिंशत् ३३। रविज्यस्य मन्दपरिधिभागाः शून्यरामाः ३०। एतैर्मन्दफलानयनं शुक्रवत्। बुधशीघ्रनीचोच्चवृत्तस्य परिधिभागाः द्विगुणचन्द्राः १३२।

देवगुरोः शीघ्रपरिधिरष्टरसाः ६८। भास्करपुत्रस्य शरगुणाः ३५ एतैः शीघ्रफलानयनं शुक्रवत् त एव स्पष्टाः यत एषां भास्करा नास्ति। वासना चेषामुपलब्धिरेव परमफलवशादिति।

इदानीं कुजस्फुटीकरणार्थमार्यात्रयं सार्धमाह। मन्दफलमध्येऽर्धं तच्छीघ्रफलस्य मध्यमे सकलो मध्ये सकृदिति सुते स्पष्टो भुक्तिः स्फुटा ग्रहवत्। आदौ तावदिष्टदैवसिकमिष्टकालिकं भौमम्। तात्कालिकशीघ्राद्विशोध्य शीघ्रकेन्द्रं कार्यम्। तत् यस्मिन् पदे वर्त्तते तस्य पदस्य भुक्ता भुक्तयोर्यदल्पं तस्य ज्या ग्राह्या सा कुजकेन्द्रपदयोर्याल्पज्या सा च त्रिभागोनैः सप्तभिरंशैर्गुणिता कार्या ६।४० दलाढयराशिज्याहृता दलाढयराशि, तस्य ज्या रवित्रियमाः २३१२ अतो येंऽशा आप्तास्तैराप्तांशैरधिकोनो यथासंख्यं कुजमन्दो मृगकर्कादौ स्थिते केन्द्रः कार्यः एवं कृते स्फुटो भवति।

तत्स्फुटपरिधिः खनगा इति तदिति स्फुटपरिधिः। मन्दस्य परामर्शस्तस्य न संख्या सर्वदा स्फुटपरिधिः शीघ्रस्फुटपरिधिश्चाप्तभागैरूना। वेदजिनास्त्र्यंशोनाः २४३।४० कुजशीघ्रकेन्द्रपदगतये याल्पा ज्या त्रिभागोनैः सप्तभिरंशैर्गुणिता दलाढयराशिज्यया हृतेत्यतो ये भागा आप्तांशास्तैरूनास्त्रिशोना वेदजिना कुजस्य शीघ्रस्फुटपरिधिर्भवतीत्यर्थः स्पष्टीकरणं कुजस्यैवमिति। एवं कृतेऽस्य स्फुटीकरणमनन्तरोक्तोपकरणैः कार्यम्। तत्कथमिति तदर्थमाह।

मन्दफलमध्येऽर्धं प्रथमं तावन्मन्दफलं स्वोपकरणैरानीयते। अस्यार्धं मध्ये ग्रहे धनमृणं वा कार्यम्। तच्छीघ्रफलस्य मध्यम इति। तस्मान्मन्दफलार्धस्फुटान्मध्याच्छीघ्रफलं स्वोपकरणैरानीय तस्यार्धं मध्यमे मन्दार्धस्फुटे धनमृणं वा सकलं मध्ये। ततो द्वितीयसंस्कृताद्भौमान्मन्दफलमुक्तवत्कृत्वा तत्सकलं करणागते मध्ये धनमृणं वा कार्यम्। ततश्चोक्तवच्छीघ्रफलं तत्तत्रैव धनं कार्यम्।

एतच्चासकृत्कृत्वा क्षितिसुते कर्म स्फुटं भवति। कुजादीनां भुक्तिरपि ग्रहवत्स्फुटा कार्या। स्पष्टतरं कर्म प्रदर्श्यते तद्यथा स्वदेशे इष्टकालिकाद्भौमे शीघ्राद्भौमं विशोध्य कुजशीघ्रकेन्द्रपदेत्यादिना शीघ्रपरिधिं च स्फुटीकृत्वा ततः प्रथमं मन्दफलमानयेत्। स्वमन्दपरिधिना तदर्धपृथक्स्थे भौमे षड्राश्यूने मन्दकेन्द्रे ऋणमधिके धनं कृत्वा ततस्तं स्वशीघ्राद्विशोध्य शीघ्रफलमानयेत्। तस्याप्यर्धं तत्रैव षड्राश्यूने शीघ्रकेन्द्रे धनमधिके ऋणं कृत्वा तस्माद्द्विकर्मस्फुटाद्भौमात्स्वमंदोच्चं विशोध्य मन्दफलमानयेत्। तद्विकृते मध्यभौमसकलप्राग्वद्धनमृणं च कृत्वा मन्दस्फुटो मध्यमो भवति। ततस्तं स्वशीघ्राद्विशोध्य शीघ्रफलं स्वोपकरणैरानीय तदपि सकलमेव मन्दस्फुटप्राग्वद्धनमृणं वा कार्यम्। एवं कृते स्फुटो भौमो भवति। ततस्तं मध्यं परिकल्पयेत्तमेव स्वशीघ्राद्विशोध्य कुजशीघ्रकेन्द्रपदयोर्यात्यज्येत्यादिना मन्दः संस्कार्यः शीघ्रपरिधिश्च ततः स्फुटभौममन्दोच्चं विशोध्य मन्दफलमानयेत्। तस्यार्धकरणागतं मध्ये धनमृणं कृत्वा ततस्तं शीघ्राद्विशोध्य शीघ्रफलं प्राग्वत् तस्याप्यर्धं तत्रैव ततश्च मन्दशीघ्रफले सकले मध्ये भौमे कृत्वा स्फुटः कार्यः। एवं तावद्यावद्विशोध्यः, प्रतिस्फुटीकरणे शीघ्रपरिधिर्मन्दयोः संस्कारः कार्यं। एवं यस्य ग्रहस्य मंदकर्मणा केवलेन स्फुटीकरणं तस्य भुक्तिरपि एकेनैव कर्मणा।

यस्य कर्मद्वयेन तस्य भुक्तिरपि कर्मद्वयेन, यस्य कर्मचतुष्टयेन तस्य भुक्तिरपि चतुष्टयेन स्फुटा कार्या। कर्मचतुष्टयेनैवात्रेयं वासना भौमः। शीघ्रमंडलादुच्चे यदा भवति तदा तन्मन्दोच्चं यथागतमेव भवति। ततः क्रमेणोपचीयते केन्द्रपदार्धं यावत्ततश्चापचीयते पदान्तं यावदेवं चतुर्थे पदेऽपि द्वितृतीययोश्च वैपरीत्येन पदसंधिषु। चतुष्टयेऽपि करणागतएवांतरे त्रैराशिककल्पना कृता। मन्दसंस्कारार्थं त्रिभागोनैः सप्ताभर्भागैः दलाढ्यराशिज्यया शीघ्रपरिधिचतुष्टय पदसंधिषु यथा पठितः। वा पदार्धे इत्यल्पः सर्वेषु तावद्भिरेव यदि भागैरतः सर्वदोपचीयते। लब्धफलेन यच्च मन्दशीघ्रफलद्वयार्धेन प्रथमं कर्म तदपि मन्दफलसंस्कारार्थम्। न चात्र वासना गम्येत्येभिर्योगातिशयेनोपलब्धे रवि यदि कारणं स्यादथवागम एव प्रमाणम्। मन्दशीघ्रपरिध्यादिषु यतः शेषग्रहणातिरेकेण भौमस्यायं विधिरिति।

वि. भा.—सितस्य (शुक्रस्य) विषमान्ते (विषमपदान्ते) मन्दोच्चनीचवृत्तस्य परिधिभागा (मन्दपरिध्यंशाः) नव ९। युग्मान्ते (समपदान्ते) मन्दपरिध्यंशा रुद्राः (एकादश), ओजान्ते (विषमपदान्ते) शीघ्रपरिध्यंशाः २६३, युग्मान्ते (समपदान्ते) २५८, मन्दफलात्संस्कृतो मध्यमो मध्यः स्फुटः (मन्दस्पष्टः) ग्रहो भवति, शीघ्रफलात् संस्कृतो मन्दस्पष्टोऽसकृत् स्पष्टो भवेदर्थान्मध्यग्रहात्पुनर्मन्दफलमानीय तत्संस्कृतो मध्यमग्रहो मन्दस्पष्टो भवेत्तस्मात् (मन्दस्पष्टात्) पुनः शीघ्रफलमानीय तत्संस्कृतो मन्दस्पष्टग्रहः स्पष्टग्रहो

भवेत्, पुनरेतस्मात्स्पष्टग्रहात्पूर्ववन्मन्दस्पष्टस्पष्टग्रहौ साध्यौ यावदविशेष इति। एवं ज्ञगुरुसौराः (बुधबृहस्पतिशनैश्चराः) स्वफलैः (मन्दफलैः शीघ्रफलैश्च) पूर्ववदसकृत् स्फुटा भवन्ति, बुधमन्दपरिध्यंशाः =३८, सुरगुरोः (बृहस्पतेः) =३३, रविजस्य(शनैश्चरस्य)=३०, विषमपदान्ते, समपदान्ते चार्याद् बुधबृहस्पति-शनैश्चरमन्दपरिध्यशेषु संस्काराभावः बुधशीघ्रपरिध्यंशाः=१३२, बृहस्पतेः=६८, भास्करपुत्रस्य (शनेः) =३५, एषामपि बुधबृहस्पतिशनीनां शीघ्रपरिध्यंशेषु संस्काराभावः सर्वदैकरूपत्वात् कुजशीघ्रकेन्द्रपदगतये याल्पज्या (कुजशीघ्र-केन्द्रं यस्मिन् पदे भवेत्तत्र गतगम्ययोर्येऽल्पा अंशास्तेषां ज्या कार्या) सा त्रिभागोनैर्विशत्यंशरहितैः सप्तभिरंशैः ६।४० गुणिता, दलाढ्यराशिज्यया (पञ्चचत्वारिंशदंशज्यया) भक्ता प्राप्तांशैर्मृगकर्क्यादिशीघ्रकेन्द्रे कुजमन्दः (कुजमन्दोच्चं) क्रमेणाधिको हीनश्च कार्यः, एवं स्पष्टीकरणोनयोगिकुजमन्दोच्चं स्फुटं भवति, तत्स्फुटपरिधिः (तस्य कुजस्य मन्दपरिध्यंशः) खनगाः =७० =त्र्यंशोना वेदजिना २४३।४० अंशा आप्तभागोना अर्थान्मन्दोच्चसंस्कारार्थं पूर्वं येंऽशा प्राप्तास्तैरूना - (हीनाः) स्तदा कुजस्य शीघ्रस्फुटपरिधिः स्यात्। एवं वक्ष्यमाणं कुजस्य स्पष्टीकरणं भवति। मध्ये (गणितागते मध्यमकुजे) ऽर्धं मन्द-फलं धनमृणं वा यथागतं देयम्। तच्छीघ्रफलस्यार्धं (तस्मादर्धमन्दफलसंस्कृतान्म-ध्यकुजाद्यच्छीघ्रफलं तदर्धं) मध्यमे(अर्धमन्दफलसंस्कृतमध्यकुजे) देयम्। पुनरर्धफल-द्वयसंस्कृतान्मध्यमाद्यन्मदफलं तत्संस्कृतान्मध्याद्यच्छीघ्रफलं च ते सकले (सम्पूर्णे) मध्ये (गणितागते) कुजे देये, ततो बुधबृहस्पतिशनिवदसकृत्कर्म कार्यं यावद-विशेषः। तदा क्षितिसुतः (कुजः) स्फुटो भवति, स्फुटा भुक्तिः (स्पष्टगतिः) ग्रहवत्साध्या, दिनान्तरस्पष्टग्रहान्तरमेव तत्समयान्तराले ग्रहस्पष्टगतिर्भव-तीति ॥३४-३५-३६-३७-३८, ३९, ४०॥

अत्रोपपत्तिः

ब्रह्मगुप्तोक्तशनेः शीघ्रपरिधिः=३५°, सूर्यसिद्धान्तकारोक्तशनिशीघ्रपरिधिः =४०°, भास्करोक्ततच्छीघ्रपरिध्यंशाः=४०° तथाऽऽचार्योक्तशनिमन्दपरिध्यंशाः =३०° भास्करोक्तशनिमन्दपरिध्यंशाः =५०°, शनिपरिध्यंशेषु भास्करेण कथं वैषम्यं कृतमिति त एव ज्ञातुं शक्नुवन्ति, सूर्यसिद्धान्तकारेण शीघ्रान्त्यफलज्याऽपि न स्थिरेति मनसि धृत्वा समपदान्तविषमपदान्तभेदेन भिन्ना भिन्नाः परिध्यंशाः पठिता यथा तदुक्तम्।

कुजादीनामतः शैघ्र्या युग्मान्तेऽर्थाग्निदस्रकाः।
गुणाग्निचन्द्राः खनगा द्विरसाक्षीणि गोऽग्नयः।
ओजान्ते द्वित्रियमला द्विविश्वे यमपर्वताः।
खर्त्तुदस्रा वियद्वेदाः शीघ्रकर्मणि कीर्त्तिताः॥

ब्रह्मगुप्तेन यथा परिधिस्फुटीकरणमभिहितं तदनुसारमेव भास्करेणापि कथितं मङ्गलस्य चतुर्ष्वपि शीघ्रकेन्द्रपदान्तेषु गणितागतमन्दोच्चमेकरूपकमेव भवति, पदमध्ये त्र्यंशोनसप्तभिरंशैः सर्वदा न्यूनं भवत्यतोऽवान्तरे ऽनुपातो यदि पञ्चचत्वारिंशच्छीघ्रकेन्द्रज्यया त्र्यंशोनसप्तांशा मन्दोच्चान्तरं लभ्यते तदेष्टशीघ्रकेन्द्र-पदगतगम्याल्पया शीघ्रकेन्द्रज्यया किमित्यनुपातेन यत्फलं तन्मकरादिकर्क्यादिकेन्द्रे गणितागतकुजमन्दोच्चे युतं हीनं कार्यं तदा स्फुटं तन्मन्दोच्चं भवितुमर्हति, तथा च मङ्गलस्य पदान्तेषु शीघ्रपरिधिरेकरूपक एव भवति, पदमध्ये त्र्यंशोनैः सप्तभिरंशैः सदा न्यून एव भवति, अवान्तरे पूर्वानुपातागतफलं तच्छीघ्रपरिधौ धनर्णं कार्यं तदा स्फुटः शीघ्रपरिधिर्भवेदिति, भास्करोक्तमप्याचार्योक्तानुरूपमेव, ग्रहस्पष्टीकरणे मङ्गलशुक्रयोरेवान्तरं तथा मङ्गलमन्दोच्चे वैषम्यं च ब्रह्मगुप्तेन दृष्टम्। काऽप्यत्र युक्तिर्न प्रतिपादिता केवलं वेध एव प्रमाणम् नान्यत्कारणं वक्तुं शक्यत इति भास्करोक्तेन ज्ञायत इति, सिद्धान्तशेखरे श्रीपतिना 'भौमो निते दिनकरे पदयातयेयन्यूनज्यका युगहताऽङ्ककृतेन्द्र १४४६ भक्ता। लब्धांशकैर्युत विहीनमसृङ्मृदूच्चं स्पष्टं भवेन्मकरकर्कटकादिकेन्द्रे' ऽनेनाचार्योक्तानुरूपमेव मङ्गलमन्दोच्चस्फुटीकरणं कथितम्। पदयातयेयन्यूनज्यकायास्त्र्यंशोनसप्तांशानां गुणकाङ्कानां स्थाने $\frac{२०}{३}$=गुणकं, दलाढ्यराशिज्यात्मकभाजकस्थाने द्वादशी ज्या=२१४५ तुल्यं भाजकं $\frac{५}{३}$ अनेनापवर्त्यगुणकं चतुर्मितं भाजकं च १४४६ तुल्यं कृतम्। तथे- 'नीचोच्चवृत्तं क्षितिजस्य मान्दं स्फुटं वदन्तीह खशैल ७० भागान्। त्र्यंशोनिताम्भोधिजिना २४३।४० इचशैघ्र्यमवाप्तभागै रहितं सदैव, ति श्रीपत्युक्त- 'तत्स्फुटपरिधिः खनगा इत्यादि' माचार्योक्तानुरूपमेव, तथा चे- 'मृदुफलदलमादौ मध्यमे मेदनीजे तदनुचलफलस्याप्यर्धमस्मिन् विधेयम्। पुनरपि परि-पूर्णं मान्दशैघ्र्ये च मध्ये ह्यसकृदवनिसूनोरेवमाहुः स्फुटत्वम्' ति श्रीपत्युक्ते- 'मन्दफलं मध्येऽर्धं तच्छीघ्रफलस्य मध्यमे सकल इत्यादि' राचार्योक्तमिदमेव मूलं 'दली-कृताभ्यां प्रथमं फलाभ्यामित्यादि' भास्करोक्तमपि बुधैश्चिन्त्यमिति ॥ ३४-३५-३६-३७-३८-३९-४० ॥

अब मङ्गलादि ग्रहोंके मन्द परिध्यंश, शीघ्र परिध्यंश
और स्पष्टीकरण को कहते हैं।

शुक्र के विषम पदान्त में मन्दोच्चनीचवृत्त परिध्यंश नव ९ होता है और सम पदान्त में ग्यारह होता है, विषम पदान्त में शीघ्र परिध्यंश २६३, और सम पदान्त में २५८ होते हैं। मध्यम ग्रह में मन्द फल के संस्कार करने से मन्द स्पष्ट ग्रह होता है। मन्द स्पष्ट ग्रह में शीघ्र फल संस्कार करने से असकृत्प्रकार से स्पष्ट ग्रह होते हैं अर्थात् मध्यम ग्रह से फिर मन्दफल लाकर मध्यमग्रह में संस्कार करने से मन्दस्पष्टग्रह होते हैं। उस (मन्दस्पष्टग्रह) से पुनः शीघ्र फल लाकर मन्दस्पष्टग्रह में संस्कार करने से स्पष्टग्रह होते हैं। पुनः इस स्पष्ट ग्रह से पूर्ववत् मन्दस्पष्टग्रह और स्पष्टग्रह साधन करना जब तक बिलकुल ठीक हो

जाय तब तक करना चाहिये, बुध, बृहस्पति और शनैश्चर मन्दफलों और शीघ्रफलों से पूर्ववत् असकृत् कर्म से स्फुट होते हैं। बुध के मन्दपरिध्यंश=३८°, बृहस्पति के=३३°, शनैश्चर के मन्दपरिध्यंश=३०°, विषमपदान्त में और समपदान्त में अर्थात् इन ग्रहों के मन्दपरिध्यंशों में संस्काराभाव होता है, बुध के शीघ्र परिध्यंश=१३२°, बृहस्पति के=६८°, शनि के=३५°, इन शीघ्र परिध्यंशों में भी संस्काराभाव होता है, अर्थात् बराबर स्थिर (एकरूपक) परिध्यंश होता है, मङ्गल का शीघ्रकेन्द्र जिस पद में हो उसमें गत केन्द्रांश और गम्य केन्द्रांश में जो अल्प हो उसकी ज्या को तृतीयांश रहित सात अंश ६°।४०′ से गुणा कर पैंतालीस अंश की ज्या से भाग देने से लब्ध जो अंश हो उस को मकरादिशीघ्र केन्द्र में मङ्गल के मन्दोच्च में जोड़ने से और कर्क्यादि केन्द्र में घटाने से स्पष्टीकरणोपयुक्त मङ्गल का मन्दोच्च होता है, उन (मङ्गल) के मन्दपरिध्यंश=७०°, और २४३°।४०′ इन में मन्दोच्च संस्कारार्थ पहले जो अंश प्राप्त हुये थे उनको हीन करने से मङ्गल की स्फुटशीघ्रपरिधि होती है। मङ्गल का स्पष्टीकरण आगे लिखे हुए नियम के अनुसार होता है। गणितागत मङ्गल में यथागत मन्दफल के आधे को धन या ऋण करना, उस मन्द फलार्ध संस्कृत मध्यम मङ्गल से शीघ्रफल साधन करना, उस के आधे को मन्दफलार्ध संस्कृत मध्यम मङ्गल में देना, मन्दफलार्ध और शीघ्र फलार्ध संस्कृत मध्यम मङ्गल से जो मन्दफल हो मध्यम मङ्गल में उस को संस्कार कर के जो हो उस से शीघ्रफल साधन करना, वे दोनों (मन्दफल और शीघ्रफल) गणितागत मङ्गल में देना, बाद में बुध, बृहस्पति और शनि की तरह असकृत्कर्म तब तक करना चाहिये जबतक बिलकुल ठीक हो जाय, तब मङ्गल स्फुट होते हैं। ग्रह की तरह स्पष्टगति साधन करना, अद्यतन श्वस्तन ग्रहों का अन्तर स्पष्टग्रहगति होती है इति ॥३४-३५-३६-३७-३८-३९-४०॥

उपपत्ति

ब्रह्मगुप्तोक्त शनि की शीघ्रपरिधि=३५°, सूर्यसिद्धान्तोक्त शनि की शीघ्रपरिधि =४०°, भास्करोक्तशनिशीघ्रप=४०, आचार्योक्त शनिमन्दपरिध्यंश=३०°, भास्करोक्तशनि-मन्दपरिध्यंश=५०°, शनि के परिध्यंशों में भास्कराचार्य आचार्योक्त से भिन्न क्यों कहे हैं इस को वे ही जान सकते हैं, सूर्यसिद्धान्तकार शीघ्रान्त्यफलज्या भी सदा स्थिर नहीं है इस बात को मन में रख कर समपदान्त और विषम पदान्त भेद से भिन्न-भिन्न परिध्यंश बताये हैं, जैसे 'कुजादीनामतः शैघ्र्या युग्मान्तेऽर्थाग्निदस्रकाः इत्यादि' संस्कृतोपपत्ति में लिखा गया है, आचार्य (ब्रह्मगुप्त) ने जिस तरह परिधि का स्पष्टीकरण किया है तदनुरूप ही भास्कराचार्य ने भी अपनी सिद्धान्तशिरोमणि में कहा है, मङ्गल के चारों शीघ्र केन्द्र पदान्त में गणितागत मन्दोच्च एक ही रूप का होता है, पदमध्य में तृतीयांश (२० कला) रहित सात अंश ६°।४०′ करके न्यून होता है, इसलिये इन दोनों के मध्य में अनुपात करते हैं, यदि पैंतालीस अंश शीघ्रकेन्द्रांश की ज्या में तृतीयांशोन सात अंश ६°।४०′ मन्दोच्चान्तर पाते हैं तब इष्टशीघ्रकेन्द्र पद में गत और गम्य में अल्प शीघ्र केन्द्रज्या में क्या इस अनुपात से जो फल आता है उसको मकरादि केन्द्र में और कर्क्यादिकेन्द्र में गणितागत

मङ्गल के मन्दोच्च में युत और हीन करने से स्फुटमन्दोच्च होता है, तथा मङ्गल के पदान्तों में शीघ्रपरिधि एकरूपक ही होती है, पदमध्य में तृतीयांशोन सात अंश ६°।४०' करके सदा न्यून ही होता है, दोनों के मध्य में पूर्वानुपातागत फल को उनके शीघ्र परिधिप्रमाण में धन और ऋण करने से स्फुट शीघ्रपरिधि होती है, आचार्योक्तानुरूप ही भास्कराचार्य कहते हैं। ग्रहस्पष्टीकरण में मङ्गल और शुक्र ही में अन्तर तथा मङ्गल के मन्दोच्च में वैषम्य को आचार्य देखे, इस में कोई युक्ति नहीं कही गयी है, केवल वेध ही प्रमाण है, यह बात भास्कराचार्य के कथन से मालूम होती है, सिद्धान्तशेखर में श्रीपति ने 'भौमो निते दिनकरे पदयातयेयन्यूनज्यका" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से आचार्योक्तानुरूप ही मङ्गल के मन्दोच्चस्फुटीकरण को कहा है, पद में गत केन्द्रांश और गम्य केन्द्रांश में जो अल्प है उस की ज्या के तृतीयांशोन सात अंश के गुणकाङ्क स्थान में $\frac{२०}{३}$=गुणक और पैंतालीस अंश ज्यात्मक भाजक स्थान में बारहसीज्या=२१४५ तुल्य भाजक को $\frac{५}{३}$ इससे अपवर्त्तन देकर गुणक स्थान में चार ४, और भाजक स्थान में १४४६ किया तथा 'नीचोच्चवृत्तं क्षितिजस्य मान्दं' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपति की उक्ति 'तत्स्फुटपरिधिः खनगाः' इत्यादि आचार्योक्त के अनुरूप ही है, तथा 'मृदुफलदलमादौ मध्यमे मेदनीजे' इत्यादि श्रीपति प्रकार का तथा 'दलीकृताभ्यां प्रथमफलाभ्यां' इत्यादि भास्करोक्त प्रकार का मूल 'मन्दफलं मध्येऽर्धं तच्छीघ्रफलस्य मध्यमे' इत्यादि आचार्योक्त प्रकार ही है इति ।। ३४-३५-३६-३७-३८-३९-४०।।

इदानीं ग्रहाणां मन्दस्पष्टगतिं स्पष्टगतिं चाह

ग्रहमन्दकेन्द्रभुक्तिर्ज्यान्तरगुणिताऽऽद्यजीवया २१४ भक्ता ।
लब्धं स्फुटपरिधिघ्नं भगणांश ३६० हृतं कलाभिस्तु ।। ४१ ।।

मृगकर्यादावूनाधिका स्वमध्यमगतिः स्फुटाऽर्केन्द्वोः ।
शीघ्रगतिं मन्दफलस्फुटभुक्त्यूनां कुजादीनाम् ।। ४२ ।।

शीघ्रफलं भोग्यज्यासङ्गुणितं त्वाद्यजीवया विभजेत् ।
फलगुणितं व्यासार्धं विभाजयेच्छीघ्रकर्णेन ।। ४३ ।।

लब्धोना शीघ्रगतिः स्फुटभुक्तिर्भवति लब्धमधिकं चेत् ।
शीघ्रगतेः शीघ्रगतिं लब्धात् संशोध्य वक्रगतिः ।। ४४ ।।

वा. भा.—ग्रहस्य मन्दकर्मणि यत् केन्द्रं तद्ग्रहमन्दकेन्द्रं तस्य भुक्तिर्यथा मध्यग्रहात् स्वमन्दोच्चं विशोध्य केन्द्रं भवति। एवं ग्रहमध्यभुक्तौ स्वमन्दोच्चभुक्तिं विशोध्य केन्द्रभुक्तिर्भवति । सा च ज्यान्तरगुणिता कार्या अवशेषमन्दकर्मणि भुजज्यायां क्रियमाणायां यज्ज्यान्तरं भवेत् तद्गुणनीयेत्यर्थः। तत आद्यजीवया भक्ता कार्या प्रथमं ज्यार्धं मनुयमला इत्यर्थः २१४; ततो यल्लब्धं तत्स्फुटमन्दपरिधिगुणं भगणांशहृतं च कृत्वा यत्तत्फलं ताः कलाः ताभिः फलकलाभिर्मृगकर्यादौ स्थिते

स्वमन्दकेन्द्रे यथासंख्यमूनाधिका सती स्वमध्यगतिः मन्दस्फुटा भवति । भौमादीनां सा मन्दस्फुटैवेत्युच्यते । रविचन्द्रयोस्तु सैव परमार्थ्यस्फुटा यतस्तौ मन्दप्रतिमण्डले भ्रमतः इत्यत्रेयं वासना ।

कक्षामण्डले यत्र प्रदेशे रविर्वर्तते, चन्द्रो वा भौमादीनां स्वमन्दनीचोच्चमध्यवृत्तं वा तत्र यज्ज्यान्तरं तेन सह त्रैराशिकं यदि तत्त्वयमसंख्याभिर्लिप्ताभिर्ज्यान्तरं लभ्यते तदा मन्दकेन्द्रभुक्तिलिप्ताभिः किमिति द्वितीयं त्रैराशिकं यदि षष्टिशतत्रयवृत्ते यत्फलं ज्यारूपमेतावत्स्वमन्दोच्चनीचवृत्ते कियदिति ततः तृतीयं त्रैराशिकं यदि मनुयमलतुल्यस्य ज्याफलस्य तत्त्वयमसंख्याश्चापलिप्ता भवति । तदस्य कियत् प्रभवत्येवं प्रथमत्रैराशिके तत्त्वयमसंस्थो भागहारः ।फलं स्वभुक्तावुपचयापचयो वा कक्षामंडलात्प्रतिमण्डलमुपरि यत्र तत्र भुक्तेरुपचयो यत्राधस्तत्रोपचयो ऽतएव चोक्तं मृगकर्क्यादावूनाधिका स्वमध्यगतिरित्येतत्सर्वं यथा तत्तेषु कक्षामण्डलादिषु प्रदर्शयेत् । उपपन्नं च यदि नाम चन्द्रकेन्द्रभुक्तिर्बहुज्यान्तरव्यापिनी तत्र केन्द्रवच्चन्द्राक्रान्तज्यान्तरादारभ्यातीतज्यांतरैर्भुक्तेः स्फुटीकरणमिच्छन्त्यपरे तत एवागामिज्यान्तेरैः कर्म कुर्वते एवमतीतैः स्फुटया आगामिज्यान्तरैरपि स्फुटया सह योगार्धेन, अपरे तु पुनर्गतात्कलानयनेऽतीतैर्ज्यान्तरैः स्फुटया गम्यावकलानयनेनागते ज्यान्तरगतया स्फुटया चन्द्रभुक्तौ कर्म कुरुते तत्र स्फुटा भुक्तिः क्षणं मध्ये एका वक्तुं शक्यते । कक्षामण्डलप्रतिमण्डलयोरन्यथासंस्थानात्तस्मादनवस्थाप्रसंगः स्यादित्याचार्येण क्रान्तज्यान्तरेणैव भुक्तिज्यानीता । स्वल्पान्तरत्वादेवं रव्यादीनामपि कल्पाः सम्भवन्ति । यदि नामात्यल्पमन्तरे तेषां भुक्तेरल्पत्वादिति । यच्चापकारणमस्यामार्यायामाद्यजीवया स्थिरयोपनिबद्धं तदन्येषां ज्यान्तराणामसम्भवाद्यतो भुक्तिज्याफलांशुवद्वापि मनुयमलानां लिप्तानां तुल्या न भवन्ति । तस्मादुक्तं सर्वमुपपन्नमिति ।

इदानीं भौमादीनां भुक्तिकरणार्थमार्याद्वयं सार्धमाह । कुजादीनां ताराग्रहाणां शीघ्रगतिः किंभूतानां मन्दफलस्फुटभुक्तीनां शीघ्रफलभोग्यजीवा संगुणिता च सती विभजेत् । कया आद्यजीवया एतदुक्तं भवति । भौमादेः ग्रहस्य पूर्वप्रदर्शितेन कर्मणा मंदफलस्फुटभुक्तिः तां स्वशीघ्रभुक्तेर्विशोध्य मन्दफलस्फुटभुक्तीनां शीघ्रगतिर्भवति । ततस्तां गुणयेत् । शीघ्रफलभोग्यया ग्रहस्य स्फुटीक्रियमाणस्य यच्छीघ्रफलं भवति तस्य फलज्यायां क्रियमाणायां यज्ज्यान्तरं गुणकारः संभवति सा शीघ्रफलभोग्यजीवेत्युच्यते तया मन्दफलभुक्त्यूनां शीघ्रगतिं संगुणय्याद्यजीवया विभजेत् । मनुयमलैरित्यर्थः ।

ततो यत्फलं तेन फलेन गुणितं व्यासार्धं तद्विभाजयेत् शीघ्रकर्णेन ततोऽपि यल्लब्धं तेन सर्वदा शीघ्रगतिरूना कर्त्तव्या । सा चोना कृता ग्रहस्य स्फुटभुक्तिस्ततः प्रदेशे स्थितस्य भवति । लब्धमधिकं चेत् शीघ्रगतेः फलगुणितात् व्यासार्धात्

शीघ्रकर्णहृताद्यल्लब्धं तच्छीघ्रगतेरथाधिकं भवति। तदा शीघ्रगतिलब्धां संशोध्य वक्रगतिर्भवति। विपरीतशोधने कृतेऽप्यवक्रभुक्तिर्भवति। तदैवैतत्संभवतीत्यर्थः। यदि नाम भौमस्यायं विशेषः प्रथममन्दफलसंस्कृतादानीय तदर्धं मध्यभुक्तावृणं धनं वा कार्यं ततस्तदूनां शीघ्रभुक्तिं शीघ्रफलार्धभोग्यजीवासंगुणितामाद्यजीवया विभजेत्।

लब्धेनोक्तवत्स्फुटभुक्तिः समानीय यदि तया सह मन्दफलार्धस्फुटभुक्तेर्यदन्तरार्धं तत्रैवैके कर्मकृतभुक्तौ धनं ऋणं वा कार्यम्। यदि मन्दस्फुटभुक्तेरधिका स्फुटभुक्तिः तद्धनमन्यथार्णमित्येवं कृते द्विकर्मस्फुटा भौमभुक्तिर्भवति। तां मध्यां परिशेषग्रहवत्तद्भुक्तेरपि स्फुटीकरणमिति कक्षामंडलादीनि यथा विन्यस्य सर्वं प्रदर्शयेत्। तत्रेयं वासना मंदफलस्फुटो ग्रहो यत्र प्रदेशे कक्षामंडले वर्त्तते तत्र शीघ्रोच्चनीचोच्चवृत्तमध्ये कृते तत्परिधिशीघ्रप्रतिमंडलपरिध्योर्यत्र संपातस्तत्र स्फुटो ग्रहः तस्य शीघ्रोच्चरेखया सहान्तरं यत्तत्प्रतिदिनमुपचीयते स्वशीघ्रभुक्तिमंदफलस्फुटभुक्त्योरन्तरेण यतः शीघ्रभुक्त्या यदि प्राक्मंदस्फुटो मन्दस्फुटभुक्त्या भवति मन्दफलभुक्त्यूना शीघ्रगतिः क्रियते। तत्र तयोरंतरं शीघ्रकेन्द्रभुक्तिर्भवति। सा च शीघ्रकेन्द्रभुक्तिः स्फुटीक्रियते। तत्र चैव शीघ्रनीचोच्चवृत्तस्य मध्यगा शलाका सैवावधित्वेन परिकल्पिता फलचापकरणे यतस्ततएव यावान्विप्रकर्षस्तावदेव ग्रहफलमतस्तत्र एवावधेः क्रमज्या प्रवर्त्तते। फलचापकरणे एतच्च प्रागेवोक्तशीघ्रफलान्ते यज्ज्याफलं तेन त्रैराशिकं यदि तत्त्वयमलैः तज्ज्यान्तरं लभ्यते तच्छीघ्रकेन्द्रभुक्तिलिप्ताभिः किमिति, ततो द्वितीयं यमलैः तत्त्वयमतुल्याश्चापलिप्ता भवन्ति। तल्लब्धज्याखंडने किमिति, अत्र प्रथमे त्रैराशिको तत्त्वसांख्यो भागहारो द्वितीयो गुणकारः ततस्तयोर्नष्टयोः शीघ्रकेन्द्रभुक्तेर्ज्यान्तरं गुणकारः। आद्यजीवा भागहारः फलं प्रतिमंडलस्थग्रहप्रदेशे स्फुटशीघ्रभुक्तिः सा च कक्षामंडले परिणाम्यते, तदर्थमुक्तं फलगुणितव्यासार्धं विभाजयेच्छीघ्रकर्णेन त्रैराशिकमिदं ततो यल्लब्धं सा शीघ्रकेन्द्रभुक्तिः स्फुटा कक्षामंडले। सा च ग्रहशीघ्रस्फुटगत्योरन्तरमतएव शीघ्रगतेः संशोध्य ग्रहस्य स्फुटभुक्तिर्भवति। लब्धमधिकं चेच्छीघ्रगतेर्यदा भवति, तदा विपरीतशोधने कृते वक्रभुक्तिर्भवति यस्माच्छीघ्रकर्णस्तदाल्पो भवति। कक्षामंडलस्योपरिस्थितत्वात्फलगुणितं व्यासार्धविभाजयेच्छीघ्रकर्णेन यावत् क्रियते तावच्छीघ्रगतेरप्यधिका शीघ्रकेन्द्रभुक्तिः स्फुटा भवति। दृग्भेदस्याधिकत्वात् स्वमध्यगतेः कक्षामंडलप्रतिमंडलावस्थितिवशेन ग्रहोपि प्राग्दिनाध्यासितप्रदेशावलंम्बितः पश्चादुपलभ्यते शीघ्रगतिः।

शीघ्रकेन्द्रस्फुटभुक्त्यन्तरगुणा अत उक्तं लब्धात्संशोध्य शीघ्रगतिर्वक्रगतिरिति सर्वमुपपन्नम्। स्वकृते सिद्धान्ते स्फुटीकरणस्य चान्याचार्यदूषणद्वारेण प्रशंसार्थमार्यात्रयमाह॥४१-४२-४३-४४॥

वि. भा.—ग्रहमन्दकेन्द्रगतिर्ज्यान्तरेण (भोग्यखण्डेन) गुणिता, आद्यजीवया (प्रथमज्यया) भक्ता यल्लब्धं तत्स्फुटपरिधिगुणितं, भगणांशै ३६०र्भक्तं लब्धाभिः कलाभिर्मृगकर्यादौ (मकरादिकेन्द्रे, कर्क्यादिकेन्द्रे च) स्वमध्यमगतिरूनाधिका तदाऽर्केन्द्वोः(रविचन्द्रयोः)स्फुटा गतिर्भवति, कुजादीनां ग्रहाणां मन्दगतिफलरहितां मध्यगतिं (मन्दस्पष्टगतिं) वदन्त्याचार्याः। स्वमन्दस्पष्टगतिरहिता शीघ्रोच्चगतिः कुजादिग्रहाणां शीघ्रकेन्द्रगतिर्भवति। तां (शीघ्रकेन्द्रगतिं) शीघ्रफलस्य ज्यायां क्रियमाणायां या भोग्यज्या (ज्यान्तरं) तया सङ्गुणितां कृत्वाऽऽद्यजीवया (प्रथमज्यया) विभजेत्, यल्लब्धं फलं तेन गुणितं व्यासार्धं (त्रिज्या) शीघ्रकर्णेन विभाजयेत्। लब्धेन रहिता शीघ्रगतिः (शीघ्रोच्चगतिः) स्फुटगतिर्भवति। चेत् (यदि) लब्धं फलं शीघ्रगतेः (शीघ्रोच्चगतेः) अधिकं तदा लब्धाच्छीघ्रोच्चगतिं संशोध्य शेषं कुजादिग्रहाणां वक्रगतिर्भवतीति ॥४१-४२-४३-४४॥

अत्रोपपत्तिः

मध्यस्पष्टभेदेन गतिर्द्विविधा भवति, या गतिः प्रतिक्षणं भिन्ना-भिन्ना भवति, सा स्पष्टाऽन्या मध्या, स्फुटा गतिरपि दैनिकतात्कालिकभेदेन द्विविधा भवति, तेन दैनिकमन्दस्पष्टागतिः, तात्कालिकमन्दस्पष्टागतिः। दैनिकस्पष्टागतिः, तात्कालिक-स्पष्टागतिः, आचार्येण दैनिकमन्दस्पष्टगतिः, दैनिकस्पष्टगतिश्चानीयते।

भू=भूकेन्द्रम्। भूल=मन्दान्त्यफलज्या। ल=मन्दग्रहगोलकेन्द्रम्। ग्र=मन्दप्रतिवृत्ते गणितागतमध्यग्रहः।उ=मन्दोच्चम्। ग्रउ=मन्दकेन्द्रम्। ग्रन=मन्दभुजफलम्=स्वल्पान्तरान्मन्दफलज्या। ग्रप=भूर=मन्दकेन्द्रज्या। ग्रश=मन्दान्त्यफलज्या, तदा भूरश, ग्रशन त्रिभुजयोः सजातीयत्वादनुपातः

$$\frac{\text{मंकेज्या} \times \text{मंअफज्या}}{\text{त्रि}} = \text{अद्यतनभुजफल}$$

$$= \text{अद्यतनमंफज्या} = \text{मंफज्या}$$

$$\text{एवं}\ \frac{\text{मंकेज्या}' \times \text{मंअंफज्या}}{\text{त्रि}} = \text{श्वस्तन-}$$

$$\text{भुजफल} = \text{श्वस्तनमंफज्या} = \text{मंफज्या}'$$

अनयोरन्तरम्

$$\frac{\text{मंअंफज्या}}{\text{त्रि}} \left(\text{मंकेज्या} \backsim \text{मंकेज्या}' \right) = \text{मंफज्या}' \backsim \text{मंफज्या} =$$

$\frac{\text{मंग्रंफज्या}}{\text{त्रि}}\times$ मन्दकेन्द्रज्यान्तर = मन्दफलज्यान्तर = मन्दफलान्तर

= मन्दगतिफलस्वल्पान्तरात्

अत्र $\frac{\text{मन्दकेग}\times\text{भोग्यखं}}{\text{प्रथमच।}}=\frac{\text{मंकेग}\times\text{भोग्यखं}}{\text{प्रथमज्या}}$ = मन्दकेज्यान्तर

एतदुत्थापनेन $\frac{\text{मंग्रंफज्या}}{\text{त्रि}}\times\frac{\text{मंकेग}\times\text{भोखं}}{\text{प्रथमज्या}}$ = मन्दगतिफल,

परन्तु $\frac{\text{मंग्रंफज्या}}{\text{त्रि}}=\frac{\text{मंपरिधि}}{\text{३६०}}$

अत उत्थापनेन $\frac{\text{मंपरिधि}}{\text{३६०}}\times\frac{\text{मंकेग}\times\text{भोखं}}{\text{प्रथमज्या}}$ = मन्दगतिफल, एतावताऽऽचार्योक्तं, मन्दकेन्द्रगतिरर्कचन्द्रयोर्ज्यान्तरेण गुणिता हृता ऽऽद्यया, जीवया स्वपरिणाहताडिता खर्तुराम ३६० विहृता गतेः फलम्, श्रीपत्युक्तमिदं सूर्यसिद्धान्तकारोक्तमन्दगतिफलानयनं चोपपद्यते, श्रीपतिसूर्यसिद्धान्तकारमते प्रथमज्या = २२५ । तत्रैव मन्दगतिफलस्वरूपे भांशपरिधिप्रमाणे $\frac{२}{९}$ ऽनेनापवर्तिते तदा पूर्वानीतमन्दगतिफलम् =

$\frac{\text{मंकेग}\times\text{भोखं}}{\text{प्रथमज्या}}\times\frac{\frac{\text{२ परिधि}}{\text{९}}}{\frac{\text{२}\times\text{३६०}}{\text{९}}}=\frac{\text{मंकेग}\times\text{भोखं}}{\text{प्रथमज्या}}\times\frac{\text{स्फुगुणक}}{\text{८०}}$, $\frac{\text{२ परिधि}}{\text{९}}$ = स्फुगुणक,

$\frac{\text{२}\times\text{३६०}}{\text{९}}$ = ८० एतावता 'ज्याखण्डकेन गुणिता मृदुकेन्द्रजेन भुक्तिर्ग्रहस्य शरयुग्मयमैर्विभक्ता, क्षुण्णा स्फुटेन गुणकेन हृता खनागैः लिप्ता गतेः फलमृणं धनमुक्तवच्च' लल्लोक्तमिदमुपपद्यते । अत्रापि प्रथमज्या = २२५, अन्यत्सर्वं समानमेव । मन्दगतिफलानयनं केषामपि समीचीनं नास्तीति पूर्वोक्तोपपत्तिदर्शनेनैव स्फुटं भवति, केवलं भास्कराचार्येण तत्साधनं यत्कृतं तत्समीचीनमस्ति, यद्यपि भास्करोक्तं 'कोटीफलघ्नी मृदुकेन्द्रभुक्तिरित्यादिना' मन्दगतिफलानयनं समीचीनमित्येतदर्थं 'वटेश्वरसिद्धान्ते' वासना प्रतिपादिताऽस्ति मया, तथाप्यत्रापि प्रतिपाद्यते ।

$\frac{\text{मंग्रंफज्या}\times\text{मंकेज्या}}{\text{त्रि}}$ = मंफज्या, पक्षयोस्तात्कालिकगत्यानयनेन $\frac{\text{मंग्रंफज्या}}{\text{त्रि}}\times$

$\frac{\text{मंकेकोज्या}\times\text{मंकेग}}{\text{त्रि}}=\frac{\text{मंगफ}\times\text{मंफकोज्या}}{\text{त्रि}}$

$\therefore$ मंगफ $=\frac{\text{मंग्रंफज्या}}{\text{त्रि}}\times\frac{\text{मंकेकोज्या}\times\text{मंकेग}}{\text{त्रि}}\times\frac{\text{त्रि}}{\text{मंफकोज्या}}=$

$$\frac{\text{मंकोटिफल}\times\text{मंकेग}}{\text{त्रि}}\times\frac{\text{त्रि}}{\text{मंफकोज्या}}=\frac{\text{भास्करोक्तमंगफल}\times\text{त्रि}}{\text{मंफकोज्या}},$$

यतः $\frac{\text{मंकोटिफल}\times\text{मंकेग}}{\text{त्रि}}=\text{भास्करोक्तमन्दगतिफ}$ ।

एतावता सिद्धं यद्भास्करोक्तं मन्दगतिफलं त्रिज्यया गुणितं मन्दफलकोटिज्यया भक्तं तदा वास्तवं मन्दगतिफलं भवेदिति एतेन च 'भास्करोक्तं गतिफलं त्रिज्यया गुणितं हृतम् । मन्दोयफलकोटिज्यामानेन भवति स्फुटमिति' विशेषोक्तसूत्रमुपपद्यते ॥

तातो मन्दस्फुटगतिप्रमाणमानीयते

प्रथमे पदे द्वितीये पदे च (मकरादिकेन्द्रे) अद्यतनमध्यग्र—अद्यतनमंफ =अद्यतनमंस्पग्र.

श्वस्तनमध्यग्र—श्वस्तनमंफ=श्वस्तनमंस्पग्र.

अनयोरन्तरेण मध्यग—मन्दगतिफ=मंस्पगति, कुजादिग्रहाणाम्

तृतीय पदे चतुर्थं पदे च (कर्क्यादिकेन्द्रे) अद्यतनमध्यग्र+अद्यतनमंफ =अद्यतनमंस्पग्र.

श्वस्तनमध्यग्र+श्वस्तनमंफ=श्वस्तनमंस्पग्र.

अनयोरन्तरेण

कुजादिग्रहाणां मध्यगति+मन्दगतिफल=मंस्पगति, रविमग ∓ रविमंगफल = रविस्पष्टगति,

चंमग ∓ चंमंगफल=चन्द्रस्पष्टगति.

अथ स्पष्टगतिसाधनार्थमुपपत्तिः

$\frac{\text{शीकेज्या}\times\text{त्रि}}{\text{शीक}}=\text{स्पकेज्या}$ । द्वितीयदिने $\frac{\text{शीकेज्या}'\times\text{त्रि}}{\text{शीक}}=\text{स्पकेज्या}'$,

अत्र शीकेज्या=मंस्पकेज्या

अनयोरन्तरम्

$$\frac{\text{त्रि}\ (\text{शीकेज्या}'\backsim\text{शीकेज्या})}{\text{शीक}}=\text{स्पकेज्या}'\backsim\text{स्पकेज्या}=\frac{\text{त्रि}\times\text{शीकेज्यान्तर}}{\text{शीक}}$$

=स्पकेज्यान्तर, शीक=शीघ्रकर्णः

परन्तु $\frac{\text{भोखं}\times\text{शीकेग}}{\text{प्रथमचा}}$=शीकेज्यान्तर, अत उत्थापनेन $\frac{\text{त्रि.}}{\text{शीक}}\times\frac{\text{भोखं}\times\text{शीकेग}}{\text{प्रथमचा}}$

$=\frac{\text{त्रि.}}{\text{शीक}}\ \frac{\text{भोख}\times\text{शीकेग}}{\text{प्रज्या}}$=स्पष्टकेज्यान्तर = स्पकेन्द्रान्तर = स्पकेग, स्वल्पान्तरात् । ततः अद्यतनशीउ—अद्यतनस्पग्र=अद्यतनस्पके तथा श्वस्तनशीउ—श्वस्तनस्पग्र=श्वस्तनस्पके, अनयोरन्तरम्=शीउग—स्पग=स्पकेग

ततः शीउग—स्पकेग=स्पगति, यदि शीउग<स्पकेग तदा विलोमशोधनेन वक्रा गतिः=ऋणात्मिका गतिर्भवेदेतावताऽऽचार्योक्तं सर्वमुपपन्नम् । सिद्धान्तशेखरे—

चञ्चलकेन्द्रगतिः फलभोग्यज्यागुणिता ऽऽद्यगुणेन २२३ विभक्ता ।
व्यासदल ३४१५ म्रफलं श्रुतिभक्तं तद्रहिताशुगतिः स्फुटभुक्तिः ॥
स्यादवनीतनयादिखगानां शीघ्रगतेः फलमभ्यधिकं चेत् ।
तत्फलतोऽपि विशोध्य शेषं वक्रगतिर्भवति द्युचराणाम्, ॥

इति श्रीपत्युक्तं स्पष्टगतिसाधनमाचार्योक्तानुरूपमेव, लल्लाचार्योक्तमपि स्फुटगतिसाधनमीदृशमेवास्ति, परं केषामप्याचार्याणां स्फुटगतिसाधनं न समीचीनमिति तदुपपत्तिदर्शनेनैव स्फुटं भवति, केवलं सिद्धान्तशिरोमणौ 'फलांशखाङ्कान्तरशिञ्जिनीघ्नी' त्यादिना भास्कराचार्येण तात्कालिकगत्या सूक्ष्मं स्पष्टगतिसाधनं कृतमिति विवेचकैर्विवेचनीयम् ॥४१-४२-४३-४४॥

अब ग्रहों की मन्दस्पष्टगति और स्पष्टगति को कहते हैं

हि. भा.—मन्दकेन्द्र गति को ज्यान्तर (भोग्यखण्ड) से गुणाकर प्रथमज्या से भाग देकर जो लब्धि हो उसको स्फुट परिधि से गुणाकर भगणांश ३६० से भाग देकर जो लब्ध कला हो उसको मकरादि केन्द्र में अपनी मध्यम गति में घटाने से और कर्क्यादिकेन्द्र में जोड़ने से रवि और चन्द्र की स्पष्टगति होती है, अपनी मध्यगति में मन्दगति फल को संस्कार करने से कुजादि ग्रहों की मन्दस्पष्टगति होती है, अपनी मन्दस्पष्टगति को शीघ्रोच्चगति में घटाने से कुजादि ग्रहों की शीघ्रकेन्द्रगति होती है, शीघ्रकेन्द्रगति को भोग्य खण्ड से गुणा कर प्रथमज्या से भाग देने से जो लब्धि हो उसको व्यासार्ध (त्रिज्या) से गुणा कर शीघ्रकर्ण से भाग देने से जो लब्धि हो उसको शीघ्रोच्चगति में घटाने से स्फुटगति होती है, यदि लब्धि शीघ्रोच्चगति से अधिक हो तब लब्धि में शीघ्रोच्चगति को घटाकर जो शेष रहता है वह कुजादि (मङ्गलादि) ग्रहों की वक्रगति होती है. इति ॥४१-४२-४३-४४॥

उपपत्ति

मध्य और स्पष्टभेद से गति दो तरह की होती है, प्रतिक्षण में जो गति भिन्न होती है, वह स्पष्टगति है, जो प्रतिक्षण में भिन्न नहीं होती है वह मध्यगति है। स्पष्टगति भी दैनिक और तात्कालिक भेद से दो प्रकार की होती है, दैनिकमन्दस्पष्टगति, तात्कालिक-मन्दस्पष्टगति, दैनिकस्पष्टगति, तात्कालिकस्पष्टगति, आचार्य दैनिकमन्दस्पष्टगति और स्पष्टगति का साधन करते हैं। संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये।

भू = भूकेन्द्र, भूल = मन्दान्त्यफलज्या, ल = ग्रहमन्दगोलकेन्द्र, ग्र = मन्दप्रतिवृत्त में गणितागतमध्यमग्रह। उ = मन्दोच्च, ग्रउ = मन्दकेन्द्र, ग्रन = मन्दभुजफल = मन्दफलज्या स्वल्पान्तर से, ग्रन = भूर = मन्दकेन्द्रज्या, ग्रग = मन्दान्त्यफलज्या, भूरग, ग्रगन दोनों त्रिभुज सजातीय हैं इसलिये अनुपात करते हैं,

$$\frac{\text{मंकेज्या} \times \text{मंअंफज्या}}{\text{त्रि}} = \text{अद्यतनभुजफल} = \text{अद्यतनमन्दफलज्या}, = \text{मंफज्या},$$

$$\frac{\text{मंकेज्या}' \times \text{मंअंफज्या}}{\text{त्रि}} = \text{श्वस्तनभुजफल} = \text{श्वस्तनमंदफलज्या} = \text{मंफज्या}',$$

दोनों का अंतर करने से

$$\frac{\text{मंअंफज्या}}{\text{त्रि}}(\text{मंकेज्या}' \backsim \text{मंकेज्या}) = \frac{\text{मंअंफज्या} \times \text{मंकेज्यान्तर}}{\text{त्रि}} = \text{मंफज्या}' \backsim \text{मंफज्या} =$$

मन्दफलज्यान्तर = मन्दफलान्तर = मंगतिफल

स्वल्पान्तर से, परन्तु $\frac{\text{मन्दकेग} \times \text{भोखं}}{\text{प्रथमचाप}} = \frac{\text{मंकेग} \times \text{भोखं}}{\text{प्रथमज्या}} = \text{मन्दकेन्द्रज्यान्तर}$, उत्थापन देने से

$$\frac{\text{मंअंफज्या}}{\text{त्रि}} \times \frac{\text{मंकेग} \times \text{भोखं}}{\text{प्रथमज्या}} = \text{मंगतिफल}$$ । परन्तु $\frac{\text{मंअंफज्या}}{\text{त्रि}} = \frac{\text{मंपरिधि}}{\text{भाग}} = \frac{\text{मंपरिधि}}{३६०}$

अतः $\frac{\text{मंपरिधि}}{३६०} \times \frac{\text{मंकेग} \times \text{भोखं}}{\text{प्रथमज्या}} = \text{मंगतिफल}$, इससे आचार्योक्त उपपन्न हुआ, सिद्धान्तशेखर में "मन्दकेन्द्रगतिरर्कचन्द्रयोः" इत्यादि संस्कृतोपपत्ति में लिखित श्रीपत्युक्तप्रकार, तथा सूर्यसिद्धान्तकारोक्त मन्दगति फलानयनप्रकार भी उपपन्न हुआ, उसी मन्दगतिफलस्वरूप में भांश और परिध्यंश को $\frac{२}{९}$ इससे अपवर्तन देने से मन्दगतिफल

$$= \frac{\text{मंकेग} \times \text{भोखं}}{\text{प्रज्या}} \times \frac{\frac{२\ \text{परिधि}}{९}}{\frac{२ \times ३६०}{९}} = \frac{\text{मंकेग} \times \text{भोखं}}{\text{प्रज्या}} \times \frac{\text{स्फुगुणक}}{८०}, \quad \frac{२\ \text{परिधि}}{९} = \text{स्फुगुणक}$$

इससे 'ज्याखण्डकेन गुणिता' इत्यादि संस्कृतोपपत्ति में लिखित लल्लोक्त मन्दगतिफलानयन उपपन्न होता है, मन्दगतिफलानयन किसी भी आचार्य का ठीक नहीं है, यह पूर्वोक्तोपपत्ति देखने ही से स्पष्ट है। केवल भास्कराचार्योक्त मन्दगतिफलानयन ठीक है, यद्यपि वटेश्वर-सिद्धान्त में इस विषय को हम दिखला चुके हैं, तथापि यहाँ लिखते हैं।

$\frac{\text{मंअंफज्या. मंकेज्या}}{\text{त्रि}}$ = मंफज्या, दोनों पक्षों की तात्कालिक गति लेने से

$\frac{\text{मंअंफज्या}}{\text{त्रि}} \times \frac{\text{मंकेकोज्या. मंकेग}}{\text{त्रि}} = \frac{\text{मंगफ. मंफकोज्या}}{\text{त्रि.}}$ अतः $\frac{\text{मंअंफज्या}}{\text{त्रि}} \times \frac{\text{मंकेकोज्या. मंकेग}}{\text{त्रि}}$

$\times \frac{\text{त्रि}}{\text{मंफकोज्या}} = \frac{\text{मंकोफ. मंकेग}}{\text{त्रि}} \times \frac{\text{त्रि}}{\text{मंफकोज्या}} = \frac{\text{भास्करोक्तमन्दगतिफल. त्रि}}{\text{मंफकोज्या}}$ = मन्दगतिफल,

$\because \frac{\text{मंकोफ. मंकेग}}{\text{त्रि}}$ = भास्कर मंगफ,

इससे सिद्ध हुआ कि भास्करोक्त मन्दगतिफल को त्रिज्या से गुणाकर मन्दफलकोटिज्या से भाग देने से वास्तवमंदगति फल होता है, इससे 'भास्करोक्तं गतिफलं त्रिज्यया गुणितं' इत्यादि संस्कृतोपपत्ति में लिखित म. म. सुधारक द्विवेदी जी का सूत्र भी उपपन्न होता है.

मन्दस्पष्टगति प्रमाण लाते हैं

प्रथम पद में और द्वितीय पद में (मकरादि केन्द्र में) अद्यतनमध्यग्र—अद्यतनमंफ
=अद्यतनमंस्पग्र

श्वस्तनमध्यग्र—श्वस्तनमंफ=श्वस्तनमंस्पग्र

दोनों का अंतर करने से

कुजादि ग्रहों की मध्यगति—मंन्दगतिफल=मंदस्पष्टगति,

तृतीय पद में और चतुर्थ पद में (कर्क्यादिकेन्द्र में) अद्यतनमध्यग्र+अद्यतनमंफ
=अद्यतनमंस्पग्र.

श्वस्तनमध्यग्र+श्वस्तनमंफ =श्वस्तनमंस्पग्र.

दोनों का अन्तर करने से

कुजादि ग्रहों की मध्यगति+मंगतिफल=मंदस्पगति

रविमध्यगति ∓ रमंगतिफल=स्परविगति

एवं चंमध्यगति ∓ चंमंगतिफल=चंस्पष्टगति

अब स्पष्टगति साधन के लिये उपपत्ति

$\frac{\text{शीकेज्या.त्रि}}{\text{शीक.}}$ = स्पकेज्या, द्वितीय दिन में $\frac{\text{शीके'ज्या. त्रि}}{\text{शीक}}$ = स्पके'ज्या, यहां शीकेज्या = मन्द-स्पष्टकेन्द्रज्या, शीक = शीघ्रकर्ण.

दोनों का अन्तर करने से

$\frac{\text{त्रि (शीके'ज्या — शीकेज्या)}}{\text{शीक}}$ = स्पके'ज्या — स्पकेज्या = $\frac{\text{त्रि. शीकेज्यान्तर}}{\text{शीक}}$ = स्पकेज्यान्तर

परन्तु. $\frac{\text{भोग्यं. शीकेग}}{\text{प्रथमचा}}$ = शीकेज्यान्तर, उत्थापन करने से $\frac{\text{त्रि}}{\text{शीक}} \times \frac{\text{भोग्यं. शीकेग}}{\text{प्रथमचा}} = \frac{\text{त्रि}}{\text{शीक}}$

$\times \frac{\text{भोखं. शीकेग.}}{\text{प्रज्या}}$ = स्पष्टकेज्यान्तर = स्पकेन्द्रान्तर = स्पकेग स्वल्पान्तर से

∴ अद्यतनशीउ — अद्यतनस्पग्र = अद्यतनस्पके, श्वस्तनशीउ — श्वस्तनस्पग्र = श्वस्तन-स्पके, दोनों का अन्तर करने से शीउग — स्पग = स्पकेग ∴ शीउग — स्पकेग = स्पग; यदि शीउग < स्पकेग तब विलोमशोधन से ऋणात्मिकागति = वक्रगति होती है, इससे आचार्योक्त उपपन्न हुआ। सिद्धान्तशेखर में 'चञ्चलकेन्द्रगतिः फलभोग्यज्यागुणिता' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपत्युक्त, स्पष्टगति साधन आचार्योक्तानुरूप ही है, लल्ला-चार्योक्त स्पष्टगति साधन भी ऐसा ही है, लेकिन किसी भी आचार्य से कहा गया स्फुटगति साधन ठीक नहीं है, यह विषय पूर्वोक्तोपपत्ति देखने ही से स्पष्ट है, केवल सिद्धान्तशिरोमणि में 'फलांशखाङ्कान्तरशिञ्जिनीघ्नी' इत्यादि से तात्कालिकस्पष्टगति से भास्करोक्त स्पष्ट-गति साधन सूक्ष्म है, इसको विवेचक लोग विचारें इति ॥४१-४२-४३-४४॥

अत्र विशेषविचारः

अत्र "फलांशखाङ्कान्तरशिञ्जिनीघ्नी" त्यादि भास्करीयविधानेन—

स्पष्टकेन्द्रगतिः = $\frac{\text{कोज्याफ} \times \text{शीकेग}}{\text{क}}$

अथवा स्पकेग = शीकेग — गफ

∴ शीकेग — गफ = $\frac{\text{कोज्याफ} \times \text{शीकेग}}{\text{क}}$

वा शीकेग.क — गफ.क = कोज्याफ.शीकेग.

समीकरणेन—

गफ = $\frac{\text{शीकेग (क — कोज्याफ)}}{\text{क}}$ .... (१)

एतेन "मन्दस्फुटीकृतां भुक्तिं प्रोज्झ्य शीघ्रोच्चभुक्तितः। तच्छेषं विवरेणासौ हन्यात्त्रिज्यान्त्यकर्णयो" रित्यादिसूर्यसिद्धान्तोक्तं शीघ्रगतिफलमुपपद्यते।

अत्रैव गूढार्थप्रकाशे रङ्गनाथस्तु तात्कालिकया गत्या शीघ्रगतिफलं (१) समीकरणेन समानीय "त्रिज्यान्त्यकर्णयो" रित्यत्र सौरवचसि त्रिज्याशब्देन शीघ्रफलकोटिज्यां परिगृह्य सौरमतं समर्थयति। अत्रैव सौरवासनायां कमलाकरैस्तु लल्लमतमण्डनार्थं त्रिज्यामेवाङ्गीकृत्य बहूपपादितम्। तन्नादरणीयमिति सुधावर्षिण्यां तत्प्रणेतारः परमगुरुचरणा वदन्ति। त्रिषु राशिषु फलशोधनेन या ज्या सैवात्र त्रिज्येत्यर्थं विधाय रङ्गनाथमतं समर्थयन्ति च अन्यथा "वृत्तद्वययोगगे द्युचरे मध्यैव गतिः स्पष्टे" ति लल्लवचसा वृत्तद्वययोग एव सौरमतेनापि मध्यगतिः स्पष्टगतेः समा भवेत्। तन्न समीचीनम्। "कक्षामध्यगतिर्यग्रेखाप्रतिवृत्तसंपाते" तस्य समत्वसिद्धेः।

इदानीं स्पष्टीकरणमिदं कस्मै न देयमित्याह

देयमसुताय नेदं शपथैरपि दत्तसुकृतनाशाय।
यात्राविवाहजातकफलस्फुटत्वं यतः स्पष्टैः ॥४५॥

वा. भा.—वासनाभाष्यं नास्ति।

वि. भा.—यतः (यस्मात् कारणात्) स्पष्टैः (स्पष्टग्रहैरेव) यात्राविवाहजातकफलानां स्फुटत्वं भवति, अतः शपथैरपीदं स्पष्टीकरणं असुताय (अपुत्राय) न देयमन्यथा दत्तसुकृतनाशाय (दातुः शोभनकर्मनाशाय) भवति, केवलं भक्ताय, स्वान्ते चिरवासिने शिष्याय देयमिदमिति ॥४५॥

अब स्पष्टीकरण किसके लिये नहीं देना चाहिये कहते हैं

हि. भा.—जिस कारण से स्पष्टग्रहों ही से यात्रा-विवाह-जातकफलों की स्फुटता होती है, इसलिये शपथ खाने से भी इस स्पष्टीकरण को अपुत्र के लिये नहीं देना चाहिये अर्थात् भक्त, बहुत दिनों तक अपने पास रहने वाले विद्यार्थियों के लिये देना चाहिये, अपुत्र को देने से किये हुये सुन्दर कर्मों का नाश होता है इति ॥४५॥

इदानीमार्यभटादीनां दोषमाह

मेषादितः प्रवृत्ता नार्यभटस्य स्फुटा युगस्यादौ।
श्रीषेणस्य कुजाद्याः खेटाः सर्वे हि विष्णुचन्द्रस्य ॥४६॥
न दृष्टाः स्पष्टाः श्रीषेणार्यभटविष्णुचन्द्रेषु।
यस्मात्कुजादयस्ते विदुषां नैवादरस्तस्मात् ॥४७॥

वा. भा.—वासनाभाष्यं नास्ति।

वि. भा.—आर्यभटस्य श्रीषेणस्य विष्णुचन्द्रस्य सर्वे कुजाद्याः खेटाः (मङ्गलादिग्रहाः) युगस्यादौ मेषादितो न प्रवृत्ता अर्थात्कुजाद्याः सर्वे ग्रहा युगादौ मेषादौ नाऽसन्नतन्ते स्पष्टा न सन्तीति, यस्मात्कारणात्-श्रीषेणार्यभटविष्णुचन्द्रेषु-अर्थात्तत्तन्त्रेषु ते कुजादयो ग्रहाः स्पष्टा न दृष्टा- (न दृश्योग्या) स्तस्मात्कारणात् विदुषां (पण्डितानां) मध्ये नैवादरो (अर्थात्तेषां तन्त्राणां विद्वत्समाजे आदरो न) ऽस्तीति ॥४६-४७॥

अब आर्यभटादि आचार्यों के दोष को कहते है

हि. भा.—आर्यभट-श्रीषेण-विष्णुचन्द्र इन आचार्यों के तन्त्रों में मङ्गलादि सब ग्रह युग के आदि में मेषादि से प्रवृत्त नहीं हुये इसलिये वे स्पष्ट नहीं हैं, अर्थात् उनके मत में मङ्गलादि सब ग्रह युगादि में मेषादि में नहीं थे, जिस कारण से श्रीषेण-आर्यभट-विष्णुचन्द्र इन आचार्यों के तन्त्रों में वे कुजादि ग्रह स्पष्ट नहीं है। उस कारण से पण्डितों के मध्य में उनका आदर नहीं है इति ॥४६-४७॥

इदानीं भौमादिग्रहाणां वक्रारम्भकालिकान्
मार्गारम्भकालिकांश्च शीघ्रकेन्द्रांशानाह

अग्न्यष्टिभि १६३ रिषुमनुभिः १४५ शरसूर्यै १२५
रिषुरसेन्दुभि १६५ स्त्रिभवैः ११३
शीघ्रान्त्यकेन्द्रमार्गैर्भौमादीनां भवति वक्रम् ॥४८॥

चक्रांशकैस्तदूनैरनुवक्रं तदधिकोनभागकलाः ।
मन्दफलस्फुटभुक्त्यूनशीघ्रभुक्त्या हृता दिवसाः ॥४९॥

वा. भा.—शीघ्रान्त्यकेन्द्रभागैः रविशेषे कर्मणि यच्छीघ्रकेन्द्रं तद्भागकेन्द्रं कृत्वा वक्रं निरूपयेत् । भौमादीनां यथासंख्यं तद्यथा भौमस्याग्न्यष्टिभिः १६३, बुधस्येषुमनुभिः १४५, गुरोः शरसूर्यैः १२५, शुक्रस्येषुरसेंदु १६५, शनेस्त्रिभवैः ११३ एतैर्भागैः राश्यादिकेन्द्राणि भौमस्य ५२३ बुधस्य च २५ जीव ५ शुक्रस्य १५ शनेः ३२३ चक्रांशकैस्तदूनैरनुवक्रमिति । प्रत्येकस्य वक्रकेन्द्रचक्रार्धाद्विशोध्य यथा स्वमनुवक्रं केन्द्रं भवति कृतेव भौमादीनामनुवक्रे केन्द्राणि भौ ६।७ बु०।७।५ जी ७।१५। शु६।१५ शनेः ८७ यत्र दिनेऽन्त्यशीघ्रकेन्द्रवक्रकेन्द्रं तुल्यं भवति । तत्र दिने ग्रहस्य वक्रः । यत्र दिने अनुवक्रकेन्द्रतुल्यं तत्र दिने ग्रहस्यानुवक्रः एतावती तौ च वक्रानुवक्रौ यथा ज्ञायेते तदर्थमिदमुक्तम् । तदधिकोनभागकलाः तेषां वक्र-भागानामनुक्रवभागानां वा स्वशीघ्रकेन्द्रभागैस्तद्दैवसिकैः सहान्तरे कृते ये भागाः अधिका ऊना वा भवन्ति तेषां कला कार्यास्ताश्च कला मन्दफलस्फुटभुक्त्यूनशीघ्र-भुक्त्या हृता इत्यर्थः । दिवसत्वं व्रजन्ति फलं दिवसादिकः कालो वक्रस्यानुवक्रस्य

वा भवतीत्यर्थः। पादे शीघ्रकेन्द्रमधिकं तदतीतस्य अथ वक्रानुवक्रकेन्द्रमधिकमतस्तस्यैव वक्रानुवक्रदिनं ज्ञात्वा सकृद्ग्रहः स्फुटः कार्यस्तदन्त्यशीघ्रकेन्द्रवक्रानुवक्रौ निरूप्याविति अत्रेयं वासना। भूमध्याच्छीघ्रनीचोच्चवृत्तमध्यं यावदूर्ध्वा कोटिः परमफलज्यातुल्यं शीघ्रनीचोच्चवृत्तव्यासार्धं भुजा पूर्वेणापरेण वा तयोर्वर्गयुति मूलं तिर्यक्कर्णः परमफलज्या ग्राह्या भूमध्यं यावत्तस्य कर्णस्य शीघ्रनीचोच्चवृत्तशलाकायाश्चान्तरे यावच्छीघ्रनीचोच्चवृत्तमुत्पादयेत् भ्रमति प्रतिमंडलपरिधौ स च तत्र प्रदेशे पश्चाद्गच्छन्नुपलभ्यते। तस्मादुपपन्नं सर्वं गोले दर्शयेत्। 'कक्षामंडलादीनि विन्यस्य यद्येकैवेति ॥४८ ४९॥

वि. भा.—अग्न्यष्टिभिरिषुमनुभिरित्यादिपठितशीघ्रकेन्द्रांशैर्भौमादिग्रहाणां वक्रं भवेदर्थादेरटितैरेतैः शीघ्रकेन्द्रांशैस्तेषां वक्रारम्भो भवति, तद्रहितैश्चक्रांशै ३६०रनुवक्रमर्थान्मार्गारम्भः। मन्दफलस्फुटभुक्तिः (मन्दस्पष्टागतिः) तदूना (तद्रहिता) शीघ्रभुक्तिः (शीघ्रोच्चगतिः) शीघ्रकेन्द्रगतिर्भवति तया तदधिकोनभागकलाभक्तास्तदा गतैष्या दिवसा भवन्ति, शीघ्रान्त्यकेन्द्रभागैरसकृद्विधिनाऽविशेषकर्मणि स्थिरीभूतैः केन्द्रांशैरिति ॥४८-४९॥

अत्रोपपत्तिः

अथ शीउग—स्पकेग=स्पगति, यदा च शीउग<स्पकेग तदा विलोमशोधनेन वक्रा गतिर्भवितुमर्हति, परमेवं कुत्र स्थितिरिति विचार्यते, फलांशखाङ्कान्तरशिञ्जिनीघ्नीत्यादिभास्करोक्तप्रकारेण $\frac{\text{फकोज्या} \times \text{शीकेग}}{\text{शीक}}$=स्पकेग.

एतत्स्वरूपदर्शनेन सिद्ध्यति यद्यत्र फलकोटिज्यायाः परमत्वं शीघ्रकर्णे च परमाल्पत्वं भवेत्तत्रैव स्पष्टकेन्द्रगतेः परमाधिकत्वं भवितुमर्हति, नीचस्थाने फलाभावात्फलकोटिज्यायाः परमत्वं भवति, कर्णस्य परमाल्पत्वमपि तत्र भवत्यतो नीचस्थान एव स्पष्टकेन्द्रगतेः पराधिक्यं भवितुमर्हति तेनै शीउग<स्पकेग तस्य सम्भावना नीचस्थाने एव भवेदर्थात्तत्रैव ग्रहा वक्रगतिका भवन्ति, परन्तु वक्रगतित्वारम्भस्तु ततः (नीचात्) पूर्वत एव भवितुमर्हत्यतः कियन्मिते शीघ्रकेन्द्रांशे वक्रारम्भो भवतीति विचार्यते।

कल्प्यते वक्रारम्भकालिककेन्द्रकोटिज्यामानम्=य

फलांशखाङ्कान्तरशिञ्जिनीघ्नी द्राक्केन्द्रभुक्तिरित्यादिभास्करोक्त्या

$\frac{\text{फकोज्या}=\text{केग}}{\text{कर्ण}}$=स्पकेग, नीचस्थानस्य कर्क्यादिकेन्द्रे विद्यमानत्वात् कर्क्यादिकेन्द्रिककर्णः=$\sqrt{\text{त्रि}^2+\text{अंफज्या}^2-2\,\text{अंफज्या}\times\text{य}}$, तथा द्राक्केन्द्रकोटिमौर्व्यान्त्य-

फलज्या गुणया क्रमादित्यादिसिद्धान्तशिरोमणिग्रन्थसंशोधकोक्त्या फलकोटिज्या प्रमाणम्

$=\frac{\text{त्रि}^2-\text{य}\times\text{अंफज्या}}{\text{कर्णः}}$, ततः $\frac{\text{फकोज्या}\cdot\text{केग}}{\text{कर्ण}}=\text{स्पकेग}=\frac{(\text{त्रि}^2-\text{य}\times\text{अंफज्या})\,\text{केग}}{\text{कर्णं}}$

कर्णवर्गस्योत्थापनात् $\frac{(\text{त्रि}^2-\text{य}\times\text{अंफज्या})\,\text{केग}}{\text{त्रि}^2+\text{अंफज्या}^2-2\,\text{अंफज्या}\cdot\text{य}}=\text{स्पकेग}$। अत्र केग = शीघ्रकेन्द्रगतिः, कर्ण = शीघ्रकर्णः परन्तु वक्रारम्भे ग्रहस्पष्टगतिः = ०, तेन शीघ्रोच्चगतिः = स्पष्टकेगतिः, शीघ्रोच्चगतिः = उग, ।

$$\text{ततः}\ \frac{(\text{त्रि}^2-\text{य}\cdot\text{अंफज्या})\,\text{केग}}{\text{त्रि}^2+\text{अंफज्या}^2-2\,\text{अंफज्या}\cdot\text{य}}=\text{उग}$$, छेदगमेन

$\text{त्रि}^2\cdot\text{केग}-\text{य}\cdot\text{अंफज्या}\cdot\text{केग}=\text{त्रि}^2\cdot\text{उग}+\text{अंफज्या}^2\cdot\text{उग}-2\,\text{अंफज्या}\cdot\text{य}\cdot\text{उग}\cdot$ समशोधनेन $\text{त्रि}^2\cdot\text{उग}-\text{त्रि}^2\,\text{केग}+\text{अंफज्या}^2\cdot\text{उग}=2\,\text{अंफज्या}\cdot\text{य}\cdot\text{उग}-\text{य}\cdot\text{अंफज्या}\cdot\text{केग}$ तुल्यगुणकपृथक्करणेन $=\text{त्रि}^2\,(\text{उग}-\text{केग})+\text{अंफज्या}^2\cdot\text{उग}=\text{त्रि}^2\cdot\text{मंस्पग}+\text{अंफज्या}^2\cdot\text{उग}=\text{य}\cdot\text{अंफज्या}\,(2\,\text{उग}-\text{केग})$

$$=\text{य}\cdot\text{अंफज्या}\,(\text{उग}+\text{उग}-\text{केग})$$
$$=\text{य}\cdot\text{अंफज्या}\,(\text{उग}+\text{मंस्पग})$$

$$\text{अतः}\ \frac{\text{त्रि}^2\cdot\text{मंस्पग}+\text{अंफज्या}^2\cdot\text{उग}}{\text{अंफज्या}\,(\text{उग}+\text{मंस्पग})}=\text{य}\cdot$$ । अत्र मंस्पग = मध्यगति स्वीकृता

$=\frac{\text{त्रि}^2\cdot\text{मग}+\text{अंफज्या}^2\cdot\text{उग}}{\text{अंफज्या}\,(\text{उग}+\text{मग})}=\text{य}=\text{केकोज्या}$, अस्याश्चापं नवतियुतं तदा वक्रारम्भकाले शीघ्रकेन्द्रांशा भवेयु, एतावता "त्रिज्याकृतिः खचरमध्यमभुक्तिनिघ्नी शीघ्रोच्चभुक्तिगुणितोऽन्त्यफलस्य वर्गः । योगस्तयोः परफलज्यकया विभक्तः शीघ्रोच्च-भुक्तिखगवेगसमासहृच्च· ॥ लब्धस्य धनुषो भागा वियदङ्कसमन्विताः । वक्रारम्भे ग्रहस्य स्युः शीघ्रकेन्द्रलवाः स्फुटाः" संशोधकोक्तमित्युपपद्यते । अत्र मन्दस्पष्ट-मध्यमगत्योः समत्वकल्पनया प्रकारोऽयं न समीचीन इति विज्ञ ज्ञेयः ।

अत्र गणितं प्रदर्श्यते

मङ्गलस्य वक्रारम्भकालिककेन्द्रांशानयनाय तदन्त्यफलज्या = ७८, उच्चगतिः = ५९′।८″, त्रिज्या = १२०, शीघ्रकेन्द्रगतिः = २८′ स्वल्पान्तरात्, मङ्गलस्य मध्यमगतिः = ३१′।२६″

त्रि² = (१२०)² = १४४००, त्रि²·मग = १४४०० × ३१

= ४४६४००, तथा अंफज्या² = ७८² = ६०८४, उग = ५९

अंफज्या^{2} × उग = ६०८४ × ५९ = ३५८९५६, उग + मग
= (३१।२६) + (५९।८) = ९०।३४

अंफज्या = ७८, अंफज्या (उग + मग) = ७८ (९०।३४) = ७०६४,

त्रि^{2} · मग + अंफज्या^{2} · उग = ४४६४०० + ३५८९५६ = ८०५३५६

अतः $\frac{\text{त्रि.}^2 \text{ मग} + \text{अंफज्या.}^2 \text{ उग}}{\text{अंफज्या (उग + मग)}} = \frac{८०५३५६}{७०६४}$ = ११४ = य = शीघ्रकेन्द्रकोज्या,

अस्याश्चापम् = ७४°, नवतियुतं तदा मङ्गलस्य वक्रारम्भे शीघ्रकेन्द्रांशाः = १६४,° आचार्योक्तग्रहाणां वक्रारम्भकालिकशीघ्रकेन्द्रांशा एव लल्लाचार्येण, श्रीपतिना, भास्कराचार्येण च स्वस्वसिद्धान्ते प्रोक्ताः सूर्यसिद्धान्तोक्त 'मन्दस्फुटीकृतां भुक्ति प्रोह्य शीघ्रोच्चभुक्तितः। तच्छेषं विवरेणाथ हन्यात् त्रिज्यान्त्यकर्णयोरित्यादि' शीघ्रगतिफलानयनेऽस्मिन् यदि त्रिज्यान्त्यकर्णयोरित्यत्र त्रिज्याशब्देन त्रिज्याया एव ग्रहणं क्रियेत्तदा तदुक्तकेन्द्रांशा न मिलन्ति यथा तदुक्त्या $\frac{\text{केग. त्रि}}{\text{क}}$ = उग, ततः

केग. त्रि = उग. क वर्गकरणेन केग^2. त्रि^{2}. = उग^2. क^2 = उग^2 (त्रि^{2} + अंफज्या^{2} — २ केकोज्या. अंफज्या) = त्रि^{2} (उग^2 — २ उग. मग + मग^2) = उग.^{2} त्रि^{2} + उग^2. अंफज्या^{2} — उग^2. २ केकोज्या. अंफज्या = त्रि^{2}. उग^2 — २ उग. मग. त्रि^{2} + त्रि^{2}. मग^2. समशोधनेन

उग^2. अंफज्या^{2} — उग^2. २ केकोज्या. अंफज्या = त्रि^{2} मग^2 — २ उग. मग. त्रि^{2}. पुनः समशोधनेन

उग^2. २ केकोज्या. अंफज्या = उग^2. अंफज्या^{2} + २ उग. मग. त्रि^{2} — त्रि.^{2} मग^2
= उग^2. अंफज्या^{2} + त्रि^{2}. मग (२ उग — मग)

अतः $\frac{\text{उग}^2\text{. अंफज्या}^2 + \text{त्रि}^2\text{. मग (२ उग — मग)}}{\text{२ उग}^2\text{. अंफज्या}}$

$= \frac{\text{उग}^2\text{. अंफज्या}^2 + \text{त्रि}^2 \text{ (उग}^2 \text{ — केग}^2\text{)}}{\text{२ उग}^2\text{. अंफज्या}}$ = केकोज्या

अस्याश्चापं नवतियुतं तदा कमलाकरमतानुसारेण वक्रारम्भशीघ्रकेन्द्रांशा भवन्ति।

अत्र गणितं प्रदर्श्यते

कुजस्यान्त्यफलज्या = ७८, मध्यमागतिः = ३१'।२६'', उच्चगतिः ५९'।८',
त्रिज्या = १२०, शीघ्रगतिः = २८'

अंफज्या^{2} = ७८^2 = ६०८४, उग^2 = ३४८१, उग^2. अंफज्या^{2}
= ६०८४ × ३४८१ = २११७८४०४

केग^2 = २८^2 = ७८४, उग^2 — केग^2 = ३४८१ — ७८४ = २६९७, त्रि^{2}
= (१२०)^2 = १४४००

त्रि^{2} (उग^2 — केग^2) = २६९७ × १४४०० = ३८८३६८००

उग^2 अंफज्या^{2} + त्रि^{2} (उग^2 — केग^2) = २११७८४०४ + ३८८३६८००
= ६००१५२०४

२ उग^2 = ६९६२, अंफज्या = ७८, २ उग^2 × अंफज्या = ६९६२ × ७८
= ५४३०३६

अतः $\frac{\text{उग}^2 \text{ अंफज्या}^2 + \text{त्रि}^2(\text{उग}^2 - \text{केग}^2)}{\text{२ उग}^2 \text{. अंफज्या}} = \frac{\text{६००१५२०४}}{\text{५४३०३६}}$ = १११ अस्या-श्चापम् = ६८° नवतियुतं ६८° + ९०° = १५८° = कमलाकरमतानुसारेण वक्रारम्भकालिककुजशीघ्रकेन्द्रांशा आचार्योक्तशीघ्रकेन्द्रांश १६३° तो महदन्तरिता अतस्त्रिज्याशब्देन (त्रिषु राशिषु शीघ्रफलस्य विशोधनेन यच्छेषं तज्ज्याऽर्थाच्छीघ्रफलकोटिज्या) ति गूढप्रकाशे रङ्गनाथव्याख्या साधीयसी, यतः फलकोटिज्या सम्बन्धेनैव पूर्वमानीताः कुजवक्रकेन्द्रांशाः १६४ पाठपठिततत्केन्द्रांशेन सह तदन्तरम् = १, कमलाकरेण व्यर्थमेव रङ्गनाथमतं खण्डितमिति विवेचकैर्विवेचनीयम् ॥ नीचस्थानाद्यन्मितेऽन्तरे वक्रारम्भो भवति तद्विरुद्धदिशि तन्मित एवान्तरे वक्रत्यागो भवत्यतो वक्रारम्भकालिककेन्द्रांशहीना भगणांशाः ३६० मार्गारम्भ (वक्रत्यागकालिक) कालिकाः केन्द्रांशाः भवन्तीति ग्रहो वक्रत्वमवक्रत्वं वा गतो गमिष्यति वेत्येतदर्थमिष्टशीघ्रकेन्द्रांशेभ्यो वक्रावक्रपठितकेन्द्रांशा विशोध्याः शेषेणानुपातो यदि केन्द्रगत्यैकं दिनं लभ्यते तदा शेषेण किमित्यनेन लब्धदिनैर्वक्रत्वमवक्रत्वं ग्रहो गतो गमिष्यति वेति बोध्यम् ॥४८-४९॥

अब भौमादि ग्रहों के वक्रारम्भकालिक और मार्गारम्भकालिक शीघ्रकेन्द्रांश को कहते हैं

हि. भा.—१६३°, १४५°, १२५°, १६५°, ११३° इन पठित शीघ्र केन्द्रांशों में क्रमशः मङ्गलादि ग्रह वक्र होते हैं और इन्हीं को चक्रांश में घटाने से जो शेष रहते हैं उतने शीघ्र केन्द्रांश में वे अनुवक्र होते हैं, शीघ्रोच्चगति में मन्दस्पष्टगति को घटाने से शीघ्र केन्द्रगति होती है, पठितकेन्द्रांश से इष्टकेन्द्रांश के अधिक वा अल्प रहने से दोनों के अन्तर में केन्द्रगति से भाग देने से गतदिन और एष्यदिन होते हैं अर्थात् इष्टदिन से पहले वा पीछे ग्रह समागत दिनों में ग्रह वक्र या अवक्र हो गये होंगे या होंगे इति ॥४८-४९॥

उपपत्ति

शीउग—स्पकेग=स्पगति, जब शीउग $<$स्पकेग तब विलोमशोधन से वक्रगति होती है, लेकिन ऐसी स्थिति कहाँ होती है, इसके लिये विचार करते हैं। फलांशखाङ्कान्तर-शिञ्जिनीघ्नी इत्यादि भास्करोक्त प्रकार से $\frac{\text{फकोज्या. शीकेग}}{\text{शीक}}$ =स्पकेग इसको देखने से सिद्ध होता है कि जहाँ पर फलकोटिज्या का परमत्व होगा और शीघ्रकर्ण का परमाल्पत्व वहीं पर स्पष्ट केन्द्रगति का परमत्व हो सकता है, नीचस्थान में फलाभाव होने के कारण फलकोटिज्या का परमत्व होता है, तथा शीघ्रकर्ण का परमाल्पत्व होता है अतः शीउग $<$स्पकेग ऐसी स्थिति नीचस्थान ही में हो सकती है, परन्तु वक्रता का आरम्भ तो नीचस्थान से कुछ पहले ही से होगा, कितने शीघ्र केन्द्रांश में वक्रारम्भ होता है उस केन्द्रांश का साधन करते हैं।

कल्पना करते हैं वाक्ररम्भकालिक केन्द्रकोटिज्यामान=य

फलांशखाङ्कान्तरशिञ्जिनीघ्नी इत्यादि भास्करोक्त प्रकार से $\frac{\text{फकोज्या}\cdot\text{केग}}{\text{कर्ण}}$ =स्पकेग, नीचस्थान कर्यादि केन्द्र में है, नीचासन्न ही में वक्रारम्भ होता है अतः $\sqrt{\text{त्रि}^2+\text{अंफज्या}^2-2\ \text{अंफज्या}\times\text{य}}$=कर्ण; तथा द्राक्केन्द्रकोटिमौर्व्यान्त्यफलज्या गुणाया इत्यादि सिद्धान्तशिरोमणिस्थ संशोधकोक्त प्रकार से $\frac{\text{त्रि}^2-\text{य}\cdot\text{अंफज्या}}{\text{कर्ण}}$=फलकोज्या स्पष्टकेन्द्रगति स्वरूप में फलकोटिज्या और कर्ण का उत्थापन करने से $\frac{(\text{त्रि}^2-\text{य}\cdot\text{अंफज्या})\ \text{केग}}{\text{कर्ण}^2}=\frac{(\text{त्रि}^2-\text{य}.\ \text{अंफज्या})\ \text{केग}}{\text{त्रि}^2+\text{अंफज्या}^2-2\ \text{अंफज्या}\cdot\text{य}}$=स्पकेग, केग=शीघ्र-केन्द्रगतिः। कर्ण=शीघ्रकर्ण परन्तु वक्रारम्भ में स्पष्टगति=० इसलिये शीघ्रोच्चगति =स्पष्टकेग। शीउगति=उग.

$\frac{(\text{त्रि}^2-\text{य}\cdot\text{अंफज्या})\ \text{केग}}{\text{त्रि}^2+\text{अंफज्या}^2-2\ \text{अंफज्या}\cdot\text{य}}$=उग, छेदगम करने से।

$\text{त्रि}^2\ \text{केग}-\text{य}\cdot\text{अंफज्या}.\ \text{केग}=\text{त्रि}^2\ \text{उग}+\text{अंफज्या}^2\ \text{उग}-2\ \text{अंफज्या}\cdot\text{य}\cdot\text{उग}$ समशोधन करने से

$\text{त्रि}^2\ \text{उग}-\text{त्रि}^2\ \text{केग}+\text{अंफज्या}^2\cdot\text{उग}=2\ \text{अंफज्या}\cdot\text{य}\cdot\text{उग}-\text{य}\cdot\text{अंफज्या}\cdot\text{केग}$ तुल्यगुणक को पृथक् करने से

$$त्रि^2 (उग - केब) + अं फज्या^2 \cdot उग = त्रि^2 \cdot मंस्पग + अं फज्या^2 \cdot उग$$
$$= य \cdot अं फज्या (२ उग - केग)$$
$$= य \cdot अं फज्या (उग + उग - केग)$$
$$= य \cdot अं फज्या (उग + मंस्पग)$$

अतः $\frac{त्रि^2 \cdot मंस्पग + अं फज्या^2 \cdot उग}{अं फज्या (उग + मंस्पग)} = य$ । यहाँ मध्यमगति और मन्दस्पष्टगति को तुल्य मान लिया गया है $= \frac{त्रि^2 . मग + अंफज्या^2 . उग}{अं फज्या (उग + मग)} =$ केकोज्या, इसके चाप में नवत्यंश जोड़ने से वक्रारम्भ कालिक शीघ्र केन्द्रांश होता है, इससे "त्रिज्याकृतिः खचरमध्यमभुक्तिनिघ्नी इत्यादि संस्कृतोपपत्ति में लिखित संशोधकोक्त" सूत्र उपपन्न होता है, लेकिन यहाँ मन्दस्पष्टगति और मध्यमगति बराबर स्वीकार की गयी है, तज्जनित त्रुटि इसमें है।

यहाँ गणित दिखलाते हैं

मङ्गल के वक्रारम्भ कालिक केन्द्रांशानयन के लिये, मङ्गल की अन्त्यफलज्या $= ७८$, उच्चगति $= ५९'।८''$, त्रि $= १२०$, शीघ्रकेन्द्रगति $= २८'$ स्वल्पान्तर से, मध्यमगति $= ३१'।२६''$ ।

त्रि$^2 = (१२०)^2 = १४४००$, त्रि$^2 \cdot$ मग $= १४४०० \times ३१ = ४४६४००$, तथा
अं फज्या$^2 = (७८)^2 = ६०८४$, उग $= ५९$

अं फज्या$^2 \cdot$ उग $= ६०८४ \times ५९ = ३५८९५६$, उग + मग
$= (३१।२६) + (५९।८) = ९०।३४$

अं फज्या (उग + मग) $= ७८ (९०।३४) = ७०६४$,

त्रि$^2 \cdot$ मग + अं फज्या$^2 \cdot$ उग $= ४४६४०० + ३५८९५६ = ८०५३५६$,

अतः $\frac{त्रि^2 मग + अं फज्या^2 \cdot उग}{अं फज्या (उग + मग)} = \frac{८०५३५६}{७०६४} = ११४ = य =$ शीघ्रकेकोज्या, इसका चाप $= ७८°$, नवत्यंश जोड़ने से मङ्गल का वक्रारम्भ कालिक शीघ्रकेन्द्रांश हुआ $७४° + ९०° = १६४°$, आचार्योक्त मङ्गलशीकेन्द्रांश $= १६३°$, मङ्गलादि ग्रहों के आचार्योक्त वक्रारम्भ कालिक शीघ्रकेन्द्रांश ही को लल्लाचार्य, श्रीपति, भास्कराचार्य ने अपने-अपने सिद्धान्तग्रन्थ में कहा है। सूर्यसिद्धान्तोक्त 'मन्दस्फुटीकृतां भुक्तिं प्रोह्य शीघ्रोच्चभुक्तितः' इत्यादि शीघ्रगतिफलानयन में 'त्रिज्यान्त्यकर्णयोः' यहाँ त्रिज्या शब्द से यदि त्रिज्या ही का ग्रहण किया जाय तब उनके पठित केन्द्रांश नहीं मिलते हैं जैसे सूर्यसिद्धान्तोक्तप्रकार से

$\frac{केब. त्रि}{कर्ण} = लब$, ∴ केब $\cdot$ त्रि $=$ लब $\cdot$ क । कर्ण $=$ क

वर्ग करने से केग^{2}· त्रि^{2} = उग^{2}· क^{2} = उग^{2} (त्रि^{2} + अंफज्या^{2} − २ केकोज्या.

अंफज्या) = त्रि^{2} (उग^{2} − २ उग· मग + मग^{2})

= उग^{2}· त्रि^{2} + उग^{2}· अंफज्या^{2} — उग·^{2} २ केकोज्या·

अंफज्या = त्रि·^{2} उग^{2} — २ उग· मग· त्रि^{2} + त्रि^{2}· मग^{2}

समशोधन से उग^{2}· अंफज्या^{2} — उग·^{2} २ केकोज्या· अंफज्या = त्रि·^{2} मग^{2} — २ उग·

मग. त्रि^{2} पुनः समशोधन से

उग·^{2} २ केकोज्या· अंफज्या = उग^{2}. अंफज्या^{2} + २ उग· मग· त्रि^{2} — त्रि^{2}· मग^{2}

= उग^{2} अंफज्या^{2} + त्रि^{2}· मग (२ उग — मग)

अतः $\dfrac{\text{उग}^{2}\cdot \text{अंफज्या}^{2} + \text{त्रि}^{2}\cdot \text{मग (२ उग — मग)}}{\text{२ उग}^{2}\cdot \text{अंफज्या}}$

$= \dfrac{\text{उग}\cdot^{2} \text{अंफज्या}^{2} + \text{त्रि}^{2} (\text{उग}^{2} — \text{केग}^{2})}{\text{२ उग}^{2} — \text{अंफज्या}} = \text{केकोज्या},$

इसके चाप में नवत्यंश जोड़ने से कमलाकरमतानुसार वक्रारम्भ कालिक शीघ्रकेन्द्रांश होता है।

प्रतीत्यर्थं गणित दिखलाते हैं

जैसे मङ्गल की अन्त्यफलज्या = ७८, मध्यमगति = ३१'।२६'',

उच्चगति = ५९'।८'', त्रिज्या = १२०, शीघ्रकेगति = २८'

अंफज्या^{2} = (७८)^{2} = ६०८४, उग^{2} = ३४८१, उग^{2}· अंफज्या^{2}

= ६०८४ × ३४८१ = २११७८४०४१

केग^{2} = २८^{2} = ७८४, उग^{2} — केग^{2} = ३४८१ — ७८४ = २६९७,

त्रि^{2} = (१२०)^{2} = १४४००

त्रि^{2} (उग^{2} — केग^{2}) = २६९७ × १४४०० = ३८८३६८००

उग^{2}· अंफज्या^{2} + त्रि^{2} (उग^{2} — केग^{2}) = २११७८४०४ + ३८८३६८००

= ६००१५२०४, २उग^{2} = ६९६२

२उग^{2}· अंफज्या = ६९६२ × ७८ = ५४३०३६

$\therefore \dfrac{\text{उग}^{2}\cdot \text{अंफज्या}^{2} + \text{त्रि}^{2} (\text{उग}^{2} — \text{केग}^{2})}{\text{२उग}^{2}\cdot \text{अंफज्या}} = \dfrac{\text{६००१५२०४}}{\text{५४३०३६}} = \text{१११}$

इसका चाप = ६८° नवत्यंश जोड़ने से ६८° + ९०° = १५८° = कमलाकरमतानुसार वक्रारम्भकालिक मङ्गलशीकेन्द्रांश यह आचार्योक्तशीघ्रकेन्द्रांश १६३° से बहुत अन्तरित

(फरक) है इसलिये त्रिज्या शब्द से त्रिज्या का ग्रहण करना ठीक नहीं है, त्रिज्या शब्द से शीघ्रफलकोटिज्या का ग्रहण करना चाहिये। यह सूर्यसिद्धान्त की गूढार्थप्रकाश टीका में रङ्गनाथ का कहना बहुत ठीक है, क्योंकि फलकोटिज्या के सम्बन्ध में ही लाये हुये मङ्गल के शीघ्रकेन्द्रांश=१६४, पाठपठितकेन्द्रांश १६३ के साथ अन्तर=१ कमलाकर ने व्यर्थ ही रङ्गनाथ मत का खण्डन किया है, इस विषय को विवेचक लोग विचारें। नीच स्थान से जितने अन्तर में वक्रारम्भ होता है उसके विरुद्ध दिशा में उतने ही अन्तर में वक्रत्याग होता है, इसलिये वक्रारम्भकालिककेन्द्रांश को भगणांश ३६० में घटाने से मार्गारम्भ (वक्रत्याग कालिक) कालिक केन्द्रांश होता है। ग्रहों की वक्रता या अवक्रता इष्टदिन से कितने पहले हो चुकी है या होगी इसके लिये इष्टशीघ्रकेन्द्रांश में वक्रावक्रपठितकेन्द्रांशों को घटाकर शेष से अनुपात करते हैं, यदि केन्द्रगति में एक दिन पाते है तो शेष में क्या इससे लब्ध दिनों में ग्रह वक्रत्व या अवक्रत्व में प्राप्त हो चुके हैं या होंगे इति ॥४८-४९॥

इदानीं वक्रातिवक्रानुवक्रपरिभाषामाह

शीघ्रात्स्फुटग्रहोनाच्छेषे मध्यस्फुटान्तरार्धं वा ।
अधिके धनमृणमूने स्फुटग्रहान्मध्यमे चापि ॥५०॥

राशिषु चतुर्षु वक्रं षट्स्वतिवक्रमनुवक्रमष्टासु ।
अप्राप्ताऽतीतकला भुक्त्यास्यैवोद्धृता दिवसाः ॥५१॥

वा. भा.—इदानीं वक्रानुवक्रपरिज्ञानं प्रकारान्तरेण प्रदर्शयन्नार्याद्वयमाह । शीघ्रात् स्फुटग्रहोनाद्यः शेषः तस्मिन् शेषे मध्यग्रहस्फुटग्रहयोर्यदन्तरं तस्यार्धं धनमृणं वा कार्यम् । स्फुटग्रहान्मध्यमेऽधिके धनमूने ऋणं कृत्वा तेन प्रकारेण वक्रानुवक्रपरिज्ञानं तत्कथमिति चेत्तदर्थमुक्तं राशिचतुर्षु वक्रमित्यादि एतदुक्तं भवति । स्वशीघ्रात् स्फुटग्रहं विशोध्यावशेषे मध्ये स्फुटान्तरार्धदलं यदि स्फुटग्रहान्मन्दस्फुटो ग्रहोऽधिको भवति । अथोनः तदा मध्यस्फुटान्तरार्धं शेषसंज्ञकाद्विशोध्यते एवं कृते राश्यादिकं यद्भवति, यत्र यदि राशिचतुष्टयं तत्रैव दिनेऽस्य वक्रमथ तत्र राशिषट्कं तत्रत्यदिने ग्रहस्यातिवक्रमप्यष्टौ राशयो भवन्ति, तत्तत्रैव दिने ग्रहस्यानुवक्रं यदा पुनरूनाधिकं केन्द्रं भवति तदा तत्कर्मणा राशिचतुष्टयादिकेन्द्रेभ्यस्ताश्च भुक्त्यास्यैव हृता दिवसत्वं प्रयान्ति । यथा शीघ्रात्स्फुटग्रहोनाच्छेषे एवं शीघ्रभुक्तेः स्फुटभुक्त्यूनायाः शेषे यथामध्यं स्फुटान्तरार्धमेवं मध्यमः । भुक्तिस्फुटभुक्त्योरन्तरार्धमधिके ऋणमूने स्फुटग्रहान्मध्ये एवमधिकायां धनमृणं शून्यायां स्फुटभुक्तेर्मध्यमायां मन्दस्फुटभुक्तिर्मध्यमोच्यते करणागता मध्या च अनेन प्रकारेण या भुक्तिः सास्य भुक्तिः तया हृता अप्राप्तातीता वा कलाः कर्तव्याः, फलं दिवसादिः वक्रस्यानुवक्रस्यावशेषे सकृत् कर्म प्राग्वदिति । एवमेतदार्याद्वयमस्माकमुपाध्यायैर्व्याख्यातं न वा यमर्थं

वासनाविरुद्धिः। इदानीं कुजगुरुशनीनामुदयास्तमयपरिज्ञानार्थमार्यामाह। एतदुक्तं भवति स्वशीघ्रात् स्फुटग्रहं विशोध्यावशेषे मध्ये ॥५०-५१॥

वि. भा.—स्फुटग्रहोनात् (स्पष्टग्रहरहितात्) शीघ्रात् (शीघ्रोच्चात्) यच्छेषं तस्मिन् स्फुटग्रहात् मध्यमे (मन्दफलसंस्कृते) अधिके सति मध्यस्फुटान्तरार्धं (मध्यस्य मन्दफलस्फुटस्य ग्रहस्य स्फुटग्रहस्य च यदन्तरं तस्यार्धं) धनं कार्यम्। स्फुटग्रहात् मन्दफलसंस्कृते ग्रहे ऊने सति तस्मिन् शेषे मध्यस्फुटान्तरार्धमृणं कार्यम्। एवं संस्कृते शेषे चतुर्षु राशिषु दृष्टेषु वक्रं ज्ञेयम्। षट्सु राशिषु दृष्टेषु अतिवक्रमष्टासु राशिषु दृष्टेषु अनुवक्रं (वक्रत्यागं) ज्ञेयम्। अप्राप्तातीतकलाः (वक्रज्ञाने) इष्टदिने शीघ्रात् स्फुटग्रहोनादित्यादिविधिना, शेषं मध्यस्फुटान्तरार्धसंस्कृतं राशिचतुष्काद्यदल्पं तदा संस्कृतस्य राशिचतुष्कस्य चान्तरे याः कलास्ता अप्राप्तकलाः, यदि संस्कृतं राशिचतुष्कादधिकं तदा तयोरन्तरे याः कलास्ता अतीतकला भवन्ति, एवं गतकला अस्य संस्कृतस्य भुक्त्यैवार्थात् गतैष्यदिनयोः 'शीघ्रात् स्फुटग्रहोना' दित्यादिविधिनाऽऽनीतयोः संस्कृतयोरन्तरतुल्यया भुक्त्या (गत्या) हृता (भक्ता) दिवसा भवन्तीति ॥५०-५१॥

अत्रोपपत्तिः

वक्रातिवक्रादीनां नामानि संहिताकारोक्तवज्ज्ञेयानि शिष्यधीवृद्धिदे लल्लाचार्येणैवमेव कथ्यते यथा—

"मध्यस्फुटान्तरदलेन चलात् समेतान्मध्ये,
स्फुटात् समधिके सति चान्यथोनात्।
स्पष्टं त्यजेत् कृतषडष्टसु तत्र भेषु,
वक्रातिवक्रकुटिला गतयो भवन्ति" ॥

सिद्धान्तशेखरे "शीघ्रोच्चात् स्पष्टमध्यग्रहविवरदलं मध्यमे शोध्यमूने देयं स्पष्टादनूने स्फुटखचरमथप्रोज्झ्य तत्रावशेषे। वक्रं विद्ध्यब्धिराशिष्वथ ऋतुषु महावक्रमष्टासु वक्रत्यागं केन्द्रभुक्त्या पुनरपि हरसे यातयेयान्यहानि" श्रीपत्युक्तमिदं ब्रह्मगुप्तोक्तलल्लाचार्योक्तयोरनुरूपमेव, गतैष्यदिनानयनं सुगममेवेति ॥५०-५१॥

अब वक्र-अतिवक्र और अनुवक्र की परिभाषा कहते हैं

हि. भा.—शीघ्रोच्च में स्पष्टग्रह को घटाने से जो शेष रहे उसमें स्पष्टग्रह से मन्दफल संस्कृत ग्रह के अधिक रहने से मन्दफलस्फुटग्रह और स्फुटग्रह के अन्तरार्ध को धन करना, स्फुटग्रह से मन्दफल संस्कृतग्रह के ऊन (कम) रहते से उस शेष में मध्यस्फुटान्तरार्ध को ऋण करना, इस तरह संस्कृत शेष चार राशि में देखा जाय तो वक्र समझना चाहिये, छः राशि में अतिवक्र और आठ राशि में अनुवक्र समझना चाहिये, वक्रज्ञान के

लिये इष्टदिन में 'शीघ्रात् स्फुटग्रहोनात्' इत्यादि विधि से मध्यस्फुटान्तरार्ध संस्कृत शेष चार राशि से अल्प हो तो मध्यस्फुटान्तरार्ध संस्कृत शेष और चार राशि की अन्तरकला अप्राप्तकला (एष्यकला) होती है, यदि मध्यस्फुटान्तरार्ध संस्कृत शेष चार राशि से अधिक हो तो दोनों की अन्तरकला अतीतकला (गतकला) होती है, गतकला और एष्यकला को गतदिन और एष्यदिन के 'शीघ्रात्स्फुटोनात्' इत्यादि विधि से लाये हुये संस्कृत शेष द्वय के अन्तर तुल्य गति से भाग देने से गतदिन और एष्यदिन होता है ।।५०-५१।।

उपपत्ति

वक्र-अतिवक्र-अनुवक्र इन सबों के नाम फलार्थ संहिताकार ने जो रक्खे हैं उसी तरह समझने चाहियें, शिष्यधीवृद्धिद में लल्लाचार्य आचार्योक्तानुसार ही कहते हैं जैसे 'मध्य-स्फुटान्तरदलेन चलात् इत्यादि' संस्कृतोपपत्ति में लिखा गया है, सिद्धान्तशेखर में शीघ्रो-च्चात् स्पष्टमध्यग्रहविवरदलं इत्यादि' संस्कृतोपपत्तिमें लिखित पद्य से श्रीपति 'ब्रह्मगुप्तोक्त और लल्लाचार्योक्त के' अनुरूप ही कहते हैं । गतैष्यदिनानयन सुगम ही है इति ।।५०-५१।।

इदानीं कुजादिग्रहाणामुदयास्तकेन्द्रांशानाह

अष्टयमैः २८ कृतचन्द्रै १४ र्मुनीन्दुभि १७ र्भौमजीवरविजानाम् ।
उदयः प्रागस्तमयस्तदूनचक्रांशकैः पश्चात् ।।५२।।

खशरै ५० र्जिनै २४ र्ज्ञसितयोरिषुतिथिभि १५५ र्मुनिनगेन्दुभिः १७७ पश्चात् ।
उदयास्तमयौ व्यस्तौ मण्डलभागैस्तदूनैः प्राक् ।।५३।।

वा. भा.—शीघ्रान्त्यकेन्द्रभागैरष्टयमैर्भौमस्य प्रागुदयो भवति २८ स्वशीघ्र-केन्द्रभागैः कृतचन्द्रैः १४ जीवस्य प्रागुदयो भवति, स्वशीघ्रकेन्द्रभागैर्मुनीन्दुभिः १७ शनेरुदयो भवति । प्रागस्तमयास्तु पश्चाद्भवति । चक्रांशैस्ते ऊनास्तदूनाः यथा स्वोदयभागैरूनाश्च चक्रांशका ये विशेया भवन्तीत्यर्थः । चक्रांशकाः प्रसिद्धा एव तद्यथा भौमस्यास्तमयशीघ्रकेन्द्रभागाः ३३२ गुरोः ३४६, शनेः ३४३, सर्वाण्युदया-स्तकेन्द्राणि, राश्याधिकानि । भौ । उ० । २८ जी उ० । १४ श० उ० । १७ । भौम ११ जी अ ११।१६ श अा ११।१३ । अत्रातीतानां ग्रहाणां दर्शनं प्राग्वत् । तदधि-कोना भागकला मन्दफलस्फुटभुक्त्यूनशीघ्रभुक्त्या हृता दिवसा इति न्यायेनात्रोप-पत्तिः । तद्यथा रविकक्षायां सर्वथा ग्रहसर्वप्रतिमण्डले नीचोच्चवृत्तमध्ये भ्रमति । ततो यदा परमे प्रतिमण्डलोच्चप्रदेशे ग्रहः स्थितो भवति तदा समाधोग्रह शीघ्रो भवति समश्च रविरत एव भूस्थैस्तदा ग्रहो नोपलभ्यते । मनागपि रविकिरण-पिहितहग्भिस्ततो यथा-यथा ग्रहोऽवलम्बतेऽर्कस्तथा प्रथममेवोदयं याति रवेः शीघ्रत्वादर्कस्य अस्तमयेऽपि परिवर्त्य शीघ्रभावेनार्कः पुनर्ग्रहमासादयति पश्चि-मदिग्भावात् । अतएवास्तंगतेऽर्के ग्रह उपलभ्यते । उदयास्तमयौ यदा भवतो

भागनियमश्चोपलब्धा यन्त्राभियोगातिशयाच्च तस्मादुपपन्नं कक्षामण्डलादिषु विन्यस्तेषु एते वोदयास्तमयभागा अविक्षिप्ते, ग्रहो विक्षिप्ते मण्डलवशाद्भिद्यन्ते, तदर्थमुदयास्तमयाध्यायो भविष्यतीति ॥५२॥

अधुना बुधशुक्रयोरुदयास्तमयपरिज्ञानार्थमार्यामाह । शीघ्रान्त्यकेन्द्रभागैरित्यनुवर्तते खशरैः ५० एतावद्भिः स्वशीघ्रकेन्द्रभागैर्बुधस्य पश्चात् उदयो भवति, जिनैः २४ एतावद्भिः शुक्रस्योदयपश्चात् इषुतिथिभिः १५५ एतावद्भिश्च शीघ्रान्त्यकेन्द्रभागैः पश्चादस्तमयो बुधस्य मुनिनगेन्दुभि १७७ रेतावद्भिः पश्चात्, शुक्रस्यास्तमयः उदयास्तमयौ व्यस्तौ मण्डलभागैरिति पश्चादर्धोदयभागा बुधस्य ५० मण्डलभागेभ्यो विशोध्य शेषभागाः खचन्द्रगुणाः ३१० एतावद्भिर्भागैर्बुधस्यास्तमयः शुक्रस्यापरोदयभागाः खचन्द्रगुणाः एतांश्चक्रभागेभ्यो विशोध्य शेषाः रसाग्निगुणाः ३३६, एतावद्भिर्भागैः शुक्रस्य प्रागस्तमयस्तथा पश्चादर्धास्तमयभागा बुधस्य १५५ एतन्मण्डलभागैर्विशोध्य शेषाः शरखयमाः २०५ एतावद्भिर्भागैर्बुधस्य प्रागुदयो भवति । तथा पश्चादर्धास्तमयभागाः शुक्रस्य १७७ एतान्मण्डलभागेभ्यो विशोध्य शेषाः त्रिवसुचन्द्राः १८३ एतावद्भिः प्रागुदयो भवति । शुक्रस्य एवं राश्यादिके पश्चादुदयकेन्द्रे बुधशुक्रयोः । बु. १. २ शु. २६ तथा पश्चादस्तमयकेन्द्रे बु।५।५।शु ५।२७। पूर्वार्धोदयकेन्द्र ६२७ शु. ६३ तथा प्रागस्तमयकेन्द्रे बु १०।१०।शु११।६ एतेभ्योऽतीतानागतदिवसानयनं प्राग्वन्मन्दस्फुटभुक्त्यूनया शीघ्रगत्या केन्द्रान्तरं विभज्य वक्रानुवक्रवदिति तत्रेयं युक्तिः । शीघ्रगतित्वाद्बुधशुक्रयोः पश्चाद्रवेरवलम्बनं भवति । अतोऽस्तंगते रवौ पश्चिमायां दिशि तावुपलभ्येते चन्द्रवत् । यदा च वक्रिणौ भवतस्तदा रविस्ताभ्यां शीघ्रो भवति । प्राग्गतौ तौ च पश्चादवलम्बेते तयोः प्रागुदयो भौमःजीवसौराणामिवाऽस्तमयञ्च वैपरीत्यात् । शेषमन्यद्ग्रहवत् कक्षामण्डलादीनि विन्यस्य प्रदर्शयेत् । गोले छेद्यके वा भागपरिनिष्टा चेयं विक्षिप्तयोरेवेति ॥५३॥

वि. भा.—भौमजीवरविजानां (मङ्गलगुरुशनैश्चराणां) २८, १४, १७ शीघ्रकेन्द्रांशैः क्रमशः प्रागुदयो भवति, एतत्केन्द्रांशरहितैश्चक्रांशकैः पश्चिमायां दिश्यस्तमयो भवति ॥ ज्ञसितयोः (बुधशुक्रयोः) क्रमशः ५०, २४ शीघ्रकेन्द्रांशैः पश्चादुदयः, तथा १५५. १७७ शीघ्रकेन्द्रांशैः पश्चादस्तमयो भवति, उदयास्तमयौ व्यस्तौ मण्डलभागैस्तदूनैः प्रागित्यस्यायमर्थः—बुधस्य पश्चादुदयकेन्द्रांशाः ५० तान्मण्डलभागेभ्यो ३६० विशोध्यावशिष्टा ३१० स्तैःप्रागस्तमयः । तथा शुक्रस्यापरोदयकेन्द्रांशाः २४, तान् मण्डलभागेभ्यो विशोध्यावशिष्टा ३३६ एतावद्भिः प्रागस्तमयः । तथा बुधस्य पश्चादुदयकेन्द्रांशाः १५५ एतान् मण्डलभागेभ्यो विशोध्यावशिष्टाः २०५ एतैः केन्द्रांशैः प्रागुदयः । शुक्रस्य पश्चादस्तमयकेन्द्रांशाः १७७ एतान् मण्डलभागेभ्यो विशोध्यावशिष्टाः १८३ एतैः प्रागुदय इति ॥५२-५३॥

अत्रोपपत्तिः

कुजगुरुशनीनां शीघ्रोच्चं रविरेवास्ति, शीघ्रोच्चस्थाने तेषां परमास्तो भवेत्। ततो रवेरधिकगतित्वात्तेभ्योऽग्रतो गच्छति यदा कालांशतुल्यमन्तरं भवेत्तदा रविसामीप्यवशेन तेषां रात्रिशेषे पूर्वदिश्युदयो दृश्यते, तेन कालांशतुल्ये स्पष्टशीघ्रकेन्द्रांशे यत्फलचापं तेन कालांशा युतास्तदा तेषां ग्रहाणामुदयकेन्द्रांशा भवेयुरिति। यथा

यदि त्रिज्यया कालांशतुल्यस्पष्टकेन्द्रांशज्या लभ्यते तदाऽन्त्यफलज्यया किं जाता कालांशतुल्यस्पष्टकेन्द्रांशजनितफलज्या $= \frac{\text{अफज्या} \times \text{कालांशज्या}}{\text{त्रि.}}$

अस्याश्चापं कालांशयुतं तदा कुजगुरुशनीनामुदयकेन्द्रांशा भवन्तीत्येतावता

"कालांशजीवाऽन्त्यफलज्यया घ्नी त्रिभज्ययाऽऽप्तफलस्य चापम्।
कालांशयुक्तं चलकेन्द्रभागाः समुद्गमे मन्दकुजेज्यकानाम्॥"

विशेषसूत्रमुपपद्यते।

अत्र प्रतीत्यर्थं गणितं प्रदर्श्यते

यथा कुजज्यान्त्यफलज्या $= ८१$, तत्कालांशाः $= १७$, कालांशज्या $= ३५$, त्रिज्या $= १२०$, तदा $\frac{\text{कालांशज्या.अंफज्या}}{\text{त्रि}} = \frac{३५ \times ८१}{१२०} =$ फलज्या $= २३$, एतच्चापं $= ११^\circ$ कालांश १७ युतं तदा $११^\circ + १७^\circ = २८^\circ =$ कुजस्योदयकेन्द्रांशाः, एवं गुरुशन्योरपि तदुदयकेन्द्रांशा नेया इति।

बुधशुक्रयोस्तुल्य एव मध्यरविः एतत्तुल्यमेव मन्दस्पष्टं बुधं शुक्रं वा मत्वा स्पष्टेन बुधेन, शुक्रेण सह कालांशतुल्येऽन्तरे पश्चिमायां दिशि तदुदयो दृश्येत, ततः $\frac{\text{कालांशज्या.त्रि}}{\text{अंफलज्या}} =$ स्पकेज्या, अस्याश्चापं कालांशसहितं तदा प्रथमपदे पश्चिमोदयकेन्द्रांशाः स्युः। द्वितीयपदे वक्रतां प्राप्य रवेरल्पगतित्वात्तत्रैवास्तं गच्छतः। तृतीयपदे तयोः पुनरुदयो भवति, नीचस्थाने तयोः परमास्तं गतत्वाद्रात्रिशेषे पूर्वदिशि स चोदयो दृश्यते। चतुर्थपदे तयोः कालांशान्तरे स्थितत्वात्तत्रैवास्तस्तेन पूर्वोदयकेन्द्रांशाः $=$ चा $-$ कालांश $+ १८० =$ चा $+ (१८० -$ कालांश$)$ एतेन "ज्ञशुक्रयोस्तु त्रिभशिञ्जिनीघ्नीकालांशजीवाऽन्त्यफलज्ययाऽऽप्ता। चापं स्वकालांश तदूनभार्धयुक्तं परेन्द्रच्युद्गमने स्वकेन्द्रम्।" ति तदीय सूत्रमुपपद्यते।

प्रतीत्यर्थं गणितं प्रदर्श्यते। बुधस्यान्त्यफलज्या $= ४४$, त्रिज्या $= १२०$,

पश्चिमोदयकालांशाः=१३, कालांशज्या=२७, तदा $\frac{\text{कालांशज्या.त्रि}}{\text{अंफज्या}}=\frac{२७\times १२०}{४४}$ =७३ अस्याश्चापम्=३७° कालांश १३ युतं ३७+१३=५० तत्पश्चिमोदय-केन्द्रांशाः, पूर्वोदये कालांशाः=१२ ततः पूर्वोदयकेन्द्रांशाः=(१८०—कालांश)+चाप=३७+१६८=२०५ एवमेव शुक्रस्यापि केन्द्रांशा आनेतव्या इति सिद्धान्तशेखरे—

"वस्वस्विभि २८ र्युगकुभि १४ र्नगचन्द्रमोभिः,
१७ प्राच्युद्गमः क्षितिजजीवशनैश्चराणाम् ।
शीघ्राख्यकेन्द्रजलवैर्भगणांशशुद्धैरेभिः,
पुनर्नियतमस्तमयः प्रतीच्याम् ॥
द्राक्केन्द्रजैः खविषयैश्च ५० जिनैश्च २४,
भागैरुद्गच्छतो बुधसितौ दिशि पाशपाणेः ।
तस्यामपीषुतिथिभिः १५५ स्वरशैलचन्द्रैः १७७,
भागैस्तयोर्निगदितोऽस्तमयो ग्रहज्ञैः" ॥

एभिः श्रीपतिना, सिद्धान्तशिरोमणौ—

"प्राच्यामुदेति क्षितिजोऽष्टदस्रैः २८,
शक्रै १४ र्गुरुः सप्तकुभिश्च १७ मन्दः ।
स्वस्वोदयांशो नितचक्रभागैस्त्रयो,
व्रजन्त्यस्तमयं प्रतीच्याम् ॥
खाक्षै ५० र्जिनै २४र्ज्ञसितयोरुदयः प्रतीच्याम-
स्तश्च पञ्चतिथिभि १५५ र्मुनिसप्तभूभिः १७७ ।
प्रागुद्गमः शरनखै २०५ स्त्रिधृतिप्रमाणै १८३ रस्तश्च
तत्रदशवन्हिभि ३१० रङ्गदेवैः ३३६ ॥
अवक्रवक्रास्तमयोदयोक्तभागाविकोनाः कलिका विभक्ताः ।
द्राक्केन्द्रभुक्त्याप्तदिनैर्गतैष्यै रवक्रवक्रास्तमयोदयाः स्युः ।"

भास्करेण चाऽऽचार्योक्तानुरूपमेव सर्वं कथितमिति ॥५२-५३॥

अब कुजादिग्रहों के उदयकेन्द्रांश और अस्तकेन्द्रांश को कहते हैं

_हि. भा._—मङ्गल, गुरु, और शनैश्चर क्रमशः २८, १४, १७ इन केन्द्रांशों में पूर्व दिशा में उदित होते हैं । इन केन्द्रांशों को ३६० में घटाने से जो रहता है उन केन्द्रांशों में पश्चिम दिशा में वे अस्त होते हैं । बुध, और शुक्र क्रमशः ५०,२४ केन्द्रांशों में पश्चिम दिशा में उदित होते हैं तथा १५५, १७७ इन केन्द्रांशों में पश्चिम दिशा में अस्त होते हैं ।

बुध के पश्चादुदय केन्द्रांश=५०, इसको ३६०° चक्रांश में घटाने से शेष ३१० इतने केन्द्रांश में पूर्व दिशा में अस्त होते हैं। शुक्र के पश्चिमोदयकेन्द्रांश=२४, चक्रांश३६० में घटाने से शेष ३३६ इतने केन्द्रांश में पूर्व दिशा में अस्त होते हैं। बुध के पश्चादुदय केन्द्रांश १५५ इनको चक्रांश में घटाने से शेष २०५ इन केन्द्रांशों में पूर्व दिशा में उदय होते हैं। शुक्र के पश्चादस्तमय केन्द्रांश १७७ इनको चक्रांश में घटाने से शेष १८३ इन केन्द्रांशों में पूर्व दिशा में उदित होते हैं इति ॥५२-५३॥

उपपत्तिः

कुज-गुरु और शनैश्चर इन सबों का रवि ही शीघ्रोच्च है, शीघ्रोच्च स्थान में उन सबों का परमास्त होता है, उन सबों से रवि के शीघ्रगतित्व के कारण रवि आगे चला जाता है, जब कालांश तुल्य अन्तर होता है तो रवि के सानिध्यवश से रात्रिशेष में उन सबों का उदय होता है, इसलिये कालांशतुल्य स्पष्टकेन्द्रांश में जो फलचाप होता है उसको कालांश में जोड़ने से उनके उदय केन्द्रांश होते हैं। जैसे यदि त्रिज्या में कालांश तुल्य स्पष्टकेन्द्रांश की ज्या पाते हैं तो अन्त्यफलज्या में क्या इस अनुपात से कालांश तुल्यस्पष्ट केन्द्रांशज्या जनित फलज्या आती है $\frac{\text{अंफज्या.कालांशज्या}}{\text{त्रि.}}$ इसके चाप में कालांश जोड़ने से कुज, गुरु और शनैश्चर इन सबों के उदय केन्द्रांश होते हैं, इससे म. म. पण्डित सुधाकर द्विवेदी का सूत्र उपपन्न हुआ, "कालांशजीवाऽन्त्यफलज्ययाघ्नी त्रिजज्ययाप्ता" इत्यादि संस्कृतोपपत्ति में लिखित सूत्र को देखिये। प्रतीत्यर्थंगणित देखिये, जैसे कुज की अन्त्यफलज्या=८१, कालांश=१७, कालांशज्या=३५, त्रिज्या=१२०, तब उपरिलिखित सूत्रानुसार $\frac{\text{कालांशज्या.अंफज्या}}{\text{त्रि}}$

$=\frac{३५\times८१}{१२०}$=फलज्या, इसका चाप=११° कालांश जोड़ने से ११°+१७°=२८°= कुज के उदय केन्द्रांश, इसी तरह गुरु और शनैश्चर का उदय केन्द्रांश लाना चाहिये। बुध और शुक्र के बराबर ही मध्यमरवि होते हैं, इसके बराबर ही मन्दस्पष्ट बुध या शुक्र को मानकर स्पष्ट बुध या स्पष्ट शुक्र के साथ कालांश तुल्य अन्तर पर पश्चिम दिशा में उनके उदय को देखते हैं, तब $\frac{\text{कालांशज्या.त्रि}}{\text{अंफज्या}}$=स्पकेज्या, इसके चाप में कालांश जोड़ने से प्रथमपद में पश्चिमोदयकेन्द्रांश होता है, द्वितीयपद में वक्रता को प्राप्त कर रवि से अल्पगतित्व के कारण वहीं पर वे दोनों (बुध, शुक्र) अस्त होते हैं, तृतीयपद में उन दोनों का फिर उदय होता है, नीच स्थान में उन दोनों का परमास्त होने से रात्रि शेष में पूर्व दिशा में वह उदय देखा जाता है, चतुर्थपद में उन दोनों के कालांशान्तर पर रहने के कारण वे वहीं पर अस्त होते हैं इसलिये पूर्वोक्त केन्द्रांश=चाप—कालांश+१८०=चा

+(१८०—कालांश) इससे संस्कृतोपपत्ति में लिखित 'ज्ञशुक्रयोस्तु त्रिभशिञ्जिनीघ्नी इत्यादि' म. म. सुधाकर द्विवेदी का सूत्र उपपन्न होता है, अब प्रतीति के लिये गणित दिखलाते हैं।

बुध की अन्त्यफलज्या = ४४, पश्चिमोदयकालांश = १३, कालांशज्या = २७, त्रिज्या = १२०, तब पूर्वलिखितसूत्रानुसार $\frac{\text{कालांशज्या.त्रि}}{\text{अंफज्या}} = \frac{२७ \times १२०}{४४} = ७३$, इसका चाप = ३७° कालांश जोड़ने से ३७° + १३° = ५०° = पश्चिमोदयकेन्द्रांश पूर्वोदयकालांश = १२, तब पूर्वोदयकेन्द्रांश = (१८० — कालांश) + चाप = २७ + १६८ = २०५, इसी तरह शुक्र का भी केन्द्रांश लाना चाहिये। सिद्धान्तशेखर में श्रीपति 'वस्वस्विभियुँगकुभि: इत्यादि' संस्कृतोपपत्ति में लिखित सूत्र से और सिद्धान्तशिरोमणि में भास्कराचार्य ने 'प्राच्यामुदेति क्षितिजोऽष्टदस्रै: इत्यादि' संस्कृतोपपत्ति में लिखित सूत्रों से आचार्योक्तानुरूप ही सब कुछ कहा है इति ॥५२-५३॥

इदानीं स्वदेशे कथं स्पष्टा भवन्तीत्येतदर्थमाह

स्पष्टाद्युरात्रिदलयो रव्युदयास्तमययो रविचरार्धात् ।
एष्ये ह्यधिकेऽतीतादवक्रितो वक्रितो हीने ॥५४॥

वा. भा.—य एते ग्रहा अनन्तरोक्तप्रकारेण स्पष्टास्ते यदि दिनार्धकालिका मध्यमा आसन् पदार्थविपादेति न्यायेन तदा स्पष्टा एवैतावता कर्मणा भवन्ति। अथौदयिका अस्तमयिका वा स्युस्तदा रविचरार्धाच्च स्वदेशेऽधिका अस्तमयिका वा भवन्ति। चरदलकर्म च पुरतो वक्ष्यति एह्यत्यधिक इत्यादि आगामिदिने य स्फुटो ग्रहः सपद्यतीतदिनस्फुटग्रहाधिको तदा ग्रहस्य वक्रत्वं नास्ति। ऋजुगतिस्तदा ग्रह इति इतरोऽप्यहीनस्तदा वक्रीग्रहो ज्ञेय इत्यत्र वासना निरक्षदेशे यत्सदौदयिके ग्रहः स स्वदेशोन्मंडलप्राप्तक्रान्तिको भवति। स्वदेशोदयश्च स्वक्षितिजमंडले तयोश्चान्तरं चरदलं तेनार्वागग्रतो वा ग्रहो नीत्वा स्वक्षितिजप्राप्तकालिका क्रियन्ते, अस्तमयेऽप्येवं तस्मादुदयास्तमययोश्चरदलकर्मणा च स्फुटा भवन्ति। दिनरात्र्यर्धयोस्तु पुनर्याम्योत्तरमंडलस्यैकत्वात्स्वदेशनिरक्षयो: कर्मान्तराभावश्चरार्धाभावात्। यदि रविसावनेनानीता मध्यास्तद्रविचरदलेनार्कोदयकालिका:। अन्यथा ग्रहास्तावदनेन चरदलेन तदुदयकालिका भवन्ति। अथ नक्षत्रसावनेन तच्चरदलं विनापि तदुदयकालिका भवन्त्येवं रविग्रहाणां ग्रहाद्युपलक्षणार्थं तस्मादुपपन्नम्। ग्रहश्च यदा वक्री भवति तदा प्रतिक्षणं पश्चादुपलभ्यते स चावश्यमेवातीतदिनस्फुटादूनो भवति। अवक्रितश्च गतो ग्रहो यदि स चातीतदिनस्फुटादधिको भवतीति किमत्रोच्यते तस्मादवक्रितस्यैव लक्षणं कतमनेनोतरार्धेनेति। इदानीं सर्वग्रहाणां क्रान्तिज्यानयनार्थमार्यामाह।

वि. भा.—पूर्वं ये कुजादिग्रहाः साधितास्ते द्युरात्रिदलयोर्दिनार्धे रात्र्यर्धे वा गणिनागताः स्पष्टाः स्युः। अर्थात्तेषु चरसंस्काराभावः रव्युदयास्तसमयोः (यदि रव्युदयेऽस्तमये वा) साधितास्तदा रविचरार्धान् (रविचरफलसंस्कारात्) स्वदेशे रव्युदयेऽस्तमये वा ते स्पष्टा भवन्ति, अनीताद् ग्रहान् (गतदिनोद्भवाद् ग्रहात्) एष्ये (आगामिदिनोद्भवे ग्रहे) अधिके सति अवक्रिनः (मार्गः) हीने (गतदिनोद्भवग्रहादागामिदिनोद्भवग्रहे न्यूने) सति वक्रितो ज्ञेयः उपपत्तिरपि भाष्येनैव स्पष्टेति ।५४॥

अब स्वदेश में कैसे स्पष्ट ग्रह होते हैं इसके लिये कहते हैं

हि. भा.—पहले जो कुजादि ग्रहों का साधन किया गया है वे (साधितग्रह) दिनार्धकाल में या रात्र्यर्ध में स्पष्ट होते हैं। क्योंकि उनमें चर संस्कार नहीं किया गया है, यदि रवि के उदयकाल में या अस्तकाल में साधित ग्रह हों तो उनमें रविचरफल संस्कार करने से स्वदेश में रवि के उदयकाल या अस्तकाल में वे स्पष्ट होते हैं। यदि गतदिन के ग्रह से अग्रिम दिन का ग्रह अधिक हो तो ग्रह को मार्गी समझना चाहिये यदि गतदिन के ग्रह से अग्रिम दिन का ग्रह हीन हो तो ग्रह को वक्र समझना चाहिये। इसकी उपपत्ति भी साफ ही है ॥५४॥

इदानीं पञ्चज्यानयनमाह

जिनभागज्यागुणिता सूर्यज्या व्यासदलहृता लब्धम् ।
इष्टापक्रमजीवा विषुवदुदग्दक्षिणा सवितुः ॥५५॥

इष्टापक्रमवर्गं त्रिज्यावर्गाद्विशोध्य शेषपदम् ।
विषुवदुदग्दक्षिणतः स्वाहोरात्रार्धविष्कम्भः ॥५६॥

क्रान्तिज्या विषुवच्छायया गुणा द्वादशोद्धृता क्षितिजा ।
स्वाहोरात्रेऽनष्टा व्यासार्धेनाहता भक्ता ॥५७॥

स्वाहोरात्रार्धेन क्षयवृद्धिज्याधनुश्चरप्राणाः ।
ते षड्हृता विनाड्यो विनाडिका नाडिकाः षष्ट्या ॥५८॥

वा. भा.—अत्र सूर्यग्रहणं सूर्याद्युपलक्षणार्थं तेनायमर्थः जिनसंख्याभागाः जिनसंख्याभागाश्चतुर्विंशतिभागाः इत्यर्थः। तेषां या ज्या तया गुणिताः नवरद-चन्द्रैरिति यावत् १३२९ कासौ सूर्यज्या इष्टकालिकस्फुटग्रहज्येत्यर्थः, सा जिन-भागज्या गुणिता सती व्यासदलहृता कार्या। ततो यल्लब्धं सापक्रमज्या भवतीष्ट-कालिका सवितुरन्यस्य वा ग्रहादेर्ज्या दिनज्यागुणिता सती व्यासदलहृता कार्या। ततो यल्लब्धं सापक्रमज्या भवतीष्टकालिका सवितुरन्यस्य वा ग्रहादेर्यतो ज्या कृता तस्येत्यर्थः। सा च विषुवदुत्तरेण दक्षिणेन च भवति, मिथस्तुलादिमे ग्रहे यथा-संख्यं सैव स्फुटा क्रान्तिज्या भवति, चन्द्रादीनां पुनश्चापि कृता स्वविक्षेपयुतवियुता

सती सामान्यदिशोः स्फुटक्रान्तिर्भवति। तज्ज्या स्वक्रान्तिज्या भवति। अत्रेयं वासना। यत्र मंडलज्या व्यासदलतुल्या भवति तदा विषुवन्मंडलापमंडलयोरन्तरं क्रान्तिः सा मेषादौ, अपमंडलार्धा स्थितस्योत्तरा तुलादौ दक्षिणः उत्क्रान्तिज्या रवेः सैव स्फुटा यतोऽपमंडल एव रविर्भ्रमति चन्द्रादीनां मंडलवर्णाद्भिद्यते। यतो मेषादावुन्मंडलस्थिता अपि ग्रहाःराश्यादिभागेन विक्षेपवशाद्विषुवतो दक्षिणेनापि भवन्ति यतो विमंडलगाश्चन्द्रादयो भ्रमन्ति। अतस्तत्क्रान्तिज्या चापस्य स्वविक्षेपयुतवियुतस्य या ज्या सा ग्रहस्य स्फुटा स्वक्रान्तिज्या भवति। एतच्च गोलाध्याये ऽस्माभिः पूर्वमेव व्याख्यातम्। उपपन्नं चैतत्सर्वं गोले प्रदर्शयेदिति।

इदानीं स्वाहोरात्रार्द्धसूत्रद्वयमार्यामाह। अपक्रमग्रहणेन स्वक्रान्तिज्योच्यते, तेनायमर्थः। इष्टस्य रव्यादेः ग्रहस्याश्विन्यादेर्नक्षत्रस्यागस्त्यमृगव्याघस्य वा यस्यैव स्वक्रान्तिज्यावर्गं व्यासार्धवर्गाद्विशोध्य मूलं गृह्यते तस्यैव स्वाहोरात्रवृत्तस्य व्यासार्धं भवति। तच्च विषुवदुत्तरेण भवति। उत्तरायाः स्वक्रांतिज्याया दक्षिणायाश्च दक्षिणेन तावता व्यासार्धेन यावद्वृत्तमुत्पद्यते तावद्वृत्तं तत्रदिने अहोरात्रेण ग्रहः पश्चाद् भ्राम्यन्नुत्पादयति नक्षत्रादीनां तु पुनः स्थिराण्येव स्वाहोरात्रवृत्तानि इत्यत्र वासनागोले विन्यस्य विषुवदुत्तरेण दक्षिणेन वा क्षितिजे क्रान्तिचापभागादितुल्येऽन्तरे सूत्रस्यैकमग्रं बद्धवा तावत्येवान्तरे तत्रैवोन्मंडले बध्नीयात्तद्दक्षिणोत्तरायतं ज्यावदवतिष्टते। तदर्धक्रांतिज्या तत्क्रान्त्यग्रे सूत्रस्यैकमग्रं बद्ध्वा द्वितीयमग्रं शलाकायां बध्नीयात्। भूमध्यक्रांतिज्यातुल्येऽन्तरे दक्षिणेनोत्तरेण वा स्वाहोरात्रार्धमेवमायतं चतुरस्रं क्षेत्रं पूर्वापरायतं निष्पन्नं भवति। निरक्षदेशे साक्षे चोत्तरमुन्नतं भवति। क्रमेण यावन्मेषस्तत्र सममंडलं प्रविशति। तस्य क्षेत्रस्य क्रांतिज्याकोटिः स्वाहोरात्रार्धं भुजस्तस्या संपाताद् भूमध्यं यावत् व्यासार्धं कर्णः कर्णकृते कोटिकृतिं विशोध्य मूलं भुजज्या इत्यतो व्यासार्धवर्गात् क्रान्तिज्यावर्गं विशोध्य मूलं गृह्यते। येन भुजा भवति। तच्च स्वाहोरात्रार्धस्तस्मादुपपन्नम्।

इदानीं चरदलानयनार्थमार्याद्वयमाह। रव्यादेरिष्टग्रहनक्षत्रादीनां वा या स्वक्रान्तिज्या तां स्वदेशविषुवच्छायया संगुण्य द्वादशभिरुद्धरेत्। फलं क्षितिज्या भवति। सा च स्वाहोरात्रार्धवृत्ते निष्पन्ना भवति तामनिष्टं स्थापयेत्, छायानयनार्थं ततः क्षितिज्यां व्यासार्धेन निहत्य स्वाहोरात्रार्धेन विभजेत्। फलं क्षयवृद्धिज्या तस्याः धनुश्चरदलप्राणा भवन्ति। षड्दृता विनाड्यो विनाड्यश्च षड्दृता नाड्यो भवन्तीति किमत्रोच्यते। वासनात्र तद्यथा वक्ष्यमाणविधिनाग्रां कृत्वा तत्प्रमाणव्यासार्धेन वृत्तमुत्पादयेत्। तद्वृत्तं गोलपूर्वभागे विन्यसेत्तथा यथा विषुवन्मंडलनिरक्षदेशक्षितिजस्वदेशक्षितिजसममंडलानां चतुर्णां यः सम्पातस्तस्माद्भूमध्यप्रापि यत्सूत्रं तत्र मध्यं तस्य भवति याम्योत्तरमंडले वोत्थितं भवति। यथा याम्योत्तरमंडलेऽवलम्बककोटिरेवमत्र क्रान्तिज्या कोटिर्यथा याम्योत्तरेऽक्षज्या भुजा एवमत्र मंडले

क्षितिजोन्मंडलयोरन्तरं क्षितिजा भुजा, अतस्त्रैराशिकमाचार्येण प्रकल्पितं यदि लंबककोटेरक्षज्या भुजा उत्क्रान्तिज्याकोटेः का भुजेत्यतो लंबस्थाने द्वादशकः कोटिः अक्षज्यास्थाने च विषुवच्छाया भुजा। अतः फलं क्षितिजा भुजा ततः पुनरपि त्रैराशिकं यदि स्वाहोरात्रवृत्ते एतावती भुजा तद्व्यासार्धवृत्ते कियतीति फलं क्षयवृद्धिज्या, यत्र दिने स्वाहोरात्रवृत्तमेव व्यासार्धवृत्तमेकत्वाद्भ्रममाणस्य विषुवन्मंडले भ्रमवशाद्भूगोलस्य तत्रैव स्वाहोरात्रवृत्ते षष्टिघटिकाः प्रकल्पान्ते ताभिश्च खखषड्नसंख्याः प्रमाणा भवन्ति। चक्रलिप्ताश्च तावत्य एव अतः क्षितिजा रूपं यदुन्मंडलक्षितिजयोरन्तरं तत्क्षयवृद्धिज्यारूपेण परिणमितं तस्याश्चापलिप्तायाः प्राणा भवन्ति। यस्मात्प्राणेन कलां भूमंडलं भ्रमतीति पूर्वमेव गोलाध्याये व्याख्यातः। प्राणैर्विना नाड्यो विनाडिभिर्घटिका उक्तवत् कार्या किमत्रोच्यते ? ततश्चरदलं घटिकांतरं क्षितिजोन्मंडलयोरंतरे स्वाहोरात्रवृत्तस्य खण्डकं भवति। रविवासनेनानीता लंकोदयकालिका भवन्ति। तस्माद्रविचरदल-कर्म आर्ययाह ॥५५-५६-५७-५८॥

वि. भा.—सूर्यज्या (रविभुजज्या) जिनभागज्या (परमक्रान्तिज्या) गुणिता, व्यासदलहृता (त्रिज्याभक्ता) लब्धं सवितुः (सूर्यस्य) इष्टापक्रमजीवा (इष्ट-क्रान्तिज्या) भवति; सा च विषुवदुदग्दक्षिणाऽर्थान्नाडीवृत्तादुत्तरदिशि सूर्ये उत्तरा, दक्षिणे दक्षिणा भवति, त्रिज्यावर्गात् इष्टापक्रमवर्गं (इष्टक्रान्तिज्यावर्गं) विशोध्य शेषस्य पदं (मूलं) स्वाहोरात्रार्धविष्कम्भः (द्युज्या), नाडीवृत्तादुत्तरे सूर्ये उत्तरा द्युज्या, दक्षिणे दक्षिणा क्रान्तिज्याविषुवच्छायया (पलभया) गुणा, द्वादशभक्ता तदा स्वाहोरात्रे (द्युज्यावृत्ते) क्षितिजा (कुज्या) भवति, साऽनष्टा (पृथक्) स्थाप्या, सा कुज्या व्यासार्धेनाहता (त्रिज्यागुणिता) स्वाहोरात्रार्धेन (द्युज्यया) भक्ता तदा क्षयवृद्धिज्या (चरज्या) भवति, अस्या धनुः (चापम्) तदा चरप्राणाः (चरासवः) भवन्ति, ते षड्भक्तास्तदा विनाड्यः (पलानि) भवन्ति, नाडिकाः षष्ट्या भक्ता तदा विनाडिकाः (पलानि) भवन्तीति ॥५५-५६-५७-५८॥

अत्रोपपत्तिः

क्रान्तिवृत्ते यत्र रविरस्ति तदुपरिगतं ध्रुवप्रोतवृत्तं कार्यं तथा नाडीवृत्त-क्रान्तिवृत्तयोः सम्पातात् (गोलसन्धितः) नवत्यंशेन वृत्तं (अयनप्रोतवृत्तं) कार्यं तदा चापीयजात्यत्रिभुजमुत्पद्यते, गोलसन्धितोऽयनप्रोतवृत्तक्रान्तिवृत्तयोः सम्पातं यावत् क्रान्तिवृत्ते नवत्यंशा एकोऽवयवः। गोलसन्धित एवायनप्रोतवृत्तनाडीवृत्तयोः सम्पातं यावन्नाडीवृत्ते नवत्यंशा द्वितीयोऽवयवः अयनप्रोतवृत्ते नाडीक्रान्तिवृत्तयो-रन्तरे परमक्रान्त्यंशास्तृतीयोऽवयव इत्यवयवत्रयैर्जायमानमेकं त्रिभुजम्। तथा गोलसन्धितो रविं यावत् क्रान्तिवृत्ते रविभुजांशाः कर्णः एकोऽवयवः। रवितो नाडीवृत्तध्रुवप्रोतवृत्तयोः सम्पातं यावत् ध्रुवप्रोतवृत्ते रवेरिष्टक्रान्तिर्भुजो द्वितीयः

ऽवयवः । गोलसन्धितो नाडीवृत्तध्रुवप्रोतवृत्तयोः सम्पातं यावन्नाडीवृत्ते विषुवांशाः कोटिस्तृतीयोऽवयव इत्यवयवत्रयैर्जायमानं द्वितीयत्रिभुजम् । एतयोस्त्रिभुजयोर्ज्या-क्षेत्रद्वयं सजातीयं भवत्यतस्तावल्लघुत्रिभुजस्य (द्वितीयत्रिभुजस्य) ज्याक्षेत्रं क्रियते । गोलकेन्द्रात् (भूकेन्द्रात्) गोलसन्धिगतरेखा कार्या तदुपरिग्रहाल्लम्बः कार्य इयमेव भुजज्या, तथा भूकेन्द्रान्नाडीवृत्तध्रुवप्रोतवृत्तसम्पातगता रेखा कार्या, तदुपरिग्रहा-देव लम्बरेखा क्रान्तिज्या, एतयो (भुजज्याक्रान्तिज्ययोः) मूलगता रेखा विषु-वांशचापस्य ज्या नास्ति, भुजज्या-क्रान्तिज्या तन्मूलगतरेखाभिर्यत्त्रिभुजं जातं तदेवोक्तचापीयजात्यत्रिभुजस्य ज्याक्षेत्रम् । क्रान्तिज्याया नाडीवृत्तधरातलोपरि-लम्बत्वान्मूलगतरेखाया नाडीवृत्तधरातले स्थितत्वान्मूलगतरेखोपर्यपि क्रान्तिज्याया लम्बत्वमत उक्तं त्रिभुजं 'भुजज्या-क्रान्तिज्या-तन्मूलगतरेखाभिर्जायमानं' जात्या-त्मकम् । गोलसन्धिगतरेखोपरि ध्रुवप्रोतवृत्तनाडीवृत्तयोः सम्पाताल्लम्बो विषु-वांशज्या, बद्धरेखा गोलसन्धिगतरेखोपरिलम्बोऽस्ति, तर्हि गोलकेन्द्रान्नाडीवृत्तध्रुव-प्रोतवृत्तसम्पातगता रेखा त्रिज्या कर्णः । विषुवांशज्याभुजः, विषुवांशज्यामूलाद् गोलकेन्द्रं यावद्विषुवांशकोटिज्याकोटिरिति भुजत्रयैर्जायमानं त्रिभुजमेकम्, गोल-केन्द्रात् क्रान्तिज्यामूलं यावत् क्रान्त्युत्क्रमज्योनत्रिज्या (द्युज्या) कर्णः, मूलगत-रेखा भुजः गोलकेन्द्राद् भुजज्यामूलं यावत्कोटिरिति भुजत्रयैर्जायमानं द्वितीयं त्रिभुजम्, एतयोस्त्रिभुजयोः सजातीयत्वादनुपातो यदि त्रिज्यया विषुवांशज्या लभ्यते तदा द्युज्यया किमित्यनुपातेन समागता मूलगतरेखैतावता सिद्ध्यति कस्यापि चापीयजात्यस्य कर्णचापज्या वास्तवा भवति । भुजकोटिचापयोर्मध्ये एकस्य ज्या वास्तवा भवति तदन्यस्य ज्या वास्तवा न भवत्यर्थाद् यस्य ज्या वास्तवा तत्कोटिव्यासार्धवृत्ते परिणता भवति यथोपरिलिखितचापीयजात्यत्रिभु-जज्याक्षेत्रे भुजांशक्रान्त्यंशयोः कर्णभुजचापयोर्ज्ये वास्तविके स्तः, कोटिचापस्य विषुवांशस्य ज्या वास्तवा न किन्तु भुज (क्रान्ति) कोटिव्यासार्धे (द्युज्यावृत्त-व्यासार्धे) परिणता सती मूलगतरेखा (कमलाकरोक्तव्यक्षोदयलवज्या) जाता, नवत्यंश, नवत्यंश, जिनांशैर्जायमानत्रिभुजस्य ज्याक्षेत्रं (त्रिज्या, परमक्रान्तिज्या, तत्कोटिज्या परमाल्पद्युज्या संज्ञिकेति कर्णभुजकोटिभिर्जायमानं त्रिभुजं) पूर्वोक्त-त्रिभुजस्य (भुजज्या-क्रांतिज्या-व्यक्षोदयलवज्याभिरुत्पन्नस्य) सजातीयमतोऽनुपातो यदि त्रिज्यया परमक्रान्तिज्या (जिनज्या) लभ्यते तदा भुजज्यया किं समागता

क्रान्तिज्या तत्स्वरूपम् $= \frac{\text{जिनज्या. भुजज्या.}}{\text{त्रि.}}$, त्रिज्या कर्णः, क्रान्तिज्या भुजः,

तत्कोटिज्या (द्युज्या) कोटिरेतद्भुजत्रयैरुत्पन्नत्रिभुजे $\sqrt{\text{त्रि}^2 - \text{क्रांज्या}^2} = \text{द्युज्या}$, ततोऽग्रा कर्णः, क्रान्तिज्या कोटिः, कुज्या भुज इति भुजत्रयैरुत्पन्नत्रिभुजमेकम् । द्वादशकोटिः, पलभा भुजः, पलकर्णः कर्ण इति भुजत्रयैरुत्पन्नं द्वितीयत्रिभुजम् ।

एतयोरक्षक्षेत्रयोः सजातीयत्वादनुपातेन $\frac{\text{पभा. क्रांज्या}}{१२} = \text{कुज्या}$, क्षितिजाहोरात्र-

वृत्तसम्पातगतध्रुवप्रोतवृत्ते ध्रुवान्नाडीवृत्तं यावन्नत्यंशाः । ध्रुवात्पूर्वस्वस्तिकं यावदुन्मण्डले नवत्यंशाः । नाडीवृत्ते पूर्वस्वस्तिकाद् ध्रुवप्रोतवृत्तनाडीवृत्त-सम्पातं यावच्चरम् । एभिर्भुजत्रयैरुत्पन्नमेकं चापीयत्रिभुजम् । ध्रुवात् क्षितिजाहो-रात्रवृत्तसम्पातं यावद् ध्रुवप्रोतवृत्ते द्युज्याचापम । ध्रुवादुन्मण्डलाहोरात्रवृत्तयोः सम्पातं यावद् द्युज्याचापम्, अहोरात्रवृत्ते क्षितिजोन्मण्डलयोरन्तरे कुज्यांश इति भुजत्रयैरुत्पन्नं द्वितीयत्रिभुजमेतयोस्त्रिभुजयोर्ज्याक्षेत्रसजातीयादनुपातो यदि द्युज्यया कुज्या लभ्यते तदा त्रिज्यया किं समागच्छति चरज्या तत्स्वरूपम् = $\frac{\text{कुज्या. त्रि}}{\text{द्यु}}$, अस्याश्चापम् चरासवः । रविभुजज्या, क्रान्तिज्या, द्युज्या, कुज्या, चरज्या, इत्येवात्र पञ्चज्या यदानयनं पूर्वं कृतम् । आचार्यमतेनाऽयनांशाभावोऽतो यथागतरविरेव साधितरविः । भास्करेण सायनरवेर्भुजज्या साधिता, इत्येव तन्मते विशेष इति ॥ ५५-५६-५७-५८ ॥

अब पञ्चज्यानयन को कहते हैं

हि.भा.—रवि भुजज्या को जिनज्या (परम क्रान्तिज्या) से गुणा कर त्रिज्या से भाग देने से लब्धि रवि की इष्ट क्रान्तिज्या होती है नाड़ी वृत्त से सूर्य के उत्तर रहने से उसकी (क्रान्ति-ज्या) की दिशा उत्तर होती है, और नाडीवृत्त से सूर्य के दक्षिण रहने से उसकी दिशा दक्षिण होती है । त्रिज्यावर्ग में से इष्ट क्रान्तिज्या वर्ग को घटाकर शेष का मूल अहोरात्र वृत्त का व्यासार्ध (द्युज्या) होता है, इसकी दिशा भी क्रान्तिज्या की दिशा की तरह होती है, क्रान्ति-ज्या को पलभा से गुणा कर द्वादश १२ से भाग देने से क्षितिज्या (कुज्या) होती है, इसको पृथक् स्थापन करना, उस कुज्या को त्रिज्या से गुणा कर द्युज्या से भाग देने से क्षयवृद्धिज्या (चरज्या) होती है, इसका चाप चर प्राण (चरासु) होता है, चरासु को छः से भाग देने से विनाड़ी (पल) होती है, नाड़ी (दण्ड) को ६० से भाग देने से विनाड़िका (पल) होती है इति ॥ ५५-५६-५७-५८ ॥

उपपत्ति ।

क्रान्तिवृत्त में जहां रवि है उनके ऊपर ध्रुवप्रोतवृत्त कर देना, नाड़ीवृत्त और क्रान्तिवृत्त के सम्पात (गोलसन्धि) से नवत्यंश व्यासार्ध से वृत्त (अयनप्रोतवृत्त) करना, तब दो चापीय जात्य त्रिभुज बनता है, गोल सन्धि से अयन प्रोतवृत्त क्रान्तिवृत्त के सम्पात पर्यन्त क्रान्तिवृत्त में नवत्यंश एक भुज, गोल सन्धि से अयन प्रोत वृत्त नाड़ीवृत्त के सम्पात पर्यंत नाड़ीवृत्त में नवत्यंश द्वितीयभुज, नाड़ीवृत्त और क्रान्तिवृत्त के अन्तर्गत अयन प्रोत वृत्तीय चाप (परम क्रान्ति) तृतीय भुज; इन तीनों भुजों से एक त्रिभुज बना, तथा गोलसन्धि से रविपर्यन्त क्रान्तिवृत्त में रविभुजांश कर्ण एक भुज, रवि से रविगत ध्रुव प्रोतवृत्त के नाड़ीवृत्त सम्पात

पर्यन्त ध्रुव प्रोतवृत्त में इष्ट क्रान्ति द्वितीय भुज गोल सन्धि से ध्रुव प्रोतवृत्त नाड़ीवृत्त के सम्पात पर्यन्त नाड़ी वृत्त में विषुवांश कोटि तृतीय भुज, इन तीनों भुजों से द्वितीय त्रिभुज हुआ, इन दोनों चापीय जात्य त्रिभुजों का ज्याक्षेत्र सजातीय होता है इसलिए पहले लघु त्रिभुज (द्वितीय त्रिभुज) का ज्याक्षेत्र करते हैं, गोल केन्द्र (भूकेन्द्र) से गोलसन्धिगतरेखा कर देना उसके ऊपर रवि केन्द्र से लम्ब रेखा रवि भुजज्या होती है, भूकेन्द्र से नाड़ीवृत्त ध्रुव प्रोत वृत्त सम्पातगत रेखा करना, उस के ऊपर रवि केन्द्र से लम्ब रेखा क्रान्तिज्या (क्रान्ति चाप की ज्या) होती है, इन दोनों (भुजज्या और क्रान्तिज्या) की मूल गत रेखा कर देना यह विषुवांश चाप की ज्या नहीं है, भुजज्या, क्रान्ज्यिा, तन्मूलगत रेखाओं से जो त्रिभुज होता है, वही उक्त चापीय जात्य त्रिभुज का ज्याक्षेत्र होता है नाड़ीवृत्त धरातल के ऊपर क्रान्ज्यिा लम्ब है, तथा मूलगत रेखा नाड़ीवृत्त धरातलगत है इसलिए मूलगत रेखा के ऊपर भी क्रान्ज्यिा लम्ब होती है (धरातल के ऊपर रेखा लम्ब की परिभाषा से) इसलिये उक्त त्रिभुज; जात्य त्रिभुज हुआ, नाड़ी वृत्त और ध्रुव प्रोत वृत्त के सम्पात से गोलसन्धिगत रेखा के ऊपर लम्ब रेखा विषुवांश चाप की ज्या है, मूलगत रेखा गोल संधिगत रेखा के ऊपर लम्ब है, गोल केन्द्र से नाड़ीवृत्त ध्रुव प्रोतवृत्त सम्पातगत त्रिज्या कर्ण, विषुवांशज्या भुज, और विषुवांशज्या मूल से गोल केन्द्र पर्यन्त विषुवांश कोटिज्या कोटि, इन तीनों भुजों से एक त्रिभुज हुआ तथा गोल केन्द्र से क्रान्तिज्या मूल पर्यन्त क्रान्ति की उत्क्रमज्योन त्रिज्या (क्रान्तिकोटिज्या = द्युज्या) कर्ण, मूलगत रेखा भुज, और गोल केन्द्र से भुजज्या मूल पर्यन्त कोटि, इन तीनों भुजों से द्वितीय त्रिभुज हुआ, ये दोनों त्रिभुज सजातीय हैं इसलिए अनुपात करते हैं यदि त्रिज्या में विषुवांशज्या पाते हैं तो द्युज्या में क्या इससे मूलगत रेखा आती है इससे सिद्ध होता है कि किसी भी चापीय जात्य त्रिभुज के ज्याक्षेत्र में कर्णचाप ज्या वास्तविक होती है, भुजचाप और कोटिचाप में किसी एक चाप की ज्या वास्तविक ही होती है, अन्य चाप की ज्या वास्तव नहीं होती है अर्थात् जिस चाप की ज्या वास्तविक होती है उसी के कोटिव्यासार्ध वृत्त में परिणत होती है, जैसे उपरिलिखित चापीय जात्य त्रिभुज के ज्याक्षेत्र में भुजांशकर्ण और क्रान्तिभुज की ज्याएं वास्तविक हैं, कोटिचाप विषुवांश की ज्या वास्तव नहीं है किन्तु भुज (क्रान्ति) कोटिव्यासार्धवृत्त (द्युज्या व्यासार्ध वृत्त) में परिणत होकर मूलगत रेखा (कमलाकरोक्त व्यक्षोदय लबज्या) होती है, नवत्यंश, नवत्यंश और जिनांश इन भुजों से उत्पन्न त्रिभुज का ज्याक्षेत्र (त्रिज्या कर्ण, जिनज्या भुज, जिनांश कोटिज्या = पर माल्पद्युज्या, कोटि से उत्पन्न त्रिभुज) पूर्वोक्त त्रिभुज (भुजज्या, क्रान्तिज्या, मूलगत रेखाओं से उत्पन्न त्रिभुज) का सजातीय है इसलिये अनुपात करते हैं यदि त्रिज्या में जिनज्या (परम क्रान्तिज्या) पाते हैं तो रविभुजज्या में क्या इस अनुपात से इष्टक्रान्तिज्या आती है, $\frac{\text{जिज्या. भुज्या}}{\text{त्रि}}$ = इक्रांज्या, त्रिज्या कर्ण, क्रान्तिज्या भुज, क्रान्तिकोटिज्या (द्युज्या) कोटि इन भुजों से उत्पन्न त्रिभुज में $\sqrt{\text{त्रि}^2 - \text{क्रांज्या}^2}$ = द्युज्या, अग्राकर्ण, क्रान्तिज्या कोटि, कुज्या भुज इन भुजों से उत्पन्न एक त्रिभुज, तथा द्वादश कोटि पलभा भुज, पलकर्ण

कर्ण, इन भुजों से उत्पन्न द्वितीय त्रिभुज, दोनों अक्षक्षेत्र हैं इसलिये सजातीय होने के कारण अनुपात करते हैं $\frac{\text{पभा. क्रांज्या}}{१२}$ = कुज्या, क्षितिजाहोरात्र वृत्त के सम्पातगत ध्रुवप्रोत वृत्त में ध्रुव से नाड़ी वृत्त पर्यन्त नवत्यंश, ध्रुव से पूर्वस्वस्तिक पर्यन्त उन्मण्डल में नवत्यंश, पूर्वस्वस्तिक से ध्रुवप्रोत वृत्त नाड़ीवृत्त के सम्पात पर्यन्त नाड़ीवृत्त में चरांश, इन भुजों से उत्पन्न एक त्रिभुज, तथा ध्रुव से क्षितिजाहोरात्र वृत्त के सम्पात पर्यन्त ध्रुव प्रोत वृत्त में द्युज्या चाप एक भुज, ध्रुव से उन्मण्डल और अहोरात्र वृत्त के सम्पात पर्यन्त उन्मण्डल में द्युज्याचाप द्वितीय भुज, अहोरात्र वृत्त में क्षितिज वृत्त और उन्मण्डल के अन्तर्गत चाप तृतीय भुज, इन भुजों से उत्पन्न द्वितीय त्रिभुज का ज्याक्षेत्र प्रथम त्रिभुज के ज्याक्षेत्र का सजातीय है इसलिये अनुपात करते हैं। यदि द्युज्या में कुज्या पाते हैं तो त्रिज्या में क्या इससे चरज्या आती है, $\frac{\text{कुज्या. त्रि}}{\text{द्यु}}$ = चरज्या, इसका चाप = चरासु, यहां रविभुजज्या, क्रान्तिज्या, द्युज्या, कुज्या, चरज्या, यह पञ्चज्यानयन किया गया है, आचार्य के मत में अयनांशाभाव है, इसलिए यथागत रवि ही साधित रवि होता है; भास्कराचार्य ने सायन रवि की भुजज्या का साधन किया हैं वही उन के मत में विशेषता है, इति ॥ ५५-५६-५७-५८ ॥

इदानीं चरकर्माह

चरदलघटिका गुणिता भुक्तिः षष्ट्याहृता कलाद्याप्तम् ।
ऋणमुदयेऽस्तमये धनमुत्तरगोलेऽन्यथा याम्ये ॥ ५९ ॥

वा. भा.—चरदलघटिकाभिरिष्टग्रहभुक्तिं संगुणय्य षष्ट्या विभजेत् फलं लिप्तादि तदुत्तरगोलस्थे रवावौदयिके ग्रहे ऋणमस्तमयिके धनं दक्षिणगोलस्थे च रवावौदयिके धनमस्तमयिके ऋणमेवं स्वदेशार्कोदयकाले ऽस्तमयकाले वा ग्रहो भवति अस्तमयिको यो ऽर्धभुक्त्याकृत् तत्र च काले चरदलघटिकातुल्यादि तस्य घटिका गता भवति अतो रव्युदयकालिको ग्रहश्चरदलघटिका फलेनोपचितौदयिको भवति, फलं च त्रैराशिकेन यदि घटिकानां षष्ट्या ग्रहभुक्तितुल्यलिप्ता भवन्ति। तच्चरदलघटिकाभि : किमिति - लिप्तादिफलं पश्चादप्युन्मंडलकालिका एवं तत्र च काले दिनशेषघटिकाश्चरदलतुल्या भवन्ति । अतश्चरार्धघटिका फलेनोपचितो ग्रहो रव्यौदयिको भवति । याम्ये गोलार्धे वैपरीत्ये तत् क्षितिजमंडलादध: स्थितत्वादुन्मंडलस्य यथास्थितं सर्वं गोले प्रदर्शयेत् । स्वदेशाक्षाग्रयोर्गोलिं विन्यसेत् ।

वि. भा.—भुक्तिः (ग्रहगतिः) चरार्धघटीभिर्गुणिता, षष्ट्या भाज्या, कलादिफलं यल्लब्धं तदुत्तरगोले उदयकाले ग्रहे ऋणं दक्षिणगोले धनं कार्यं अस्तमये

ऽन्यथा (विपरीतं) ऽर्थादुत्तरगोले सहितं दक्षिणगोले रहितं कार्यमिति ॥ ५९ ॥

अत्रोपपत्तिः

अहर्गणेन साधिना ग्रहा लंकाक्षितिजोदयकालिका भवन्ति, ते देशान्तरफलेन संस्कृतास्तदोन्मण्डलकालिका भवन्ति, परन्त्वपेक्षितास्तु स्वक्षितिजोदयकालिकाः, उन्मण्डलस्वक्षितिजयोरन्तरे चरार्धम् तेनानुपातो यदि षष्टिघटीभिर्ग्रहगतिकला लभ्यन्ते तदा चरार्धघटीभिः किं समागच्छन्ति चरार्धघट्यन्तर्गतग्रहगतिकलाः, आभिः कलाभिरुत्तरगोल उन्मण्डलकालिको ग्रहो हीन (उन्मण्डलात् स्वक्षितिजस्याधो विद्यमानत्वात्) स्तदा स्वक्षितिजोदयकालिकग्रहो भवेत्। दक्षिणगोले स्वक्षितिजस्योन्मण्डलादुपरि स्थितत्वात्ताभिः कलाभिः सहितो ग्रहः (उन्मण्डलकालिकः) स्वक्षितिजोदयकालिको भवेत्। परं चरार्धघट्यन्तर्गतग्रहगतिग्रहणमन्तरैवैवं भवितुमर्हति तद्गतिग्रहणन्त्वावश्यकमत आचार्योक्तचरफलसंस्कारो न शोभनः, असकृत्कर्मणाऽत्र ग्रह औदयिको भवितुमर्हतीति, सकृत्कर्मणापि पूर्वं वास्तवोदयान्तरसाधने एकासुजेन गतिमङ्गुणितैकलिप्तोत्पन्नास्वित्याद्युपपत्तौ भाज्यस्थाने यदि प्राचीन चरफलं गृह्येत तदा वास्तवं चरफलं समागच्छेदेवेति ॥ ५९ ॥

अब चरकर्म को कहते हैं।

हि. भा.—ग्रहगति को चरखण्ड घटी से गुणा कर साठ से भाग देने से जो कलादि फल हो उसको उत्तर गोल में उदयकाल में ग्रह में ऋण करना, दक्षिण गोल में धन करना, अस्तकाल में विपरीत (उल्टा) अर्थात् उत्तर गोल में ग्रह में धन करना और दक्षिण गोल में ऋण करना चाहिये इति ॥५९॥

उपपत्ति

अहर्गण से साधित ग्रह लङ्काक्षितिजोदय कालिक होते हैं, उन में देशान्तर फल को संस्कार करने से उन्मण्डल कालिक होते हैं लेकिन अपेक्षित है स्वक्षितिजोदयकालिक ग्रह, उन्मण्डल और स्वक्षितिज के अन्तर में चरार्ध है, इसलिये अनुपात करते हैं, यदि साठ ६० घटी में ग्रहगति कला पाते हैं तो चरार्ध घटी में क्या इससे चरार्ध घटी सम्बन्धिनी ग्रहगति कला आती है। इनको उत्तर गोल में उन्मण्डल से अपने क्षितिज को नीचा रहने के कारण उन्मण्डल कालिक ग्रह में से घटाने से स्वक्षितिजोदय कालिक ग्रह होते हैं। दक्षिण गोल में उन्मण्डल से अपने क्षितिज के ऊपर रहने के कारण पूर्वागत चरार्ध घटी सम्बन्धिनी ग्रहगति कला को उन्मण्डल कालिक ग्रह में जोड़ने से स्वक्षितिजोदय कालिक ग्रह होते हैं। लेकिन चरार्ध घट्यन्तर्गत जो कुछ ग्रहगति होगी उसका ग्रहण आचार्य ने नहीं किया है, लेकिन उसका ग्रहण करना आवश्यक है इसलिए आचार्योक्त चरफलसंस्कार ठीक नहीं है, असकृत्कर्म से यहां

औदयिक ग्रह हो सकते हैं, सूक्तप्रकार से भी पहले वास्तवोदयान्तर साधन में 'गुरुभुजेन रवि-संगुणितैक लिप्तोन्मितासु इत्यादि' की उपपत्ति में भाष्यस्थान में प्राचीनोक्त चरफल ग्रहण से वास्तव चरफल आता है, सिद्धान्तशेखर में 'ग्रहगति चर खण्ड प्राणपिण्डाभिहताः' इत्यादि श्रीपति का प्रकार आचार्योक्तानुरूप ही है, भास्कराचार्य भी ''चरघ्नभुक्तिर्द्युनिशाम् भक्ता'' इत्यादि से उसी विषय को कहते हैं. चरफल संस्कार किसी भी प्राचीनाचार्य का ठीक नहीं है यह उपर्युक्त युक्ति से स्पष्ट है इति ।।५९।।

इदानीं दिनरात्रिमानमाह

दिनमानरात्रिघटिकाश्चरार्धघटिकाभिरुत्तरे गोले ।
पञ्चदश युक्तहीना याम्ये हीनाधिका द्विगुणाः ॥ ६० ॥

वा. भा.—स्पष्टार्थोऽत्र वासना, इष्टदिने स्वाहोरात्रवृत्तं घटिकांकितं कृत्वा सभागैस्तत्रैकस्मिन्वृत्तपादे पंचदशघटिका भवन्ति । याम्योत्तरमंडलस्वाहोरात्र-वृत्तसंपातादुभयतोपि प्राक्परयोरुन्मंडलेन सह त्वहोरात्रसंपातौ । पंचदशघटिका-वच्छिन्नौ नवस्वदेशोन्मंडलोदयास्तमयौ क्षितिजस्यान्यत्वात् उत्तरगोलेऽधःक्षितिजं क्षितिजाच्च रविमुद्यन्तं पश्यति भूस्थः तस्मात्प्राक्प्रदर्शितचरदलघटिकाभिरधिकाः पंचदशघटिका दिनार्धं भवति । पश्चादस्तक्षितिजमेवास्तमेति तस्मात्ततोपि स्वाहो-रात्र खंडलकेन चरदलाख्येन पंचदशघटिका उपचिता सत्यो दिनार्धत्वं भजन्ते अतो द्विगुणं दिनदलमेव दिनप्रमाणं शेषा घटिकास्वाहोरात्रवृत्ते एभिःप्रमाणम् तच्चोभयश्च तच्चरदलेनखंडित मतो द्विगुणं पंचचरदलं त्रिंशतो विशोध्य रात्रि : प्रमाणमुत्तरगोले याम्ये सर्वं वैपरीत्येन योजयेत् । निरक्षदेशे पुनः क्षितिजोन्मंडल-योरेकत्वाच्चरदलाभाव एवमुत्तरगोले तावद्दिनार्धमुपचीयते । यावत् पंचदश घटिकाश्चरार्धं भवति, तत्ररात्रेरभावः तत्र दिने एतच्च तत्र सम्भवति, यत्र षट्षष्टि रक्षांशा : पुरत : परतश्च तावदुपचीयते यावन्मेरौ । तत्र मेरौ षड्भिर्मा-सैर्दिनं षड्भी रात्रि : एवं निरक्षदक्षिणेनापि योज्यम् एतच्च त्रिप्रश्नोत्तराध्याये वक्षत्याचार्यः, एवमपि तत्रैव व्यावर्णयिष्याम : ।

वि. भा.—उत्तरे गोले पञ्चदशनाड़िकाश्चरार्धघटीभिर्युक्ता हीनाश्च द्विगुणा-स्तथा याम्ये (दक्षिणे गोले) पञ्चदश घटिकाश्चरार्धघटीभिर्हीना युक्ताश्च द्विगुणा-स्तदा दिनमानघट्यो रात्रिमानघट्यो भवन्तीति ॥ ६० ॥

अत्रोपपत्तिः

उन्मण्डलयाम्योत्तरवृत्तयोरन्तरे पञ्चदश घट्यः । स्वक्षितिजोन्मण्डलयो-रन्तरे चरार्धम् । उत्तरगोले स्वक्षितिजादुन्मण्डलस्योपरिस्थित्वाच्चरघटीयुक्ताः

पञ्चदशनाड्यो दिनार्धप्रमाण भवेत्। दक्षिणगोले तु स्वक्षितिजादुन्मण्डलस्याधः स्थितत्वाच्चरघटीहीनाः पञ्चदशघट्यो दिनार्धप्रमाणम्। उभयगोलीय दिनार्धमानं त्रिंशतः शोध्यं तदोभयगोलीयरात्र्यर्धमानं भवेत्। द्विगुणीकरणेन दिनरात्रिमाने भवतः सिद्धान्तशिरोमणौ चरघटीसहिता रहिता इत्यादिना, भास्करेणाप्येवमेव कथ्यत इति ॥ ६० ॥

अब दिन मान और रात्रिमान को कहते हैं।

हि. भा.—उत्तर गोल में पन्द्रह १५ घटी में चरार्ध घटी को जोड़ने से और घटाने से दिनार्ध घटी और रात्र्यर्ध घटी होती है, द्विगुणित करने से दिनमान और रात्रिमान होता है। दक्षिण गोल में पन्द्रह १५ घटी में से चरार्ध घटी को घटाते से और जोड़ने से दिनार्ध और रात्र्यर्ध मान होता है, द्विगुणित करने से दिन मान और रात्रिमान होता है. इति ॥६०॥

उपपत्ति

उन्मण्डल और याम्योत्तर वृत्त के अन्तर में पन्द्रह घटी है, और स्वक्षितिज तथा उन्मण्डल के मध्य में चर घटी है, उत्तरगोल में स्वक्षितिज से उन्मण्डल ऊपर है इसलिये पन्द्रह घटी में चरघटी को जोड़ने से दिनार्धमान होता है, दक्षिण गोल में स्वक्षितिज से उन्मण्डल नीचा है इसलिये पन्द्रह घटी में से चरघटी को घटाने से दिनार्ध मान होता है, दोनों गोलों के दिनार्धमान को तीस में से घटाने से दोनों गोलों (उत्तर गोल और दक्षिण गोल) का रात्र्यर्ध मान होता है, द्विगुणित करने से दिनमान और रात्रिमान होता है, सिद्धान्तशिरोमणि में "चरघटी सहिता रहिता इत्यादि से" भास्कराचार्य भी इसी तरह कहते हैं इति ॥६०

इदानीं ग्रहाणां नक्षत्रानयनमाह

भान्यश्विन्यादीनि ग्रहलिप्ताः खखवसूद्धृता लब्धम्।
भुक्तिहृते गतगम्ये दिवसाः षष्ट्या गुणे घटिकाः ॥ ६१ ॥

वा. भा.—इदानीं नक्षत्रानयनार्थं सर्वग्रहाणामार्यामाह। इष्टस्फुटग्रहलिप्ताः खखवसुभिर्विभजेत् फलभुक्तानि नक्षत्राण्यश्विन्यादीनि भवन्ति, शेषलिप्तागतसंज्ञाः ताश्च खखवसुभ्यो विशोध्य गम्यसंज्ञा भवन्ति। ततो गत गम्ये द्वे अपि तस्यैव ग्रहस्य भुक्त्या विभजेत्। फलं दिवसा: शेषात् षष्टिगुणात् घटिका विघटिकाश्च एवं गतात् प्राक् कालं गम्यादिष्टाभिहृ तः चन्द्रभागेन व्यवहारेण स्फुटचन्द्रादुक्तवन्नक्षत्राद्यंतावानीय चरदलं विनाप्रमाणादिभिर्व्यवहारः इष्टावधे कार्येति प्रसिद्धत्वान्नोदाहृत इति अत्र वासना स्फुट ग्रहे मेषादिराशिगणना मेषादयश्चाश्विन्यादिभिर्नवभिर्नवभिर्नक्षत्रपादैर्नक्षत्रपादाश्चाष्टादश - शत - लिप्ता-प्रमाणस्य

राशेर्नवमांश : तैश्चतुर्भिरष्टौ गतानि भवन्ति । चक्रलिप्तानां सप्तलिप्ताना सप्त-विंशतितमांश इत्यर्थ : ।

तस्माद् ग्रहलिप्ताभिरेको दिवसो भवति । तच्छेषलिप्ताभिः कियन्तो दिवसा इति दिवसादिकालो गताद्वाद्वा कार्य : क्षयवृद्धी च नक्षत्रभोगस्य प्रतिमंडलव-शाद्भू मेरत्यासन्नोऽन्तिदूरे वा ग्रहो भवति । तस्मादुपपन्नं कक्षामंडलादिषु पूर्व-विन्यस्तेषु सर्वं प्रदर्शयेदिति ।

वि. भा.—ग्रहलिप्ताः (ग्रहकलाः) नवसूद्धृता (८०० एभिर्भक्ताः) स्तदा लब्धं अश्विन्यादीनि भानि (नक्षत्राणि) भवन्ति, गतगम्ये (गतगम्यकले) भुक्ति हृते (ग्रहगतिकलाभक्ते) तदा गतगम्या दिवसा भवन्ति, तच्छेषे षष्ट्या गुणे भुक्तिहृते घटिका भवन्तीति ॥ ६१ ॥

अत्रोपपत्तिः

यदि चक्रकलातुल्यग्रहगतौ सप्तविंशतिर्नक्षत्राणि लभ्यन्ते तदेष्टग्रहगतिकलायां किमिति समागच्छन्ति गतनक्षत्राणि तत्स्वरूपम् $= \frac{२७ \times \text{ग्रहक}}{२१६००} = \frac{\text{ग्रकला}}{८००} =$ गत-नक्षत्र $+ \frac{\text{शे}}{८००}$ अत्र शेषं वर्त्तमान नक्षत्रस्य गतावयवमानम् हराच्छुद्धं तदा तद्भो-ग्यावयवः स्यात् । ततोऽनुपातो यदि गतिकलाभिरेकं दिनं लभ्यते तदा गतकलाभि-र्गम्यकलाभिश्च किं समागच्छन्ति गतदिनानि गम्यदिनानि च । शेषे षष्ट्या गुणे गतिहृते तदा घटिका भवन्तीति ॥ ६१ ॥

अब ग्रहों के नक्षत्रानयन को कहते हैं ।

हि.भा.—ग्रह कला को आठ सौ ८०० से भाग देने मे लब्ध अश्विनी आदि नक्षत्र होते हैं । गतकला और गम्य कला को ग्रहगति कला से भाग देने से गतदिन और गम्य दिन होते हैं, शेष को साठ से गुणा कर गति से भाग देने से घटी होती हैं. इति ॥ ६१ ॥

उपपत्ति ।

यदि चक्रकलातुल्य ग्रहगति में सत्ताइस २७ नक्षत्र पाते हैं तो इष्टग्रहगति कला मे क्या इससे गत नक्षत्र आते हैं $\frac{२७ \times \text{ग्रकला}}{२१६००} = \frac{\text{ग्रकला}}{८००} =$ गतनक्षत्र $+ \frac{\text{शे}}{८००}$ यहां शेष वर्त्तमान नक्षत्र के गतावयव है, और उसको हर में से घटाने से उसका भोग्यावयव होता है, तब अनुपात करते हैं, यदि गतिकला में एक दिन पाते हैं तो उसको गतकला और गम्यकला में

क्या इससे गत दिन और गम्य दिन आते हैं। शेष को साठ से गुणा कर गति से भाग देने से घटी होती है। सिद्धान्त शिरोमणि में 'ग्रहकला: सरवीन्दुकला हृता:' इत्यादि से भास्कराचार्य भी इसी बात को कहते हैं. ॥ ६१ ॥

इदानीं तिथ्यानयनमाह

अर्कोनचन्द्रलिप्ताः खयमस्वर ७२० भाजिताः फलं तिथयः।
गतगम्ये षष्टिगुणे भुक्त्यन्तरभाजिते घटिकाः ॥ ६२ ॥

वा. भा.—इदानीं तिथ्यानयनार्थमार्यामाह स्पष्टार्थेयमार्या अमावास्यान्ते चन्द्र-सूर्यौ तुल्यावेकसूत्रगौ भवतस्तत्र प्रतिदिनं पश्चादवलम्बते। तस्माद्रविमुक्ति विशोध्य गत्योरन्तरं सिद्धं भवति यस्मादमावास्यान्तात् द्वावपि प्रवृत्तौ तयोश्चान्तरे द्वादशभिर्भागैरेका तिथिर्भवति। यतश्च चक्रांशकानां त्रिंशद्भागेन द्वादशभागा भवन्ति। तयोश्चान्तरे चक्रममावास्यान्ते भवति द्वादशभिश्च भागैः खयमस्वरसंख्या लिप्ता भवति। अतोऽर्कोनचन्द्रलिप्ता खयमस्वरभाजितफलं तिथीत्युक्तम् शेषेण सह त्रैराशिकं यदि भुक्तान्तरेण षष्टिघटिका लभ्यन्ते तच्छेषाभिर्लिप्ताभिः कियत् इति शेषं प्राग्वत्। अथ सूर्यो गोलाध्यायेपि त्रिदिवसप्रतिपादने विस्तरेण मया व्याख्यात एवेति। रवि चन्द्रांतरदर्शनार्थमाह ॥

वि. भा.—अर्कोनचन्द्रलिप्ताः (रविचन्द्रान्तरकलाः) खयमस्वरभाजिताः (७२० एभिर्भक्ताः) फलं गततिथयो भवन्ति, गता हराच्छुद्धास्तदा गम्या भवन्ति, गतगम्यकले षष्ट्या गुणिते भुक्त्यन्तरभाजिते (रविचन्द्रगत्यन्तरकलाभिर्भक्ते) तदा गतघटिका गम्यघटिकाश्च भवन्तीति ॥ ६२ ॥

अत्रोपपत्तिः

अमान्ते रविचन्द्रावेकत्रैव भवतः (दर्शः सूर्येन्दुसङ्गम इत्युक्तेः) ततोऽनन्तरं चन्द्रोऽधिकगतित्वादग्रतो गच्छति, एवं गच्छन् चन्द्रः पुना रविणा सह यदा मिलति तदा द्वितीयोऽमान्तश्चान्द्रमासपूर्त्तिश्च भवति तत्र च रविचन्द्रयोर्गत्यन्तरांशाः ३६०, ततोऽनुपातो यदि रविचन्द्रगत्यन्तरांशेन ३६० तत्तुल्येन त्रिंशत्तिथयो (चान्द्रमासस्य त्रिंशत्तिथ्यात्मकत्वात्) लभ्यन्ते तदेष्टरविचन्द्रगत्यन्तरेण किमिति

$$\text{फलं गतास्तिथयस्तत्स्वरूपम्} = \frac{३० \times \text{रविचन्द्रान्तरांश}}{३६०} = \frac{३० \times \text{रविचंद्रान्तरांश} \times २}{३६० \times २}$$

$$= \frac{६० \times \text{रविचन्द्रान्तरांश}}{७२०} = \frac{\text{रविचन्द्रान्तरकला}}{७२०} = \text{गतति} + \frac{\text{शे}}{७२०}$$ अत्र शेषं वर्त्तमानतिथेर्गतावयवरूपम। तत् हराच्छुद्धं तदा वर्त्तमानतिथेर्भोग्यावयवो

भवति। ततोऽनुपातो यदि गत्यन्तरकलाभिः षष्टिघटिका लभ्यन्ते तदा गतकलाभिर्गम्यकलाभिश्च किं समागच्छन्ति गतघटिका गम्यघटिकाश्चेत्यनेनाचार्योक्तमुपपद्यते, अथपूर्वोक्तगततिथिस्वरूपम् $= \frac{३० \times \text{रविचन्द्रान्तरांश}}{३६०} = \frac{\text{रविचन्द्रान्तरांश}}{१२}$ = गतति $+ \frac{\text{शे}}{१२}$, अत्र शेषं वर्त्तमानतिथेर्गतावयवरूपम् तद्धराच्छुद्धं भोग्यं स्यात्। ततोऽनुपातः पूर्ववत् $= \frac{६० \times \text{गतकला}}{\text{गत्यन्तरकला}} = \frac{\text{गतविकला}}{\text{गत्यन्तरक}}$ = गतघटिकाः। $\frac{६० \times \text{भोग्यकला}}{\text{गत्यन्तरक}} = \frac{\text{भोग्यविकला}}{\text{गत्यन्तरक}}$ भोग्यघटिकाः एतेन "मिहिर विरहितेन्दोरंशकेभ्यो द्विचन्द्रैः १२ गततिथिनिचयः स्यात्तत्र शेषं गताख्यम्। तदपि हरविशुद्धं गम्यकं तद्विलिप्ता गतिविवरविभक्ता यातयेयाख्यनाड्यः" श्रीपत्युक्तमुपपद्यते, सिद्धान्तशिरोमणौ भास्करेणापी 'रविरसैर्विरवीन्दुलवाहृता इत्यादिना' दमेव कथ्यत इति ॥ ६२ ॥

अब तिथ्यानयन को कहते हैं।

हि. भा.—रवि और चन्द्र की अन्तरकला को सात सौ बीस ७२० से भाग देने से लब्धि गत तिथि होती है, गत को हर में से घटाने से गम्य होता है, गत कला और गम्य कला को साठ ६० से गुणा कर गत्यन्तर से भाग देने से गत घटी और गम्य घटी होती है इति. ॥ ६२ ॥

उपपत्ति

अमान्त काल में रवि और चन्द्र एक ही स्थान में रहते हैं, उसके बाद चन्द्र शीघ्रगति होने के कारण रवि से आगे चला जाता है इसतरह प्रतिदिन चलते चलते फिर रबि के साथ मिलता है तब द्वितीय अमान्त होता है, और चन्द्र मास की पूर्ति होती है, तथा वहाँ रवि और चन्द्र के गत्यंतरांश = ३६०° होता है, तब अनुपात करते हैं यदि रवि और चन्द्र के तीन सौ साठ ३६० अंश तुल्य गत्यन्तरांश में तीस ३० तिथि (१ चन्द्रमास तीस तिथि के होते हैं) पाते हैं तो इष्ट रवि चन्द्र के गत्यन्तरांश में क्या इससे गततिथि प्रमाण आता है।

$$\frac{३० \times \text{रविचन्द्रान्तरांश}}{३६०} = \frac{३० \times \text{रविचन्द्रान्तरांश} \times २}{३६० \times २} = \frac{६० \times \text{रविचन्द्रान्तरांश}}{७२०} =$$

$\frac{\text{रविचन्द्रान्तर कला}}{७२०}$ = गतनक्षत्र $+ \frac{\text{शे}}{७२०}$ यहां शेष वर्त्तमान तिथि का गतावयव रूप है उसको हर में से घटाने से वर्त्तमान तिथि का भोग्य अवयव होता है, तब अनुपात करते हैं। यदि गत्यन्तर कला में साठ घटी पाते हैं तो गत कला और गम्य कला में क्या इससे गत घटी

और गम्य घटी आती है इससे आचार्योक्त उपपन्न हुआ । पूर्वोक्त गततिथि स्वरूप=

$\frac{३० \times \text{रविचन्द्रान्तरांश}}{३६०} = \frac{\text{रविचन्द्रान्तरांश}}{१२} = \text{गतति} + \frac{\text{शे}}{१२}$ यहां भी शेष वर्त्तमान तिथि

का गतावयव रूप है। इसको हर १२ में से घटाने से भोग्य होता है। तब अनुपात करते हैं

$\frac{६० \times \text{गतकला}}{\text{गत्यन्तरक}} = \frac{\text{गत विकला}}{\text{गत्यन्तरक}} = \text{गतघटी}, \frac{६० \times \text{भोग्यकला}}{\text{गत्यन्तरक}} = \frac{\text{भोग्य विकला}}{\text{गत्यन्तरक}} = \text{भोग्यघटी}$

इससे 'मिहिरविरहितेन्दो रंशकेभ्यो द्विचन्द्रैः' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपति का पद्य उपपन्न होता है। सिद्धान्त शिरोमणि में भास्कराचार्य भी 'रविरसैर्विरवीन्दुलवाहृता' इत्यादि से इसी को कहते हैं ॥ ६२ ॥

इदानीं योगानयनमाह

रविचन्द्रयोगलिप्ताः खखवसुभिर्भाजिताः फलं योगाः ।
गतगम्ये षष्टिगुणे भुक्तिसमासोद्धृते नाड्यः ॥ ६३ ॥

सु. भा.—स्पष्टार्थम् । संप्रत्युपलब्धचतुर्वेदाचार्यटीकायामियमार्या नोपलभ्यते ॥ ६३ ॥

वि. भा.—रविचन्द्रयोगकलाः ८०० एभिर्भक्तास्तदा लब्धं गतयोगा भवन्ति, गतगम्यकले षष्ट्यागुणिते भुक्तिसमासोद्धृते (रविचन्द्रगतियोगभक्ते) तदा गता नाड्यो गम्यनाड्यश्च भवन्तीति ॥ ६३ ॥

अत्रोपपत्तिः

रविचन्द्रयोर्गतियोगेन योगा जायन्ते, यदा रविचन्द्रयोर्गतियोगः=२१६०० तदा सप्तविंशतिर्योगाभवन्त्यतोऽनुपातो यदि रविचन्द्रयोर्गतियोगकलाया २१६०० मेतत्तुल्यायां सप्तविंशतिर्योगा लभ्यन्ते तदेष्टगतियोगे किं समागच्छन्ति गतयोगास्तत्स्वरूपम् $= \frac{२७ \times \text{गतियोग}}{२१६००} = \frac{\text{गतियोग}}{८००} = \text{गतयोग} + \frac{\text{शे}}{८००}$, अत्रापि शेषं वर्त्तमानयोगस्य गतावयवरूपम् । एतत् हराच्छुद्धं तदा वर्त्तमानयोगस्य भोग्यावयवरूपम् । ततोऽनुपातो यदि गतियोगकलायां षष्टिघटिका लभ्यन्ते तदा गतकलायां गम्यकलायां च किं समागच्छन्ति गतनाड़िका गम्यनाड़िकाश्चेति । सिद्धान्तशेखरे श्रीपतिना "रविविधुयुतिलिप्ताः खाभ्रनागै ८०० विभक्ताः फलमिह गतयोगान् विद्धि विष्कम्भपूर्वान् । तदनु च गतगम्याः सत्तु ६० निघ्ना विभक्ताः स्वगतियुतिकलाभिर्नाड़िका भुक्तभोग्याः" अनेनाऽऽचार्योक्तानुरूपमेव सर्वं कथितमिति ॥ ६३ ॥

अब योगानयन को कहते हैं।

हि. भा.—रवि और चन्द्र की योगकला (गतियोग कला) को आठ सौ ८०० से भाग देने से लब्ध गत योग होते हैं। गतकला और गम्यकला को साठ से गुणा कर गति योग द्वारा भाग देने से गतनाड़ी और गम्य नाड़ी होती है इति ॥ ६२ ॥

उपपत्ति।

रवि और चन्द्र के गति योग से योग बनते हैं, जब रवि और चन्द्र के गतियोग= २१६०० तब सत्ताईस २७ योग होते हैं, इससे अनुपात करते है, यदि रवि और चन्द्र के गति योग कला २१६०० एतत्तुल्य में सताइस योग पाते हैं तो इष्ट गति योगकला में क्या इससे गतयोग प्रमाण आता है, $\frac{२७ \times गतियोगक}{२१६००} = \frac{गतियोगक}{८००} = गतयो + \frac{शे}{८००}$ यहां शेष वर्त्तमान योग के गतावयव रूप है। उसको हर ८०० में से घटाने से वर्त्तमान योग का भोग्यावयव रूप होता है, तब अनुपात करते हैं यदि गतियोग कला में साठ ६० घटी पाते हैं तो गतयोगकला में और गम्य योग कला में क्या इससे गत नाड़ी और गम्य नाड़ी आती है। सिद्धान्तशेखर में श्रीपति ने 'रविविधुयुतिलिप्ता इत्यादि संस्कृतोपपत्ति में श्लोक से आचार्योक्तानुरूप ही सब कुछ कहा है ॥ ६३ ॥

इदानीं रविचन्द्रांतरमाह

राश्यंशकलाविकलाः स्फुटमासान्तेंऽशलिप्तिका विकलाः।
पक्षान्ते तिथ्यन्ते समा रवीन्द्वोः कलाविकलाः ॥ ६४ ॥

वा. भा.– अमावास्यान्ते स्फुटार्कचंद्रयो : किमप्यन्तरं भवति। तस्मात्ते-राश्यादय : समा एवोपर्युपरिस्थितत्वाद्भूमध्यस्थितस्य द्रष्टु : पक्षान्ते चार्धवक्रांतरितौ द्वावपि भवतोऽतस्तत्र भागादयश्च समा एव राशयश्चभिन्नाः प्रतिदिनमभेदादिति।

वि. भा.—स्फुटमासान्ते रवीन्द्वोः (रविचन्द्रयोः) राश्यंशकलाविकलाः समा-भवन्त्यर्थाद्राश्याद्यवयवाःसमा भवन्ति, पक्षान्ते रविचन्द्रयोरंशलिप्तिका विकलाः समा भवन्त्यर्थाद्रविचन्द्रावंशाद्यवयवेन तुल्यौ भवतः। तिथ्यन्ते रवीन्द्वोः कला विकलाः समा भवन्तीति ॥ ६४ ॥

अत्रोपपत्तिः

रविचन्द्रयोरन्तरांशा यदा द्वादशांशसमास्तदैका तिथिर्भवति, स्फुटमासान्ते

त्रिंशत्तिथयोऽन्तस्तत्र रविचन्द्रान्तरांशाः = ३० × १२ = ३६०° वा शून्यसमा अतो रवि-चन्द्रौ राश्याद्यवयवैस्तत्र समौ भवतः पक्षान्ते पञ्चदश तिथयोऽतस्तत्र रविचन्द्रान्त-रांशाः = १५ × १२ = १८०° = ६ राशयः। अतस्तत्र रविचन्द्रावंशाद्यवयवैः समौ भवतः कथमन्यथा तयोरन्तरे केवलं राशय एव तिष्ठन्ति, कस्मिन्नपि तिथ्यन्ते रवि-चन्द्रयोरन्तरांशा द्वादशभक्ता एव भवितुमर्हन्ति, तेन तिथ्यन्ते कलाविकलासमत्वा-देव केवलमंशा उत्पद्यन्ते, सिद्धान्तशेखरे श्रीपतिना 'मासान्ते समताऽर्कशीतमहसोः क्षेत्रेण राश्यादिना पक्षान्ते पुनरेतयोः सदृशता भागादिना जायते, अन्यस्याश्च तिथे-र्विरामसमये लिप्तादिना तुल्यता, ऽनेनाऽऽचार्योक्तानुरूपमेव कथ्यते। लल्लाचार्येण 'मासान्ते रविशशिनौ समौ भवेतां पक्षान्ते लवकलिकाविलिप्तिकाभिः। अन्यस्या अपि च तिथेः सदाऽवसाने तुल्यौ स्तः खलु कलिकाविलिप्तिकाभिः' पीदमेव कथ्यत इति ॥ ६४ ॥

अब रवि और चन्द्र के अन्तर को कहते हैं।

हि. भा.—स्फुटमासान्त में रवि और चन्द्र के राशि, अंश, कला, और विकला सम होती है अर्थात् राशाद्यवयव से दोनों बराबर होते हैं। तिथ्यन्त में उन दोनों के कला, विकला बराबर होती है अर्थात् कलाद्यवयव से बराबर होते हैं इति ॥ ६४ ॥

उपपत्ति।

रवि और चन्द्र के अन्तरांश जब बारह अंश होते हैं तब एक तिथि होती है, स्फुट-मासान्त में तीस तिथियां होती हैं इसलिये वहाँ रवि चन्द्रान्तरांश = ३० × १२ = ३६० वां शून्य के बराबर, अतः वहां रवि और चन्द्र राश्याद्यवयवों से बराबर होते हैं। पक्षान्त में पन्द्रह १५ तिथियां होती हैं इसलिये रवि चन्द्रान्तरांश = १५ × १२ = १८० = ६ राशि, अतः वहां रवि और चन्द्र अंशाद्यवयवों से बराबर होती है, क्योंकि उन दोनों के अन्तर करने से केवल राशि ही रहती है। किसी भी तिथ्यन्त में रवि चन्द्र का अन्तरांश बारह से विभक्त ही रहता है इसलिये तिथ्यन्त में रवि और चन्द्र कलाद्यवयव से बराबर होते हैं। सिद्धान्त शेखर में श्रीपति 'मासान्ते समताऽर्क शीत महसो, इत्यादि। संस्कृतोपपत्ति में लिखित श्लोक से आचार्योक्तानुरूप ही कहते हैं, लल्लाचार्य भी 'मासान्ते रवि शशिनौ समौ भवेताम्' इत्यादि, संस्कृतोपपत्ति में लिखित श्लोक से इसी बात को कहते हैं इति ॥ ६४ ॥

इदानीं स्थिरकरणान्याह

कृष्णचतुर्दश्यन्ते शकुनिः पर्वणि चतुष्पदं प्रथमे।
तिथ्यर्धेऽन्ते नागं किस्तुघ्नं प्रतिपदाद्यर्धे ॥ ६५ ॥

वा. भा.—स्पष्टार्थेयमार्या इदानीं ध्रुवकरणानयनार्थमार्यामाह ।

वि. भा.—कृष्णपक्षीयचतुर्दश्याः परार्धे शकुनिः, पर्वणि प्रथमे (अमावास्या पूर्वार्धे) चतुष्पदं करणम् । तिथ्यर्धेऽन्ते (अमावास्योत्तरार्धे) नागं, प्रतिपदाद्यर्धे (शुक्लपक्षीय प्रतिपत्पूर्वार्धे) किंस्तुघ्नं करणं भवतीति ।। ६५ ।।

अत्रोपपत्तिः

लल्लाचार्येण "शशिनि कृशशरीरे या चतुर्दश्यवश्यं शकुनिरपरभागे जायते नाम तस्याः । तदनु तिथिदले ये ते चतुष्पादनागे प्रतिपदि च यदाद्यं तद्धि किंस्तुघ्न-माहुः" नेन, श्रीपतिना चे "कृशशशिचतुर्दश्यामन्त्ये दले शकुनिर्भवेत् प्रथमशकले-ऽमावास्यायाश्चतुश्चरणाह्वयम् । करणमुदितं नागस्तस्या दले चरमे बुधैः प्रतिपदि भवेत् किंस्तुघ्नाख्यं सदा प्रथमे दले" त्यनेन, भास्करेण च "शकुनितोऽसितभूत-दलादनु" इति मूलोक्त्या "कृष्णचतुर्दश्यर्धादुपरि यान्यवशिष्यन्ते त्रीणि चतुर्थं प्रतिपत्प्रथमार्धे च । एतानि चत्वारि शकुनिनः । शकुनिचतुष्पदनागकिंस्तुघ्नानी-ति शेषः" व्याख्ययाऽनयाऽमावास्यापूर्वोत्तरार्धयोश्चतुष्पदनागाख्ये करणे कथिते । सूर्यसिद्धान्ते च "ध्रुवाणि शकुनिर्नागं तृतीयं तु चतुष्पदम् किंस्तुघ्नं तु चतुर्दश्याः कृष्णायाश्चापरार्धतः" इत्यनेनाऽमावास्या पूर्वोत्तरार्धयोः नागचतुष्पदाख्ये करणे कथिते तदनयोः करणयोः पूर्वापरक्रमभेदे सूर्यसिद्धान्तसुधावर्षिण्यां "प्रायः सर्वेषां मते ब्राह्मक्रम एव युक्तोऽतः प्रथमं शकुनिः । तृतीयं तु नागम् । चतुष्पदं द्वितीयमि-त्यध्याहार्यम्" म.म. सुधाकरद्विवेदिनो लिखितवन्त इति ।। ६५ ।।

अब स्थिर करणों को कहते हैं ।

हि. भा.—कृष्ण पक्ष की चतुर्दशी के परार्ध में शकुनि करण, अमावास्या के पूर्वार्ध में चतुष्पद करण और परार्ध में नाग करण, शुक्लपक्ष की प्रति पदा के पूर्वार्ध में किंस्तुघ्न करण होते हैं इति ।। ६५ ।।

उपपत्ति

लल्लाचार्य 'शशिनि कृशशरीरे या चतुर्दश्यवश्यं' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से 'कृश शशि चतुर्दश्यामन्त्ये दले' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति तथा 'शकुनितोऽसितभूतदलादनु' इससे भास्कराचार्य भी आचार्योक्तानुरूप ही कहते है। सूर्य सिद्धान्त में "ध्रुवाणि शकुनिर्नागं तृतीयं तु चतुष्पदम्" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से अमावास्या के पूर्वार्ध में नागकरण और उत्तरार्ध में चतुष्पद करण कहते हैं, इन दोनों करणों के पूर्वापर क्रम भेद के विषय में सूर्य सिद्धान्त की सुधावर्षिणी टीका में 'प्राय'

सर्वेषां मते ब्राह्मक्रम एव युक्तोऽत: प्रथमं शकुनि: । तृतीयं तु नागम् । चतुष्पदं द्वितीयमित्य- ध्याहार्यम् म.म.सुधाकर द्विवेदी लिखते हैं इति ॥ ६५ ॥

इदानीं चरकरणान्याह

व्यर्केन्दुकला भक्ताः खरसगुणैर्लब्धमूनमेकेन ।
चरकरणानि बवादीन्यगहृतशेषे तिथिवदन्यत् ॥ ६६ ॥

वा.भा.—स्पष्टार्थोयं । तिथ्यर्धभोगात्मिका करणस्य तिथिवद्वासना योज्या खरसगुणै: फलं चोनमेकेनात: क्रियते यत: सितप्रतिपदार्धात्करणानां बवादीनां प्रवृत्ति: प्रागर्धस्य स्थिरेण नित्यमेवाङ्कत्वादिति । यानि स्फुटगत्याध्याय एव युज्यते वक्तुं तान्यतिबहुत्वात् स्फुटगत्युत्तराध्याये वक्ष्यामीत्येतदार्यामाह ॥

वि. भा.—व्यर्केन्दुकला: (रविचन्द्रान्तरकला:) खरसगुणै: (३६० एभि:) भक्ता लब्धमेकेन हीनं, अगहृतशेषे (सप्तभक्तावशिष्ट) बवादीनि चर करणानि भवन्ति अन्यत्कर्मतिथिसाधनवत्कार्यमिति ॥ ६६ ॥

अत्रोपपत्तिः

तिथिसाधनार्थं यदि ३६०° तुल्य रविचन्द्रयोर्गत्यन्तरेण त्रिंशत्तिथयो लभ्यन्ते तदेष्टरविचन्द्रान्तरांशे किमिति जाता गतास्तिथय:$=\frac{३० \times \text{रविचन्द्रान्तरांश}}{३६०}=$ $\frac{\text{रविचन्द्रान्तरांश}}{१२}$ ततस्तिथिर्द्विगुणाकरणानीत्यत: करणानि$=\frac{२ \times \text{रविचन्द्रान्तरांश}}{१२}$ $=\frac{\text{रविचन्द्रान्तरांश}}{६}=\frac{\text{रविचन्द्रान्तरांश} \times ६०}{६ \times ६०}=\frac{\text{रविचन्द्रान्तरकला}}{३६०}$, चत्वारि स्थिरकरणानि येषां स्थिति: पूर्वश्लोकेन स्पष्टाऽस्ति, किंस्तुघ्न संज्ञक स्थिर करणस्य प्रतिपदाद्यर्धगतत्वात् बवादीनां च शुक्लप्रतिपदोऽन्त्यार्धमारभ्य प्रवृत्ते:, पूर्वं $\frac{\text{रविचन्द्रान्तरक}}{३६०}$ लब्धेषु चैकमूनीक्रियत, तत: सप्तभक्तेऽवशेषं बवादिकरणं भवेत् । अत्रापि षष्टिगुणिताद् गतगम्याद् गत्यन्तरेण भक्ताद् वर्त्तमानकरणस्य गतगम्यघट्यो भवन्ति, सिद्धान्तशेखरे "भानुहीनशशिभागसमूहात् स्याद्बवादिकरणं रसभक्तात् । रूपहीनमगभाजितशेषं शेषकर्म तिथिवच्च विधेयम्" इत्यनेन श्रीपतिना रविरसैर्विरवीन्दुलवाहृता इत्यादिना भास्करेण च रविचन्द्रान्तरांशवशेन करणा- नयनं कृतम् । आचार्येण (ब्रह्मगुप्तेन) रविचन्द्रान्तर कलावशेन तज्ज्ञानं क्रियत इति ॥ ६६ ॥

अब चर करणों को कहते हैं।

हि. भा. -- रवि और चन्द्र की अन्तर कला को तीन सौ साठ ३६० से भाग देने से जो लब्ध हो उसमें से एक घटा कर सात से भाग देने से शेष ववादि करण होते हैं, अन्य कर्म (गत घटी, गम्य घटी साधन) तिथिसाधनवत् करना चाहिये इति ॥ ६६ ॥

उपपत्ति।

तिथि साधन के लिये यदि तीन सौ साठ ३६० रवि और चन्द्र के गत्यन्तरांश में तीस तिथि पाते हैं तो इष्ट रवि चन्द्रान्तरांश में क्या इससे गततिथि आती है, $\frac{३० \times \text{रविचन्द्रान्तरांश}}{३६०} = \frac{\text{रविचन्द्रान्तरांश}}{१२}$ = गततिथि, तिथि को द्विगुणित करने से करण होते हैं इस नियम से $\frac{२ \times \text{रविचन्द्रान्तरांश}}{१२} = \frac{\text{रविचन्द्रान्तरांश}}{६} = \frac{\text{रविचन्द्रान्तरांश} \times ६०}{६ \times ६०}$ $= \frac{\text{रवि चन्द्रान्तरकला}}{३६०}$ = करण, चार स्थिर करण है जिनकी स्थिति पूर्वश्लोक में कही गयी है, शुक्ल पक्ष की प्रति पदा के पूर्वार्ध में किंस्तुघ्न करण के रहने के कारण तथा शुक्लपक्ष की प्रतिपदा के परार्ध से ववादि करणों की प्रवृत्ति के कारण पूर्व $\frac{\text{रविचन्द्रान्तर कला}}{३६०}$ लब्धि में से एक घटाना चाहिये, तब सात से भाग देकर जो शेष रहता है वह ववादि करण होता है। यहां भी गतकला और गम्यकला को साठ से गुणा कर गत्यन्तर से भाग देनेसें वर्त्तमान करण की गतघटी और गम्य घटी होती है, सिद्धान्तशेखर में "भानु हीनशशिभागसमूहात्" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से 'श्रीपति, तथा 'रविरसैर्विरवीन्दुलवा हृता' इत्यादि से भास्कराचार्य ने रविचन्द्रान्तरांश से करणानयन किया है। आचार्य ने रविचन्द्रान्तर कला वश से उन का साधन किया है, कोई विशेषता नहीं है इति ॥ ६६ ॥

इदानीमवशिष्टं स्फुटगत्युत्तराध्याये वक्ष्यामीत्येतदर्थमाह।

इह नोक्तानि बहुत्वात् स्पष्टगतेरुत्तरेऽभिधास्यामि।
संक्रान्तिभतिथिकरण व्यतिपाताद्यन्तगणितानि ॥ ६७ ॥

सु. भा.—स्पष्टार्थम् ॥ ६७ ॥

वि. भा.—संक्रान्ति भतिथिकरणव्यतिपाताद्यन्त गणितानि (संक्रान्तिकाल-नक्षत्रतिथिकरण व्यतिपातादीनामन्तकालं निर्णेतुं गणितानि) स्पष्टगतेरध्यायस्य

बहुत्वात् (अधिकत्वात्पृथुत्वाद्वा) इह (स्पष्टगत्यध्याये) नोक्तानि (न कथितानि) स्पष्टगत्युत्तरेऽध्यायेऽभिधास्यामीति ॥ ६७ ॥

अब शेष विषयों को स्फुटगत्युत्तराध्याय में कहता हूं इसके लिये कहते हैं

हि. भा.—संक्रान्तिकाल-नक्षत्र-तिथि-करण-व्यतिपात आदि का अन्तकाल निर्णय करने के लिये गणितों को यहां स्पष्टगति अध्याय के बहुत्व (विस्तृतित्व) के कारण नहीं कहा गया है, स्पष्टगत्युत्तर नामक अध्याय में कहूंगा इति ॥ ६७ ॥

इदानीमध्यायोपसंहारमाह

ज्यापरिधिस्पष्टीकरणदिनगतिचरार्धभतिथिकरणेषु ।
स्फुटमतिरध्यायः सप्तषष्टिरार्याद्वितीयोऽयम् ॥ ६८ ॥

वा. भा.—इति भट्टमधुसूदनसुतचतुर्वेदपृथुस्वामिकृते ब्रह्मसिद्धान्तभाष्ये द्वितीयः अयमध्यायो ग्रन्थशतैर्नवभि र्व्याख्यातः द्वितीयः। स्वदेशराश्युदयैर्योलग्नं जानाति तृतीयः, लग्नाद्घटिका योजनानि चतुर्थः, दिनगतछायां पञ्चमः, दिनशेषाच्छायां षष्ठः तत्कालाच्छायां सप्तमः एवमत्र सप्तप्रश्नाः।

वि. भा.—ज्यासाधनम्, स्फुटपरिध्यानयनम् । ग्रहादिस्पष्टीकरणम् । दिनगतिसाधनम् । चरखण्ड नक्षत्रतिथि करणानां साधनानि, एतेषु विषयेषु सप्तषष्टिरार्याः (सप्तषष्टि संख्यकाऽऽर्या छन्दसा) अयं द्वितीयोऽध्यायः स्फुटगतिः (स्फुट गतिनामकः) समाप्तिं गत इति शेषः ॥ ६८ ॥

इति श्रीब्राह्मस्फुट सिद्धान्ते स्पष्टाधिकारो द्वितीयः समाप्तः ॥

अब अध्याय के उपसंहार को कहते हैं ।

हि. भा.—ज्यासाधन-स्फुटपरिध्यानयन, ग्रहादि स्पष्टीकरण, दिनगति साधन, चरार्ध-नक्षत्र-तिथि-करणों के साधन, इन विषयों में सड़सठ ६७ आर्या छन्द से स्फुटगति नामक द्वितीय अध्याय समाप्त हुआ ॥ ६८ ॥

इति श्री ब्राह्मस्फुट सिद्धान्त में स्पष्टाधिकार द्वितीय (अधिकार) समाप्त हुआ ।

ब्राह्मस्फुटसिद्धान्तः

त्रिप्रश्नाधिकारः

ब्राह्मस्फुटसिद्धान्तः

त्रिप्रश्नाधिकारः

त्रयाणां प्रश्नानां दिग्देशकालानामुत्तरं यत्राभिधीयते स त्रिप्रश्नाधिकारस्तत्र-आदौ दिग्ज्ञानमाह ।

पूर्वापरयोर्बिन्दू तुल्यच्छायाग्रयोर्दिगपराद्यः ।
पूर्वान्यः क्रान्तिवशात् तन्मध्याच्छङ्कुतलमितरे ।।१।।

वा. भा.—पूर्वापरयोः कपालयोर्बिन्दू कार्यौ तुल्यछायांगुलाग्रयोः । एतदुक्तं भवति । सलिलकृतसमायामवनौ द्वादशांगुलं शंकुं विन्यसेदभीष्टप्रमाणं वा ततः कियत्यपि गते दिवसस्याभीष्टे काले छायाग्रे बिन्दुर्देयः स आद्यः बिन्दुरुच्यते । ततो यावति दिनगते काले छायाग्रे बिन्दुर्दत्त स्तावति दिवसस्य शेषे च छायाग्रे द्वितीयो बिन्दुर्देयः, अन्यदुच्यते । ततो विवस्वति प्राक्कपालस्थेय आद्यो बिन्दुर्दत्तः सापरा दिग्भवति । अपरकपालस्थे च सवितरि योऽन्यो बिन्दुर्दत्तः सा पूर्वा दिक् । यदि नाम-क्रान्तिवशेन दिग्भेद उपपद्यते । प्रथमबिन्दुदानकालिकाद्रवेः क्रान्तिज्यां कृत्वा द्वितीयबिन्दुकालिकाच्च रवेः क्रान्तिज्या कार्या । तयोरन्तरं बिन्द्वन्तरालकालस्य क्रान्तिज्या भवति । व्यासार्धंरविज्यापरिणाहछायांगुलतुल्ये मंडले परिणाम्यते । तेन छायांगुलैर्हत्वा व्यासार्धेन विभजेत् । फलं छायामंडले अंगुलादि तेन बिन्दुश्चाल्यः निरक्षदेशजे दिक्साधने साक्षे चेद्दक्छायांगुले वृत्ते अतस्तां विषुवत्कर्महतां द्वादश-भिर्विभजेत् । फलं परिणतप्राप्ताया पूर्वबिन्दोश्चालनं कार्यम् । ततः उत्क्रमक्षांशैर्विना दिशो यो वेत्तीत्येवं यथासम्भवं फलांगुलैरग्राक्षानगत्या छायामंडले द्वितीयो यो बिन्दुः स उत्तरायणे उत्तरेण संचाल्य दक्षिणायने दक्षिणेन चैवं सा पूर्वा दिग्भवति । ततः पूर्वापरबिन्दोर्मस्तके सूत्रं प्रसार्य रेखां कुर्यात् । सा प्राच्यपरा भवति । तन्मध्या-च्छंकुतलमितर इति तयोर्बिन्दोर्मध्यम् । तस्माच्छंकुतलं यावत्सूत्रं प्रसार्य रेखां कुर्यात् सा दक्षिणोत्तरा भवति । एवं तद्रेखानुसारेण द्वे अपि दक्षिणोत्तरे सिद्धे भवतः इत्यर्थः । अथ चैकं बिन्दुमध्ये कृत्वा द्वितीयप्रठितसूत्रप्रमाणेन वृत्तमालिख्यत । एवं वृत्त-द्वयपरस्परानुप्रवेशात् मत्स्या उपपद्यन्ते । तस्य मुखपुच्छावगाहिसूत्रं दक्षिणोत्तरे पूर्वा दिग्रेखामध्यादित्यत्रेयं वासना पूर्वाह्णे परस्यां दिशि छायाग्रं भवतीत्यभीष्ट-भूदेशस्थितस्य शंकोः तस्याद्यो बिन्दुरपरादिग्भवति । अपराह्णे च पूर्वस्यां दिशि छायाग्रं पतति तेन सा पूर्वा दिक् । कालस्य तुल्यत्वात्तद्गतरेखया पूर्वापरत्वमुपपन्नं स्याद्यद्यर्कभोगो विषुवन्मण्डलगत्या भविष्यद्यावदर्कगतिरपमंडल एवापमंडलस्य तिर्य-

क्कृत्क्रान्तिवशेन दिग्भेद उपपद्यते। उत्तरायणे प्रतिक्षणमुद्गमनादर्कस्य छायाग्रे दक्षिणेन वलति। तत्सूत्रमपि यावच्चलितं तावदुत्तरेण संचाल्यते । येन समपूर्वेण भवति प्रथमबिन्दोः दक्षिणेन दक्षिणानयने च तदवच्छायामंडलपरिणतक्रान्तिज्यया अग्रया वा तद्युज्यते। यतः स्वमंडले तावदेव व्यासार्धस्तत्र बिन्द्वन्तरालक्रान्तिज्या-परिणामे यत्त्रैराशिकं तद। तिस्पष्टं तया च बिन्दुचालने युज्यते। निरक्षे क्षितिजो-न्मंडलयोरेकत्वात् साक्षे च तद्भेदादग्रयैव युज्यते। अग्राकरणं च कथ्यमानवासन-येति। त्रिछायाग्रज्ञो यः क्रान्त्यक्षांशैर्विना दिशो यो वेत्ति तस्योत्तरमाह ॥१॥

वि. भा.—पूर्वापरयोः कपालयोस्तुल्यच्छायाग्रयोर्यौ बिन्दू भवतस्तत्राऽऽद्यः (प्रथमबिन्दुः) अपरादिक् (पश्चिमा दिक्) अन्यः (द्वितीयो बिन्दुः) पूर्वा दिक्, क्रान्तिवशात् (पूर्वापरकपालयोस्तुल्यच्छायाग्रयो र्ये क्रान्ती भवतस्तद्वशाद्भेद उत्पद्यते इत्यध्याहार्यम्) तन्मध्यात् (तयोश्छायाग्रयोर्मध्यं तन्मध्यं तस्मात्) शङ्कुतलं (शङ्कुमूलंयावद्या रेखा तत्र) इतरे (दक्षिणोत्तरे ककुभौ) भवतः। अत्रैतदुक्तं भवति जलादिसमीकृतायां भूमाविष्टदिने तन्मध्यच्छायाव्यासार्धेन वृत्तं विलिख्य तत्केन्द्रे द्वादशाङ्गुलशङ्कुः स्थाप्यः, पूर्वकपालस्थे सूर्ये तस्य शङ्कोश्छायाग्रं तद्वृत्तपरिधौ यत्र लगति स बिन्दुः स्थूलपश्चिमादिक् पश्चिमकपालस्थे रवौ तस्यैव शङ्कोश्छायाग्रं पूर्वभागे तद्वृत्तपरिधौ यत्र निर्गच्छति स बिन्दुः स्थूलपूर्वादिक्, स्थूलपूर्वपश्चिम-बिन्दुगता रेखा स्थूलपूर्वापरा, तस्यां तयोश्छायाग्रयोर्मध्यं यत्तस्माच्छङ्कुमूलगतारेखा दक्षिणोत्तरा भवतीति ॥१॥

अत्रोपपत्तिः

अथ छायाप्रवेशनिर्गमकालिकक्रान्त्योरसमत्वात् $\frac{\text{त्रि.ज्याक्रां}}{\text{ज्यालं}}$ = अग्रा,

$\frac{\text{त्रि.ज्याक्रां}'}{\text{ज्यालं}}$ = अग्रा', अत्र क्रां = छायाप्रवेशकालिकक्रान्तिः। क्रां' = छायानिर्गमकालिक-

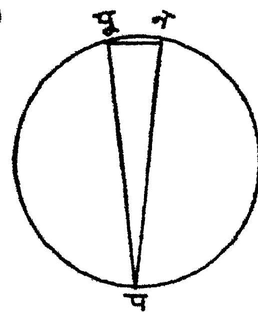
क्रान्तिः। अग्रयोरन्तरेण $\frac{\text{त्रि}\cdot\text{ज्याक्रां}'}{\text{ज्यालं}} - \frac{\text{त्रि}\cdot\text{ज्याक्रां}}{\text{ज्यालं}} = \frac{\text{त्रि}}{\text{ज्यालं}}$ (ज्याक्रां' − ज्याक्रां)

= अग्रा' − अग्रा = अग्रान्तरम्। एतत् छायाकर्णगोले समानीयते, यदि त्रिज्या-व्यासार्धे इदमग्रान्तरं लभ्यते तदा छायाकर्णव्यासार्धे किं समागच्छति छायाकर्ण-

व्यासार्धेऽग्रान्तरम् = $\frac{\text{त्रि}\cdot\text{छाक}}{\text{ज्यालं}\cdot\text{त्रि}}$(ज्याक्रां' − ज्याक्रां), = $\frac{\text{छाक}}{\text{ज्यालं}}$(ज्याक्रां' − ज्याक्रां),

एतदग्रान्तरचालनवशाद् वास्तवपूर्वापररेखायाः समानान्तररेखाया ज्ञानं भवेत्ततः केन्द्रबिन्दुतस्तत्समानान्तरा रेखा वास्तवपूर्वापरा रेखा भवेत्। "छायानिर्गमन-प्रवेशसमयार्कक्रान्तिजीवान्तरं क्षुण्णं स्वश्रवणेन लम्बकहृतं स्यादङ्गुलाद्य

फलम्। पश्चाद्बिन्दुमनेन स्व्ययनतः संचालयेद् व्यत्ययात् स्पष्टा प्राच्यपराऽथवाऽयनवशान् प्राग्बिन्दुमुत्सारयेन्" अमुमेव श्रीपतिप्रकारं दृष्ट्वा भास्करेण 'तत्कालापमजीवयोस्तु विवराद् भाकर्णमित्याहताल्लम्बज्याप्तमिताङ्गुलैरयनदिङ्मैन्द्री स्फुटा चालिता' दं कथितम्। पर छायाकर्णवृत्तपरिध्यग्रान्तरदानानौचित्यान्नहि श्रीपत्याद्युक्तप्रकारेण स्फुटपूर्वापरदिशोर्ज्ञानमतस्तद् वास्तवानयनं प्रदर्श्यते।



पू=स्थूलपूर्वादिक्। प=स्थूलपश्चिमादिक्। पूपके अर्धबिन्दुतः पूप अर्धव्यासार्धेन वृत्त कार्य,पूप रेखा वास्तवपूर्वापररेखाऽसमान्तरा पूबिन्दुतोऽग्रान्तरसमा भुजान्तरसमा वा रेखा पूर्णज्यारूपा (पून) देया (रे·४ अध्याययुक्त्या) पन रेखा कार्या, $<$पूनप=९०, तदेयमेव रेखा वास्तवपूर्वापररेखायाः समानान्तरा भवति ततो वास्तवपूर्वापररेखाज्ञानं भवेदेवेति ॥१॥

अब त्रिप्रश्नाधिकार प्रारम्भ किया जाता है

तीन प्रश्नों (दिशा, देश, काल) का उत्तर जिसमें कहा जाता है, वह त्रिप्रश्नाधिकार है, उसमें पहले दिशा ज्ञान को कहते हैं।

हि॰ भा.—पूर्वकपाल में पश्चिमकपाल में तुल्यछायाग्रद्वय में जो दो बिन्दु हैं उनमें प्रथम बिन्दु पश्चिम दिशा है, द्वितीय बिन्दु पूर्व दिशा है, पूर्वकपाल और पश्चिमकपाल में तुल्यछायाग्रद्वय की जो क्रान्ति होती है उसके वश से भेद होता है, दोनों छायाग्रद्वय के मध्य से शङ्कुमूलपर्यन्त जो रेखा होती है वह दक्षिणोत्तर रेखा है, उसी में दक्षिण दिशा और उत्तर दिशा होती है। जलादि से समान की हुई पृथ्वी में इष्ट दिन में मध्यान्हकालिक छाया व्यासार्ध से वृत्त बनाकर उसके केन्द्र में द्वादश १२ इगुल शङ्कु स्थापित करना, सूर्य के पूर्वकपाल में रहने से उस शङ्कु का छायाग्र उस वृत्तपरिधि में जहां प्रवेश करता है वह बिन्दु स्थूल पश्चिम दिशा है, पश्चिम कपाल में सूर्य के रहने से शङ्कु का छायाग्र पूर्वभाग में उस वृत्त परिधि में निर्गत होता है वह स्थूल पूर्व दिशा है, दोनों बिन्दु (स्थूल पूर्वपश्चिम) गतरेखा स्थूल पूर्वापर रेखा होती है, उसमें दोनों छायाग्रों के मध्य से शङ्कु मूलगत रेखा दक्षिणोत्तर रेखा होती है इति ॥१॥

उपपत्ति

छायाप्रवेशकालिक और निर्गमकालिक क्रांति की अतुल्यता से दोनों क्रान्तिज्या भी अतुल्य होती हैं क्रां=छायाप्रवेशकालिक क्रान्ति। क्रां'=छायानिर्गमकालिक

क्रान्ति, $\frac{\text{त्रि.ज्याक्रां}}{\text{ज्यालं}} = \text{अग्रा}$, $\frac{\text{त्रि.ज्याक्रां}'}{\text{ज्यालं}} = \text{अग्रा}'$ दोनों का अन्तर करने से $\frac{\text{त्रि.ज्याक्रां}'}{\text{ज्यालं}} - \frac{\text{त्रि.ज्याक्रां}}{\text{ज्यालं}} = \frac{\text{त्रि}}{\text{ज्यालं}}(\text{ज्याक्रां}' - \text{ज्याक्रां}) = \text{अग्रा}' - \text{अग्रा}$, $=$ अग्रान्तर $=$ भुजान्तर, इसको छायाकर्ण गोल में लाते हैं। अनुपात करते हैं यदि त्रिज्याव्यासार्ध में यह अग्रान्तर पाते हैं तो छायाकर्ण व्यासार्ध में क्या इससे छायाकर्ण व्यासार्ध में अग्रान्तर आया $\frac{\text{त्रि.छाक}}{\text{ज्यालं.त्रि}}(\text{ज्याक्रां}' - \text{ज्याक्रां}) = \frac{\text{छाक}}{\text{ज्याल}}(\text{ज्याक्रां}' - \text{ज्याक्रां}) =$ छायाकर्णगोल में अग्रान्तर इससे पूर्व-बिन्दु के चालनवश से वास्तव पूर्वापर रेखा की समानान्तर रेखा का ज्ञान होता है, केन्द्र-बिन्दु से उसकी समानान्तरा रेखा वास्तव पूर्वापर रेखा होती है, पूर्वापर रेखा की समानान्तर रेखा के अर्ध बिन्दु से उसके ऊपर लम्बरेखा या पूर्वापर रेखा के अर्ध बिन्दु (केन्द्रबिन्दु) से उसके ऊपर लम्बरेखा दक्षिणोत्तर रेखा होती है, सिद्धान्तशेखर में "छायानिर्गमनप्रवेशसमयार्कक्रान्तिजीवान्तरं" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक श्रीपतिप्रकार को देख कर भास्कराचार्य ने "तत्कालापमजीवयोस्तु विवरात् इत्यादि" सिद्धान्तशिरोमणि में कहा है। लेकिन छायाकर्ण वृत्तपरिधि में अग्रान्तर या भुजान्तर दान देना अनुचित है इसलिए श्रीपत्यादि कथित प्रकार से स्फुट पूर्वापर दिशा का ज्ञान ठीक से नहीं हो सकता है, अतः वास्तव ज्ञान के लिए युक्ति बतलाते हैं।

यहाँ संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये। पू = स्थूल पूर्वदिशा, प = स्थूल पश्चिम दिशा, पूप रेखा वास्तवपूर्वापर रेखा की असमानान्तर रेखा, पू बिन्दु से अग्रान्तर तुल्य या भुजान्तर तुल्य पूर्णज्या रूप रेखा (पून) दिये (रे. ४ अध्याय युक्ति से) पन रेखा कीजिए, $\angle$पूनप $= ९०$, तब यहीं पन रेखा वास्तव पूर्वापर रेखा की समानान्तर होती है, केन्द्र बिन्दु से इसकी समानान्तर रेखा वास्तव पूर्वापर रेखा होगी, इस तरह वास्तविक पूर्व पश्चिम दिशाओं का ज्ञान हुआ, केन्द्र बिन्दु से पूर्वापर रेखा के ऊपर लम्ब रेखा दक्षिणोत्तर रेखा होती है, इस तरह दक्षिणोत्तर दिशाओं का भी ज्ञान हुआ इति ॥१॥

अत्र विशेषविचारः

पूर्वापरयोर्बिन्दू तुल्यच्छायाग्रयोर्दिगपराऽऽद्यः।
पूर्वाऽन्यः क्रान्तिवशात् तन्मध्याच्छङ्कुतलमितरे ॥१॥

तुल्यच्छायाग्रयोः पूर्वापरयोः पूर्वापरकपालयोः यौ बिन्दू भवतस्तत्राद्यः पूर्वकपालीयो बिन्दुः अपरा प्रतीची दिग् भवति। अन्यः पश्चिमकपालीयो बिन्दुः पूर्वा दिग् स्यात्। अथर्दितदुक्तं भवति। समायां भुवि मध्याह्नच्छायातोऽधिक-

त्रिज्यामितेन कर्कटकेनैकं वृत्तं विलिखेत्। तद्वृत्तमध्ये एकं द्वादशांगुलाङ्कितं शंकुं स्थापयेत्। पूर्वकपाले वर्तमाने सवितरि यदा किल तच्छायाग्रं पश्चिमकपाले वृत्ते प्रविशति तद्बिन्दुमङ्कयेत्। असौ पश्चिमबिन्दुराद्यसंज्ञकः। एवं गच्छति भास्वति पश्चिमकपाले यदा किल शंकुच्छायाग्रं पुनर्निर्गच्छति तत्र खटिकयाऽन्यो बिन्दुः कार्यः। असौ पूर्वबिन्दु.। सोऽप्यङ्क्यः। याम्योत्तरवृत्तात्पूर्वभागः पूर्वकपालः। याम्योत्तरमण्डलात्पश्चिमो गोलार्धः पश्चिमकपालसंज्ञकः स्यात्। तत्र पूर्वकपाले वर्तमाने सूर्ये द्वादशांगुलशंकुच्छायाग्रं पश्चिमकपाले वृत्तपरिधौ लगति। एवं पश्चिमकपालस्थिते सूर्ये तच्छायाग्रं पूर्वकपाले वृत्तपरिधौ भिनत्ति। तत्र प्रथमो बिन्दुः पश्चिमदिक्। तथाऽपरो बिन्दुः पूर्वदिगिति। बिन्दुद्वयबद्धा रेखा पूर्वापरा भवति। तत्र मत्स्योत्पादनेन तद्रेखाया मध्यबिन्दुर्ज्ञातव्यः। तस्माच्छंकुमूलावगाहिनी रेखा इतरा याम्योत्तरा भवतीत्यर्थः

स्यादेतत्। यद्येकस्मिन् दिने रवेः क्रान्तिगतिः स्थिरा भवति नान्यथा। अतः पूर्वापरादिक् क्रान्तिवशात्परीक्षणीया। 'क्रान्तिवशा" दित्यनेन ध्वन्यते यच्छायाप्रवेशकालिकः सूर्यश्छायानिर्गमकालपर्यन्तमेकस्मिन्नेवाहोरात्रवृत्ते भ्रमति तदैव यथोक्तानयनं घटते। अन्यथा विभिद्यमानायां क्रान्तिगतौ प्रवेशनिर्गमछायाग्रबिन्दुबद्धरेखा प्राच्यपरा न भवति। छायाग्रभुजयोरतुल्यत्वात्। तत्र भुजान्तरसंस्कारः कर्त्तव्य इति आचार्याशयः स्पष्टमवगम्यते।

अत्र भाष्यकर्त्ता चतुर्वेदाचार्यः क्रान्त्यन्तरवशेन कर्णगोलीयाग्रान्तरं समानीयाचार्योक्तं दिगन्तरं निरन्तरीकृतम्। इदमेवानयनं मनसि सन्निधाय भास्कराचार्या अपि "तत्कालापमजीवयोस्तु विवराद्भाकर्णमित्याहतात्लम्बज्याप्तमितांगुलैरयनदिश्यैन्द्रीस्फुटा चालिते" ति विलक्षणं दिक्साधनं प्रोचुः। एवमेव "छायानिर्गमनप्रवेशसमयार्कक्रान्तिजीवान्तर" मित्यादि विधानेन श्रीपतिनापि दिक्साधनं स्फुटीकृतम्।

अत्रोपपत्तिः सुगमापि बालावबोधार्थमुच्यते। कल्प्यते छायाप्रवेशे रवेः क्रान्तिः = क्रा, छायानिर्गमे तस्य क्रान्तिः = क्रा'

ततोऽनुपातेन

$$\text{अग्रा} = \frac{\text{त्रि. ज्याक्रा}}{\text{ज्याल}}, \quad \text{अग्रा}' = \frac{\text{त्रि. ज्याक्रा}'}{\text{ज्याल}}$$

ततः कर्णगोलीयाग्रां विधाय छायाग्रीयो भुजः साध्यते।

∴ प्रथमछायाग्रीयो भुजः = कर्णगोलीयाग्रा ∽ वि।

$$= \frac{\text{ज्याक्रा. छाक}}{\text{ज्याल}} \backsim \text{वि}।$$

एवं द्वितीयो भुजः =कर्णगोलीयाग्रा ⌣ वि

$$= \frac{\text{ज्याक्रा.छाक}}{\text{ज्यालं}}$$

द्वयोरन्तरेण

भुग्रं = $\frac{\text{छाक}}{\text{ज्यालं}}$ (ज्याक्रा' ⌣ ज्याक्रा) अनेनान्तरेण प्राची चलिता भवतीति आचार्याः विदन्ति स्म । सूर्यसिद्धान्तेऽपि "शिलातलेऽम्बुसंशुद्धे वज्रलेपेऽपि वा समे" इत्यादिनाचार्यमतमेवाङ्गीकृतं भवेत् ।

इदानीं भाभ्रमरेखावशेन दिग्ज्ञानमाह

त्रिच्छायाग्रजमत्स्यद्वयमध्यगसूत्रयोर्युतिर्यत्र ।
सोत्तरगोले याम्या शङ्कुतलाद्दक्षिणे सौम्या ॥२॥

छायाग्रभ्रमरेखासूत्रयुतेर्वृत्तपरिधिरग्रस्पृक् ।
मध्यच्छायान्तरमुदगितरद्वा शङ्कुमण्डलयोः ॥३॥

वा. भा.—छायात्रयस्तस्मादग्रानीतैस्तन्मत्स्यद्वयमुत्पद्यते, त्रिछायाग्रजमत्स्यद्वयमित्यस्यायमर्थः स्पष्टतरो व्याख्यायते। सलिलकृतायामवनौ यथेष्टप्रमाणं शंकुं विन्यसेत्, तत एककपालस्थे सवितरि छायाग्रेष्वभीष्टेषु त्रिषु त्रयो बिंदवः कार्याः। तत एकबिन्दुं मध्ये कृत्वा इष्टप्रमाणकर्कटकेन वृत्तमालिखेत्। तेनैव कर्कटकेन द्वितीयं बिन्दुमध्ये द्वितीयं वृत्तमालिखेत्। तृतीयमपि बिन्दुमध्ये तृतीयमालिखेत्। वृत्तं तावत् प्रमाणमेव तथा चालिखेद्यथा मत्स्यद्वयमुत्पन्नं प्रतिभाति। तयोश्च यस्यां दिशि महदंतरं ते मुखे यस्यां च सन्निकर्षः ते पुच्छे ततो मुखयोः सूक्ष्मकीलकौ विन्यस्य तयोः सूत्रे बद्ध्वा पुच्छमध्यगतैः सूत्रैः स्वगत्यैकवक्रमुत्पादयेत्। तयोश्च सूत्रयोः स्वमुखपुच्छगत्यनुसारेणागतयोरर्कसम्पातः सा दक्षिणा दिग्भवति। शंकुतलादुत्तरगोलस्थाऽर्कोऽथ दक्षिणगोले तु तुलादौ वर्तते। तदा मध्यगसूत्रयोर्युतिबिन्दुरुत्तरा दिग्भवति शंकुतलादेव। एवं शंकुमूलयुतिबिन्द्ववगाहिसूत्रं प्रसार्य रेखां कुर्यात्, सा दक्षिणोत्तरा दिग् भवति। तत एकैकं बिन्दुमध्ये कृत्वा वृत्तद्वयेन मत्स्यद्वयमुत्पादयेत्। तस्य मुखपुच्छावगाहिसूत्रं पूर्वापरा दिग्भवति। अथ भिन्नकपालजं बिन्दुत्रयं भवति। तदैकैकं बिन्दुमध्ये कृत्वा तथा वृत्तान्यालिखेत् यथैकैकं वृत्तं बिन्दुत्रयमपि परिवेष्टयति शेषं पूर्ववत्। एवं साक्षे देशे दिक्साधनं निरक्षदेशे पुनर्यो बिन्दुपातपंक्तिः सैव पूर्वापरा ततश्च दक्षिणोत्तरा प्राग्वत्साध्येत्यत्र वासना। अभीष्टव्यासार्धेन नववृत्तमालिख्य दिगंकितं कृत्वा प्रदर्श्य तद्यथा स्वदेश-

पूर्वापररेखातो यावत्यन्तरे उत्तरेणार्कोदयः पूर्वस्यां दिशि भवति तावत्येवान्तरे परेण दक्षिणं न च्छायाग्रं भवति । वृत्तमध्यसंस्थितस्य शंकोः ततः स्वाहोरात्रवृत्तगत्या यथाऽर्को दक्षिणे नीयात् नक्षवशादेवं छायावृत्तमुद्गयाति वैपरीत्यानतो यदार्कः सम-मंडलरेखायां भवति, पूर्वेण तदा छायाग्रं परेण सममण्डलरेखायां भवति। यदार्को याम्योत्तररेखागतो दक्षिणेन तदा छायाग्रमपि पूर्वेण सममण्डलरेखायामेव । एवं क्रमेणोत्तरतः पुनरपरस्यां दिशि यावत्यस्तमयः पूर्वस्यां दिशि तद्वत्तावति दक्षिणेन छायाग्रास्तमयः एवं सममण्डलदक्षिणगेऽर्के यदा पुनः सममण्डलं न विशति । तदा याम्योत्तररेखयार्क उत्तरेण यदा भवति तदा छायादक्षिणेन तत्रैव रेखायां भवति । एतच्च भागचतुर्विंशतेर्नूनो यत्राक्षस्तत्र संभवति । एवमुत्तरगोलेऽवश्यं छायाग्रभ्रम-वृत्तखंडं दक्षिणाभिमुखं संभवति । दक्षिणगोले चोत्तराभिमुखं सर्वदा वासना वैपरीत्यात् । अतश्छायाग्रगवशं छायाग्रभ्रमवृत्तपृष्ठगानि भवन्ति । तैश्च मत्स्य-द्वयमुत्पद्यते । तस्य छायाभ्रमवृत्तपृष्ठगानि भवन्ति । तैश्च यन्मत्स्यद्वयमुत्पद्यते तस्य छायाग्रभ्रमवृत्ताद्बहिर्मुखे वृत्तान्तः पुच्छे । अतो वृत्तमध्ये सूत्रद्वययुतिः परिध्यावेष्टनवशात्, सा च दक्षिणाभिमुखे छायाभ्रमवृत्तखंडे दक्षिणेन यास्यतीति कृत्वोक्तं सोत्तरगोले याम्यः, शंकुतलादिति । यतः प्राच्यपरायां शंकुरुत्तराभिमुखे चोत्तरेण, अतएवोक्तं दक्षिणे सौम्येति त्रिछायाग्रज्ञो यः क्रान्त्यक्षांशैर्विना भ्रमणं छायाग्रहो वेति मध्याह्नछायां वेति अस्य प्रश्नद्वयस्योत्तरमाह ।

छायाग्रस्योक्तयो वृत्तपरिधिसूत्रयुतेः सैव छायाग्रभ्रमरेखा एतदुक्तं भवति । त्रिछायाग्रजमत्स्यद्वयमध्यगसूत्रयोर्यः संपातः प्रागार्याप्रदर्शितस्तन्मध्ये कृत्वा तच्छायाग्रगतशिरःस्पृक् यद्वृत्तं भवति तत्र दिग्मध्यस्थितस्य शंकोः छायाग्रं भ्रमति वासना चास्माभिः प्रागार्यायामत्रैवोक्ता । मध्यछायान्तरमित्यत आह । शंकुमंडलयोरिति यत्र छाया भ्रममण्डलं यच्च शंकुमूलं तयोर्यदन्तरमित्यर्थः, तच्चान्तर-मुदगितरं मध्यछायाप्रमाणं याम्योत्तररेखायामन्तरं गृह्यते इत्यर्थः ।

अत्रापि वासना प्रागार्यायामेव प्रदर्शिता । छायाभ्रमपरिधेः संस्थान-प्रदर्शनात्तया युज्यते, इति यच्छायाग्रं दृष्ट्वा क्रान्त्यक्षज्ञो दिशो विजानातीत्यस्योत्तर-मार्याद्वयेनाह ॥२-३॥

वि. भा.—इष्टदिने दिग्मध्यस्थशङ्कोर्भिन्नकालजातं छायात्रयं ज्ञात्वा तदग्रबिन्दुत्रयैरिष्टप्रमाणेन कर्कटकेन वृत्तत्रयं विलिख्य तद्योगेन मत्स्यद्वयमुत्पाद्य तन्मुखपुच्छमध्यगतरेखयोर्यत्र युतिः सोत्तरगोले याम्या (दक्षिणा) दिग् ज्ञेया यदि जिनाल्पाक्षे देशे कदाचिच्छङ्कुमूलाद्दक्षिणे छायाग्रे सा युतिर्भवति तदा सा सौम्या (उत्तरा) दिग् ज्ञेया, सूत्रयुतेर्मत्स्यद्वयमुखपुच्छनिर्गतसूत्रयुतेर्यो वृत्तपरिधिः सोऽग्रस्पृक् (छायाग्रस्पर्शकारि) भवति. अतः परिधिरेखैव छायाभ्रमणरेखा भवति, शङ्कुमण्डलयो (शङ्कुमूल-छायाभ्रमणवृत्तयोः) यदन्तरं सैव मध्यच्छाया भवति सोदग् (उत्तरा) वेतरद् (दक्षिणा) भवति, जिनाधिकाक्षे देशे मध्यच्छाया सदोत्तरा

भवति, उत्तरगोले जिनाल्पाक्षे देशे यदा रवेरुत्तरा क्रान्तिरक्षांशाधिका तदा मध्याह्नकाले शङ्कुच्छाया दक्षिणाभिमुखी भवतीति, सूर्यसिद्धान्तेऽप्येव "इष्टेऽह्नि मध्ये प्राक् पश्चाद् धृते बाहुत्रयान्तरे मत्स्यद्वयान्तरयुतेस्त्रिस्पृक्सूत्रेण भाभ्रमः" मेवास्ति, "यो मत्स्यपुच्छमुखनिर्गतरज्जुयोगस्तस्मात् प्रभात्रितयचिह्नशिरोऽवगाहि। वृत्तं लिखेन्न विजहाति हि तस्य रेखां छाये' त्यनेन लल्लाचार्येण,"मत्स्योदरद्वयगसूत्रयुतेश्च तस्या भागत्रयं स्पृशति यद् भवतीहवृत्तम्। छाया न तत्परिधिमुज्झति मध्यशङ्कोः" अनेन शङ्कुप्रभाभ्रमणमण्डलयोस्तु मध्यं मध्यप्रभावति दक्षिणमुत्तर वेत्यनेन च श्रीपतिनाप्याचार्योक्तानुरूपमेव कथ्यते। इति ॥२-३॥

अत्रोपपत्तिः

एकस्मिन् दिने यदि रवेः क्रान्तिः स्थिरा भवेत्तदाऽहोरात्रवृत्तीयप्रतिबिन्दुस्थरविकेन्द्रतः किरणसूत्राणि शङ्क्वग्रगतानि यत्र यत्र पृष्ठक्षितिजधरातले लगन्ति तेभ्यः शङ्कुमूलं यावत् छायाः, छायास्वरूपदर्शनेन सिद्धं यच्छङ्क्वग्रादहोरात्रवृत्ताधारा सूची कार्या सा पृष्ठक्षितिजधरातलेन छिन्ना सती यादृशं वक्रमुत्पादयति तादृश एवच्छायाभ्रमणमार्गः। मेरौ क्षितिजवृत्तं नाडीवृत्तम् तदहोरात्रवृत्तसमानान्तरमतः शङ्क्वग्रादहोरात्रवृत्ताधारा विषमा सूची पृष्ठक्षितिजधरातलेन (नाडीवृत्तधरातलसमानान्तरधरातलेन) छिन्ना सती छेदितप्रदेशं वृत्ताकारमुत्पादयत्यतः सिद्धं यन्मेरौ सर्वदैवच्छायाभ्रमणमार्गो वृत्ताकारो भवेत्, सूर्यसिद्धान्तकार--लल्लाचार्य--ब्रह्मगुप्तप्रभृतिभिराचार्यैर्वृत्ते सदा छायाभ्रमणं यत्स्वीकृतं तन्मेरावेव समीचीनं भवितुमर्हति, यतोऽन्यत्र साक्षे देशे न्यूनाधिकशङ्कुवशेन वृत्ते, रेखायां, परवलये, दीर्घवृत्ते, अतिपरवलये च छायाभ्रमणं भवति, निरक्षे देशे विषुवद्दिने नाडीवृत्ते रवेर्भ्रमणाच्छङ्क्वग्रस्य नाडीवृत्तधरातले स्थितत्वाच्छङ्क्वग्रान्नाडीवृत्ताधारसूच्यभावस्तेन निरक्षक्षितिजधरातलनाडीवृत्तधरातलयोर्योगरेखा (निरक्षोर्ध्वाधररेखा) भाभ्रमरेखा भवेत्। सर्वत्र सदा छायाभ्रमणं वृत्ते न भवतीति दृष्ट्वैव भास्कराचार्येण सिद्धान्तशिरोमणौ'भात्रितयाद् भाभ्रमणं न सदित्याद्गिना' वृत्ताकारस्यच्छायाभ्रमणमार्गस्य खण्डनं कृतमिति ॥२-३॥

अब भाभ्रमरेखा वश से दिग्ज्ञान को कहते हैं

हि. भा.—इष्ट दिन में जलादि से समान की हुई पृथ्वी पर मध्यच्छाया व्यासार्ध से लिखित वृत्त के केन्द्र में स्थित शङ्कु की तीन काल की छाया जानकर उन तीनों के अग्र बिन्दुओं से इष्ट कर्कट से तीन वृत्त बनाकर उनके योग से दो मत्स्य (मछली के आकार) बनाकर उनके मुख और पुच्छ के मध्यगत रेखाद्वय का योग जहां होता है उसके उत्तर गोल में दक्षिण दिशा समझनी चाहिये, यदि जिनाल्पाक्षांश देश (चौबीश अंश से कम अक्षांश वाला देश) में कभी शङ्कु मूल से दक्षिण छायाग्र में वह योग हो तब वह उत्तर दिशा समझनी

चाहिये, मत्स्यद्वय के मुख और पुच्छगत सूत्रों के योग से जो वृत्त परिधि होती है, वह छायाग्र-स्पर्शकारक वृत्त (छायाभ्रमणवृत्त) होता है, इसलिये वह वृत्तरेखा ही छायाभ्रमण रेखा होती है, शङ्कु मूल और छायाभ्रमण वृत्त का जो अन्तर है, वही मध्यच्छाया होती है, वह उत्तर या दक्षिण होती है, जिनाधिकाक्षांश देश (चौबीस अंश से अधिक अक्षांश वाला देश) में मध्यच्छाया सदा उत्तर होती है, उत्तरगोल में जिनाल्पाक्षांश देश में जब रवि की उत्तरा क्रान्ति अक्षांशाधिक होती है तब मध्याह्नकाल में शङ्कु की छाया दक्षिणाभिमुखी होती है, सूर्यसिद्धान्त में भी 'इष्टेऽह्नि मध्ये प्राक् पश्चात् इत्यादि से' इसी तरह कहा गया है, लल्लाचार्य 'यो मत्स्यपुच्छमुखनिर्गतरज्जुयोगः' इत्यादि संस्कृत-भाष्य में लिखित श्लोक से तथा 'मत्स्योदरद्वयगसूत्रयुतेश्च तस्याः' इत्यादि से तथा 'शङ्कुप्रभाभ्रमणमण्डलयोः' इत्यादि से भी, श्रीपति भी आचार्योक्तानुरूप ही कहते हैं इति ॥ २-३ ॥

उपपत्ति

यदि एक दिन में रवि की क्रान्ति स्थिर हो तब अहोरात्र वृत्त के प्रतिबिन्दुस्थ रवि केन्द्रों से शङ्क्वग्रगत किरणसूत्र (शङ्क्वग्रगत रेखायें) जहाँ-जहाँ पृष्ठक्षितिज धरातल में लगते हैं उन स्थानों से शङ्कु मूल तक छाया है, छायाग्रों के स्वरूप देखने से सिद्ध होता है कि शङ्कु के अग्र से अहोरात्रवृत्त के आधार पर सूची बनाइये उसको पृष्ठक्षितिज धरातल से काटने से जैसा वक्र बनता है वैसा ही छायाभ्रमण मार्ग होता है, मेरु वासियों का क्षितिजवृत्त नाड़ीवृत्त है, वह अहोरात्रवृत्त के समानान्तर है इसलिये शङ्क्वग्र से अहोरात्रवृत्ताधारा विषमसूची पृष्ठक्षितिजधरातल (नाड़ीवृत्त धरातल के समानान्तर धरातल) से कटित होकर कटित प्रदेश को वृत्ताकार बनाती है, इससे सिद्ध होता है कि मेरु में सदा छायाभ्रमणमार्ग वृत्ताकार होता है, सूर्यसिद्धान्तकार, लल्लाचार्य, ब्रह्मगुप्त आदि आचार्यों ने छायाभ्रमणमार्ग वृत्ताकार जो स्वीकार किया है वह मेरु ही में ठीक हो सकता है, क्योंकि मेरु से अन्यत्र साक्ष देश में न्यूनाधिक शङ्कु वश से रेखा में, वृत्त में, परवलय में, दीर्घवृत्त में अतिपरवलय में छायाभ्रमण होता है, निरक्ष देश में विषुवद्दिन में नाड़ीवृत्त में रवि के भ्रमण से और नाड़ीवृत्त धरातल में शङ्क्वग्र के रहने के कारण शङ्क्वग्र से नाड़ीवृत्त रूप अहोरात्रवृत्ताधार सूची का अभाव होता है इसलिये निरक्षक्षितिज धरातल और नाड़ीवृत्त धरातल की योगरेखा (निरक्षोर्ध्वाधर रेखा) भ्रमणरेखा होती है, सब देशों में सदा छायाभ्रमण वृत्त में नहीं होता है इस विषय को देख करके ही सिद्धान्त-शिरोमणि में भास्कराचार्य ने 'भान्तिवाद् भाभ्रमणं न वद' इत्यादि से वृत्ताकार छायाभ्रमण मार्ग का खण्डन किया है, जो बहुत ही ठीक है इति ॥२-३॥

इदानीं द्वादशाङ्गुलशङ्कुभुजानयनमाह

छायावृत्तेऽर्काग्रा कर्णगुणा व्यासदलहृताऽर्काग्रा ।
भुजफलहीना याम्या तदन्तरैक्यं भुजोऽस्याने ॥४॥

शङ्कुः प्राच्यपरायाश्छाया भुजकृतिविशेषमूलं यत् ।
तत् प्राच्यपरा छाया भुजाग्रयोरन्तरं कोटिः ॥५॥

वा. भा.—क्रान्त्यक्षांशैर्विनापि बिन्दुत्रयेण प्राग्दिक्साधनमुक्तमधुना तज्जस्य बिन्दुनैकेन दिक्साधनार्थमिदमार्याद्वयन्तेनायमर्थः छायावृत्तेऽर्काग्रा कथं भवतीत्याह: । कर्णगुणा व्यासदलहृताऽर्काग्रा । कक्षामानविधिनाऽर्काग्रां कृत्वा तया सह त्रैराशिकमिदं यदि व्यासार्धवृत्ते एतावत्यर्काग्रा तदिष्टछायाकर्णवृत्ते कियतीति फलं छायावृत्तार्काग्रांगुलरूपा । ततः स्वेदशं विषुवच्छायांगुलरूपया द्वादशांगुलशंकोःसंबन्धिन्या सह तदन्तरैक्यं यथासंख्यसौम्योत्तरगोलयोः स्थितेऽर्के भुजो भवति ।

अस्याग्रे शंकुः कुत इत्यत आह । प्राच्यपरायणा इति । अस्य भुजाग्रे यः शंकुस्तस्य शंकोश्छाया तस्य कृतिः भुजकृतिश्च तयो कृत्योः मूलं यत्तदेव मूल प्राच्यपराकोटिर्भवति । क्वेत्याह—छायाभुजाग्रयोरन्तरे कोटिरिति । एतदुक्तं भवति । समभूप्रदेशस्थितस्य शंकोश्छाया सा कर्णः यश्चोक्तवद्भुज आनीतः स शंकुमूलाद्विपरीत्येन दातव्यः येन भुजाग्रे शंकुर्भवति । यदि दक्षिणोत्तरेणोत्तरश्च दक्षिणेनेत्यर्थः स भुजः । ततो भुजकृतिः कर्णकृतेर्विशोध्य कोटिकृतिरेखावशिष्यते तस्या मूलं कोटिः सा च प्राच्यपरस्थिता भवति । अत्र वासना इष्टछायाकर्णेन व्यासार्धकल्पितेन वृत्तं समालिख्य दिगंकितं कृत्वा तदीयार्काग्रामितं सूत्रं पूर्वतोऽपरश्च दत्तोत्तरेण याम्येन वा तदुदयास्तसूत्रं तत्र वृत्तपरिणतं दत्वा याम्योत्तररेखायां तदग्रे बिन्दुः कार्यं अर्काग्रयोश्च विन्दुं कृत्वा ततो बिन्दुत्रयेण मत्स्यद्वयमुत्पाद्य तन्मुखपृच्छविनिर्गतसूत्रयुतो बिन्दुः कार्यस्तं बिन्दुमध्ये बिन्दुत्रयमपि स्थापयेद्वा वृत्तमुत्पद्यते । तच्चाहोरात्रवृत्तभूमौ बृहच्छंकुमूलभ्रम संभवति ।

भुजश्च मूलप्राच्यरेखयोरन्तरमुच्यते । तेनार्कोदयकालेऽस्तमयकाले वार्काग्रातुल्या एव भुजा भवति । सर्वत्र साक्षे देशे निरक्षे च ततो निरक्षे दिनमेव सकलाग्रा भुजा यस्य ततस्तत्र शंकुमूलमुदयास्तसूत्रं न त्यजति । साक्षे चाक्षवशात् । तिर्यक्त्वं विषुवन्मंडलस्य तद्वशादिष्टस्वाहोरात्रस्य च तेनोत्तरगोलेनोनार्काग्रा भुजा भवति । यदि प्राच्यपराया उत्तरेण शंकुः अथ दक्षिणेन तदार्काग्रतोऽधिकत्वाच्छंकुतलेऽग्रे व तत्र शोध्यते तथापि तयोरन्तरमेव छायावृत्ते च विषुवच्छायैव सर्वदा शंकुतलं भवति । अतस्तया सहान्तरमुक्तं दक्षिणगोले च सर्वदा प्राच्यपरा या दक्षिणेनार्काग्रा तुल्येऽन्तरे उदयास्तसूत्ररेखान्तरज्यातः दक्षिणेन शंकुतलतुल्येऽन्तरे शंकुमूलं भवति । अतः सर्वदा तयोर्योगो विषुवच्छायाप्रभुजा भवति । भुजश्च यदोत्तरे भवति तदावश्यं प्राच्यपराऽन्यथातस्योत्तरत्वमेव शक्यते च क्रमतः शंकुमूलादेव क्षेत्रोत्थापनं विपरीतं भुजदाने क्रियते च भुजतः । अतः शंकुमूलाद् वृत्तमध्यबिन्द्वन्तरछायार्काः । तथा च शंकुमूलप्राच्यपरान्तरं भुजकृतिकर्णकृति-

विशेष मूनं प्राच्यपरा कोटिदिग्ग्रहणमप्युपपन्नं चैतत् सर्वं गोले प्रदर्शयेदिति। शंकुछायाभ्रमणो दिग्ज्ञो वा वेत्तीत्यस्योत्तरमाह ॥४-५॥

वि. भा.—अर्काग्रा छायाकर्णगुणा, व्यासदलहृता (त्रिज्या भक्ता) तदा छायावृत्ते ऽर्काग्रा (कर्णवृत्ताग्रा) भवेत्। विषुवच्छाया (पलभा) सदा याम्या (दक्षिणा) भवेत्, तदन्तरैक्यं (कर्णवृत्ताग्रा पलभयोर्भिन्नदिशोरन्तरमेकदिशोर्योगः) तदा संस्कारदिक्को भुजो भवतीति ॥४॥

अत्रोपपत्तिः

स्वोदयास्तसूत्रपूर्वापरसूत्रयोरन्तरमग्रा, शङ्कुमूलात्स्वोदयास्तसूत्रोपरिलम्बः शङ्कुतलम्। अग्राशङ्कुतलयोः संस्कारेण शङ्कुमूलात्पूर्वापरसूत्रोपरिलम्बो भुजो भवति, त्रिज्याव्यासार्धे यदि त्रिज्याग्रीयाऽग्रा लभ्यते तदा छायाकर्णे किं समागच्छति छायाकर्णवृत्ताग्रा $=\frac{\text{अग्रा}\times\text{छायाकर्ण}}{\text{त्रि}}$, छायाकर्णगोले शङ्कुतलं पलभातुल्यं भवति कथमिति प्रदर्श्यते अथ $\frac{\text{पलभा}\cdot\text{शङ्कु}}{१२}$ शङ्कुतल, परन्तु, $\frac{१२\times\text{त्रि}}{\text{छाकर्ण}}$ शङ्कु उत्थापनेन $\frac{\text{पलभा}\cdot१२\cdot\text{त्रि}}{१२\times\text{छाक}}=$शङ्कुतल, छायाकर्णव्यासार्धे परिणाम्यते $\frac{\text{पलभा}\cdot१२\cdot\text{त्रि}\times\text{छाक}}{१२\times\text{छाक}\times\text{त्रि}}=$पलभा$=$शङ्कुतलम्। अतश्छायाकर्णगोलेऽग्रापलभयोः संस्कारेण भुजो भवेत्। यतः अग्रा$\pm$शङ्कुतल$=$भुजः। भास्कराचार्येण छायाग्रे पूर्वापररेखयोरन्तरं भुज इति स्वीकृत्य छायाकर्णवृत्ताग्रा व्यस्तगोला पलभा चोत्तरा कल्पिता, आचार्येण लघुशङ्कुमूलपूर्वापररेखयोरन्तरं भुज इति स्वीकृत्याग्रा पलभे यथा दिक्के एव स्थापिते, भुजस्याग्रे इत्यस्याग्रे सम्बन्ध इति ॥४॥

अब द्वादशाङ्गुल शङ्कु के भुजानयन को कहते हैं

हि. भा.—रवि की अग्रा को छाया कर्ण से गुणा कर त्रिज्या से भाग देने से छायावृत्त में रवि की अग्रा होती है, पलभा सर्वदा दक्षिण दिशा की होती है, उन दोनों का अन्तर और योग (कर्णवृत्ताग्रा और पलभा के भिन्न दिशा में अन्तर और एक दिशा में योग) करने से संस्कार दिशा का भुज होता है इति ॥४॥

उपपत्ति

स्वोदयास्तसूत्र और पूर्वापरसूत्र का अन्तर अग्रा है, शङ्कुमूल से पूर्वापरसूत्र के

ऊपर लम्ब शङ्कुतल है, अग्रा और शङ्कुतल का संस्कार करने से शङ्कुमूल से पूर्वापरसूत्र के ऊपर लम्ब भुज होता है, त्रिज्या व्यासार्ध में यदि त्रिज्याग्रीय अग्रा पाते हैं तो छाया-कर्ण में क्या इससे आती है छायाकर्णवृत्ताग्रा $= \frac{\text{अग्रा} \times \text{छाकर्ण}}{\text{त्रि}}$, परन्तु छायाकर्ण गोल में पलभा शङ्कुतल के बराबर होती है जैसे $\frac{\text{पलभा. शङ्कु}}{१२} = \text{शङ्कुतल}$, $\because \frac{१२ \times \text{त्रि}}{\text{छाकर्ण}} = \text{शङ्कु}$

अतः उत्थापन से $\frac{\text{पलभा. } १२ \times \text{त्रि}}{१२.\ \text{छाक}} = \text{शङ्कुतल}$, छायाकर्ण गोल में परिणामन करते हैं

$\frac{\text{पलभा. } १२.\ \text{त्रि} \times \text{छाकर्ण}}{१२.\ \text{छाकर्ण. त्रि}} = \text{पलभा} = \text{शङ्कुतल}$, इसलिए छायाकर्ण गोल में अग्रा और पलभा के संस्कार से भुज होता है, भास्कराचार्य ने छायाग्र और पूर्वापररेखा के अन्तर को भुज स्वीकार कर छायाकर्ण वृत्ताग्रा को व्यस्त गोलक और पलभा को उत्तर कल्पित किया है यहां आचार्य लघुशङ्कु मूल और पूर्वापररेखा के अन्तर को भुज स्वीकार कर अग्रा और पलभा को यथादिक्क (जिस दिशा के जो हैं उसी दिशा के) ही स्थापित किये हैं, भुजस्याग्रे इसका आगे से सम्बन्ध है इति ॥४॥

वि. भा.—प्राच्यपरायाः (पूर्वपरायाः) सकाशाद्यथा दिग्गतस्य भुजस्याग्र शङ्कुमूलं बोध्यम् । छायाभुजकृतिविशेषमूलं (छायाभुजयोर्वर्गान्तरमूलं) यद् भवेत्तदेव छायाभुजाग्रयोरन्तरं प्राच्यपरा (पूर्वापरा) कोटिर्भवेदिति ॥५॥

अत्रोपपत्तिः

शङ्कुमूलात्पूर्वापररेखोपरिलम्बो भुज इत्येव दिग्मध्यगतस्य शङ्कोश्छायाग्र-पूर्वापररेखयोरन्तरम्, दिग्मध्यगतशङ्कुच्छायाकर्णः, छायाग्रात्पूर्वापररेखोपरि-लम्बो भुजः । भुजाग्राद्दिग्मध्यं (वृत्तकेन्द्रं) यावत्पूर्वापररेखायां कोटिः, ततः $\sqrt{\text{छाया}^2 - \text{भुज}^2} = \text{कोटिः}$, भास्कराचार्येणापि सिद्धान्तशिरोमणौ "दिक् सूत्रसम्पातगतस्य शङ्कोश्छायाग्रपूर्वापरसूत्रमध्यमित्यादिना" तदेव कथ्यत इति ॥५॥

अब कोटि साधन को कहते हैं

हि. भा.—पूर्वापररेखा से भुजाग्र में शङ्कुमूल समझना चाहिये । छाया और भुज का वर्गान्तर मूल जो होता है वही छायाग्र और भुजाग्र का अन्तर पूर्वापरानकार कोटि होती है ॥५॥

उपपत्ति

शङ्कुमूल से पूर्वापररेखा के ऊपर लम्ब रेखा भुज है यही दिग्मध्य (वृत्तकेन्द्र) गतशङ्कु के छायाग्र और पूर्वापर रेखा का अन्तर है, दिग्मध्यगतशङ्कुच्छाया कर्ण, छायाग्र से

पूर्वापररेखा के ऊपर लम्बभुज, भुजाग्र से दिग्मध्यपर्यन्त पूर्वापर रेखा में कोटि, इस जात्य त्रिभुज में $\sqrt{\text{छाया}^2 - \text{भुज}^2}$ = कोटि, भास्कराचार्य ने भी सिद्धान्तशिरोमणि में "दिक्सूत्रसम्पातगतस्य शङ्कोश्छायाग्रपूर्वापरसूत्रमध्यम्" इससे इसी बात को कहते हैं इति ॥ ५ ॥

इदानीं शङ्कुच्छायाग्रयोः स्थितिमाह

दिङ्मध्ये छायाग्रं कृत्वा शङ्कोर्यथादिशं भ्रमणम् ।
दिङ्मध्यस्थितशङ्कोश्छायाग्रं भ्रमति विपरीतम् ॥६॥

वा. भा.—इष्टछायाग्रबिन्दुं कृत्वा यः पृच्छति, क्वस्थितस्य शंकोश्छायाग्रमत्र पततीत्यस्य प्रथमार्याधेंनोत्तरं तद्यथा दिङ्मध्ये छायाग्रं कृतमिति । प्राग्वदिग्साधनं कृत्वा भुजज्या कोटि तात्कालिकछायाकर्णे स्थिते एव ततः प्रश्नछायाग्रपूर्वापररेखायां विन्यासे तु तदग्रात् पूर्वापरायामेव रेखायां पूर्वकपालस्थेऽर्के पूर्वाभिमुखं कोट्यंगुलमितं सूत्रं प्रसारयेत् । अपरकपालस्थे यापराभिमुखं कोट्यन्ताद्भुजांगुलमितसूत्रमुत्तरेण देयम् । दक्षिणे दक्षिणेन शंकुं तदग्रे विन्यसेत् तत्र स्थितस्य शंकोः प्रश्नछायाः भवन्ति । एवं च शंकोर्यथादिशं भ्रमणं भवेत् । अन्यथेयं वासना पूर्वाह्णेऽवश्यमेव छाययापराभिमुखी भवितव्या ।

तदग्रं च यथा दिग्मध्ये क्रियते तथा दिग्मध्यात्पूर्वेणावश्यं शंकुरिति कृत्वा पूर्वाभिमुखी कोटिः प्रसार्यते । शंक्वोर्यथादिशं भ्रमणमित्यत उक्तम् । कोट्य-शंक्वग्राच्च भुजान्तरे वा दक्षिणे वा दीयते । यतः सममंडलरेखाया उत्तरेण दक्षिणेन वारविः शंकुश्च तत्रैव तस्य शंक्वोश्छायाप्यपरामुखी दिग्मध्यबिंदुप्रापिणी च युज्यते, पराह्णे च सर्वं वैपरीत्येनोपपद्यते एवेति । यस्त्वभीष्टे प्रदेशे शंकुं विन्यस्य छायांगुलान्युद्दिश्य च छायाग्रं पृच्छति तस्योत्तरं द्वितीयेनार्याधेंन तद्यथा दिक्साधनं कृत्वा प्राक्कोटि भुजं च । ततो दिग्मध्ये शंकुं विन्यसेत्तन्मूलादपराभिमुखी कोटिः पूर्वाह्णे पराह्णे च पूर्वाभिमुखी देया । तदग्राच्च भुजो विपरीतो देयः, उत्तरो दक्षिणेन, दक्षिणश्चोत्तरेण, तदग्रे छायाग्रं भवति । अत उक्तं दिङ्मध्यस्थितशंकोश्छायाग्रं भ्रमति विपरीतम् । इत्यत्र वासना पूर्वापररेखायां स्थितस्य शंकोः पूर्वाह्णेऽपराभिमुखी छाया, अतएवापरेण कोटिः प्रसार्यते । यतश्छायाग्रमस्माभिस्त्वेष्टमारब्धमपराह्णे पूर्वाभिमुखी प्रसार्यते ।

तत्रापि छायाग्रमेवान्वेष्टव्यं भुजोपि वैपरीत्येन दीयते यतोप्यर्कः सममण्डलरेखाया उत्तरेण तदा छायाग्रं दक्षिणेन । दक्षिणेन यदार्कस्तदा छायाग्रमुत्तरेण भवति । तच्छायाग्रं वा विन्यसेत्तदार्कसममंडलस्थितो भवति । साक्षे देशे निरक्षे

तु यतः क्रान्तिज्यातुल्यः सर्वदार्काग्रा भुजो देय इत्येवमेकस्य शंकुतलस्य छायाग्रस्य चाभीष्टकाले साधनं यदा पुनः सकलदिनभ्रमणं साधयितुमिष्यते, तदा तदैव दिङ्मध्ये छायाग्रं कृत्वा शंकुमूलत्रयं साध्यं तदुत्पन्नमत्स्यद्वयमध्यगतसूत्रयुतेर्यो वृत्तपरिधिः शंकुमूलत्रयस्पृक् । शंकुभ्रमणवृत्तमेवं दिङ्मध्यस्थितस्यैव शंकोश्छायाग्रत्रयेण मत्स्यविधानेन प्रागवच्छायाग्रभ्रमणवृत्तसाधनं कार्यम् । वासना चात्र गतार्था चेति । दृष्ट्वा विषुवच्छायां लंबाक्षज्यां करोति यो बहुधेत्यस्य प्रश्नस्योत्तरं बहुप्रकारेण लंबाक्षज्ययोः स्वरूपप्रदर्शनमार्यापिट्केनाह—

वि. भा.—पूर्वापररेखातः शंकुमूलं यद्दिक् भ्रमति ततो विलोमदिशि दिङ्मध्यस्थितशङ्कोश्छायाग्रं भ्रमतीति॥६॥

उपपत्तिः

अत्रोपपत्तिः पूर्वश्लोकोपपत्तिपर्यालोचनया स्फुटेति.॥६॥

अब शङ्कु और छायाग्र की स्थिति को कहते हैं

हि. भा.—पूर्वापररेखा से शङ्कु मूल जिस दिशा में भ्रमण करता है उससे विपरीत दिशा में दिङ्मध्य (छायावृत्त केन्द्र) स्थित शङ्कु का छायाग्र भ्रमण करता है इति.॥६॥

उपपत्ति

पूर्वश्लोकोपपत्ति के विवेचन से स्पष्ट है ॥६॥

प्रथमं विषुवत्कर्णमुक्त्वा लम्बाक्षज्ययोरानयनमाह

शङ्कुर्लम्बश्छायाऽक्षज्या तद्वर्गसंयुतेर्मूलम् ।
विषुवति विषुवत्कर्णश्छायाकर्णोऽन्यदा शङ्कुः॥७॥

उन्नतजीवाकोटिश्छाया दृग्ज्या भुजो नतज्या वा ।
कर्णश्छायावृत्ते व्यासार्धं द्वयमतोऽन्यत्र ॥८॥

शङ्कुच्छायाकृत्योस्त्रिज्याकृतितत्समासगुणहृतयोः ।
मूले लम्बाक्षज्ये तद्धंशकास्तद्धनुर्भागाः ॥९॥

विषुवत्कर्णहृते वा शङ्कुच्छायाहते पृथक् त्रिज्ये ।
अक्षज्येतरजीवे लम्बाक्षांशोत्क्रमज्योने ॥१०॥

नवतेर्लम्बाक्षांशान् प्रोह्य ज्या वेतराक्षलम्बज्ये ।
शङ्कुच्छायागुणिते छायाद्वादशहृते वाऽन्ये ॥११॥

लम्बाक्षज्यावर्गं प्रोह्य त्रिज्याकृतेः पदं वाऽन्या ।
अन्यत्र सर्वदोक्तनतजीवांशानयनमेवम् ॥१२॥

वा. भा.—स्वदेशेऽक्षाग्रयोः गोलं विन्यस्य प्रदर्शयेत्तद्यथा सममंडलाद् दक्षिणेन

याम्योत्तर मंडल विषुवन्मंडलसंपाते सूत्रस्यैकमग्रं बद्ध्वा सममंडलादुत्तरेण तावत्येवान्तरे तस्मिन्नेव याम्योत्तरमंडले द्वितीयमग्रं बध्नीयात्तद्यावदवतिष्ठते तदर्धं-सममंडल भूमध्यावगाहिसूत्रावच्छिन्नमक्षज्या तदग्रेऽवलंबकं बध्नीयात्। भूमध्य-विनिर्गतदक्षिणोत्तरं यत् सूत्रं प्रापितम् । सा स्वदेशावलम्बज्या गोलाध्याय एवास्माभिरयमर्थो व्यारव्यातः। तत्रावलम्बककोटिरक्षज्या भुजः। तद्वर्गसंयुतेः मूलं विषुवत्कर्णव्यासार्धं यतस्तत्र दिने विषुवन्मण्डलमेव स्वाहोरात्रवृत्तम्। व्यासवृत्तं च छायाकर्णेऽन्यत्र दिने ते मध्याह्ने पि न विषुवत्कर्णः दृङ् मंडलेषून्नत-जीवैव, शंकुकोटिश्च सैव छायादृग्ज्योच्यते । शंक्वपेक्षया उन्नतजीवापेक्षया तज्ज्योच्यते-तत् कोटयपेक्षया भुजज्योच्यते यतस्तत् दृङ् मंडलं ग्रहाभिमुखं भ्रमति। सममंडलोपर्यधः खस्वस्तिकं न त्यजति—इत्यस्माभिरयमर्थस्तस्यैव विन्यासे गोला-ध्याये प्रपंचितः। तस्माच्छोभनमुक्तं शंकुरुन्नतजीवाकोटिः पर्याया छाया दृग्ज्या भुजज्या नतज्या च पर्याया एव कर्णस्तु छायावृत्तमुच्यते। छायावृत्तकर्णौ द्वावपि-व्यासार्धमुच्यते तत्र विषुवच्छायाश्च। ततस्त्रिज्याकृत्या द्वेऽपि गुणयेत्। ततः कृत्यो-र्योगेन स्थानद्वयेऽपि भागहारःकर्तव्यः। फलं शंकुकृतेः लंबज्या विषुवच्छाया कृते-रक्षज्या तर्योर्लंबाक्षज्ययोर्धनुषीकृत्वा तद्भागा पृथक्-पृथक् कार्याः इत्यत्र त्रैराशिक वासना। तद्यथा द्वादशकः शंकुः कोटिर्विषुवच्छाया भुजस्तयोर्वर्गसमासो विषु-वत्कर्णवर्गस्तेन यदि शंकुकोटिवर्गो लभ्यते तदा व्यासार्धकर्णवर्गस्पृक् शंकुकोटि-वर्ग इति फलं लंबज्यावर्गः । ततो विषवत्कर्णवर्गेण विषुवच्छाया भुजवर्गो लभ्यते। तदात्रिज्या कर्णवर्गकोटिवर्गयोरन्तरं भुजवर्ग इति॥ फलमक्षज्या वर्गस्तयोर्मूले लंबाक्षज्ये, विषुवत्कर्णहृते वा शंकुछायाहते पृथक् त्रिज्ये। अत्रापि त्रैराशिकं यदि विषुवत्कर्णस्य द्वादश कोटिः तत् त्रिज्याकर्ण स्पृगिति फलं लम्बज्या। ततो विषुवत्कर्णस्य यदि विषुवच्छाया भुजः तत् त्रिज्या कर्णस्पृक् भुजेति फलमक्षज्या अतएव पृथक् त्रिज्ये द्वादश विषुवच्छायागुणैः कृत्वा विषुवत्कर्णं विभजेत्। उपपन्नं चैतदिति अथवाऽपरः प्रकारः त्रिज्येतर जीवा वालं-बाक्षांशौ क्रमज्योनालंबांक्षांशानामुत्क्रमज्या यदा त्रिज्योना क्रियते। तदाक्षज्या-भवति। यदा पुनरक्षांशानामुत्क्रमज्ययोना क्रियते। तदालंबज्या भवति। अत्रेयं वासना। दक्षिणक्षितिजाद्याम्योत्तार मंडलेयावतो लंबांशा उपरिस्थिताश्चापगत्या तेषां या क्रमज्या सा लंबज्या पूर्वमेव प्रदर्शिता। तं द्विगुणीकृत्योपरिस्थितस्य धनुषो यः शरः तावति लंबाशोत्क्रमज्या। सा च त्रिज्यातो यदा शोध्यते, तदाक्षज्या तुल्या ज्याखण्डमवशिष्यते। सममण्डलमध्यभूमध्यावगाहिना सूत्रेण तस्मादुपन्नम्। एकस्या ज्यायाः यावान् प्रकारः तयोरानयने नवतेर्यदाक्षांशाः शोध्यन्ते। नवतेस्तदाक्षांशान्विशोध्य लंबांशकाः अवशिष्यन्ते। तेषां या ज्या सा लंबज्या, यदा लंबांशकाः शोध्यन्ते नवतेः तदाक्षांशाः शेषाः भवन्ति, तेषां या ज्या साक्षज्या भवति । अक्षलम्बज्ये इत्युत्तरत्र संबंधो भविष्यतीति वासनात्र।

मेरौ नवतिरक्षांशाः ध्रुवस्योपरि स्थितत्वाद्विपुवत्कर्णस्य क्षितिजासक्तत्वात्लंबांशकाभावः निरक्षदेशेऽक्षाभावः ध्रुवयोः क्षितिजासक्तत्वान् लंबकश्च नवतिर्भागा ध्रुवोपरि स्थिनत्वादर्धान्तरे तु लंबाक्षयोगो नवतिर्भागाः तेन सममंडल-मध्यदक्षिणेन याम्योत्तरमंडलगत्या क्षितिजस्वस्तिकं नवतिर्भागास्तेभ्यो यदाक्षांशाः शोध्यन्ते नदा लंबांशाः शेषा युज्यन्ते। यदा पुनरेव लंबांशाः शोध्यन्ते तदाक्षभागाः शेषा भवंति। अनुक्रमेण ज्ञायते स्वभागानां या ज्या तज्ज्या भवतीति, अत्रोच्यते। तस्मादुपपन्नम्। यथापि स्थितं क्षेत्रं गोले प्रदर्शयेत्। इत्यपरेण (प्रकारेण) प्रकारान्तरेणानयनम्। शंकुछायागुणिते छायाद्वादशहृते चान्ये। अक्षज्यां द्वादशहतां विपुवच्छाया विभजेत्। फलं लम्बज्या, विषुवच्छायया लंबज्या हन्याद् द्वादशभिरुद्धरेत्, फलमक्षज्याभवति। युक्तिरप्यत्र यदि विषुवच्छाया भुजस्य-द्वादश कोटिः तदाक्षज्यास्पृक् इति फलं लम्बज्या यदि द्वादशकोटेर्विषुवच्छाया भुजः। तदा लंबज्या कोटेः का भुजेति। फलमक्षज्या उपपन्नम्। अथवैकस्य परिज्ञानाद् द्वितीयमानयनं लंबज्या वर्ग प्रोह्य त्रिज्याकृतेः पदश्चान्यत्रिज्या कृतेरक्षज्यावर्ग प्रोह्यमूलं लंबज्या। लंबज्यावर्ग प्रोह्य त्रिज्याकृतेः मूलमक्षज्या, यतोऽक्षज्या भुजालम्बकोटिस्त्रिज्याकर्णः। तस्मादुपपन्नं कर्णकृतेः कोटिकृतिं विशोध्य मूलं भुजस्य कृतिं प्रोह्यपदं कोटिरिति। एवं विषुवति याम्योत्तरमंडलावगाहिन्युष्ण-दीधितौ नतोन्नतज्ये बहुधा प्रदर्श्येदानीं विपुवतोऽन्यत्र दिनार्धे इति दिशति। ते एवानेनार्यार्धेनाऽन्यत्र सर्वदोन्नतनतजीवांशानयनमेवं। यथा विषुवच्छायाविषुवत्क-र्णाभ्यां नतोन्नतज्ये कृते तदंशश्च एवमिष्टदिने मध्याह्नछायया तत्कर्णेन च, नतोन्नतज्ये कृत्वा तच्चापभागाश्च कार्याः।। तेऽत्र नक्तभागास्ते तद्दैवसिका अक्षांशाः। तावद्भिर्भागैः सममंडलमध्यात्ततोर्कः मध्याह्नं करोति तत्र दिने इत्यर्थः, तत्र याव न्नताः तावद्भिरुन्नता इत्यर्थः। एवमिष्टकालेपि तात्कालिकछायया तच्छाया कर्णेन वा नतोन्नतज्ये बहुधा कार्ये, तत्र योन्नतज्या स शंकुः यावती नतज्या तावती छाया तयोर्येऽशास्ते तत्काले नतोन्नतांशा भवन्ति। यथा स्वकमिति विषुवन्मध्याह्नेऽपि नतोन्नतांशा ये कृतास्तेऽपि दृङ्मंडल एव यतः सर्वदा मध्ये याम्योत्तरमंडलमेव दृङ्मंडलं तत्र नतांशाः सममंडलविषुवन्मंडलयोरन्तरं एकान्तरे भावादर्कोऽपि तत्र दिने विषुवन्मंडलं गतो विषुवतो विप्रकर्षो ग्रहस्य क्रान्तिरत्रदिने मध्याह्न-क्रान्तिवशादूना अधिका वा अक्षांशेभ्यो नतांशा भवन्ति।

तद्द्वादशाच्चोनाधिकास्ताः दिनदलछायातत्कर्णस्य च अतः स्वमध्यछाया-कर्णाभ्यां नतोन्नतज्ये विषुवद् युज्येते। अन्यत्र दिनार्धे इष्टकालेऽपि युज्येते। दृङ्-मंडलं यतो ग्रहाभिमुखं भ्रमति। सममंडलोपर्यधः खस्वस्तिकं न त्यज्यते। इष्ट-छायाकर्णस्य यदि द्वादशशंकुः तत् त्रिज्याकर्णस्य का छायेति नतज्या लभ्यते। इत्येव भादयो दृङ्मंडलस्यैकत्वात्तस्मात् सर्वमुपपन्नम्। यथास्थितं गोले प्रदर्शये-दिति। मध्यच्छायार्कज्ञोऽक्षांशान्वा यो वेत्तीत्येतस्य प्रश्नस्योत्तरमाह।

वि. भा.—विषुवति (विषुवद्दिने) मध्याह्नकाले शंकुरेव लम्बः (लम्बज्या) भवति तत्र या छाया साऽक्षज्या कल्पनीया, तद्वर्गसंयुतेर्मूलं विषुवत्कर्णो भवति, अन्यथाऽन्यस्मिन् दिने मध्याह्नादन्यस्मिन् काले वा शंकुना यः कर्णो भवति स द्वादशांगुलशंकोश्छायाकर्णो भवति, शंकुरित्यस्याग्रिमश्लोकेन सम्बन्ध इति ।।७।।

अत्रोपपत्तिः

सायनसूर्ये मेषादिगे मध्याह्ने द्वादशांगुलशंको र्या छाया सा पलभा (विषुवती), शंकुपलभयोर्वर्गयोगमूलं पलकर्णः (विषुवत्कर्णः) अक्षज्याभुजः । लम्बज्या कोटिः । त्रिज्याकर्णः इत्यक्षक्षेत्रसजातीयमेवापवर्त्तितं (पलभाभुजः । द्वादशांगुलशङ्कुः कोटिः । पलकर्णः कर्ण इति भुजकोटिकर्णैरुत्पन्नं) लघुक्षेत्रमतोऽस्यकोटिभुजयोर्लम्बाक्षज्ये नामनी समुचिते एवेति ।। ७ ।।

अब विषुवत्कर्ण को कहते हैं।

हि. भा.—विषुवद्दिन में शंकु ही लम्बज्या होती है, वहां जो छाया होती है उसको अक्षज्या कल्पना करनी चाहिए, उन दोनों के वर्गयोग मूल विषुवत्कर्ण होता है, अन्य दिन (विषुवद्दिन से भिन्न दिन) में वा मध्यान्ह काल से भिन्न काल में शंकुवश से जो कर्ण होता है वह द्वादशांगुल शंकु का छाया कर्ण होता है, 'शंकुः' इसका अगले श्लोक से सम्बन्ध है इति ।। ७ ।।

उपपत्ति ।

सायन रवि जब मेषादि में रहते हैं तब मध्यान्ह काल में द्वादशांगुलशंकु की जो छाया होती है वह पलभा है, द्वादशांगुलशंकु और पलभा का वर्गयोग मूल पलकर्ण होता है, अक्षज्या भुज, लम्बज्या कोटि, त्रिज्या कर्ण इस अक्षक्षेत्र के सजातीय अपवर्त्तित (पलभा भुज, द्वादशांगुलशंकु कोटि, पलकर्ण कर्ण इन भुज कोटि कर्णों से उत्पन्न) लघु त्रिभुज है, इसलिये इसकी कोटि और भुज के नाम लम्बज्या और अक्षज्या समुचित ही है इति ।। ७ ।।

इदानीं संज्ञा विशेषानाह –

वि. भा.—शंकुः उन्नत जीवा वा कोटिः छाया, दृग्ज्या नतज्या वैते शब्दा एकपर्याया भुजः । यत्रैते भुजकोटी भवेतां तस्मिन् छायावृत्तेऽनयो (भुजकोट्योः) र्वशेन यः कर्णस्तदेव व्यासार्धं (त्रिज्या) ज्ञेयम् । अतोऽन्यदत्रापि द्वयं ज्ञेयमर्थात् कोटिर्भुजश्चेति यद्द्वयं तत्तयोर्वर्गयोगमूल व्यासार्धोत्पन्नवृत्ते कल्पनीयमिति ।। ८ ।।

अब संज्ञा विशेष को कहते हैं।

हि. भा.—शंकु वा उन्नतज्या कोटि, छाया, दृग्ज्या, वा नतज्या (ये एक पर्याय वाची शब्द हैं) भुज, जहां ये भुज और कोटि होती है, उस छायावृत्त में इन भुज और कोटि वश से जो कर्ण होता है वही व्यासार्ध (त्रिज्या) समझना चाहिये इससे अन्य अन्यत्र भी कोटि और

भुज ये दोनों जो हों उनको उन दोनों के वर्गयोग मूल व्यासार्धोत्पन्न वृत्त में कल्पना करना इति ॥ ८ ॥

इदानीं लम्बाक्षज्ययोरानयनमाह—

वि. भा.—शंकुशब्देनात्र द्वादशांगुलशंकुस्तथा छायाशब्देन पलभाया ग्रहणम्। द्वादशपलभयोर्वर्गयोस्त्रिज्यावर्गगुणितयोः तत्समासेन हृतयोः (द्वादशपलभयोर्वर्गयोगेन भक्तयोः) मूले तदा क्रमेण लम्बाक्षज्ये भवतः। तद्धनुभागाः (तयोश्चापांशाः) तदंशकाः (लम्बांशा अक्षांशाश्च) भवन्तीति ॥ ९ ॥

अत्रोपपत्तिः

$१२^२+पलभा^२=पलकर्ण^२, \frac{१२^२\times त्रि^२}{पलक^२}=लम्बज्या^२=\frac{१२^२\times त्रि^२}{१२^२+पलभा^२}$, तथा $\frac{पलभा^२\times त्रि^२}{१२^२+पलभा^२}=अक्षज्या^२$ एनयोर्मूले तदा लम्बाक्षज्ये भवतः। तयोश्चापे लम्बाक्षौ भवेतामिति ॥ ९ ॥

अब लम्बज्या और अक्षज्या के साधन को कहते हैं।

हि. भा.—शंकुशब्द से यहां द्वादशांगुलशङ्कु और छायाशब्द से पलभा का ग्रहण करना चाहिये, द्वादश वर्ग और पलभा वर्ग को त्रिज्या वर्ग से गुणा कर द्वादशवर्ग और पलभा वर्ग के योग से भाग देने से क्रमसे लम्बज्या और अक्षज्या होती है, दोनों के चाप करने से लम्बांश और अक्षांश होता है ॥ ९ ॥

उपपत्ति।

द्वादशांगुलशंकु=कोटि, पलभा=भुज, पलकर्ण=कर्ण,
लम्बज्या = कोटि, अक्षज्या = भुज, त्रिज्या=कर्ण, } इन कोटि भुज कर्णों से उत्पन्न अक्षक्षेत्र सजातीय हैं इसलिये अनुपात करते हैं।

$\frac{१२^२\times त्रि^२}{पलक^२}=लम्बज्या^२$, तथा $\frac{पलभा^२\times त्रि^२}{पलक^२}=अक्षज्या^२$, परन्तु $१२^२+पलभा^२=पलक^२$, अतः उत्थापन देने से $\frac{१२^२\times त्रि^२}{१२^२+पलभा^२}=लम्बज्या^२, \frac{पलभा^२ . त्रि^२}{१२^२+पलभा^२}=अक्षज्या^२$, दोनों के मूल लेने से लम्बज्या और अक्षज्या होती है, चाप करने से लम्बांश और अक्षांश होता है इति ॥ ९ ॥

इदानीं प्रकारान्तरेण तयोरानयनमाह—

वि. भा.—त्रिज्ये पृथक् शंकुच्छाया हते(द्वादश पलभागुणिते) विषुवत्कर्णहृते (पलकर्णभक्ते) लम्बाक्षज्ये भवतः। वा लम्बाक्षांशोत्क्रमज्योने त्रिज्ये अक्षज्येतर-

जीवे (अक्षज्यालम्बज्ये) भवतोऽर्थाल्लम्बांशोत्क्रमज्योना त्रिज्याऽक्षज्या, अक्षांशो-त्क्रमज्योना त्रिज्या लम्बज्या भवतीति ॥ १० ॥

अत्रोपपत्तिः

पूर्वश्लोके वर्गानुपातेन लम्बाक्षज्ययोर्वर्गावानीय तन्मूलेन लम्बाक्षज्ये समानीते, अत्रसाधारणानुपातेन तयोरानयनमस्ति त्रि — लम्बांशोत्क्रमज्या = अक्षज्या, त्रि — अक्षांशोत्क्रमज्या = लम्बज्या, सिद्धान्तशेखरे 'लम्बाक्षभागोत्क्रमशिञ्जिनी या तया त्रिमौर्वी रहितेतरा वा' इत्यनेन श्रीपतिना, 'ये दोः कोट्योस्तः क्रमज्ये तदूने त्रिज्ये ते वा कोटिदोरुत्क्रमज्ये' इति विलोमेन भास्करेणाऽपि तदेव कथ्यत इति ॥१०

अब प्रकारान्तर से उन दोनों (लम्बज्या और अक्षज्या) के साधन को कहते हैं ।

हि. भा.—त्रिज्या को पृथक् द्वादश से और पलभा से गुणा कर पलकर्ण से भाग देने से लम्बज्या और अक्षज्या होती है, वा त्रिज्या में लम्बांश की उत्क्रमज्या को घटाने से अक्षज्या होती है, तथा त्रिज्या में से अक्षांशोत्क्रमज्या को घटाने से शेष लम्बज्या होती है इति ॥ १० ॥

उपपत्ति ।

पहले के श्लोक में वर्गानुपात से लम्बज्यावर्ग और अक्षज्यावर्ग लाकर मूल लेकर लम्बज्या और अक्षज्या लाये हैं, यहां साधारण अनुपात से उन दोनों का आनयन है, त्रि—लम्बांशोत्क्रमज्या = अक्षज्या, त्रि—अक्षांशोत्क्रमज्या = लम्बज्या, सिद्धान्त शेखर में 'लम्बाक्षभागोत्क्रमशिञ्जिनी या' इत्यादि से श्रीपति तथा 'ये दो कोट्योस्तः क्रमज्ये तदूने त्रिज्ये ते वा कोटिदोरुत्क्रम ज्ये' इसके विलोम से भास्कराचार्य भी इसी बात को कहते हैं इति ॥ १० ॥

पुनः प्रकारान्तरेण लम्बाक्षज्ये आह—

लम्बाक्षांशान् नवतेः प्रोह्य (हित्वा) ज्या साध्या तदा वा (प्रकारान्तरेण) इतरा ज्या स्यादर्थाल्लम्बांशोननवतेर्ज्याऽक्षज्या, अक्षांशोननवतेर्ज्या लम्बज्या, अक्षलम्बज्ये-शंकुच्छायागुणिते (द्वादशपलभागुणिते) छायाद्वादशहृते (पलभा द्वादश भक्ते) तदा वा (प्रकारान्तरेण)ऽन्ये लम्बाक्षज्ये भवत इति ॥११॥

अत्रोपपत्तिः ।

ज्या (९०—अक्षांश) = लम्बज्या, ज्या (९०—लम्बांश) = अक्षज्या, वा $\frac{\text{अक्षज्या} \times १२}{\text{पलभा}}$ = लंज्या, तथा $\frac{\text{पभा} \times \text{लंज्या}}{१२}$ = अक्षज्या, एतावताऽऽचार्यो-क्तमुपपद्यते ॥ ११ ॥

अब पुनः प्रकारान्तर से लम्बज्या और अक्षज्या को कहते हैं ।

हि. भा.—नवत्यंश में से लम्बांश को घटाने से शेष की ज्या अक्षज्या होती है, नवत्यंश में से अक्षांश को घटाने से शेष की ज्या लम्बज्या होती है, वा अक्षज्या और लम्बज्या को क्रम से द्वादश और पलभा से गुणाकर पलभा और द्वादश से भाग देने से लम्बज्या और अक्षज्या होती है इति ॥११॥

उपपत्ति

ज्या (९०—अक्षांश) = लम्बज्या, ज्या (९०—लम्बांश) = अक्षज्या, वा $\frac{\text{अक्षज्या} \times १२}{\text{पलभा}}$ = लंज्या, $\frac{\text{पभा} \times \text{लंज्या}}{१२}$ = अक्षज्या इससे आचार्योक्त उपपन्न हुआ ॥११॥

इदानीं पुनः प्रकारान्तरेणाह —

वि. भा.—त्रिज्याकृतेः (त्रिज्यावर्गात्) लम्बाक्षज्यावर्गं प्रोह्य पदं वाऽन्या (त्रिज्यावर्गाल्लम्बज्यावर्गं विशोध्यमूलमक्षज्या तथा त्रिज्यावर्गादक्षज्यावर्गं विशोध्य मूलं ग्राह्यं वाऽन्या लम्बज्या) भवेत् । एवमन्यत्र सर्वदोन्नतनतजीवांशानयनं कार्यमर्थात् नतज्या वर्गोनात् त्रिज्यावर्गान्मूलमुन्नतज्या, उन्नतज्यावर्गोनात् त्रिज्यावर्गान्मूलं नतज्या भवेत् । एतयोश्चापे उन्नतांशा नतांशाश्च भवन्तीति ॥१२॥

अत्रोपपत्तिः ।

$\sqrt{\text{त्रि}^2 - \text{लंज्या}^2}$ = अज्या, $\sqrt{\text{त्रि}^2 - \text{अज्या}^2}$ = लंज्या, नतांशज्या = दृग्ज्या, उन्नतांशज्या = शंकुः, $\sqrt{\text{त्रि}^2 - \text{शंकु}^2}$ = दृग्ज्या, $\sqrt{\text{त्रि}^2 - \text{दृग्ज्या}^2}$ = शंकु, इति ॥१२॥

अब पुनः प्रकारान्तर से लम्बज्या और अक्षज्या को कहते हैं ।

हि. भा.—वा त्रिज्यावर्ग में से लम्बज्यावर्ग को घटाने से शेष का मूल अक्षज्या होती है, त्रिज्यावर्ग में से अक्षज्यावर्ग को घटाने से शेष का मूल लम्बज्या होती है, इसी तरह उन्नतांशज्या और नतांशज्या का आनयन करना अर्थात् नतांशज्यावर्ग को त्रिज्यावर्ग में से घटाने से शेष का मूल उन्नतांशज्या (शङ्कु) होती है, तथा उन्नतांशज्यावर्ग को त्रिज्यावर्ग में से घटाने से शेष का मूल नतांशज्या (दृग्ज्या) होती है, इन दोनों का चाप उन्नतांश और नतांश होता है । इति ॥१२॥

उपपत्ति

$\sqrt{\text{त्रि}^2 - \text{लज्या}^2} = \text{अज्या}$, तथा $\sqrt{\text{त्रि}^2 - \text{अज्या}^2} = \text{लज्या}$, $\sqrt{\text{त्रि}^2 - \text{उन्नतांशज्या}^2} = \sqrt{\text{त्रि}^2 - \text{शङ्कु}^2} = \text{दृग्ज्या}$, $\sqrt{\text{त्रि}^2 - \text{नतांशज्या}^2} = \sqrt{\text{त्रि}^2 - \text{दृग्ज्या}^2} = \text{शङ्कुः}$ इति ॥१२॥

इदानीं दिनार्धे नतांश क्रान्त्यंशज्ञाने मन्यक्षांशज्ञानमाह ।

इष्टदिनार्धनतांशक्रान्त्यंशैक्यान्तरं क्रियतुलादौ ।
अक्षांशा याम्यायां छायायामन्तरमजादौ ॥१३॥

वा. भा.—विषुवद्दिनार्धछायया अक्षलम्बज्ययोरानयनं प्रागुक्तमनेनेष्टदिनार्धछायया तयोरानयनमनेनार्यासूत्रेण प्रदर्शयति । यथा विषुवच्छाया विषुवत्कर्णेन चाक्षलंबांशा कृता एवमभीष्टदिनार्धछायया तच्छायाकर्णेन च येऽक्षांशा भवन्ति ते नतांशा उच्यन्ते ये चाक्षलंबांशाः ते उन्नतांशाः ततो दिनार्वकालिकादर्कात्क्रान्तिज्यां कृत्वा तच्चापभागाः कार्याः ते क्रांत्यंशा भवन्ति । ततो यदि मेषादौ राशिषट्के रविस्तदा नतांशानां क्रांत्यंशानां च योगः कार्यः ते स्वदेशाक्षांशा भवन्ति । दक्षिणगोले वा यद्यर्कः तदेतेषामन्तरं स्वाक्षभागाः भवन्ति । यदि दिनदलछाया सौम्या तदैवं मध्याह्न छायामुत्तराभिमुखी भवतीत्यर्थः ।

अन्तरमजादाविति । अथ मध्याह्नछाया दक्षिणाभिमुखी भवति । तदन्तरं नतांशक्रांत्यंशानां स्वदेशेऽक्षोभवति । यद्यजादौ रविरेतच्च तत्र संभवति । यत्र भागा चतुर्विंशति त ऊनोक्षो दक्षिणगोले च दक्षिणाभिमुखी छाया कदाचिदपि न सम्भवति । निरक्षदेशादुत्तरेण स्वाक्षांशान् विशोध्य नवतेः शेषाः लंबांशाः प्राग्वद्वासनात्र स्वदेशयाम्योत्तरमंडलगत्या सममंडलविषुवन्मंडलयोरन्तरे ये भागास्ते स्वाक्षभागाः ते चोत्तर गोले प्रतिदिनं क्रान्तिदिनक्रान्तिभागैरपचीयन्ते । येषां नतभागाः यतः सममण्डलस्य सन्निकृष्टो भवति । रविणा च, नतमतः स्वापचित्या पुनर्योज्यन्ते येन त एवं नतांशाः सम्भवन्ति । दक्षिणगोले चाक्षभागाः प्रतिदिनक्रान्तिभागै रुपचिताः सतो नतभागाः भवन्ति । यत्र प्रतिदिनं समंडलाद्विप्रकृष्टोरविर्भवत्यत उपचितः । पुनर्नतभागेभ्यो विशोध्यते । येन त एवावशिष्यन्तेऽक्षांशाः तस्मादुपन्नम् । यत्र पुनः सममंडलादुत्तरेणार्को मध्याह्नं करोति । यत्र चाक्षभागेभ्योऽधिका उत्तरा क्रांत्यंशा भवन्ति । तेन तत्र दिनार्धे दक्षिणाभिमुखी छाया भवति । यावद्भिस्चभागैरधिका क्रान्तिरक्षात्तावतो नतांशाः क्रान्त्यंशेभ्यो विशोध्यन्ते । येन स्वाक्षभागा च भवन्ति । तेनोक्तमंतरमजादाविति । तस्मात्सर्वमुपपन्नम् । स्वदेशाक्षाग्रयोर्गोले विन्यस्य प्रदर्शयेदिति यस्त्वरखंडकान्तिजानातीत्यस्य प्रश्नस्योत्तरमार्यामाह ॥

वि. भा.—क्रियतुलादौ (मेषादौ तुलादौ) सूर्ये इष्टदिनार्धे नतांशानां क्रान्त्यंशानां योगोन्तरमक्षांशा भवन्ति। अजादौ (मेषादौ) सूर्ये छायायां (मध्याह्नच्छायायां) याम्यायां (दक्षिणायां) सत्यां नतांशक्रान्त्यंशान्तरमेवाक्षांशा भवन्तीति ॥१३॥

अत्रोपपत्तिः

उत्तरगोले मध्याह्नकाले खस्वस्तिकनिरक्षखस्वस्तिकयोरन्तरे रवौ, रवितो निरक्षखस्वस्तिकं यावन्मध्यक्रान्तिः । रवितः खस्वस्तिकं यावन्मध्यनतांशाः, एतयोर्योगेन खस्वस्तिकान्निरक्ष खस्वस्तिकं यावदक्षांशा भवन्ति, दक्षिणगोले निरक्ष खस्वस्तिकाद्दक्षिणे सूर्ये नतांशे क्रान्त्यंशशोधनेऽक्षांशा भवन्ति । उत्तरगोले खस्वस्तिकादुत्तरे रवौ-रवितो निरक्षखस्वस्तिकं यावत्क्रान्त्यंशे नतांशशोधनेनाक्षांशा भवन्ति, सिद्धान्तशेखरे 'उदगिनापमभागसमन्विता' नतलवा इतरत्र विशेषिताः । स्वविषये हि भवन्ति पलांशकाः' इत्यनेन श्री पतिना 'नतांशापमांशान्तरं तुल्यदिक्त्वे युतिर्भिन्नदिक्त्वे पलांशा भवेयुरित्यनेन भास्कराचार्येणाप्याचार्योक्तमेव कथ्यत इति ॥१३॥

अब दिनार्धकाल में नतांश और क्रान्त्यंश के ज्ञान से अक्षांश ज्ञान को कहते हैं।

हि. भा.—मेषादि में और तुलादि में सूर्य के रहने से अर्थात् उत्तरगोल में और दक्षिणगोल में इष्टदिन के दिनार्धकाल में नतांश और क्रान्त्यंश का योग और अंतर अक्षांश होता है, मेषादि में सूर्य के रहने से अर्थात् उत्तरगोल में मध्यान्हकालिक छाया दक्षिण रहने से नतांश और क्रान्त्यंश का अन्तर ही अक्षांश होता है इति ॥१३॥

उपपत्ति

उत्तर गोल में मध्यान्ह में खस्वस्तिक और निरक्षखस्वस्तिक के मध्य में याम्योत्तरवृत्त में रवि के रहने से रवि से निरक्षखस्वस्तिक पर्यन्त रवि की मध्यक्रान्ति है, तथा रवि से खस्वस्तिक पर्यन्त रवि के मध्यनतांश है, इन दोनों का योग करने से खस्वस्तिक से निरक्षखस्वस्तिक पर्यन्त अक्षांश होता है, दक्षिण गोल में निरक्षखस्वस्तिक से दक्षिण में सूर्य के रहने से नतांश में से क्रान्त्यंश को घटाने से अक्षांश होता है, उत्तरगोल में खस्वस्तिक से उत्तर में रवि के रहने से रवि से निरक्ष खस्वस्तिक पर्यंत क्रान्त्यंश में से नतांश को घटाने से अक्षांश होता है, सिद्धांतशेखर में 'उदगिनापमभागसमन्विता नतलवा इतरत्र विशेषिताः । स्वविषये हि भवन्ति पलांशका' इससे श्रीपति, तथा सिद्धान्त शिरोमणिमें 'नतांशापमांशान्तरं तुल्यदिक्त्वे युतिर्भिन्नदिक्त्वे पलांशा भवेयुः' इससे भास्कराचार्य भी आचार्योक्त ही को कहते हैं इति ॥१३॥

इदानीं मेषादिराशीनां चरखण्डसाधनमाह।

मेषवृषमिथुनजीवा स्त्वाहोरात्रार्धचरदलप्राणान्।
प्राग्वत् कृत्वा स्वाधो विशोध्य चरखण्डकप्राणाः ॥१४॥

वा. भा.—मेषवृषमिथुनानां जीवाः कार्याः ताश्च भूनागिनग्मशांका १३३७ वृषस्यदन्ताष्टयमा २८३२ मिथुनस्य खमुनिरदा ३२७० अतः स्वाहोरात्रार्धा प्राग्वद्भवन्तीत्यर्थः। जिनभागज्यागुणिताः सूर्यज्योतिन्यायेन पृथक् क्रांतिज्या कार्या ताश्च मेषस्य वेदरसषट्कास्मार्धा ६६४।३० वृषस्य चंद्रशरभवाः ११५१ मिथुनस्य नवरदचंद्रा १३२९। एताभिश्च प्राग्वत्। स्वाहोरात्राणि। इष्टापक्रमवर्गत्रिज्यावर्गाद्विशोध्येति यावत् तद्यथा मेषस्य ३२०२, वृषस्य ३०६, मिथुनस्य २९८७, एताश्चरदलप्राणाः क्रान्तिज्याविषुवच्छायया गुणेत्यादिना प्राग्वत्। स्वदेशे विषुवच्छायया कार्या। ताश्च स्वाधो विशोध्य स्वदेशज्याश्चरदलखंडकानां पृथक् प्राणा भवन्ति।

मेषवृषमिथुनानां त एव क्रमेण कर्कसिंहकन्यानामधः क्रमेण तुलावृश्चिकधनुषां पुनरुत्क्रमेण मकरकुम्भमीनानामत्रवामता। स्वक्रांत्यग्रे स्वाहोरात्रवृत्तानि विन्यस्य प्रदर्शयेत्, स्फुटगत्यध्याय एव चरदलानयने मया प्रदर्शितानि विशेषश्च प्रदर्श्यते स्वदेशे। यत् क्षिति स्वाहोरात्रवृत्ते क्षितिजोन्मण्डलयोरन्तरं प्राणाः यदेव लग्नार्कावुद्दिश्य तदन्तरकालं पृच्छतीति। स्वदेशराश्युदयैर्विशोध्यते। तथा च युज्यते। स्वाग्रांतु कृत्वा मिथुनाहोरात्रार्धं क्रियादहोरात्रदलः वृषान्तगुणितं तज्ज्याभिरिति न्यायेन लंकोदयवत्प्राणाः कार्याः तथार्कादेव चरदलप्राणानामेष वृषमिथुनानामेत एव क्रमेण यदि मकरादौ रविरथकन्यादौ राशिशुद्धः तत्प्राण गणयोरैक्यं कार्यम्। तथा कृते प्राणलिप्तानुसारं कल्प्यास्ततो यदि मेषादौ राशित्रये रविस्तयो राशिकला अष्टादशानि। कर्क्यादौ रविस्तत्रादौ, अथवा भुक्तलिप्ताभ्यो विशोध्या शेषरविभुक्तलिप्तासंसाधनं ततो लग्नादपि स्वाहोरात्रवृत्तरवौ जीवादिकं कृत्वा मिथुनाहोरात्रमिति न्यायेन लंकोदयवत्प्राणाः कार्याः स्वचर प्राणाश्च तयोरपि प्राणगणयोरन्तरयोगे मृगकन्यादिषु लग्नवशात्ततो मेषादिपर्दविकल्पना लग्नवशाद्र्विवदेकं लग्नस्यापि भुक्तकाललिप्तासाधनं ततो लग्नभुक्तकाललिप्ताभ्योऽर्कभुक्तकाललिप्ताः शोध्याः सर्वथा न पतन्ति चेत्? लग्नलिप्ताभिरधिकाश्चक्रलिप्ताः कृत्वार्कभुक्तलिप्ताः शोध्या-एवं कृते याः सेषलग्नलिप्ताः ते सर्वे च परिकल्प्याः तावत्प्राणैर्रविलग्नान्तरं तावता प्राणानां तल्लग्नं कृतं रव्युदयादथ लग्नभुक्तकाललिप्तार्रविभुक्तकाललिप्ताभ्यो विशोध्यन्ते। तद्रव्युदयाद्वैपरीत्येन कालः शोध्यरित्यत्र वासना लंकोदयानां त्रिप्रश्नाध्यायोक्तैव तत्र राश्यंतेषूदयकोटयः दर्शिताः। इह राशिमध्येष्वपि स्वाहो-

रात्रादिभिर्गोलि प्रदर्श्य तयोश्चरदलरविलग्नयो र्लङ्कोदयान्विजानातीत्यस्य प्रश्नस्योत्तरमार्यामाह ॥

वि. भा.—मेषवृषमिथुनज्याभ्यः स्वाहोरात्रार्धे द्युज्यावृत्ते प्राग्वत् (स्पष्टाधिकारोक्तेन जिनभागज्या गुणितेत्यादिना) चरासून् कृत्वा स्वाधो विशोध्य मेषादिराशित्रितयस्य चरखण्डकप्राणा (चरार्धासवः) बोध्या इति ॥१४॥

अत्रोपपत्तिः ।

अथ मेषादि राशित्रय चरानयनम् ।

$\frac{\text{कुज्या. त्रि}}{\text{द्यु}}$ = चरज्या, परन्तु $\frac{\text{पलभा. ज्याक्रां}}{१२}$ = कुज्या, अतः $\frac{\text{पलभा. ज्याक्रां}}{१२} \times \frac{\text{त्रि}}{\text{द्यु}}$ = चरज्या तथा $\frac{\text{ज्याजि. ज्याभु}}{\text{त्रि}}$ = ज्याक्रां ∴ $\frac{\text{पलभा. ज्याजि. ज्याभु}}{\text{द्यु. १२}}$ = चरज्या, अत्र भुजज्यास्थाने मेषादिराशित्रयज्यास्तथा द्युज्या स्थानेऽपि च तेषां राशित्रयाणां द्युज्याः संगृह्य पृथक् पृथक् यानि फलान्यागच्छेयुस्तच्चापानामधोऽधः शोधनेन तेषां राशीनां चरखण्डकानि भवन्तीति । सिद्धान्त-शेखरे 'अजवृषमिथुनानां ज्या दिनज्याक्षितिज्याः सहचरदलजीवाश्चानयेत्तद्धनुर्भिः । त्रिभिरपि चरखण्डैस्तैरधोऽधो विशुद्धैश्चरदलमपि साध्य' मित्यनेन सिद्धान्त शिरोमणौ भास्कराचार्येणापि 'मेषादिराशित्रितयस्य यानि चराण्यधोऽधः परिशोधितानि । तानि चरखण्डकानीत्यनेनाऽऽचार्योक्तानुरूपमेव, कथ्यत इति ॥१४॥

अब मेषादिराशियों के चरखण्ड साधन को कहते हैं ।

हि. भा.—मेष, वृष-मिथुन राशियों की भुजज्याओं से द्युज्यावृत्त में पूर्ववत् 'स्पष्टाधिकारोक्तजिनभागज्या गुणिता' इत्यादि से चरासु साधन करके अधोऽधः शोधन करने से मेषादि राशित्रय के चरार्धासु प्रमाण होते हैं इति ॥१४॥

उपपत्ति

$\frac{\text{कुज्या. त्रि}}{\text{द्यु}}$ = चरज्या, परन्तु $\frac{\text{पलभा. ज्याक्रां}}{१२}$ = कुज्या, अतः उत्थापन से $\frac{\text{पलभा. ज्याक्रां}}{१२} \times \frac{\text{त्रि}}{\text{द्यु}}$ = चरज्या तथा $\frac{\text{ज्याजि. ज्याभु}}{\text{त्रि}}$ = ज्याक्रां ∴ $\frac{\text{पलभा. ज्याजि. ज्याभु}}{\text{द्यु. १२}}$ = चरज्या, यहां भुजज्या के स्थान में मेषादि राशित्रय की ज्या, तथा द्युज्या, स्थान में भी उन राशियों की द्युज्या लेकर पृथक् पृथक् जो फल आये उनके चापों को अधोऽधः शोधन करने से उन राशियों के

चरखण्ड होते हैं, सिद्धान्त शेखर में 'अजवृषमिथुनाना ज्या' इत्यादि मन्कृतोपपत्ति में लिखित श्लोक से, आचार्योक्तानुरूप ही कहते हैं इति ॥१४॥

इदानीं लङ्कोदय साधनमाह।

मिथुनाहोरात्रार्धं क्रियाद्यहोरात्रदलहृतं गुणितम्।
तज्ज्याभिराप्तचापान्तराणि लङ्कोदयप्राणाः ॥१५॥

वा. भा.—मिथुनाहोरात्रार्द्धं वृषमिथुनजीवाभि र्गुणितं मत्। मेषाद्याहोरात्रदलहृतं कार्यं लब्धानां चापानि कृत्वा तानि स्वाधो विशोध्य लंकोदयप्राणा भवन्ति। मेषवृषमिथुनानां त एवोत्क्रमेण कर्कटसिंहकन्यानामधः क्रमेण तुला वृश्चिकचापवराणां पुनरुत्क्रमेण मकरकुम्भमोनानामिति अत्र वासना खगोनाद्दक्षिणोत्तरस्वस्तिकयोरधः शलाकाग्रे निरक्षे प्रदेशे गोलं प्रदर्श्यते तद्यथा विषुवन्मण्डलादुत्तरतो मेषवृषमिथुनानां क्रान्त्यग्रेषु स्वाहोरात्रत्रयं बध्नीयाद्भूगोले तदेव कर्कटसिंहकन्यानां उत्क्रमेण एवं विषुवृत्ताद् दक्षिणेन तुलादीनां त्रयाणां स्वाहोरात्रत्रयं बध्नीयात्। तदेव मकरादीनामुत्क्रमेण भवति॥

ततो मेषज्यातुल्येन व्यासार्धेन वृत्तं भगोलमध्ये दक्षिणोत्तरावगाहि बध्नीयात्। तस्य मध्यं भूविनिर्गता पूर्वापरा सूत्रे भवति। तद्वद्वृषज्या व्यासार्धेनान्यं बध्नीयात्। मिथुनज्यया च व्यासार्धतुल्यया याम्योत्तरमंडलांतेष्वित्येव एवं वृत्तत्रयेपि स्वजीवाकरणात् यत्क्रांतिज्या दक्षिणोत्तरायताभुजः कोटिश्च शोध्या मेषवृषयो मिथुनस्य च स्वाहोरात्रार्धं स्वाहोरात्रवृत्तकोटिक्रमेवास्ति ते व्यासार्धवृत्ते ज्ञाते कोट्यानयनार्थं त्रैराशिकद्वयं भक्ता गुणिता कर्मेयम्। तद्यथा यदि मिथुनवृत्तकर्णस्य त्रिज्यातुल्यवृत्तस्य मिथुनाहोरात्रार्ध कोटिः तन्मेषज्याकर्णस्य का कोटिरितिफलं स्वाहोरात्रवृत्ते प्रथमं त्रैराशिके भागहारः तेन तयोर्नाशे कृते तुल्यत्वात् मिथुनाहोरात्रार्धस्य मेषज्यागुणकारस्तदहोरात्रार्धे भागहारः फलं व्यासार्धं कृतिगुणिता भार्धवृषस्यापि मिथुनस्य च प्रथमे त्रैराशिके गुणकारभागहारयोः तुल्यत्वात्तदहोरात्रार्धमेव स्वाहोरात्रकोटिः ततो व्यासार्धपरिणत विषुवत्तात्कालिकतुल्यत्वात्त्रिज्यैव व्यासार्धवृत्तकोटिः हे क्षेत्रवच्चेह प्रदर्श्यते। तद्यथापमंडले मेषांते सूत्रस्यैकमग्रं बद्ध्वा विषवतो दक्षिणेन मीनादौ बध्नीयात्।

एवं मेषान्ते कुम्भादयो योज्या। एवं मिथुनांतमकराद्योरपि तानि सूत्राणि पूर्वप्रदर्शितवृत्तानां व्यासास्तेषामवस्थितानि, यान्यूर्ध्वानि प्राच्यपरायतसूत्रावच्छिन्नानि ते कर्णाः ततो निरक्षं क्षितिजे पूर्वस्यां दिशि क्रांत्यग्रेषु सूत्रत्रयं बद्ध्वापरस्यां दिशि स्थित्वा क्षितिज एवं क्रांत्यग्रेषु बध्नीयादन्यानि तत्र तेषामुदयास्तसूत्राणि क्षितिजोन्मंडलयोरेकत्वादतः प्राच्यपरयोरग्रयोस्तत्सूत्रयोर्विवन्तरं

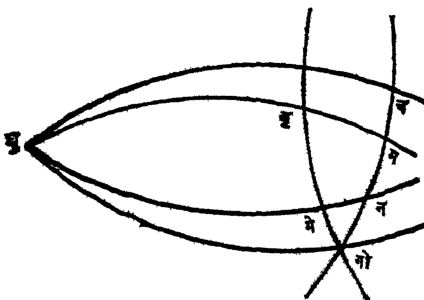
स्ववृत्तमध्यात्तावत्प्रमाणं सूत्रद्वयं दक्षिणोत्तरायतं बध्नीयात् । तत्क्रांतिज्या भुजज्या पृथक् । ततो मेषान्तरे सूत्रं बद्ध्वोर्ध्वमानीय स्वक्रांत्यग्रे बध्नीयात् सूत्रे एवं वृषमिथुनयोरपि ताः पृथक् कोटयः पूर्वप्रदर्शिताः स्वकोटय् ुदयेन मेषादीना-मुदयो भवति, तिर्यक् स्थानं यतो विषुवन्मंडलवशेन सर्वस्यैव भपंजरस्य भ्रमण-मतस्तासां कोटीनां चापानि क्रियन्ते यतो वृत्तगत्या भपंजरोदयः तस्मादुपन्न-चापानि चातः क्रियन्ते । यतो मिथुनकोटया राशित्रयमप्युदेति । वृषकोटया राशिद्वयं पृथगुदयप्रमाणानि ज्ञातुमिष्यते । तस्माच्चापान्तराणि युज्यन्ते, चाप-लिप्ताश्च प्राणाः भवन्त्येवं यतः प्राणेन कक्षाभमंडलं भ्रमतीति प्रागेव प्रतिपादितं कर्कादीनां क्रमेण वासना योज्या दक्षिणतस्तुलादीनां क्रमेण मकरादीनामुत्क्र-मेण च योज्येति ।

तद्यथा मेषादयः प्राणाः खमुनिरसेन्दवः १६७० वृषोदयप्राणाः शरनवाग-चन्द्रा १७९५ मिथुनोदयप्राणाः पंचाग्निनवशशिनः १९३५ मेषस्य खागषट्-चंद्राः शरनंदनगेन्दवः वृषस्य मिथुनास्याथ पंचाग्निनवरात्रियः । इदानीं प्रका-रान्तरेण निरक्षोदयान्प्रदर्शयन्नार्यामाह ॥

वि. भा.—मिथुनाहोरात्रार्धं (मिथुनांत द्युज्यामानं 'परमाल्प द्युज्यामानं') तज्ज्याभिः (मेषादिराशित्रयभुजज्याभिः) गुणितं क्रियाद्यहोरात्र दलहृतं (मेषादि-राशिद्युज्याभक्तं) फलानां यानि चापानि तदन्तराणि लङ्कोदयप्राणाः लङ्कोदया-सवः) स्युरिति ॥१५॥

अत्रोपपत्तिः ।

राश्यादिविन्दुर्यदा निरक्षक्षितिजे समागच्छति ततोऽनन्तरं यावता कालेन राश्यन्तबिन्दुस्तत्क्षितिजे समागच्छेत्तदेव तद्राशेर्लङ्कोदयमानमर्थाद्राश्या-द्युपरि ध्रुवप्रोतवृत्तं राश्यन्तोपरिच ध्रुवप्रोतवृत्तं कार्यं तयोरन्तरे नाडीवृत्ते यच्चापं तत्तद्राशेर्लङ्कोदयमानमिति निम्नलिखितक्षेत्रेण स्फुटं भवति, यथा—



गो=गोलसन्धिः=मेषादिः । मे=मेषान्तः = वृषादिः, वृ = वृषान्तः = मिथुनादिः, मि=मिथुनान्तः । ध्रु= ध्रुवः । गोमे=मेष भुजांशाः, गोवृ=वृष भुजांशाः । गोमि=मिथुनभुजांशाः ।

गोन=मेषोदयमानम् । नम=वृषो-दयमानम् । मच=मिथुनोदयमानम् ।

ध्रुमे=मेषान्त द्युज्याचापम्, ध्रुवृ=वृषान्त द्युज्याचापम् । ध्रुमि=मिथुनान्त-

द्युचा=परमाल्प द्युज्याचापम् । <ध्रुगोमि=परमाल्प द्युज्यांग ध्रुगोमे चापीय त्रिभुजेऽनुपातेन मेषोदयज्या मानम्= $\frac{\text{परमाल्पद्युज्या. ज्यामे}}{\text{मेषान्तद्यु}}$ एवं ध्रुगोवृ. चापीय त्रिभुजे अनुपातः $\frac{\text{परमाल्प द्युज्या. ज्यावृ}}{\text{वृषान्तद्यु}}$ = ज्या (मेषोदयमान—वृषोदयमान), ध्रुगोमिचापीय त्रिभुजेऽनुपातेन = $\frac{\text{परमाल्पद्यु. ज्यामि}}{\text{मिथुनान्तद्यु}}$ = $\frac{\text{परमाल्पद्यु. ज्यामि}}{\text{परमाल्पद्यु}}$ = ज्यामि. = त्रि, अत्र ज्यामे, ज्यावृ, ज्यामि मेषादि राशीनां ज्याः । पूर्वोक्तानां चापान्यवोधः शुद्धानि तदा मेषादिराशीनां लङ्कोदयमानानि भवन्ति । सिद्धान्तशेखरे अल्पद्युज्याविनिघ्नाः क्रियवृषमिथुनज्या हृताः स्वद्युमौर्व्या प्राणानां चापलिप्ता विरचित विवराः स्युर्निरक्षोदयास्ते' नेन तथा सिद्धान्तशिरोमणौ 'मेषादिजीवास्त्रिगृहद्युमौर्व्या क्षुण्णाहृताः स्वस्वदिनज्यया वा । चापीकृताः प्राग्वदधो विशुद्धा मेषादिकानामुदयासवः स्युरित्यनेन, भास्कराचार्येणाप्याचार्योक्तानुरूपमेव कथ्यत इति ॥१५॥

अब लङ्कोदय साधन को कहते हैं ।

हि. भा.—मिथुनान्तद्युज्या (परमाल्पद्युज्या) को मेषादि राशियों की ज्या से गुणाकर अपनी अपनी द्युज्या से भाग देकर जो फल हो उनके चापों को अधोऽधः शुद्ध करने से मेषादि राशियों के लङ्कोदय मान होते है इति ॥ १५ ॥

उपपत्ति

राश्यादि बिन्दु जब लङ्का क्षितिज में आता है उसके बाद जितने काल में राश्यन्त बिन्दु लङ्काक्षितिज में आता है वही उस राशि के लङ्कोदयमान, अर्थात् राश्यादि और राश्यन्त के ऊपर ध्रुव प्रोतवृत्त करने से दोनों ध्रुव प्रोतवृतों के अन्तर्गत नाड़ी वृत्तीय चाप, होता है, यह संस्कृतोपपत्ति में लिखित (क) क्षेत्र से स्पष्ट होता है । जैसे — गो= गोलसन्धि=मेषादि, मे=मेषान्त=वृषादि, वृ=वृषान्त=मिथुनादि, मि=मिथुनान्त । ध्रु=ध्रुव, गोमे=मेषभुजांश, गोवृ=वृषभुजांश, गोमि=मिथुनांश, गोन=मेषोदयमान, नम=वृषोदयमान । मच=मिथुनोदयमान । ध्रुमे=मेषान्तद्युज्याचाप, ध्रुवृ=वृषान्त द्युज्याचाप, ध्रुमि=मिथुनान्तद्युचाप=परमाल्पद्युचाप ध्रुगोमे चापीय त्रिभुज में अनुपात से $\frac{\text{परमाल्पद्यु. ज्यामे}}{\text{मेषान्तद्यु}}$ =मेषोदयज्या, एवं ध्रुगोवृ चापीय त्रिभुज में अनुपात से $\frac{\text{परमाल्पद्यु. ज्यावृ}}{\text{वृषान्तद्यु}}$ =ज्या (मेषोदयमान + वृषोदयमान), ध्रुगोमि चापीय त्रिभुज में अनुपात से

$\frac{\text{परमाल्पद्यु . ज्यामि}}{\text{मिथुनान्तद्यु}} = \frac{\text{परमाल्पद्यु . ज्यामि}}{\text{परमाल्पद्यु}} = \text{ज्यामि} = \text{त्रि} = \text{ज्या (मेषोदय} + \text{वृषोदय} + \text{मिथु-}$ नोदय) यहां ज्यामे, ज्यावृ, ज्यामि, मेषादिराशिज्या, पूर्वसाधितोदय मानज्याओं के चापों को अधोऽधः शुद्ध करने से मेषादि राशियों के लङ्कोदयमान होते हैं। सिद्धान्तशेखर में 'अन्त्य द्युज्या विनिघ्नाः क्रियवृषमिथुनाज्याहृता' इत्यादि, संस्कृतोपपत्ति में लिखित श्लोक से, श्रीपति तथा सिद्धान्त शिरोमणि में 'मेषादिजीवास्त्रिगृहद्युमौर्व्या' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से भास्कराचार्य भी आचार्योक्तानुरूप ही कहते हैं, सूर्य सिद्धान्तकार भी इसी तरह कहते हैं इति ॥ १५ ॥

इदानीं प्रकारान्तरेण लङ्कोदयसाधनमाह।

ज्यावर्गात् क्रान्तिज्या वर्गोनात्तत्पदाहृता त्रिज्या।
स्वाहोरात्रार्धहृताचाधश्चापान्तराण्यथवा ॥१६॥

वा. भा.—मेषज्यावर्गात् क्रांतिज्यावर्ग विशोध्य मूलं ग्राह्यम्। तेन त्रिज्यां हत्वा स्वाहोरात्रार्धेन विभजेत्। फलं मेषोदयकोटिव्यासार्धं निष्पन्नं। एवं स्वजीवा-क्रान्तिज्याभ्यां वृषमिथुनयोरपि स्वोदयकोटिः ततस्तासां चापानि कृत्वा स्वाधो विशोध्य प्राग्वन्निरक्षोदयप्राणा भवन्ति। अथवानेन प्रकारेणोत्पन्नेयं वासना पूर्वप्रदर्शितेषु वृत्तेषु स्वजीवा कार्या स्वक्रान्तिज्या ततः स्वकर्णवर्गेभ्यः स्वभुज-वर्गान्विशोध्य स्वकोटि वर्गा अवशिष्यन्ते। तेषां पदानि स्वकोटयः स्वाहोरात्राणि निष्पन्नानि ततस्त्रैराशिकं यदि स्वाहोरात्रवृत्तेषु तावत्यः कोटयः तदा त्रिज्या-वृत्तेषु कियत्यः इति पृथक् फलानि व्यासार्धवृत्तकोटयो मेषवृषमिथुनोदयानां यतस्तिर्यगपमंडलमुदक् स्थितम्। अतः स्वजीवा प्राणा न तेषामुदया भवन्ति। अन्यथा निरक्षदेशे पंचघटिका राश्युदया-अभविष्यन्। शेषा वासना प्रागार्यायां कुरुते। लग्नमुदयो स्वैरिति प्रश्नं विवक्ष्य निरक्षोदयैः स्वचर खंडकैश्च स्वोदय करणमार्यामाह।

वि. भा.—ज्यावर्गात् (मेषादिराशिज्यावर्गात्) क्रान्तिज्यावर्गहीनात्पदं (मूलं) यत्तेन त्रिज्यागुणिता स्वाहोरात्रार्धहृता (स्वद्युज्याभक्ता) अधश्चापान्तराणि चापानामधोऽधः शोधनेन यानि चापानि तानि, अथवा (प्रकारान्तरेण) लङ्कोदय-मानानि भवन्तीति ॥ १६ ॥

अत्रोपपत्तिः

अथ मेषान्तभुजांशाःकर्ण एको भुजः। मेषान्तक्रान्तिर्द्वितीयो भुजः। तद्विषुवां-शास्तल्लङ्कोदयमानं वा कोटिस्तृतीयो भुजः। एवं वृषान्तमिथुनान्तेऽपि तत्तद्भुजांश-

कान्त्यंशलङ्कोदयासुभिस्त्रिभुजद्वयं जायते । मेषान्तगतभुजस्य ज्याक्षेत्रे मेषान्तज्याकर्णः । क्रान्तिज्या भुजस्तन्मूलगत रेखा कमलाकरोक्त व्यक्षोदयलवज्या कोटिः । $\sqrt{\text{मेषान्तज्या}^2 - \text{क्रांज्या}^2}$ = व्यक्षोदयलवज्या तथा ध्रुवाद्गोलसन्धिं यावद्गोलसन्धिगतध्रुवप्रोतवृत्ते नवत्यंशाः । मेषान्तोपरिगत ध्रुवप्रोतवृत्ते ध्रुवाद्याडीवृत्त-ध्रुवप्रोतवृत्तयोः सम्पातं यावन्नवत्यंशाः । मेषान्त विषुवांशास्त्वेतद्भुजत्रयैरुत्पन्नचापीयजात्यस्य ज्याक्षेत्रं (त्रिज्याकर्णो विषुवांशज्याभुजस्तत्कोटिज्याकोटिरेतैर्भुजत्रयैरुत्पन्नं) गोलकेन्द्रात्क्रान्तिज्या मूलं यावद्द्युज्याकर्णः, व्यक्षोदयलवज्याभुजः । गोलकेन्द्राद् भुजांशज्यामूलं यावत्कोटिरेतैर्भुजत्रयैरुत्पन्नत्रिभुजस्य सजातीयत्वतोऽनुपातो यदि द्युज्यया व्यक्षोदयलवज्या लभ्यते तदा त्रिज्यया किं समागच्छति मेषान्तविषुवांशज्या लङ्कोदयज्या वा $= \frac{\text{व्यक्षोदयलज्या} . \text{त्रि}}{\text{मेद्यु}} = \frac{\sqrt{\text{मेषान्तज्या}^2 - \text{क्रांज्या}^2} \times \text{त्रि}}{\text{मेद्यु}}$ = मेषोदयज्या । एवमेव $\frac{\sqrt{\text{वृषान्तज्या}^2 - \text{वृषान्तक्रांज्या}^2} \times \text{त्रि}}{\text{वृद्यु}}$ = ज्या (मेषोदय + वृषोदय) एवं मिथुनान्तेऽपि, एतच्चापान्यधोऽधःशुद्धानि तदा मेषादीनां लङ्कोदयमानानि भवन्तीति, सिद्धान्तशेखरे श्रीपतिना "तत्क्रान्तिज्याकृतिविरहिताच्छिञ्जिनी वर्गतो वा मूलं यत् स्यात् त्रिभवनगुणास्ताड़ितस्तेन भक्तः । स्वद्युज्याभिर्विहितधनुषां तत्फलानामधोऽधः संशुद्धानामिति रसुमयास्ते निरक्षोदयाः स्युः" अनेन, भास्कराचार्येण चा "एकस्यराशेर्बृहतीज्यका या द्वयोस्त्रिभस्यापि कृती कृतानां स्वस्वापमज्याकृतिवर्जितामित्यादिना" ऽऽचार्योक्तानुरूपमेव कथ्यत इति ॥ १६ ॥

अब प्रकारान्तर से लङ्कोदय साधन को कहते हैं ।

हि. भा.—मेषादि राशियों के ज्यावर्ग में से क्रान्तिज्या वर्ग घटा कर मूल लेने से जो प्राप्त हो उनको त्रिज्या से गुणा कर अपनी अपनी द्युज्या से भाग देने से जो उपलब्ध हो उनके चापों को अधोऽधः शोधन करने से अथवा प्रकारान्तर से मेषादि राशियों के लङ्कोदयमान होते हैं इति ॥ १६ ॥

उपपत्ति ।

मेषान्त भुजांश कर्ण, मेषांत क्रान्ति भुज, और उसके विषुवांश वा उसके लङ्कोदयमान कोटि, इसी तरह वृषान्त और मिथुनान्त में भी उनके भुजांश, क्रान्त्यंश और लङ्कोदयमानों से त्रिभुजद्वय बनते हैं । मेषान्तोत्पन्न त्रिभुज के ज्याक्षेत्र में मेषान्तज्या कर्ण, मेषान्तक्रान्तिज्याभुज, तन्मूलगत रेखा कमलाकरोक्त व्यक्षोदयलवज्या कोटि, इस त्रिभुज में $\sqrt{\text{मेषान्तज्या}^2 - \text{मेषान्तक्रांज्या}^2}$ = मेव्यक्षोदयलवज्या, तथा ध्रुव से गोल सन्धिपर्यन्त गोल सन्धिगत ध्रुवप्रोतवृत्त में नवत्यंश, मेषान्तोपरिगत ध्रुवप्रोतवृत्त में ध्रुव से ध्रुव प्रोतवृत्त

और नाड़ीवृत्त के सम्पात पर्यन्त नत्रन्यंश, मेषान्तविषुवांश इन भुजों से उत्पन्न त्रिभुज के ज्याक्षेत्र (त्रिज्या कर्ण, विषुवांशज्या भुज, उसकी कोटिज्या कोटि इन तीनों भुजों से उत्पन्न) गोल केन्द्र से क्रान्तिज्या मूल तक द्युज्या कर्ण, व्यक्षोदयलवज्या भुज, गोल केन्द्र से भुजांशज्या मूल पर्यन्त कोटि इन तीनों भुजों से उत्पन्न त्रिभुज के सजातीय हैं इसलिये अनुपात करते हैं यदि मेषान्तद्युज्या में मेषान्त व्यक्षोदयलवज्या पाते हैं तो त्रिज्या में क्या इस अनुपात से मेषान्त विषुवांशज्या वा मेषान्त लङ्कोदयज्या आती है $\frac{\text{व्यक्षोदयलवज्या. त्रि}}{\text{मे द्यु}} =$

$\frac{\sqrt{\text{मेषान्तज्या}^2 - \text{मेक्रांज्या}^2} \times \text{त्रि}}{\text{मेद्यु.}} = \text{मेषोदयज्या, इसीतरह} \frac{\sqrt{\text{वृषान्तज्या}^2 - \text{वृक्रांज्या}^2} \times \text{त्रि}}{\text{वृ द्यु}}$

= ज्या (मेषोदय + वृषोदय) इसी तरह मिथुनान्त में भी होता है, इनके चापों को अधोऽधः शुद्ध करने से मेषादि राशियों के लङ्कोदय मान होते हैं। सिद्धान्त शेखर में श्रीपति "तत् क्रान्तिज्याकृति विरहितात्" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से भास्कराचार्य भी "एकस्य राशेर्बृहतीज्यका या" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से आचार्योक्तानुरूप ही कहते हैं इति ।।१६ ॥

इदानीं स्वदेशोदयसाधनमाह

स्वचरासुभिरूनयुताः क्रमोत्क्रमस्थैः क्रमोत्क्रमस्थास्ते ।
उदयप्राणा व्यस्ताश्चार्कं तात्कालिकं कृत्वा ॥ १७ ॥

वा. भा.—स्वचरखंडकै रूनयुताः किंभूताः क्रमोत्क्रमस्था अनन्तरं प्रक्रांताः निरक्षोदयाः किंभूतैश्चरासुभिः क्रमोत्क्रमस्थैः एवं कृते किं भवति। उदयप्राणाः भवन्ति । स्वदेशे राश्युदया इत्यर्थः ते च द्वादश भवन्ति। एतदुक्तं भवति । निरक्षोदयान्मेषवृषमिथुनानि संस्थाप्य क्रमेण तत उत्क्रमेण संस्थाप्यंते चरखंडकानि तेषां पार्श्वतः तद्वत्तेन त्रीण्येव चरखण्डकानि शोध्यंते यथा स्वं तत उत्क्रमस्थादिषु मेषादिषु चरखंड कान्युत्क्रमस्थान्येव योज्यन्ते । एवं मेषादीनां मानं स्वदेशे राश्युदया भवन्ति। व्यस्तास्तुलादीनां स्वदेशोदया भवन्ति । तत्रैवं जातं मेषमीनयोस्तुल्योदयकालः एवं वृषकुम्भयोर्मिथुनमकरयोः कर्कधनुर्सिंहवृश्चिकयोः कन्यातुलयोरित्यर्कस्तत्कालिकं कृत्वा इत्येतत्सूचकखण्डकस्य कृतमुत्तरमत्र सम्बद्धं भविष्यतीति । अत्र या वासना मेषादीनां या स्व कोटयः उन्मंडलप्रापिण्यः प्राक् प्रदर्शिता तासां संख्याचापानि यानि स्वाहोरात्रवृत्तगतानि तेषां ये प्राणास्तैरुदयस्तेषां मेषादीनां प्रतिपादितः ।एवं स्वदेशे पुनः तिर्यगक्षवशात् विषुवन्मंडलस्य च तद्वशेन स्वाहोरात्रवृत्तानां तत्र मेषादीनां त्रयाणां स्वोदयकोटयोऽपचीयन्ते तदपचयाच्चापानामथ पंचभिर्भवति अपचयश्च स्वे स्वाहोरात्रवृत्ते चरखंडतुल्ये तच्चरखंडानि निरक्षमेषवृषमिथुनादयः कालेभ्यो विशोध्यन्ते । यावद्विषुवन्मंडल-

पादस्योदयश्चरखंडतुल्यं खंडमनुचितं तिष्ठति। तावदयं मंडलपादः मकरं रवौ-देति, विषुवन्मंडलप्रथमपादावशेषस्य द्वितीयपादेन सहितस्योदयतो यावान्कालस्तावान् कर्कादिकस्यापमंडलपादस्य तृतीयपादचतुर्थस्य प्रथमपादवद्वामतया योज्या गोलेप्येवं प्रदर्शयेदिति लग्नमुदयं स्वैरित्यस्य प्रश्नस्योत्तरमार्यात्रयेणाह।

वि. भा.—ते पूर्वप्रकारागता मेषादिराशित्रयनिरक्षोदयाः क्रमोत्क्रमस्थाः (क्रमस्था उत्क्रमस्थाश्च स्थाप्याः) यथाक्रमं क्रमोत्क्रमस्थैः स्वचरासुभिरूनयुताः सन्तो मेषादिषण्णां राशीनामुदयप्राणाः (स्वदेशोदयासवः) भवन्ति, अत एव व्यस्ता (विपरीताः) स्तुलादिषण्णां राशीनामुदय प्राणा (स्वदेशोदयासवः) भवन्ति, अर्कं तात्कालिकं कृत्वेत्यस्याग्रे सम्बन्ध इति॥

अत्रोपपत्तिः

निरक्षस्वदेशार्कोदययोरन्तरं चरम्। मेषादिरेककालावच्छेदेन स्वदेशे निरक्षे च समुदेति, मेषान्तः प्रथमं स्वक्षितिजे ततः पश्चादुन्मण्डले लगत्यतश्चरखण्डोनो मेषोदयः स्वदेशोदयो भवति, वृषमिथुनयोरप्येवमेव, कर्कादौ तु चरखण्डानामपचीयमानत्वाद्धनं तानि परिणमन्ति, तुलादौ तून्मण्डलस्य स्वक्षितिजादधः स्थितत्वात् चरखण्डानि धनं भवन्ति, मकरादौ तु चरखण्डानामपचीयमानत्वादृणमिति॥ सिद्धान्त शिरोमणौ भास्कराचार्येण "क्रमोत्क्रमस्थाश्चरखण्डकैः स्वैः क्रमोत्क्रमस्थैश्च विहीनयुक्ताः। मेषादिषण्णामुदयाः स्वदेशे तुलादितोऽमीच विलोम संस्थाः" ऽनेनाऽऽचार्योक्तानुरूपमेव कथ्यत इति॥ १७॥

अब स्वदेशोदय साधन को कहते हैं।

हि. भा.—पूर्व प्रकार से आये हुए मेषादि तीन राशियों के निरक्षोदयमानों को क्रम से और उत्क्रम (विलोम) से स्थापित करना यथा क्रम क्रमस्थित और उत्क्रमस्थित अपनी चरासु को हीन और युत करने से मेषादि छः राशियों के स्वदेशोदयासुमान होते हैं; इतने ही विपरीत तुलादि छः राशियों के स्वदेशोदयासु मान होते हैं; 'अर्कं तात्कालिकं कृत्वा' इसका आगे से सम्बन्ध है इति॥ १७॥

उपपत्ति

निरक्षार्कोदय और स्वदेशार्कोदय का अन्तर चर है, अपने देश में और निरक्ष देश में मेषादिबिन्दु एक ही काल में उदित होता है, मेषान्तबिन्दु पहले अपने क्षितिज में आता है उसके बाद चरखण्ड कालान्तर में उन्मण्डल में आता है इसलिए निरक्षदेशीय मेषोदयमान में से चरखण्ड को घटाने से स्वदेशीय मेषोदयमान होता है, इसी तरह वृष और मिथुन का भी होता है, कर्कादि में चरखण्डों के अपचीयमानत्व (ह्रासत्व) के कारण धन होते हैं।

तुलादियों में अपने क्षितिज से उन्मण्डल के नीचा रहने के कारण चरखण्ड धन होते हैं। मकरादियों में चरखण्डों के अपचीयमानत्व के कारण ऋण होते हैं, सिद्धान्त शिरोमणि में भास्कराचार्य भी "क्रमोत्क्रमस्थाश्चरखण्डकैः" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से आचार्योक्तानुरूप ही कहते है इति ॥ १७ ॥

इदानीं स्वदेशे लग्नानयनमाह

रविभुक्तहीनराशेः कलागुणाः स्वोदयासुभिर्भक्ताः ।
राशिकलाभिर्लब्धाः प्रश्नासुभ्योऽसवः शोध्याः ॥ १८ ॥

प्रक्षिप्य राश्यभुक्तं शेषासुभ्यः क्रमेण यावन्तः ।
शुद्ध्यन्त्युदयाः सूर्ये तावन्तो राशयः क्षेप्याः ॥ १९ ॥

शेषात् त्रिंशद्गुणितादविशुद्धस्योदयासुभिर्विभजेत् ।
लब्धं भागादिरवौ प्रक्षेप्य स्यात्तथा कृते लग्नम् ॥ २० ॥

वा. भा.—यस्मिन्नभीष्टे काले दिवसगते लग्नं कर्तुमिच्छति, तत्काले तात्कालिकं रविं कृत्वा रविणा राशेर्भुक्तायाः कलाः ताः ग्राह्याः ततस्ताः स्वोदयासुभिर्गुणयेत् । रव्याक्रान्तराशिप्राणैरित्यर्थः । राशिकलाभिरष्टादशशतैर्विभजेत् । फलंलिप्ताः ततस्ते लब्धासवः प्रश्नघटिकानां य असवः तेभ्यः शोध्याः रवावपि राश्यभुक्तं भागादिक्षेप्यमेवं भागादिरहितो वा भवति । ततः पुनः प्रश्नासूनां शेषासुभ्यः क्रमेण सूर्याध्यासितराशेरनन्तरं शुध्यति, उदया यावन्तः तेपि शोध्या । सूर्येऽपि तावन्तो राशयः क्षेप्याः । यो न शुध्यति राश्युदयस्तस्य येऽसवःतैरशुद्धोदयासुभिर्विभजेत् शेषानसून् । त्रिंशद्गुणितात्फलं भागादिर्भवति । तच्च रवौ प्रक्षिप्य तथाकृते अभुक्तभागयुतेतरशुद्धराशियुते वेत्यर्थः । एवमनेन प्रकारेण खे लग्नं भवति । अथ रात्रिगते काले लग्नं करोति । तदा तात्कालिकमर्कं षड्भयुतं कृत्वा तद्भुक्तभागैरनन्तरस्थराश्युदयैश्च दिवालग्नवद्रात्रिगतकालेन कर्म कर्तव्यमित्यतिप्रसिद्धत्वान्नायमर्थो विस्तरेण मया ख्यात इति । अत्र वासना, अपमंडलस्योदयतो यत्र तत्र प्रदेशे क्षितिजमंडलेन सह युतिस्तत्र तत्र प्रदेशेऽपमंडले लग्नं भवतीत्यतो लग्नमुच्यते । क्षितिजापमंडलयुतिलग्नमित्याचार्येण गोलाध्यायेनाभिहितं मयापि तत्रैव व्याख्यातं तदर्कोदयकाले यत्रापमंडलावयवे रविः । तत्रैव लग्नं राशेरपि तत्रैव काले क्षितिजासक्तत्वात्ततो यथा यथा तेनाभ्युदयकालेन विप्रकृष्टो रविर्भवति । तथा तथार्क क्षितिजान्तर स्थितेनापमंडलखंडलकेनोपचितो रविः लग्नपदे सभागो भवति । अत उपचीयते तत्कथमिति जानामीतिवादो भुक्तराशेः कला इत्यादिकस्तद्यथा, यत्र राशौ रविस्ततो भुक्तं रवेरग्रतः स्थितं यद्भागादिकं भुक्तिर्यतो कालेनोदेतीति कृत्वा तत्र राशिकादिलिप्ता भचरणराशेरुदयतः स्वोदयेन तद्वदधिको लग्नभागः प्राणा भवन्ति । तद-

भुक्तलिप्तानां क्रियन्ते इति फल प्रागाः तस्य राशिशेषस्योदयतो भवन्ति। अतस्तत्पूर्वापरायने सूर्ये परांशभुक्तं दीयते।

येन तदवधिके लग्नभोगः संगृहीतो भवति। ततु प्रश्नप्राणेभ्योऽन्येऽपि यावन्तोऽनंतराश्युदयाः शुध्यन्ति तावन्तोऽपि राशयोऽपमंडल उदिताः तत्र काले भवन्त्यतो रवौ प्रक्षिप्यन्ते। तावानपि लग्नभागसंगृहीता भवन्ति। यस्य राशे-रुदयप्राणाः न शुद्ध्यन्ति। सा राशिरुदयस्थिता वर्त्तते। तदवयवान्त्रये पुनः त्रै-राशिकं यदि तदुदयप्राणैः त्रिंशद्भागा भवन्ति। तच्छेषप्राणैः कियन्त इति फल भागा, एवं षष्ट्यादि तदपि रवौ दीयते। येन क्षितिजामक्ता स्वका क्रांति प्रदेश योरन्तरे अपमंडलखण्डं संगृहीतं भवत्येनच्चार्केण तात्कालिकेन कर्म यतः सावना-होरात्रस्य घटिका नाक्षत्रस्य रवेर्गति मत्वा अन्यथैकदिन भागोत्थैः प्राणैरविका षष्टिघटिका नक्षत्राः स्युः न चैवं यस्माद्धूतिथिकरणलग्नछायादिषु सावन घटिकाभिरेव व्यवहारः तस्मात् तात्कालिकी करणमुत्पन्नमर्कस्य यतः सौरेण दिनेनार्कसावननक्षत्रयोरन्तरं दिनमेकं भवति। रात्रिगतेऽपि—अर्कास्तमयावधे योज्या वामनेयमिति तदेतत्साक्षावलंबचरखण्डस्योदयानयनं तत्सर्वं निरक्षदेशे उत्तरेण दक्षिणेन वा सर्वमन्यस्येति यथास्थितं गोले प्रदर्शयेदिति लग्नाद्घटिकाया वेत्तीत्यस्य प्रश्नस्योत्तर मार्यात्रयेणाह ॥

वि. भा.—अर्कं (रविं) तात्कालिकं कृत्वा रविभुक्तकला रहितराशिकलाः (भोग्यकलाः) स्वोदयासुभिः (यस्मिन् राशौ रविस्तद्राशेः स्वदेशोदयासुभिः) गुणाः राशिकलाभिर्भक्ता लब्धा असवः प्रश्नासुभ्यः (इष्टकालासुभ्यः) शोध्याः, राश्यमुक्तं (राशिभोग्यांशान्) रवौ प्रक्षिप्य (संयोज्य), शेषासुभ्यः क्रमेण यावन्तो राश्युदयाः शुद्ध्यन्ति तावन्तो राशयः सूर्ये क्षेप्याः(योज्याः) शेषात् त्रिंशद्गुणितात्-अविशुद्ध-स्योदयासुभिः (अशुद्धराश्युदयासुभिः) विभजेत्, लब्धमंशादिकं रवौ क्षेप्यं (योज्यं) तथाकृते सति लग्नं स्यादिति ॥१८-१९-२०॥

अत्रोपपत्तिः

उदयक्षितिजक्रान्तिवृत्तयोः सम्पातो लग्नम्। यस्मिन् राशौ रविरस्ति तद्राशेर्भोग्यकलाभिरनुपातः क्रियते यदि राशिकलाभिस्तद्राशेः स्वोदयासवो लभ्यन्ते तदा रविभोग्यकलाभिः किं समागच्छन्ति रविभोग्यासवः। एतेऽसव इष्टकालासु-(रविभोग्यासु लग्नभुक्तासु तदन्तरालोदयासूनां योगासु) भ्यः शोध्यास्तदा लग्न-भुक्तासु रविलग्नान्तरालोदयास्वोर्योगा अवशिष्यन्ते, अत्र यावन्तो राश्युदयाः शुद्धा भवेयुस्ते शोध्याः शेषादनुपातो यद्यशुद्धोदयासुभिः (यस्य राशेरुदयमानं न शुद्धं तदुदयासुभिः)त्रिंशदंशा लभ्यन्ते तदा शेषासुभिः किं समागतांशादि फलेऽशुद्धपूर्वेम-

षादिराशिभिर्युतं लग्नं भवेत् । परन्तु राशीनां स्थूलत्वात्तदुदयासवः स्थूला भवन्ति स्वदेशोदयमानवशेनैव लग्नानयनं सर्वैः प्राचीनैः कृतमस्त्यतस्तल्लग्नायनं न समीचीनं तत एव सिद्धान्तशिरोमणेष्टिप्पण्यां बापूदेवशास्त्रिणा शुद्धं लग्नानयनं कृतं परं तदपि समीचीनं नास्ति । म. म. पण्डित सुधाकरद्विवेदिना तत्खण्डनं कृतम् । "आकाशमध्यविषुवांशवशात्प्रकुर्याद्यष्टिं दिवाकरमपक्रमकोटिभागान् । यष्टिं जिनांशजगुणं विषुवांशकं च स्वाक्षाढ्यहीनदिनभागमितं क्रमेण । सौम्यानुदग्गोलगते प्रकल्प्यसाध्यो भुजांशोऽथ भुजांशखयोः । युतेर्मितं सायनलग्नमानं भवेत्स्फुटं गोलविदां बुधानामित्यनेन शुद्धं लग्नानयनं च कृतमस्ति, प्राचीनैः सूर्यसिद्धान्तकारादिभिर्निरयणरवित एव लग्नानयनं कृतमित्यपि तेषां दोषः, षड्भिः प्रकारैर्मयाऽपूर्वं लग्नानयनं कृतमस्ति, तज्ज्ञानार्थं मदीयं 'लग्नानयनम्' पुस्तकमवलोकनीय मिति ॥१८-१९-२०॥

अब स्वदेश में लग्नानयन को कहते हैं ।

हि. भा.—रवि को तात्कालिक करके उनकी राशिभोग्यकला को स्वोदयासु (जिस राशि में रवि है , उसके स्वदेशोदयासु) से गुणा कर राशिकला से भाग देने से जो असुात्मक लब्धि हो उसको इष्टकालासु में से घटा देना, राशि के भोग्यांश को रवि में जोड़कर शेषासु में क्रम से जितने राश्युदयासु घटे उतनी राशि सूर्य में जोड़ देना, शेष को तीस से गुणा कर अशुद्धोदय (जिस राशि का उदयासु मान नहीं घटा है उससे) से भाग देकर जो अंशादिक लब्धि हो उसको रवि में जोड़ देना ऐसा करने से लग्न होता है इति ॥ १८-१९-२० ॥

उपपत्ति

उदयक्षितिज में क्रान्तिवृत्त का जो बिन्दु लगा है अर्थात् उदयक्षितिज और क्रान्तिवृत्त का सम्पात बिन्दु लग्न है, जिस राशि में तात्कालिक रवि है उस राशि की भोग्यकला से अनुपात करते हैं यदि राशिकला में उस राशि के स्वोदयासुमान पाते हैं तो रवि भोग्यकला में क्या इससे रवि का भोग्यासु प्रमाण आता है, इसको इष्टकालासु (रविभोग्यासु, लग्नभुक्तासु और रविलग्नान्तरालोदयासुओं के योग) में से घटा देना तब जो शेष रहे उसमें जितने राश्युदयमान घटे उन्हें घटा देना । शेष से अनुपात 'यदि अशुद्धराश्युदयासु में तीस अंश पाते हैं तो शेषासु में क्या' से जो अंशादिक फल आता है उसमें मेषादि से अशुद्ध राशि से अव्यवहित पूर्व राशितक राशि संख्या जोड़ने से लग्न होता है । परन्तु राशियों के स्थूलत्व के कारण उनका उदयमान भी स्थूल होता है, सब प्राचीनाचार्यों ने स्थूल राश्युदयमान ही के वश से लग्नानयन किया है इसीलिये वह ठीक नहीं है, अतः सिद्धान्त शिरोमणि की टिप्पणी में संशोधक (बापूदेव शास्त्री) ने शुद्ध लग्नानयन किया है । लेकिन वह भी ठीक नहीं है, महामहोपाध्याय पण्डित सुधाकर द्विवेदी ने उसका खण्डन किया है । और 'आकाशमध्य विषुवांशवशात्प्रकुर्यात्' इत्यादि संस्कृतोपपत्ति में लिखित श्लोकों से अपना शुद्ध लग्नानयन प्रकार किया है, सूर्य

सिद्धान्तकार ब्रह्म गुप्त आदि प्राचीनाचार्यों ने निरयणरवि ही से लग्नानयन किया है जो उचित नहीं है, सायन रवि से लग्नानयन करना समुचित है जैसा कि बहुत आचार्यों ने किया है, मैंने छः प्रकार से अपूर्व लग्नानयन किया है उसके लिये मेरी 'लग्नानयनम्' पुस्तक को देखिये । इति ॥ १८-१९-२० ॥

इदानीं लग्नात् कालानयनमाह —

रविराश्य भुक्तलिप्तास्तदुदयगुणिता हृता गृहकलाभिः ।
लब्धं प्राणाः स्थाप्याः प्रक्षिप्यार्के गृहाभुक्तम् ॥२१॥

तावत्सूर्ये राशीन् क्षिपेत् समं राशिभिर्यावत् ।
क्षिप्तग्रहाणां प्राणान् प्रक्षिप्य स्थापितेष्वसुषु ॥२२॥

तदधिक कलोदयवधं राशिकलाभिर्भजेत् फलप्राणान् ।
प्रक्षिप्य प्राणेषु प्राणाः सूर्योदयादसकृत् ॥२३॥

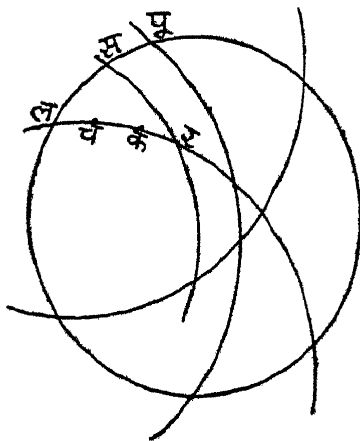
सु. भा.—यथा कालात् लग्नानयनमेवं लग्नाद्वैपरीत्येन कालानयनं सिद्धमपि अनेनार्यात्रियेणोच्यते । यदेष्टकालिकं लग्नमुद्दिश्य कालं कश्चित् पृच्छति । तदौदयिकादादित्याद्राशिभुक्तिलिप्ता ग्राह्या । ताश्च तेनैव स्वराश्युदयेन संगुणय्य गृहकलाभिर्विभजेत्, अष्टादशशतैरित्यर्थः । फलं प्राणास्तदेकांते स्थाप्य ततो राशिभुक्तं सूर्ये क्षिप्त्वा अन्यानपि राशींस्तावत् क्षिपेत् । समो लग्नराशिभिर्विभजेत् । क्षिप्तराशीनां प्राणान् संकलय्य पूर्वस्थापितेषु योज्या, ततस्तस्य राशेरधिकं भागादि तस्याधिकस्य याः कलाः तासां तदुदयप्राणानां च यो वधः तं च राशिकलाभिर्विभजेत् फलं प्राणाः तांश्च प्रक्षिप्य पूर्वस्थापितेषु प्राणा दिनगता भवन्ति । सूर्योदयात्तदधिकं भागादिसूर्ये प्रक्षिपेदेवं प्राणा उत्पद्यन्ते । ते स्थूला यतस्तात्कालिकेनार्केण कृतास्तदर्थमसकृद्ग्रहणं तेत कालेन रविं तात्कालिकं कृत्वा रविराशिभुक्तलिप्ता इत्यादिना कालानयनं तावद्यावत्स्थिरकालो भवति रविश्च तत्र कालेन लग्नमथश्च रात्रिगते काले तदा षड्भयुतार्कलग्नयोरंतरात्प्राग्वदिति । अत्रापि वासना सैव रव्याक्रान्तक्षितिजासक्त देशयोरन्तराले यदपमंडलखंडं तद्योगतो ये प्राणाः स कालः पूर्वमेव तात्कालिकार्कोपरिवदसकृत्करणमपि कालस्योपपन्नं दिवारात्रिलग्नाभ्यामिति । अथ रात्रिशेषकाले लग्नं कर्तुमिच्छति तदर्थमार्याषमाह ॥

वि. भा.—रविराश्यभुक्तलिप्ताः । रविराश्याधिष्ठितभोग्यकलाः तदुदयगुणिताः राश्युदयगुणिताः गृहकलाभिः अष्टादशशतकलाभिर्हृताः । लब्धं प्राणा भोग्यासवो भवन्ति ते एकत्र स्थाप्याः । ततो लग्न राशितः पूर्वं यावन्तो राशयःस्युः तान् राशीन् सूर्ये क्षिपेत्, तेषां रविक्षिप्तराशीनां प्राणान् संकलय्य पूर्वस्थापितेषु

असुषु पूर्वानीतभोग्यासु प्रमाणेषु प्रक्षिप्य संयोज्य स्थापयेत् । तदविककलोदयवधं लग्नभुक्तकला तदधिष्ठित उदयासवश्च अनयोर्वधः, तं अष्टादशशतकलाभिर्भक्तं लब्धासवः लग्नभुक्तासवः पूर्वानीतेषु असुषु प्रक्षेप्याः तदा इष्टघटिकासवो भवन्ति 'सूर्योदयमारभ्य आसां घटीनां सावनार्कमत्वात् असकृत् कर्म कर्तव्यं सावनेष्टया-घटिकया वा ।

अत्रोपपत्तिः ।

"अत्र" अर्कस्य भोग्यः तनुभुक्तयुक्तो मध्योदयाढ्यः समयो विलग्नात् "इति भास्करीयलग्नात् कालानयनविधानेन तात्कालिकार्कस्य भोग्यासूनां लग्नस्य भुक्तासूनां च तदन्तरालयराश्युदयास्विनाश्च समाहारेण तात्कालिकार्कोपरिगता-होरात्रवृत्तक्षितिजवृत्त सम्पातावधिमावनेष्टघटिका प्रमाणा भवतीति गोले प्रत्य-क्षमेव स्पष्टम् ।



ल = लग्नम्

र = तात्कालिक रवि

क = रविराशेरन्तः

च = लग्नराशेरादिः

कच = तदन्तरालराशयः

रस = सावनेष्टघट्यः

स = रव्युपरिगताहारोत्रवृत्तक्षितिजवृत्ति-संपातः ।

अत्र रस चापात्मकेषु प्राणेषु रक चापासवः कच चापासवस्तथा चल चापासवश्च वर्तन्ते तदर्थमाचार्येणेह रकचापासवः $= \frac{\text{रविराश्यभुक्तक} \times \text{उअ}}{१८००} =$ भोग्यासु । एवं लग्नभुक्तासवः चल चापासवः $= \frac{\text{उअ} \times \text{लग्नभुक्तकला}}{१८००}$, एवं च क च पूर्णराश्युदयासवश्च ये स्युस्तान् सर्वान् संपीड्य रविसावनेष्टघटिकासु मानं भवति । एषामसूनां चलत्वादसकृत्कर्मकरणेन स्फुटं सावनेष्टघटीमानं भवति । अतएव भास्कराचार्याः । "लग्नार्थमिष्टघटिका यदि सावनास्तास्तात्कालिकार्क-करणेन भवेयुरार्क्ष्यं" इति गोले विशेषं विहितवन्तः ॥ २१-२२-२३ ॥

हि. भा.—पूर्व ग्रन्थ में तात्कालिक सूर्य और इष्ट काल जान कर लग्न बनाया गया

है अब इस ग्रन्थ से तात्कालिक के रवि और लग्न ज्ञात करके इष्ट काल बनाते हैं।

गोल युक्ति से तात्कालिक रवि केन्द्र के ऊपर जो अहोरात्र वृत्त होता है, उसमें क्षितिजपर्यन्त इष्टकाल कहा गया है, इस इष्ट काल में उदयक्षितिज से ऊपर सूर्य के रहने पर रवि के भोग्यासु, लग्न के भुक्तासु और तदन्तर्गत राशियों का उदयासु, इन सबों का योग है। अत एव आचार्य कहते हैं कि रवि के भोग्यांश को वर्तमान राश्युदय से गुणा कर राशिकला (१८००) से भाग देकर जो लब्धि आया वह रवि के भोग्यासु हैं, उसमें लग्न के भुक्तासु अर्थात् लग्न के भुक्तांश को राश्ययुदय से गुणा कर राशि कला से भाग देकर लब्धि तुल्य रवि के पूर्वानीत भोग्यासु में जोड़ते हैं, और अन्तरवर्ती राशियों का उदयासु जोड़कर सावनेष्ट घटी आचार्य बनाते हैं, परंच सावनेष्ट घटी चल है इसलिये आचार्य यहां असकृत् कर्म करते हैं।

आचार्य का सकृत् कर्म कहने का तात्पर्य यह है कि नाक्षत्रेष्ट घटी ज्ञात नहीं है, ज्ञात है सावनेष्ट घटी अत एव उक्त प्रकार द्वारा नाक्षत्रेष्ट घटी ज्ञात नहीं होगी। इसलिए सकृत् क्रिया द्वारा इष्ट घटी स्थिर की जाती हे। भास्कराचार्य भी कहते हैं कि "लग्नार्थमिष्टघटिका यदि सावनास्ताः तात्कालिकार्ककरेण भवेयुरार्क्ष्यः" का गोलाध्याय में विशेष वर्णन है ॥ २१-२२-२३ ॥

इदानीं विलोमलग्नं ततः कालानयनं चाह

प्रागुदये प्रश्नासुभिरूनोऽर्को भुक्तराशिभिर्लग्नम्।
कृत्वैवमूनमर्कं लग्नसमं प्राग् भवेत्कालः ॥ २४ ॥

वा. भा.—अर्कोदयात्प्राग् यदा क्रियते तदा रात्रिशेषघटिकाभिः स्वोदये प्राग्वत् कर्म यदि नामभुक्तराशिभिरेतदुक्तं भवति। तात्कालिकाद्रवेर्भुक्तभागान् संलिख्य लिप्ता कार्याः तदुदयाक्रान्तराश्युदयप्राणैः शेषं संगुणय्य अष्टादशशतैः विभजेत् फलं प्राणाः प्राणेभ्यो विशोध्य सूर्याच्च राशिभुक्तं विशोधयेत्। विशेषणेभ्यो भुक्तं राशिप्राणास्तावच्छोध्या यावच्छुध्यन्ति सूर्यादपि तावत्संख्या यश्च शोध्या अशुद्धराश्युदयप्राणैः शेषप्रश्नप्राणेभ्यस्त्रिदशादिगुणितेभ्यो यत्फलं ादि तदपि रवेः संशोध्य रात्रिशेषे लग्नं भवति। वासनामुखे पश्चाल्लग्नमतो भुक्तेन राशिखण्डेनापचितोऽर्को लग्नं भवति गोले चन्द्रं प्रदर्शयेदिति द्वितीये र्न रात्रिशेषलग्नात्कालानयनमाह।

यथाकालेनोनोऽर्कस्व देशराश्यु दयेनोनत्वं प्राप्तः एवं वैपरीत्येन लग्नस्य समं तीतः कालांकितो भवति एतदुक्तं भवति लग्नाद् भुक्तभागैरर्काच्च भुक्तभागैरंतरा युदयैश्चैभिस्तै र्यः कालः स रात्रिशेषो भवति रविरप्यूनो लग्नसमो भवति। नाप्यत्र क्षितिजादधः स्थिते नापमंडलखण्डेन योज्या प्राग्वदिति यच्छाया गतेन वृ्रेण नतञ्च वेत्तीत्येतस्य प्रश्नस्योत्तरं बहुभिः प्रकारैः वक्ष्यति तत्र तावदेकेन

प्रकारेण गतशेषाच्छेदानयनमार्यासार्धमाह ।

वि. भा.—प्रश्नासुभिः प्राक् (पूर्वं) उदये (लग्ने) ऽपेक्षिते भुक्तराशिभिः (भुक्तांशैर्भुक्तराशिभिश्च) अर्कः (रविः) ऊनः (हीनः) तदा लग्नं भवेत् । लग्नात्कालानयने चार्कलग्नसममूनं कृत्वा एवं प्राक् (सूर्योदयात्पूर्व)इष्टकालो भवेत् । एतदुक्तं भवति तात्कालिकरवेर्भुक्तांशादिकं रव्याक्रान्त राश्युदयमानेन सङ्गुण्य त्रिंशद्भिर्भक्ता लब्धमिष्टासुभ्यो विशोध्य रवेश्च राशिभुक्तं शोधयेत् । शेषासुभ्योऽपि यावन्तो राशयोऽभुक्ताः शोधयितुं शक्यन्ते तेषामसून् विशोध्य रवावपि तावन्तो राशयः शेषासूंश्च त्रिंशता संगुण्याशुद्धराश्युदयेन विभज्य लब्धमंशादिकं रवेः शोध्यं तदा रात्रिशेषे लग्नं भवति । एवमानीताद्रात्रिशेषलग्नात्कालानयनार्थं यथापूर्वं कालेन हीनो रविः स्वदेशराश्युदयलब्धराश्यंशादिभिर्लग्नत्वं प्रापितः एवं वैपरीत्येन लग्नस्य समतां नीते सति तस्मिन् रवौ रात्रिशेषगतकालः स्पष्टो भवति। एतदुक्तं भवति, लग्नादभुक्तांशैरन्तरराश्युदयैश्च संमिलितैरसकृत्कर्मणा रात्रिशेषे स्फुटः कालो भवति । रविरभुक्तांशराश्यादिरहितो लग्नसमो भवतीति ॥ २४ ॥

अत्रोपपत्तिरपि भाष्यरूपैव बोध्या। सिद्धान्तशेखरे 'प्रागुद्गमादपि रविर्गतराशिभागैः प्राग्भोदयैर्विरहितश्च विलग्नमेवमूने रवौ तनुसमे च कृते स कालः' श्रीपत्युक्तमिदं शिरोमणौ 'भुक्तासुशुद्धेर्विपरीतलग्नमित्यादि' भास्करोक्तं चाऽऽचार्योक्तानुरूपमेवेति ॥ २४ ॥

अब विलोमलग्न को तथा उससे कालानयन को कहते हैं ।

हि. भा.—इष्टासु से पूर्व लग्न अपेक्षित हो तो भुक्तांश और भुक्तराशियों को रवि में से घटाने से लग्न होता है, तात्कालिक रवि के भुक्तांशादि का जिस राशि में रवि हो उस राशि के उदय मान से गुणाकर तीस से भाग देकर जो लब्धि हो उसको इष्टासु में से घटा कर सूर्य में से भी राशिभुक्त को घटा देना चाहिए। शेषासु में जितनी अभुक्त राश्युदयमानासु घट सके उन्हें घटा कर रवि में से भी उतनी राशियां घटा देना, शेषासु को तीस से गुणाकर अशुद्धराशि के उदयमान से भाग दे कर जो अंशादिक लब्धि हो उसको रवि में से घटाने से रात्रि शेष में लग्न होता है । इस तरह लाए हुए रात्रि शेष लग्न से अभुक्तांश और रवि तथा लग्न के अन्तर में जो राशियां हैं उनके उदयमानों के योग से असकृत् कर्म से रात्रि शेष में स्फुट इष्टकाल होता है ।। २४ ।।

इसकी उपपत्ति भाष्य रूप ही है । सिद्धान्त शेखर में "प्रागुद्गमादपि रविर्गतराशिभागैः इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से, श्रीपति तथा सिद्धान्त शिरोमणि में "भुक्तासु शुद्धे विपरीतलग्नं" इत्यादि से भास्कराचार्योक्त के अनुरूप ही कहा है इति ।।२४।।

इदानीमिष्टशंकुमाह ।

गतशेषाल्पस्यान्हः सौम्येतरगोलयोश्चरार्धेन ।
ऊनाधिकस्य जीवा स्वाहोरात्रार्धसंगुणिता ॥२५॥

त्रिज्याहृता युतोना क्षितिज्यया सौम्ययाम्ययोश्छेदः ।
छेदोऽवलम्बकगुणो व्यासार्धविभाजितः शंकुः ॥२६॥

वा. भा.—यत्राभीष्टकाले दिनगतच्छायां कर्तुमिष्यते । तात्कालिकदिनगतकालो ऽल्पः किं शेषात्तयोर्योऽल्पः स गृह्यते तस्य दिनगतस्य वान्याह्नं जीवा कार्या किं भूतश्चरार्धेनोनाधिकस्य उत्तरगोले चरदलं घटिकाभिरूनस्य याम्ये युतस्य ततः सा जीवा स्वाहोरात्रार्धसंगुणिता त्रिज्याहृता सती युतोना कार्या कये-त्याह क्षितिज्यया यथासंख्यं सौम्ययाम्यगोलयोः स्थितेऽर्के छेदो भवति । अत्र वासनास्वदेशाक्षप्रयोगोर्गोले विन्यस्य प्रदर्शयेत् । तद्यथाभीष्टदिनस्वाहोरात्रं घटिकांकितं विन्यस्याग्राः सूत्रे च दक्षिणोत्तरायते प्राग्वद् बद्ध्वा क्षितिजमण्डले पूर्वापरयोस्तदग्रयोश्च पूर्वापरयोर्मध्ये उदयास्तसूत्रं च । बद्ध्वा उन्मण्डल स्वाहोरात्रसंपातयोः पूर्वपरायतं निरक्षोदयास्तसूत्रं च बध्नीयात् । एवं स्थिते क्षितिजस्वाहोरात्रसंपातात् यावत्यो घटिका दिनगताः तावत्यः स्वाहोरात्रवृत्तेन संगुणय्य तदग्रे कोऽपि लक्षितं चिह्नं कार्यं तावानुदयस्तत्र काले रविगतिघटिकाश्च एव ताभ्यश्चरदलघटिका उत्तरगोले शोध्यन्ते यत उन्मण्डलावधेरुपर्यधश्च क्रमज्याश्च प्रवर्त्तते । तच्चोन-मंडलमुपरिक्षितिजात्स्थितम् चरदलाख्येन । स्वाहोरात्रखंडलकेनातस्तदेवं विशोध्यते क्षितिजार्कांतरस्थितस्वाहोरात्रखण्डात् । येन शेषघटिकानां या ज्या तस्योन्मंडला-वधि भवति । दक्षिणगोले चरदलघटिका योज्यन्ते दिनगते काले यतः क्षितिजादध उन्मण्डलं तच्च क्रमस्य प्रवृत्तौ रवेरुन्मण्डलाक्रांतस्थितं स्वाहोरात्रखंडं संगृहीतं भवति तस्य ज्योन्मंडलावधि भवति । व्यासार्धवृत्तकल्पनाया: सतः स्वाहोरात्रवृत्ते परिणाम्यते तदर्थमिदं त्रैराशिकं यदि व्यासार्धवृत्ते एतावती स्वाहोरात्रे कियतीति फलं स्वाहोरात्रवृत्तनिष्पन्नरव्युन्मंडलान्तरज्या भवति । स्वक्षितिजार्कान्तरज्या च स्वाहोरात्र निष्पन्नेष्यते । अतः सौम्यगोले क्षितिज्यायुता क्रियते क्षितिजस्याधः स्थितत्वात्, क्षितिज्यया हीना क्रियते येन स्वक्षितिजावधेर्ज्या भवति सैव स्वाहोरात्रेऽभीष्टज्योच्यते स्वक्षितिज्या चार्यभटादिष्वस्मत्सिद्धान्ते च छेद इत्यभि-धीयते ।

तावत्प्रमाणं सूत्रं मेषतुलादौ क्षितिज्यया युतं सत् द्विगुणं कृत्वा तत् सूत्रस्यैकमग्रं रविचिह्ने स्वाहोरात्रवृत्ते बद्ध्वा द्वितीयमग्रं निरक्षक्षितिजाधः

तावत्येव धनुः स्वाहोरात्रवृत्त एव बध्नीयात् तत्र रवोदयान्तसूत्रावच्छिन्नं छेदः तस्यैव सूत्रस्य निरक्षोदयान्तसूत्रेण सह यत्र संपातः तदवच्छिन्ना जीवेत्युच्यते। रव्युन्मंडलयोरन्तरज्या पूर्वप्रदर्शिता। छेदतुल्येन व्यासार्धेन दक्षिणोत्तरायतं वृत्तं छेदोदयास्तमध्ये सूत्रं कृत्वा विन्यसेत्, तत्र छेदः कर्णः शंकुः कोटिशंकुतलं भुजा यथा विषुवन्मध्याह्ने व्यासार्धकर्णोऽवलंबककोटिरक्षज्या भुजज्या याम्योत्तरमंडलस्येत्यनेन बीजेन सर्वाण्येव छायानयनानि भवन्ति इत्येतत्सर्वं गोले प्रदर्शयेदिति तदिदानीं शंक्वानयनार्थमुत्तरमार्यामाह।

छेदोऽवलंबकगुणो व्यासार्ध विभाजितः शंक्वोरन्तरमेव छेद आनीतः सोऽवलंबकगुणव्यासार्धविभाजितशंकुर्भवति। अत्र वासना स्वाहोरात्रवृत्ते रव्युपलक्षितचिह्ने सूत्रस्यैकमग्रं बद्ध्वा द्वितीयमग्रं गुरु कृत्वाऽवलंबयेत्। ततो भूमध्यात् द्वितीयं सूत्रं प्रसार्यविलंबितसूत्रस्पृक् क्षितिजे बध्नीयात्। तयोः सूत्रयोः यः संपातस्तत्र शंकुमूलं तस्मादुपरि रविं यावत् शंकुभूगोलमध्यं यावत् छाया तस्य शंकोश्छेदमूलं यावच्छंकुतलं छेदश्च कर्णो त्रैराशिककल्पनेयं यदि व्यासार्धतुल्येऽवलंबकतुल्यः शंकुः तदत्र छेदतुल्ये याम्योत्तरमंडले कियान् शंकुरिति फलमिष्टकाले दिनगतशंकुर्भवत्येव, एवमपराह्नेऽपि योज्या वासना। तुल्यत्वाद्रविछायास्ते इत्येतत्सर्वं गोले प्रदर्शयेदिति इदानीं छायां द्वितीयप्रकारेणानयनार्थमार्यार्धमाह॥

वि. भा.—अन्हो दिवस्य गतशेषाल्पस्य (गतशेषयोर्योऽल्पस्तस्यार्थादुन्नतकालस्य) सौम्येतरगोलयोः (उत्तरदक्षिणगोलयोः) चरार्धेन क्रमेणोनाधिकस्य जीवा (सूत्रं) स्वाहोरात्रार्धसंगुणिता (द्युज्यांगुणा) त्रिज्याहृता (त्रिज्याभक्ता) तदा कला भवति, सा सौम्ययाम्ययोः (उत्तरदक्षिणगोलयोः) क्षितिज्यया (कुज्यया) युतोना तदा छेदो (इष्टहृतिः) भवेत्। छेदः, अवलम्बकगुणः (लम्बज्यागुणितः) व्यासार्ध विभाजितः (त्रिज्याभक्तः) तदेष्टशंकुर्भवेदिति ॥२५-२६॥

अत्रोपपत्तिः।

याम्योत्तरवृत्तात्पूर्वमर्थान्मध्यान्हात्पूर्वं यत्र रविर्वर्त्तते तत उदयक्षितिजं यावद्दिनगतकालः, रवितोऽस्तक्षितिजं यावद्दिनशेषकालोऽत्र दिनशेषकालाद्दिनगतकालोऽल्पोऽस्त्यतः स एवोन्नतकालोऽर्थात्क्षितिजाहोरात्रवृत्तयोः सम्पातोपरिगतध्रुवप्रोतवृत्तनाडीवृत्तयोः सम्पाताद्रव्युपरिगतध्रुवप्रोतवृत्तनाडीवृत्तयोः सम्पातं यावत्। उत्तरगोले क्षितिजाहोरात्रवृत्तयोः सम्पातोपरिगतध्रुवप्रोतवृत्तं नाडीवृत्ते

पूर्वस्वस्तिकाच्चरान्तरेऽधोलगत्यत उन्नतकाले तच्चरमानमूनीक्रियते तदा पूर्वस्वस्तिकाद्रव्युपरिगतध्रुवप्रोवृत्तनाड़ीवृत्तयोः सम्पातं यावत्सूत्रचापं भवेदेतस्य ज्या सूत्रसंज्ञकम्। दक्षिणगोले क्षितिजाहोरात्रवृत्तयोः सम्पातोपरिगतध्रुवप्रोतवृत्तं नाड़ीवृत्ते पूर्वस्वस्तिकाच्चरान्तरं उपरिलगत्यत उन्नतकाले चरयोजनेन सूत्रचापं भवति, तज्ज्या सूत्रमर्थाद्रव्युपरिगतध्रुवप्रोतवृत्तनाड़ीवृत्तयोः सम्पातात्पूर्वापरसूत्रोपरिलम्बः, ध्रुवात्पूर्वस्वस्तिकं यावदुन्मण्डले नवत्यंशाः ध्रुवादेव रव्युपरिगतध्रुवप्रोतवृत्तनाड़ीवृत्तयोः सम्पातं यावत् ध्रुवप्रोतवृत्ते नवत्यंशाः नाड़ीवृत्ते सूत्रचापम्। एतद्भुजत्रयैरुत्पन्नत्रिभुजस्य ज्याक्षेत्रं (त्रिज्याकर्णः सूत्रं भुजः, सूत्रकोटिज्या कोटिः) ध्रुवाद्रविं यावद् द्युज्याचापम् ध्रुवादुन्मण्डलाहोरात्रवृत्तयोः सम्पातं यावद् द्युज्याचापम्। अहोरात्रवृत्ते ध्रुव प्रोतवृत्तोन्मण्डलयोरन्तर्गतं चापमेतत्त्रिभुजस्य ज्याक्षेत्रेण (द्युज्याकर्णः, रवितो निरक्षोदयास्तसूत्रोपरिलम्वः कलासंज्ञको भुजः, कलामूलादहोरात्रवृत्तगर्भकेन्द्रं यावत्कोटिः) सजातीयमतोऽनुपातो यदि त्रिज्यया सूत्रं लभ्यते तदा द्युज्यया किमिति समागच्छति कला $= \frac{\text{सूत्र} \times \text{द्यु}}{\text{त्रि}}$ रवितः स्वोदयास्त सूत्रोपरिलम्ब इष्टहृतिः, स्वोदयास्तसूत्रनिरक्षोदयास्तसूत्रयोरन्तरमिष्टहृतिखण्डं कुज्याऽस्ति, उत्तरगोले निरक्षोदयास्तसूत्रात्स्वोदयास्तसूत्रस्याधः स्थितत्वात् कुज्यया युता कलेष्टहृतिर्भवेत्। दक्षिणगोले तु कुज्यया हीना कलेष्टहृतिः। ततस्त्रिज्याकर्णः अक्षज्याभुजः। लम्बज्या कोटिरिति भुजत्रयैरुत्पन्नमेकमक्षक्षेत्रम्। तथेष्टहृतिः कर्णः। इष्टशंकुः कोटिः शंकुतलं भुजः एतद्भुजत्रयैरुत्पन्नं द्वितीयमक्षक्षेत्रमेतयोः सजातीयत्वादनुपातो यदि त्रिज्यया लम्वज्या लभ्यते तदेष्टहृतौ किं समागच्छतीष्टशंकुः $= \frac{\text{लंज्या. इहृ}}{\text{त्रि}}$ एतेनोपपन्नमाचार्योक्तम्। सिद्धान्तशिरोमणौ भास्कराचार्येण "अथोन्नतादूनयुताच्चरेण क्रमादुदग्दक्षिणगोलयोर्ज्या। स्यात्सूत्रमेतद्गुणितं द्युमौर्व्या व्यासार्धभक्तं च कलाभिधानम्" ऽप्यनेनाचार्योक्तानुरूपमेव कथ्यत इति॥

अब इष्ट शंकु के साधन को कहते हैं।

हि. भा.—दिनगत और दिनशेष में जो अल्प रहता है वह उन्नत काल है, उत्तर गोल में उन्नत काल में चरार्ध को घटाने से और दक्षिण गोल में उन्नत काल में चरार्ध को जोड़ने से जो होता है उसकी ज्या (सूत्र) को द्युज्या से गुणा कर त्रिज्या से भाग देने से कला होती है, उत्तर गोल में कला में कुज्या को जोड़ने से और दक्षिण गोल में कला में कुज्या को घटाने से छेद (इष्ट हृति) होता है, इष्टहृति को लम्बज्या से गुणा कर त्रिज्या से भाग देने से इष्टशंकु होता है इति॥ २५-२६॥

उपपत्ति ।

मध्यान्ह से पूर्व जहां रवि है वहां से उदयक्षितिज पर्यन्त दिनगत काल है, और रवि से अस्तक्षितिज पर्यन्त दिन शेष काल है, यहां दिन शेष काल से दिनगत काल अल्प है इसलिये वही (दिनगत काल) उन्नत काल होता है, दिनगत काल से दिनशेष काल के अल्प रहने से वही (दिनशेष काल) उन्नत काल (क्षितिज वृत्त और अहोरात्र वृत्त के संम्पातोपरिगत ध्रुवप्रोतवृत्त और नाड़ी वृत्त के सम्पात से रव्युपरिगत ध्रुवप्रोतवृत्त-नाड़ी वृत्त के सम्पात पर्यन्त नाड़ीवृत्त में) होता है, उत्तर गोल में क्षितिजवृत्त और अहोरात्रवृत्त के सम्पातोपरिगत ध्रुव प्रोतवृत्तनाड़ीवृत्त में पूर्वस्वस्तिक से चरान्तर पर नीचा लगता है इसलिये उन्नत काल में से चर को घटाने से पूर्वस्वस्तिक से रव्युपरिगत ध्रुव प्रोतवृत्त नाड़ीवृत्त के सम्पात पर्यन्त नाड़ीवृत्तीय चाप चापसूत्र होता है इसकी ज्या सूत्र संज्ञक है, दक्षिण गोल में क्षितिजवृत्त और अहोरात्र वृत्त के सम्पातोपरिगत ध्रुवप्रोतवृत्त नाड़ीवृत्त में पूर्वस्वस्तिक से चरान्तर पर ऊपर लगता है इसलिये उन्नत काल में चर को जोड़ने से सूत्रचाप होता है इसकी ज्या (रव्युपरिगत ध्रुवप्रोतवृत्त नाड़ीवृत्त के सम्पात से पूर्वापर सूत्र के ऊपर लम्बरेखा) सूत्र है, ध्रुव से पूर्व स्वस्तिक पर्यन्त उन्मण्डल में नवत्यंश, ध्रुव से रव्युपरिगत ध्रुवप्रोतवृत्त नाड़ीवृत्त के सम्पात पर्यन्त ध्रुवप्रोतवृत्त में नवत्यंश, नाड़ीवृत्त में सूत्रचाप, इन तीनों भुजों से उत्पन्न त्रिभुज का ज्याक्षेत्र (त्रिज्या कर्ण, सूत्र भुज, सूत्र कोटिज्या कोटि) ध्रुव से रविपर्यन्त द्युज्याचाप, ध्रुव से उन्मण्डलाहोरात्रवृत्त के सम्पातपर्यन्त उन्मण्डल में द्युज्याचाप, अहोरात्रवृत्त में ध्रुवप्रोतवृत्त और अहोरात्रवृत्त के अन्तर्गत चाप, इन तीनों भुजों से उत्पन्न त्रिभुज के ज्याक्षेत्र (अहोरात्र वृत्त के गर्भकेन्द्र से रविपर्यन्त द्युज्या कर्ण, रवि से निरक्षोदयास्त सूत्र के ऊपर लम्ब कला संज्ञक भुज, कलामूल से अहोरात्रवृत्त के गर्भ केन्द्र पर्यन्त कोटि) का सजातीय है इसलिये अनुपात करते हैं यदि त्रिज्या में सूत्र पाते हैं तो द्युज्या में क्या इससे कला आती है, $\frac{\text{सूत्र. द्यु}}{\text{त्रि}}$ = कला, रवि से स्वोदयास्त सूत्र के ऊपर लम्ब रेखा इष्टहृति है, स्वोदयास्तसूत्र और निरक्षोदयास्तसूत्र का अन्तर इष्ट हृति की खण्ड कुज्या है, उत्तरगोल में निरक्षोदयास्तसूत्र से स्वोदयास्त सूत्र नीचा है इसलिये कला में कुज्या को जोड़ने से इष्ट हृति होती है, दक्षिण गोल में कला में से कुज्या को घटाने से इष्ट हृति होती है, त्रिज्या कर्ण, अक्षज्या भुज, लम्बज्या कोटि इन तीनों भुजों से उत्पन्न एक अक्षक्षेत्र, तथा इष्टहृति कर्ण, इष्टशंकु कोटि, शंकुतल भुज, इन तीनों भुजों से उत्पन्न द्वितीय अक्षक्षेत्र, दोनों अक्ष क्षेत्र सजातीय हैं इसलिये अनुपात करते हैं यदि त्रिज्या में लम्बज्या पाते हैं तो इष्टहृति में क्या इससे इष्टशंकु प्रमाण आता है $\frac{\text{लंज्या. इह}}{\text{त्रि.}}$ = इशं, इससे आचार्योक्त उपपन्न होता है, सिद्धान्त शिरोमणि में भास्कराचार्य भी "अथोन्नतादून-कुताथरेण' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से आचार्योक्तानुरूप ही कहते हैं इति ॥२५-२६॥

इदानीं प्रकारान्तरेण शंकुं ततो दृग्ज्यां चाह—

विषुवत्कर्णविभक्तश्छेदो वा द्वादशाहतः शंकुः ।
शंकुकृतिविहीनाया व्यासार्धकृतेः पदं दृग्ज्या ॥ २७ ॥

वा. भा.—अथवा अन्तरानीतछेदो द्वादशगुणो विषुवविभक्तश्च शंकुर्भवति । अत्र वासना यदि विषुवत्कर्णव्यासार्धवृत्ते द्वादशिका कोटिः तच्छेदव्यासार्धवृत्ते क्रियतेति फलं कोटिरूर्ध्वा शंक्वाख्या अत्र विषुवन्मध्याह्ने याम्योत्तरमण्डलस्य व्यासार्धस्थाने विषुवत्कर्णः कल्पितोऽवलंबस्थाने द्वादश शंकुं कुर्यात् । प्रागेवोक्तं शंकुतलमिति । तत्सर्वमुपपन्नमिति तदानीं गम्यवृहच्छंकोश्छायानयनार्थं द्वितीयमार्यार्धमाह ।

शंकुकृतिविहीनाया व्यासार्धकृते फल दृग्ज्या ॥ अनन्तरानीत शंकोर्वर्गेणोनायाः कस्याः व्यासकृतेः यच्च मूलं दृग्ज्या सा भवति । दृग्ज्या छायोच्यते वासना तु स्वाहोरात्रवृत्ते ऽप्युपलक्षितचिह्नमध्यं यावत्कर्णस्तिर्यक् तत् एव रविचिह्नादधः सूत्रं भूमध्यविनिर्गतक्षितिजप्रान्तसूत्रावच्छिन्नं शंकुकोटिः । तन्मूलाद्भूमध्यं यावत् दृग्ज्या छाया भुजः, कर्णकृतेः कोटिकृतिं विशोध्य मूलं भुज इत्यर्थः । सर्वं गोले प्रदर्शयेदिति एवं महाशंकुछायामानीय द्वादशांगुलछायानयनार्थमार्यार्धमाह ॥ २७ ॥

वि. भा.—छेदः (हृतिः) द्वादशाहतः (द्वादशभिर्गुणितः) विषुवत्कर्णविभक्तः (पलकर्णभक्तः) तदा वा (प्रकारान्तरेण) शंकुर्भवेत् । शंकुकृतिविहीनाया (शंकुवर्गरहितायाः) व्यासार्धकृतेः (त्रिज्यावर्गात्) पदं (मूलं) तदा दृग्ज्या भवतीति ॥ २७ ॥

अत्रोपपत्तिः

पलभा भुजः, द्वादशांगुलशंकुः कोटिः, पलकर्णः कर्णः,
शंकुतलं भुजः, इष्टशंकुः कोटिः, छेदः (हृतिः) कर्णः, } अनयोरक्षक्षेत्रयोः सजातीयत्वादनुपातो यदि पलकर्णे कर्णे द्वादशांगुल शंकुः कोटिर्लभ्यते तदा हृतिकर्णे किं समागच्छतीष्ट

शंकुः $= \frac{१२ \times \text{हृति}}{\text{पक}}$, ततो दृग्ज्या भुजः । इष्टशंकुः कोटिः । त्रिज्या कर्णः, एतैर्भुजकोटिकर्णैरुत्पन्न छायाक्षेत्रे $\sqrt{\text{त्रि}^2 - \text{इशंकु}^2} =$ दृग्ज्या । एतावताऽऽचार्योक्तमुपपन्नम् ।

अब प्रकारान्तर से शंकु और दृग्ज्या को कहते हैं –

हि. भा. – हृति को बारह से गुणा कर पल कर्ण से भाग देने से वा (प्रकारान्तर से) इष्टशंकु होता है। त्रिज्यावर्ग में से शंकुवर्ग घटा कर मूल लेने से दृग्ज्या होती है इति ॥२७॥

उपपत्ति

पलभा = भुज, द्वादशाङ्गुलशंकु = कोटि, पलकर्ण = कर्ण
शंकुतल = भुज, इष्टशंकु = कोटि, छेद (हृति) = कर्ण } ये दोनों अक्षक्षेत्र सजातीय हैं

इसलिये अनुपात करते हैं यदि पलकर्ण में द्वादशांगुलशंकु पाते हैं तो छेद(इष्टहृति)में क्या इससे इष्टशंकु आता है $\frac{१२ \times इहृति}{पलक}$ = इशंकु । दृग्ज्या = भुज, इष्टशंकु = कोटि, त्रिज्या = कर्ण इस छाया क्षेत्र में $\sqrt{त्रि^२ - इशंकु^२}$ = दृग्ज्या, इससे आचार्योक्त उपपन्न हुआ ॥ २७ ॥

इदानीं छायाकर्णावाह

दृग्ज्या द्वादशगुणिता विभाजिता शंकुना फलं छाया ।
व्यासार्धं छेदहृतं विषुवत्कर्णाहतं कर्णः ॥ २८ ॥

वा. भा.—दृग्ज्यानन्तरानीतां द्वादशगुणितां शंकुना विभक्तां छायामानीय द्वादशांगुलस्य शंकोरिति वाक्यशेषः अथवा दृग्ज्यानेनैव गृहतरुपर्वतादीनां प्रमाणेन संगुणिता तस्मै तावती छाया तत्र काले भवति अत्र त्रैराशिकवासना यदि बृहच्छं-कोर्दृग्ज्या छाया द्वादशांगुलस्य शंकोर्वेति फलं द्वादशांगुलशंकोश्छाया यतो व्यवहा-रार्थं शंकुलक्षणमनेनैव यंत्राध्याये कृतम् । मूले द्व्यंगुलविपुलसूच्यग्रो द्वादशांगुल-छायाशंकुस्तलाग्रबिद्धोग्रबोधलंबेति । अथवा छेदादन्येन प्रकारेण छायानयनमुत्त-रमार्यार्धमाह ॥

व्यासार्धं छेदहृतं विषुवत्कर्णहतं कर्णः । व्यासार्धं विषुवत्कर्णेन संगुण्य छेदेन विभजेत् फलं तात्कालिका छाया कर्णो भवति । द्वादशांगुलस्य शंकोः कर्णकृते द्वादशांगुलशंकुकृतिं विशोध्य मूलछाया द्वादशां गुलस्य शंकोरेवेत्यत्र वासना । भूमध्या-द्वैपरीत्येन तद्यथा यदि पूर्वापरछाया कर्णस्य द्वादश शंकुःकोटिः तद्व्यासार्धं कर्णस्य पूर्वापरस्यैव दृङ्मण्डलगतस्य का कोटिरिति फलं तात्कालिको बृहच्छंकुः कोटि-रूपः ततो द्वितीयं त्रैराशिकं यदि विषुवन्मध्याह्ने याम्योत्तरमण्डलगता यावलंब-कोटि व्यासार्धकर्णं तदिष्टशंकुकोटिर्याम्योत्तरछेदव्यासार्धं गतो यः कर्ण इति फलंच्छेद इत्यत्र लंबकस्थाने द्वादशकोटिः परिकल्पिता व्यासार्धस्थाने विषुवत्कर्णस्तेन प्रथम-त्रैराशिके द्वादशगुणकारो द्वितीये भागहारस्तयोर्नष्टयोर्व्यासार्धस्य विषुवत्कर्णो गुणकारस्थितछायाकर्णो भागहारः फलं छेदः यदा पुनर्व्यासार्धंच्छेदेन भागो दीयते

तदा फलं छाया कर्णो भवति । एवं वैपरीत्यादत उपपन्नं गोले चेतन् प्रदर्शयेदिति ।
अपरेण प्रकारेण छायानयनार्थमार्यार्धमाह ।

वि. भा.—दृग्ज्या द्वादशगुणिता, शंकुना विभाजिता (भक्ता) फलं छाया भवेत् । व्यासार्धं (त्रिज्या) विषुवत्कर्णा हतं (पलकर्णगुणितं) छेदहृत(हृतिभक्तं) तदा कर्णः (छायाकर्णः) भवेदिति ॥२८॥

अत्रोपपत्तिः ।

छाया = भुजः । द्वादशांगुलशंकुः = कोटिः । छायाकर्णः = कर्णः । }
दृग्ज्या = भुजः । इष्टशंकुः = कोटिः । त्रिज्या = कर्णः } अनयोश्छाया-
क्षेत्रयोः सजातीयत्वादनुपातो यदि शंकुना दृग्ज्या लभ्यते तदा द्वादशांगुलशंकुना किं समागच्छति छाया $=\frac{\text{दृग्ज्या}\times 12}{\text{शंकु}}$, तथा यदि शंकुना त्रिज्या लभ्यते तदा द्वादशांगुलशंकुना किं समागच्छति छायाकर्णः $=\frac{\text{त्रि}\times 12}{\text{शंकु}}$, परन्तु $\frac{12\times\text{हृति}}{\text{पक}}=$ शंकुः, अनेन शंकोरुत्थापनेन छायाकर्ण $=\frac{\text{त्रि}\times 12}{12\times\text{हृति}}=\frac{\text{त्रि}\times\text{पक}}{\text{हृति}}$ एतेनाऽऽचार्योक्तमुपपद्यते, श्रीपतिना 'व्यासदले विषुवच्छ्रवणाघ्ने छेदहृते यदि वेप्सितकर्णः' ऽप्यनेनाऽऽचार्योक्तमेव कथ्यते, पूर्वानुपातद्वयेन समागते छाया-छाया कर्ण एव 'दृग्ज्या त्रिजीवे रविसंगुणेति शंकूद्धृते भाश्रवणौ भवेतामिति भास्करोक्तं इति ॥२८॥

अब छाया और कर्ण को कहते हैं ।

हि. भा.—दृग्ज्या को बारह से गुणा कर शंकु से भाग देने से छाया होती है, त्रिज्या को पलकर्ण से गुणा कर छेद (इष्टहृति) से भाग देने से छाया कर्ण होता है इति ॥ २८ ॥

उपपत्ति ।

छाया = भुज, द्वादशांगुल शंकु = कोटि, छायाकर्ण = कर्ण }
दृग्ज्या = भुज, इष्टशंकु = कोटि, त्रिज्या = कर्ण } ये दोनों छाया क्षेत्र सजातीय हैं
इसलिये अनुपात करते हैं । यदि शंकु में दृग्ज्या पाते हैं तो द्वादशांगुल शंकु में क्या इससे छाया आती है $\frac{\text{दृग्ज्या}.\ 12}{\text{शंकु}}$ = छाया, तथा यदि शंकु में त्रिज्या पाते हैं तो द्वादशाङ्गुल शंकु में क्या इससे छायाकर्ण आता है $\frac{\text{त्रि}.\ 12}{\text{शंकु}}$ = छायाकर्ण, परन्तु $\frac{12\times\text{हृति}}{\text{पक}}$

=शंकु, इससे शंकु को उत्थापन देने से $\frac{\text{त्रि} . १२}{\frac{१२ \times \text{हृति}}{\text{पक}}}$ = छायाकर्ण = $\frac{\text{त्रि. पक}}{\text{हृति}}$ इससे आचार्योक्त उपपन्न होता है। सिद्धान्त शेखर में श्रीपति भी 'व्यासदले विषुवच्छ्रवणघ्ने छेदहृते यदि वेप्सितकर्णः' इससे आचार्योक्त ही को कहते हैं, पहले अनुपात द्वय से आई हुई छाया और छायाकर्ण ही को 'दृग्ज्या त्रिजीवे रविसंगुणे ते शंकूद्धृते भाश्रवणौ भवेताम्' से भास्कराचार्य भी कहते हैं इति ॥ २८ ॥

इदानीं प्रकारान्तरेणच्छायाकर्णानयनमिष्टान्त्यां चाह

गुणितं वा द्वादशभिर्व्यासार्धं शंकुना हृतं कर्णः।
जीवाक्षयवृद्धिज्यायुतहीना ज्या क्रियतुलादौ ॥ २९ ॥

वा. भा.—द्वादशभिर्व्यासार्धं संगुणय्य बृहच्छंकुना विभजेत्। फलं छायाकर्णः अथवानेन प्रकारेणोच्यते, इयमुपपत्तिर्यदि बृहच्छंकुकोटेः पूर्वापरकर्णव्यासार्धद्वादशांगुलस्य कोटेः क इति फलं छायाकर्ण इत्युपपन्नम्। दृङ्मण्डलक्षेत्र-इति तत इदानीं ज्याऽऽनयनार्थमुत्तरमार्यार्धमाह। जीवाक्षयवृद्धिज्यायुतहीना ज्याक्रियतुल्यादौ। गतशेषाल्पस्याह्नसोम्योत्तर गोलयोश्चरार्धेन ऊनाधिकस्य जीवा कृता सात्र गृह्यते तेनायमर्थः, जीवा मेषादौ क्षयवृद्धिज्यया युता सती ज्याख्या भवति तुलादिराशिषट्केस्थेऽर्के क्षयवृद्धिज्यया हीना सती ज्या भवति अत्र वासना क्षितिजाकांतरस्थाहोरात्र वृत्तखण्डाश्चरदलाख्यं स्वाहोरात्रखण्डलकं कर्णाद् विशोध्य शेषस्य या जीवा क्रियते। सोन्मण्डलावधिज्या व्यासार्धवृत्तनिष्पन्नजीवा भवति पूर्वमेव प्रदर्शिता क्षयवृद्धिज्या चरदलखण्डलस्य जीवातीतोत्तरे गोले योज्यते क्षितिजस्याधः स्थितत्वाद् दक्षिणे गोले शोध्यते क्षितिजस्योपरि स्थितत्वादुन्मण्डलादेः एवं कृते क्षितिजख्यंतरज्या व्यासार्धवृत्ते भवति निष्पन्नछेद इत्यर्थः प्राग्वत्क्षेत्रं प्रदर्शयेत् प्रामाणीकृतछेदेन सह भेदोनसंस्थान कृत इति इदानीं छेदानयनार्थमार्यार्धमाह ॥ २९ ॥

वि. भा.—व्यासार्धं (त्रिज्या) द्वादशभिर्गुणितं शंकुना हृतं (शंकुभक्तं) तदा वा (प्रकारान्तरेण) छायाकर्णो भवेत्। जीवा (दिनगत दिनशेषयोरल्पस्य गोल क्रमाच्चरार्धोनयुतस्यार्थात्सूत्रचापस्य ज्या) क्रियतुलादौ (उत्तरगोले दक्षिणगोले च) क्षयवृद्धिज्यया (चरज्यया) युतहीना तदा ज्या (इष्टान्त्या) भवतीति ॥ २९ ॥

अत्रोपपत्तिः

यदि शंकुना त्रिज्या लभ्यते तदा द्वादशेन किमिति समागच्छति छायाकर्णः = $\frac{\text{त्रि. १२}}{\text{शंकु}}$, क्षितिजाहोरात्रवृत्तयोः सम्पातोपरिगतं ध्रुवप्रोतवृत्तमुत्तरगोले पूर्वस्वस्तिकाच्चरान्तरेऽधो दक्षिणगोले तूपरि नाडीवृत्ते लगति तद्बिन्दुतः।

(क्षितिजाहोरात्रवृत्तसम्पातोपरिगतध्रुवप्रोतवृत्तनाडीवृत्तयोः सम्पातात्) पूर्वापरसूत्रस्य समानान्तरारेखा कार्या तदुपरि ग्रहोपरिगतध्रुवप्रोतवृत्तनाडीवृत्तयोः सम्पातात्लम्बः कार्यः सेष्टान्त्या, दिनगतशेषयोर्यदल्पं तदुन्नत (उन्नतकालः) मुत्तरदक्षिणगोलयोश्चरार्धेन हीनं युतं तदा सूत्रचापं (ग्रहोपरिगतध्रुवप्रोतवृत्त नाडीवृत्तयोः सम्पातात्पूर्वस्वस्तिकं यावत्) भवेदेतस्य ज्या, सूत्रं (ग्रहोपरिगत-ध्रुवप्रोतवृत्तनाडीवृत्तयोः सम्पातात्पूर्वापरसूत्रोपरिलम्बः) पूर्वकृतपूर्वापरसूत्र-समानान्तररेखा पूर्वापरसूत्रयोरन्तरं चरज्या उत्तरगोले दक्षिणगोले च चरज्यया क्रमेण युतं हीनं सूत्रमिष्टान्त्या भवत्यत्राऽऽचार्येण सूत्रस्य नाम 'जीवा' इष्टान्त्याया नाम 'ज्या' कथ्यते सिद्धान्तशेखरे श्रीपतिना 'द्वादशभिर्गुणिते यदि वाऽस्मिन् कर्णमवेहि नरेण विभक्ते' तथा 'प्राग्वद्धोन्नतकालतश्चरदलन्यूनाधिकाच्छिञ्जिनी युक्तोना चरजीवया भवति सा ज्याख्या दिनज्याहृता। भक्ताऽत्र त्रिभजीवया हृतिरसौ छेदो हरो वा ततः शङ्कुः पूर्ववदेव भाश्रवणयोःसिद्धिस्ततश्चोक्तवत्' ऽऽचार्योक्त्यो 'गुणितं वा द्वादशभिरित्यादिश्लोकस्य' 'साऽहोरात्रार्धगुणेत्याद्यग्रिम-श्लोकस्य च' एनयोरनुरूपमेव कथ्यते, इति ॥२९॥

अब प्रकारान्तर से छायाकर्णानयन और इष्टान्त्या को कहते हैं

हि. भा.—त्रिज्या को बारह से गुणाकर शङ्कु से भाग देने से वा (प्रकारान्तर से) छायाकर्ण होता है, जीवा (दिनगत और दिनशेष में जो अल्प है वह उन्नत काल है उसमें गोल क्रम से चरार्ध को ऊन और युत करने से जो होता है उसकी ज्या अर्थात् सूत्र) में उत्तर गोल में और दक्षिण गोल में क्रम से चरज्या को जोड़ने और घटाने से ज्या (इष्टान्त्या) होती है इति ॥२९॥

उपपत्ति

यदि शङ्कु में त्रिज्या पाते हैं तो द्वादश में क्या इससे छायाकर्ण आता है

$\frac{\text{त्रि.१२}}{\text{शङ्कु}}$ = छायाकर्ण, क्षितिजाहोरात्रवृत्त के सम्पातोपरिगतध्रुवप्रोतवृत्त उत्तरगोल में पूर्वस्वस्तिक से चरान्तर पर नीचा और दक्षिण गोल में चरान्तर पर ऊपर नाड़ीवृत्त में लगता है, उस बिन्दु से (क्षितिजाहोरात्रवृत्तसम्पातोपरिगतध्रुवप्रोतवृत्त और नाड़ीवृत्त के सम्पात से) पूर्वापर सूत्र की समानान्तर रेखा कर देना, उसके ऊपर ग्रहोपरिगत ध्रुव-प्रोतवृत्त और नाड़ीवृत्त के सम्पात बिन्दु से जो लम्ब होता है वही इष्टान्त्या है, दिनगत और दिनशेष में जो अल्प रहता है वह उन्नत काल है, उसमें उत्तर गोल और दक्षिण गोल क्रम से चरार्ध को हीन-युत करने से जो होता है उसकी ज्या (ग्रहोपरिगतध्रुवप्रोत-वृत्त और नाड़ीवृत्त के सम्पात से पूर्वापर सूत्र के ऊपर लम्बरेखा), समानान्तर रेखा और पूर्वापर सूत्र का अन्तर चरज्या है, उत्तरगोल में और दक्षिणगोल में सूत्र में चरज्या को

क्रम से युत-हीन करने से इष्टान्त्या होती है, यहां आचार्य सूत्र के नाम जीवा' तथा इष्टान्त्या का 'ज्या' कहते हैं, सिद्धान्तशेखर में श्रीपति 'द्वादशभिर्गुणिते' इत्यादि तथा प्राग्वद्वोन्नतकालतश्चरदलन्यूनाधिकात् इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से 'आचार्योक्तगुणितं वा द्वादशभिः' इत्यादि के तथा 'साऽहोरात्रार्धगुणा' इत्यादि अग्रिम श्लोक के अनुरूप ही कहते हैं इति ॥२९॥

इदानीं पुनश्छेदाद्यानयनमाह

साऽहोरात्रार्धगुणा व्यासार्धविभाजिता ऽथवा छेदः ।

शङ्क्वादि प्राग्वज्ज्या स्वाहोरात्रार्धघातहृता ॥३०॥

वा. भा.—ज्येत्यनुवर्तते ज्यास्वाहोरात्रार्धेन संगुणय्य व्यासार्धेन विभजेत् । फलं छेदो भवति। त्रैराशिकेन वासनात्र यदिव्यासार्धवृत्ते एतावती ज्या तत्स्वाहोरात्रवृत्ते कियतीति फलं स्वाहोरात्रेष्टज्याछेद इत्युच्यते। तेन छेदेन शंक्वादिकं गोले क्षेत्रे वा प्रदर्शयेत् प्राग्वदिति ।

शंक्वादिप्राग्वज्ज्यास्वाहोरात्रार्धघातहृता व्यासार्धकृतिगुणिता विषुवत्कर्णेन वा भवति कर्णः। छेदेन शंक्वादिप्राग्वदिति गतार्थोऽयं ग्रन्थः ज्यायाः स्वाहोरात्रस्य च यो घातः परस्परगुणना तेन घातेन हृतार्कसौरव्यासार्धकृतिरिति किं भूतेत्याह ॥३०॥

वि. भा.—सा(पूर्वानीतेष्टान्त्या) ऽहोरात्रार्ध(द्युज्या) गुणा, व्यासार्ध (त्रिज्या) भक्ताऽथवा (प्रकारान्तरेण) छेदः (इष्टहृतिः) भवेत् । ततः प्राग्वत् (पूर्ववत्) शङ्कादि भवेत् । ज्यास्वाहोरात्रार्धघातहृता इत्यस्याग्रिमश्लोकेन सम्बन्ध इति ॥३०॥

अत्रोपपत्तिः

भूकेन्द्राद् ग्रहोपरिगतध्रुवप्रोतवृत्तनाड़ीवृत्तयोः सम्पातगतरेखा त्रिज्या, ग्रहोपरिगतध्रुवप्रोतवृत्तनाड़ीवृत्तयोः सम्पातात्पूर्वोक्तपूर्वापरसूत्रसमानान्तररेखोपरिलम्ब इष्टान्त्या, तन्मूलगतारेखा चैतद्भुजत्रयेणोत्पन्नमेकं त्रिभुजम्। अहोरात्रवृत्तगर्भकेन्द्राद् ग्रहगता रेखा द्युज्या, ग्रहात् स्वोदयास्तसूत्रोपरिलम्बरेखेष्टहृतिः' तयोर्मूलगतरेखा चैतद्भुजत्रयैरुत्पन्नं द्वितीयत्रिभुजम् । एतयोस्त्रिभुजयोःसाजात्यादनुपातो यदि त्रिज्ययेष्टान्त्या लभ्यते तदा द्युज्यया किमित्यनेनाऽऽगच्छतीष्टहृतिः $= \frac{\text{इष्टान्त्या}\cdot\text{द्यु}}{\text{त्रि}}$, ततः पूर्ववच्छङ्क्वादि भवेदेवेति ॥३०॥

अब पुनः छेदादि के आनयन को कहते हैं

हि भा.—पूर्व साधित इष्टान्त्या को द्युज्या से गुणा कर त्रिज्या से भाग देने से वा (प्रकारान्तर से) छेद (इष्टहृति) होता है। उससे पूर्ववत् शङ्कु आदि होता है, 'ज्या-स्वाहोरात्रार्धघातहृता' इसका अग्रिम श्लोक के साथ सम्बन्ध है इति ॥३०॥

उपपत्ति

भूकेन्द्र से ग्रहोपरिगतध्रुवप्रोतवृत्त और नाडीवृत्त की सम्पातगतरेखा त्रिज्या, ग्रहोपरिगत ध्रुवप्रोतवृत्त और नाडीवृत्त के सम्पात से पूर्वोक्त पूर्वापर सूत्र की समानान्तर रेखा के ऊपर लम्बरेखा इष्टान्त्या, भूकेन्द्र से इष्टान्त्या मूलगतरेखा, इन तीनों भुजों से उत्पन्न एक त्रिभुज, अहोरात्रवृत्त के गर्भकेन्द्र से ग्रहगत रेखा द्युज्या, ग्रह से स्वोदयास्त-सूत्र के ऊपर लम्ब रेखा इष्टहृति, अहोरात्रवृत्त के गर्भकेन्द्र से इष्टहृति मूलगतरेखा, इन तीनों भुजों से उत्पन्न द्वितीय त्रिभुज, ये दोनों त्रिभुज सजातीय हैं इसलिये अनुपात करते हैं यदि त्रिज्या में इष्टान्त्या पाते हैं तो द्युज्या में क्या इससे इष्टहृति आती है

$\frac{\text{इष्टान्त्या.द्यु}}{\text{त्रि}}$ = इष्टहृति, इससे पूर्ववत् शङ्कु आदि का ज्ञान सुगम ही है इति ॥३०॥

इदानीं प्रकारान्तरेण छायाकर्णं शंकुं चाह

व्यासार्धकृतिगुणिता विषुवत्कर्णेन वा भवेत् कर्णः।
लम्बगुणो वा घातः शङ्कुर्व्यासार्धकृतिभक्तः ॥३१॥

घातो वाऽर्कगुणस्त्रिज्या विषुवत्कर्णवधहृतः शंकुः।
कर्णकृतेः संशोध्य द्वादशवर्गं पदं छाया ॥३२॥

वा. भा.—अत्रेयं वासना भूमध्याद्वैपरीत्येन त्रैराशिकत्रयं भक्त्या प्रकल्पिता। तद्यथा यदि छायाकर्णस्य द्वादशशंकुस्तद्व्यासार्धकर्णस्य कः शंकुरिति फलं बृहच्छंकुः ततो यदि लंबककोटेर्व्यासार्धकर्णः तदस्या शंकुकोटेः कर्णं दक्षिणोत्तरा-वगाहिनी वृत्ते फलं छेदः ततस्तृतीयं यदि स्वाहोरात्रवृत्तेऽयं छेदः। तद्व्यासार्धवृत्ते क इति फलं ज्या एवमवस्थिते लंबकस्थाने द्वादशसंकुः कोटिः व्यासार्धस्थाने विषुवत्कर्णः कर्णः प्रथमत्रैराशिके द्वादशको गुणकारो द्वितीये भागहारस्तुल्य-त्वात्तयोर्नाशे कृते व्यासार्धस्याव्यासार्धमेव गुणकारः विषुवत्कर्णश्च स्वाहोरात्रार्ध-छायाकर्णयोर्घातो भागहारः फलं ज्या भवति। यदा पुनस्तस्यैव भाज्यराशेः स्वाहोरात्रार्धज्ययोर्घातेन भागो हि क्रियते तदा फलं छायाकर्णो भवत्येतत्सर्वं गोले प्रदर्शयेदिति ज्याप्रकारान्तरेण शंक्वानयनमुपगर्यार्धेनाह 'लंबगुणो वा घातः शंकु-व्यासार्धकृतिभक्तः' अथवा ज्यास्वाहोरात्रार्धं ।त न्वदेशावलम्बज्यया संगुणय्य गृहीतं गुज्यते यावदिहोन्मंडलादधो रविः क्षितिजाद्योपरि स्युन्मंडलान्तरस्थस्य स्वाहोरात्र-

खंडस्य जीवाऽत्रापि गृहीता स चोन्मंडलादेवाधः प्रवर्त्तते तच्चरदलप्राणेभ्यो गतप्राण-शेषं वा विशोध्यते येनार्कोन्मंडलांतरे स्वाहोरात्रवृत्तखंडस्य या ज्या सा जीवेत्युच्यते। उन्मंडलादधस्ताद्रवेश्चरदलमित्यर्थः। क्षयवृद्धिज्या च क्षितिजोन्मंडलयोरन्तरस्थस्य स्वाहोरात्रवृत्तखंडस्य जीवातोऽवलम्बनं क्षयवृद्धिज्यातो विशोध्यते। येन क्षितिजा-दुपरि रवेरधश्च स्वाहोरात्रवृत्तखंडस्य ज्याखण्डे संगृहीतं भवति सैव ज्योच्यते। तस्मादुक्तं जीवोना क्षयवृद्धिज्या सा भवति। यदा पुनस्तदेवावलम्बनं स्वाहोरात्रार्धेन विभज्यते। तदा स्वाहोरात्रपरिणता क्षितिजा भवति। तस्मात्तस्याः स्वावलम्बनं विशोध्य छेदो भवति। अथ प्रश्नचरदलकालौ तुल्यौ भवतस्तदोन्मंडल एव रविर्भ-वति। तत्र स्वाहोरात्रापेक्षया क्षितिज्याछेदः तावानुच्छ्रायो रवेर्भवतस्तदोन्मंडलएव रविर्भवति।

ततः स्वाहोरात्रव्यासार्धे क्षेपेण क्षयवृद्धिजा ज्या। तावानेवोच्छ्राय इति तावता व्यासार्धेन प्राग्वत्तं दर्शयेत् दक्षिणोत्तरावगाही। तस्यापि तात्का-लिकशंकुकोटिः शंकुतलं भुजे ज्यादिका त्रैराशिकवासना योज्या छेदोऽवलंबक-गुण इत्यादिभिः सूत्रैर्यदुक्तमुक्तवच्छेषमिति तस्मात् सर्वमुपपन्नम्। यथास्थितं गोले प्रदर्शयेदिति इदानीं द्युदलान्तरज्यार्धयोरानयनमाह ॥३१॥

अथवा ज्या स्वाहोरात्रघातं द्वादशभिः संगुणय्य त्रिज्या विषुवत्कर्णयो-र्वधेन विभजेत्। फलं बृहच्छंकुर्भवति। प्रागार्याधेनात्र वासना। द्वितीये त्रैराशिके व्यासार्धस्थाने विषुवत्कर्णोऽवलंबकस्थाने द्वादशका कोटिरितोयान्विशेषः। तस्मा-दुपपन्नम्। गोले प्रदर्शयेदिति। इदानीं छायाकर्णछायानयनमुत्तरार्यार्धेनाह। कर्णकृतेः संशोध्य द्वादशवर्गं पदं छाया। छायाकर्णवर्गाद्द्वादशशंकोर्वर्गं विशोध्य मूलं तस्यैव शंकोश्छाया तात्कालिकी भवति। वासनात्र छायाकर्णं कर्णो द्वादशकः शंकुः कोटिः छाया भुजा तस्मात्कर्णकृतेः कोटिकृतिं विशोध्य मूलं भुजा इत्युपपन्नम्। एवं यथेष्टप्रमाणस्य शंकोश्छायाकर्णेन योज्यम्। तरुगृहपर्व-तादीनां वेति। अथ यत्र दिने चरदलकालादथाल्पप्रश्नकालो भवति दिनगतः शेषश्चोत्तरगोले तत्र छेदः ज्ययोरानयनार्थमार्यामाह ॥३२॥

वि. भा.—व्यासार्धकृतिः (त्रिज्यावर्गः) विषुवत्कर्णेन (पलकर्णेन) गुणिता, ज्यास्वाहोरात्रार्धघातहृता (इष्टान्त्या द्युज्याघातभक्ता) तदा वा (प्रकारान्तरेण) कर्णः (छायाकर्णः) भवेत्। घातः (इष्टान्त्या द्युज्याघातः) लम्बज्यागुणितः, व्यासार्धकृतिभक्तः (त्रिज्यावर्गभक्तः) तदा वा (प्रकारान्तरेण) इष्टशंकुर्भवेत्। वा घातो द्वादशगुणितः, त्रिज्यापलकर्णघातभक्तस्तदेष्टशंकु-र्भवेत्। छायाकर्णवर्गात् द्वादशवर्गं संशोध्य पदं (मूलं) ग्राह्यं तदा छाया भवेदिति ॥३१-३२॥

अत्रोपपत्तिः

यदि त्रिज्ययेष्टान्त्या (ज्या) लभ्यते तदा द्युज्यया किं समागच्छतीष्ट-हृतिः $=\frac{\text{इष्टान्त्या}\cdot\text{द्यु}}{\text{त्रि}}=\frac{\text{ज्या}\cdot\text{द्यु}}{\text{त्रि}}$, ततो व्यासार्धं छेदहृतं विषुवत्कर्णाहतं कर्णं

इत्यनेन छायाकर्णः $=\frac{\text{त्रि}\cdot\text{पलक}}{\text{इहृति}}=\frac{\text{त्रि}\cdot\text{पक}}{\frac{\text{ज्या}\cdot\text{द्यु}}{\text{त्रि}}}=\frac{\text{त्रि}^{2}\cdot\text{पक}}{\text{ज्या}\cdot\text{द्यु}}=\frac{\text{त्रि}^{2}.\text{पक}}{\text{घात}}$, तत इष्टशंकुः $=$

$\frac{\text{त्रि}\cdot 12}{\text{छाकर्ण}}=\frac{\text{त्रि}\cdot 12}{\frac{\text{त्रि}^{2}\cdot\text{पक}}{\text{घात}}}=\frac{\text{त्रि}\cdot 12\cdot\text{ज्या}\cdot\text{द्यु}}{\text{त्रि}^{2}\cdot\text{पक}}=\frac{\text{त्रि}\cdot 12}{\text{पक}}$, $\frac{\text{ज्या}\cdot\text{द्यु}}{\text{त्रि}^{2}}=\frac{\text{लंज्या}\cdot\text{ज्या}.\text{द्यु}}{\text{त्रि}^{1}}=$

$\frac{\text{लंज्या}.\text{घात}}{\text{त्रि}^{1}}=\frac{\text{लंज्या}}{\text{त्रि}}$, $\frac{\text{घात}}{\text{त्रि}}=\frac{12}{\text{पक}}$, $\frac{\text{घात}}{\text{त्रि}}$ एतेनाऽऽचार्योक्तमुपपद्यते ॥३१-३२॥

अब प्रकारान्तर से छायाकर्ण और इष्टशंकु को कहते हैं

हि. भा.—त्रिज्या वर्ग को पलकर्ण से गुणा कर इष्टान्त्या (ज्या) और द्युज्या घात से भाग देने से छाया कर्ण होता है। वा घात को लम्बज्या से गुणा कर त्रिज्या वर्ग से भाग देने से इष्टशंकु होता है, वा घात को बारह से गुणा कर त्रिज्या और पलकर्ण के घात से भाग देने से इष्टशंकु होता है, छायाकर्ण वर्ग में द्वादश वर्ग को घटा कर मूल लेने से छाया होती है इति ॥३१-३२॥

उपपत्ति

यदि त्रिज्या में इष्टान्त्या पाते हैं तो द्युज्या में क्या इससे इष्टहृति आती है

$\frac{\text{इष्टान्त्या}\cdot\text{द्यु}}{\text{त्रि}}=\frac{\text{ज्या}\cdot\text{द्यु}}{\text{त्रि}}=\frac{\text{घात}}{\text{त्रि}}=$ इहृति 'व्यासार्धं छेदहृतं विषुवत्कर्णाहृतं कर्णः' इससे

छायाकर्ण $=\frac{\text{त्रि}.\text{पक}}{\text{इहृति}}=\frac{\text{त्रि}.\text{पक}}{\frac{\text{ज्या}.\text{द्यु}}{\text{त्रि}}}=\frac{\text{त्रि}^{2}\text{पक}}{\text{ज्या}.\text{द्यु}}$ इससे इष्टशंकु $=\frac{\text{त्रि}.12}{\text{छाकर्ण}}=\frac{\text{त्रि}.12}{\frac{\text{त्रि}^{2}\text{पक}}{\text{ज्या}.\text{द्यु}}}=$

$\frac{\text{त्रि}.12\cdot\text{ज्या}.\text{द्यु}}{\text{त्रि}^{2}.\text{पक}}=\frac{\text{त्रि}.12}{\text{पक}}$, $\frac{\text{ज्या}.\text{द्यु}}{\text{त्रि}^{2}}=\frac{\text{लंज्या}.\text{घात}}{\text{त्रि}^{2}}=\frac{12}{\text{पक}}\times\frac{\text{घात}}{\text{त्रि}}$, इससे आचार्योक्त उपपन्न हुआ इति ॥३१-३२॥

इदानीमिष्टच्छेदान्त्ययोर्विशेषमाह

अन्त्याः प्रत्यग्भूता यदि [illegible] विहिता।

हृज्योना चीजोना [illegible] ॥३३॥

वा. भा.—अल्पा दिनगता शेषा वा उत्तरगोले यदा प्रश्नघटिकानां प्राणा भवन्ति। तद्दैवसिकचरदलप्राणेभ्यः तदा विपरीतशोधनं कार्यं कृते च येऽधिकाश्चर-दलप्राणाश्च भवन्ति तेषां क्रमज्या कार्या सा जीवेत्युच्यते। ततस्तां स्वाहोरात्रार्धेन सगुणय्य व्यासार्धे। विभजेत्। फलं हृत इत्युच्यते क्षितिजाहृतयोना कार्या सा छेदो भवति। क्षयवृद्धिज्या जीवोना सती ज्याख्या भवति। अथ प्रश्नकालः चरदलेन समो भवति। तदा क्षितिजैव छेदः क्षयवृद्धिज्यावज्ज्या भवति। उक्तवच्छेदमिति छेदेन ज्यायाश्च यथा छायानयनानि प्रागुक्तान्येवमत्रापि काले कार्याण्यतश्चोत्तर-गोले सम्भवन्ति। यत उक्त शेषाल्प स्याद्भवति इति अत्रेयं वासना उत्तरगोले गतकालाच्छेषाद्वा तच्चरदलकालो विशोध्यते। यत उन्मंडलोपरि रवेरधश्च स्वाहो-रात्रवृत्तखंडस्य यः शलाकाया अधः स्वोदयास्तसूत्रं स्थितं स्वक्षितिजादुन्मंडलस्यो-परिस्थितत्वाद् दक्षिणगोलेऽन्यथाऽतस्तदन्तरं विशोध्यते। तच्चान्तरं क्षितिजा तस्मादुपपन्नं यदा पुनः तदेव स्वाहोरात्रार्द्धं व्यासार्धं परिकल्प्यते तदा क्षितिजापि क्षयवृद्धिज्या तदनुसारिण्या तयापि त्रिज्यायुतविहीना सौम्येतरगोलयोरन्त्या युज्यत एव वासनातुल्यत्वात्तदप्युपपद्यते। द्युदलांत्यज्यान्त्ययोरभिधानमग्रे युज्यते यतः सैव परावृद्धिः तत्र दिने तयोर्विषुर्वाद्दिने युतः क्रान्त्यभावाद्। व्यासार्धतुल्यं स्वाहो-रात्रार्धक्षितिजोन्मंडलयो संयोगात्। तत्र दिने चरदलस्याभावः। प्राच्यपरैर्वा निरक्ष-स्वदेशयोरुदयास्तसूत्रं तस्मात्तत्व्यासार्धमेव द्युदलांत्या ज्यांत्या च सर्वमेव तद्गोले प्रदर्शयेत्। निरक्षदेशे तूत्तरेणोपपद्यन्ते सर्व एव छायानयनप्रकारा इति। इदानीं द्युदलांत्यज्याछायानयनार्थमार्याद्वयेनाह॥३३॥

वि. भा.—यदि प्रश्नासूनां (इष्टासूनां) संख्या अल्पाः, चरार्धासवो बहव-स्तदोत्तरगोले चरासुभ्य इष्टासून् विशोध्य शेषस्य जीवा सूत्रसंज्ञा स्यात्, सा द्युज्या गुणा त्रिज्याभक्ता तदा कला भवेत्। तया हृतयोना क्षितिजा (कुज्या) छेदो भवेत्। क्षयवृद्धिज्या (चरज्या) जीवोना (सूत्रसंज्ञया हीना) तदेष्टान्त्या स्यात्, तत इष्टहृत्यन्त्याभ्यां शेषं शङ्क्वादिसाधनं पूर्ववत्कार्यमिति॥३३॥

अत्रोपपत्तिः

'यत्र क्वचिच्छुद्धिविधौ यदेह शोध्यं न शुध्येद्विपरीतशुद्धया' इत्यादिभास्कर-कथितविधिना विलोमशोधनेन स्फुटैवास्ति, लल्लाचार्येण "अल्पीयांसो भवेयुः सवितृचरदलादिष्टकालासवश्चेत् सौम्ये गोले तदानीं चरदलसमयात् पातयित्वे-ष्टकालम्। कार्या शेषस्य जीवा चरशकलगुणस्तद्विहीनोऽन्त्यका स्यात् त्रिज्या-भक्ताऽथ सैव द्युगुणा विगुणिता छेद इष्टः प्रदिष्टः" एवं कथ्यते, सिद्धान्तशेखरे श्रीपतिना "अभीष्टप्राणाश्चेच्चरशकलतः स्युस्त्वनधिका उदग्गोले पात्याश्चर-शकलतो ज्या चरगुणः। तयोनस्त्रिज्याप्तो दिनगतगुणोऽस्वाबभिमतो भवेच्छे-दस्तस्मात् कथितविधिना स्तः श्रवणभे" अनेन लल्लोक्तमेवोक्तमिति॥३३॥

अब इष्टछेद और इष्टान्त्या के विषय में विशेष कहते हैं

हि. भा.—यदि इष्टासु की संख्या अल्प हो और चरार्धासु की संख्या अधिक हो अर्थात् चरासु यदि इष्टासु से अधिक हो तो उत्तरगोल में चरासु में इष्टासु को घटाकर शेष की जीवा सूत्र संज्ञक होती है, उसको द्युज्या से गुणा कर त्रिज्या से भाग देने से कला होती है, कुज्या में उसे घटाने से इष्टहृति होती है, चरज्या में जीवा (सूत्र) को घटाने से इष्टान्त्या होती है, तब इष्टहृति और इष्टान्त्या से पूर्ववत् शङ्कु आदि का साधन करना चाहिये इति ॥३३॥

उपपत्ति

'यत्र क्वचिच्छुद्धिविधौ यदेह शोध्यं न शुध्येद्विपरीतशुद्धया' इत्यादि भास्करकथित विधि से विलोम शोधन से स्पष्ट है, लल्लाचार्य 'अल्पीयांसो भवेयुः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से आचार्योक्तानुसार ही कहते हैं। सिद्धान्तशेखर में श्रीपति ने 'अभीष्टप्राणाभ्ये च्चरशकलतः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से, लल्लोक्त ही को कहा है इति ॥३३॥

इदानीं हृत्यन्त्ययोः साधनमाह

स्वाहोरात्रार्धमुदग्दक्षिणयोः क्षितिजया युतविहीनम्. ।

द्युदलान्त्यज्या त्रिज्या क्षयवृद्धिज्या युतोनाऽन्त्या ॥३४॥

वा. भा.—इष्टदिनस्वाहोरात्रार्धं तद्दैवसिक क्षितिज्यया मेषादौ युतं तुलादौ च हीनं द्युदलान्तरज्या भवति । एवं क्षयवृद्धिज्यया युतव्यासार्द्धमुत्तरगोलेऽन्त्या भवति । दक्षिणगोले हीनमन्त्या भवति । विषुवद्दिने द्युदलमन्त्यज्या व्यासार्धे तुल्ये भवत इत्यत वासना पूर्वविन्यासे निरक्षोदयःसूत्रस्याधः शलाकया सह यत्र संपातस्तत्र सूत्रस्यैकमग्रं बद्ध्वा द्वितीयमग्रमूर्ध्वं नीत्वा याम्योत्तरमंडलस्याहोरात्र-मंडलयोः संपाते बध्नीयात् । तत्स्वाहोरात्रार्द्धं साक्षदेशे तिर्यक्स्थितं भवति । तत्र निरक्षोदयास्तसूत्रयोरन्तरमुत्तरगोले योज्यते । ततो व्यासार्धं कृत्वा विभजेत् फलं बृहच्छङ्कुर्भवति । अत्र वासना त्रैराशिकद्वयेन यदिव्यासार्धवृत्ते एतावती ज्या तत्स्वाहोरात्रवृत्ते कियतीति फलं छेदः । ततो द्वितीयं यदि व्यासार्धकर्णस्य लंबज्या कोटिः तदस्य लब्धछेदस्य का कोटिरिति फलं बृहच्छंकुस्तस्मादुपपन्नं यथास्थिते क्षेत्रे प्रदर्शयेदिति ज्ययैवान्त्येन प्रकारेण शंक्वानयनमार्यार्धेनाह ॥३४॥

वि. भा.—उत्तरदक्षिणगोलयोः स्वाहोरात्रार्धं (द्युज्या) क्षितिजया (कुज्यया) यथाक्रमं युतविहीनं तदा द्युदलान्त्यज्या (हृतिः) भवेत् । तथा गोलयो-स्त्रिज्या क्षयवृद्धिज्यया (चरज्यया) युतोना तदाऽन्त्या भवेदिति ॥३४॥

अत्रोपपत्तिः

क्षितिजाहोरात्रवृत्तयोः सम्पातोपरिगतं ध्रुवप्रोतवृत्तमुत्तरगोले दक्षिण-गोले च क्रमेण नाडीवृत्ते पूर्वस्वस्तिकाच्चरान्तरेऽध ऊर्ध्वं लगति ताभ्यां पूर्वापर-सूत्रस्य समानान्तररेखे कार्ये तदुपरि ग्रहोपरिगतध्रुवप्रोतवृत्तनाडीवृत्तयोः सम्पाता-ल्लम्बरेखे गोलयोरिष्टान्त्ये पूर्वापरसूत्र-समानान्तररेखयोरन्तरं चरज्याऽस्ति, मध्याह्नकाले याम्योत्तरवृत्ते रवेः स्थितत्वात्तदुपरिगतध्रुवप्रोतवृत्तनाडीवृत्तयोः सम्पातो निरक्षखस्वस्तिकमेव तस्मात् पूर्वापरसूत्रसमानान्तररेखोपरिलम्बरेखा निरक्षोर्ध्वाधरसूत्रमेव तेन भूकेन्द्रान्निरक्षखस्वस्तिकं यावत् त्रिज्यायामुत्तरगोले पूर्वापरसूत्र-समानान्तररेखयोरन्तर्गतं निरक्षोर्ध्वाधरसूत्रखण्डं (चरज्या) योज्यं तदा निरक्षखस्वस्तिकात् समानान्तररेखां यावल्लम्बरूपाऽन्त्या भवेत् । दक्षिण-गोले तु त्रिज्यायां चरज्यायाः शोधनेन तत्प्रमाणं भवति । तथा चाहोरात्रवृत्तगर्भ-केन्द्राद्रवि यावद् द्युज्यायां निरक्षोदयास्तस्वोदयास्तसूत्रयोरन्तर्गतं कुज्यामानं गोलयो युतं विहीनं तदा दिनार्धे रवितः स्वोदयास्तसूत्रपर्यन्तं लम्बरूपा हृतिर्भवति। सिद्धान्तशेखरे "स्वाहोरात्रदलं युतोनमवनीमौर्व्या दिनार्धान्त्यका व्यासार्धं चरजीवया भवति सा चान्त्याऽर्कगोलक्रमात्' ऽनेन श्रीपतिना, भास्करेण 'क्षितिज्ययैवं द्युगुणश्च सा हृतिश्चरज्ययैवं त्रिगुणोऽपि सान्त्यका' ऽनेनाऽऽचार्योक्तमेव कथ्यत इति ॥३४॥

अब हृति और अन्त्या को कहते हैं

हि. भा.—उत्तरगोल में द्युज्या में कुज्या को जोड़ने से और दक्षिणगोल में द्युज्या में कुज्या को घटाने से हृति (मध्यहृति) होती है। तथा उत्तरगोल में त्रिज्या में चरज्या को जोड़ने से और दक्षिणगोल में त्रिज्या में चरज्या घटाने से अन्त्या (मध्याह्नकाल में) होती है ॥३४॥

उपपत्ति

क्षितिजाहोरात्रवृत्त के सम्पातोपरिगत ध्रुवप्रोतवृत्त उत्तरगोल में और दक्षिण-गोल में क्रम से नाड़ीवृत्त में पूर्वस्वस्तिक से चरान्तर पर नीचे और ऊपर लगता है, उन दोनों बिन्दुओं से पूर्वापर सूत्र की समानान्तर रेखाओं के ऊपर ग्रहोपरिगतध्रुवप्रोतवृत्त और नाड़ीवृत्त के सम्पात से लम्बरेखा इष्टान्त्या है, मध्याह्नकाल में रवियाम्योत्तरवृत्त में रहता है इसलिये ग्रहो (रवि) परिगत ध्रुवप्रोतवृत्त (याम्योत्तरवृत्त) और नाड़ीवृत्त के सम्पात निरक्षखस्वस्तिक से पूर्वापरसूत्र के समानान्तररेखा के ऊपर लम्बरेखा निरक्षो-र्ध्वाधर रेखा ही है, भूकेन्द्र से निरक्षखस्वस्तिक पर्यन्त त्रिज्या में पूर्वापर सूत्र समानान्तर रेखाओं के मध्यगत निरक्षोर्ध्वाधरसूत्रखण्ड (चरज्या) को उत्तरगोल में जोड़ने से और दक्षिणगोल में घटाने से निरक्षखस्वस्तिक से समानान्तररेखा पर्यन्त लम्बरूपरेखा अन्त्या

होती है। तथा मध्याह्नकाल में निरक्षोदयास्तसूत्रस्थ अहोरात्रवृत्त गर्भकेन्द्र से रवि-पर्यन्त द्युज्या में गोलक्रम से निरक्षोदयास्तसूत्र और स्वोदयास्तसूत्र के अन्तर्गत कुज्या को जोड़ने और घटाने से रवि से स्वोदयास्त सूत्र पर्यन्त लम्बरेखा हृति होती है। सिद्धान्तशेखर में 'स्वाहोरात्रदलं युतोनमवनीमौर्व्या' इत्यादि संस्कृत उपपत्ति में लिखित श्लोक से श्रीपति तथा 'क्षितिज्ययैवं द्युगुणश्च सा हृतिः' इत्यादि से भास्कराचार्य भी आचार्योक्त बात को ही कहते हैं इति ॥३४॥

इदानीं प्रकारान्तरेणेष्टकर्णसाधनमाह

छेदहृता द्युदलान्त्या दिनार्धकर्णेन सङ्गुणा कर्णः।
भक्ता ज्ययाऽथवान्त्या दिनार्धकर्णाहृता कर्णः ॥३५॥

वा. भा.—अनन्तरमेवानीतां द्युदलान्त्यज्यां तद्दैवसिकदिनार्धछायाकर्णेन संगुणय्य छेदिना विभजेत्। फलं छायाकर्णस्तात्कालिकस्तच्छायानयनं प्राग्वदित्यत्र वासना मध्याह्ने द्युदलांत्यज्यैव छेदः तदिष्टछायाकर्णस्य कश्छेद इत्येवं स्थिते द्युदलकर्णे संगुणय्य यावच्छायाकर्णेन भागो दीयते तावच्छेद आगच्छति। भागहार-लब्ध्योर्व्यत्ययात्तस्मादुपपन्नं पूर्वन्यस्तेषु द्युदलांत्यादिसूत्रेषु गोले सर्वं प्रदर्शयेदिति अन्यथा च छायाकर्णानियनमुत्तरार्धेनाह।

"भक्ता ज्ययाऽथवान्त्या दिनार्धकर्णाहृता कर्णः अथवानन्तरमेवानीतामंत्यां दिनार्धकर्णेन हत्वा ज्यया विभजेत्। फलं छायाकर्णस्तात्कालिको भवति। वासना-प्यत्र प्रागार्याविन तुल्या यतो दिनार्धेऽन्त्यज्या भवति सैव स्वाहोरात्रपरिणता द्युद-लांत्यज्योच्यते। इष्टकालिकापि ज्या स्वाहोरात्रपरिणता छेद इत्युच्यते। तस्मात्त्रैरा-शिकवासना सैवात्र विवक्षा कुतो भेद इति। एवं दिनगतशेषाच्छेदानयनं प्रागुक्त-मिदानीं नतकालाद् द्युलान्त्यज्यया छेदानयनार्थमार्यामाह ॥३५॥

वि. भा.—द्युदलान्त्या (हृतिः) दिनार्धकर्णेन (मध्यच्छायाकर्णेन) गुणिता छेदहृता (इष्टहृतिभक्ता) तदा कर्णः (इष्टच्छायाकर्णो) भवेत्। अथवाऽन्त्या दिना-र्धकर्णाहृता (मध्यच्छायाकर्णगुणा) ज्यया (इष्टान्त्यया) भक्ता तदेष्टच्छाया-कर्णो भवेदिति ॥३५॥

अत्रोपपत्तिः

अथ मध्यशङ्कुः $=\dfrac{१२\times त्रि}{मक्षक}$, ततो यदि हृत्या मध्यशङ्कुर्लभ्यते तदेष्टहृत्या किं

समागत इष्टशङ्कुः $=\dfrac{मशं\times इहृ}{हृ}$ मध्यशङ्कोरुत्थापनेन $=\dfrac{१२\times त्रि\times इहृ}{मक्षक\times हृ}$

$= \frac{१२ \times त्रि}{मछाक} \cdot \frac{इअन्त्या}{अन्त्या}$ ततो दृग्ज्या त्रिजीवे रविसङ्गुणे तेशङ्कूद्धृते भाश्रवणौ भवे ।।मितिभास्करोक्त्या $= \frac{१२ \times त्रि}{इष्टशङ्कु} =$ इछाकर्ण $= \frac{१२ \times त्रि \times मछाक \times हृ}{१२ \times त्रि \times इहृ}$

$= \frac{मछाक + हृ}{इहृ} = \frac{मछाक. अन्त्या}{इअन्त्या} \because \frac{हृ}{इहृ} = \frac{अन्त्या}{इअन्त्या}$ एतावताऽऽचार्योक्तमुपपन्नमिति, सिद्धान्तशेखरे "आद्याऽथ द्युदलोत्थकर्णगुणिता छेदोद्धृता वा श्रुतिः स्यादन्त्याऽपि दिनार्धकर्णगुणिता ज्याप्ता च कर्णोऽथवे" त्यनेन श्रीपतिनाऽऽचार्योक्तमेव कथ्यते इति ।।३५।।

अब प्रकारान्तर से इष्टच्छायाकर्ण साधन को कहते हैं

हि. भा.—हृति को मध्यच्छायाकर्ण से गुणाकर इष्टहृति से भाग देने से इष्टच्छाया कर्ण होता है, अथवा अन्त्या को मध्यच्छाया कर्ण से गुणाकर इष्टान्त्या से भाग देने से इष्टच्छाया कर्ण होता है इति ।।३५।।

उपपत्ति

मध्यशङ्कु $= \frac{त्रि. १२}{मछाक}$ तब अनुपात करते हैं यदि हृति में मध्यशङ्कु पाते हैं तो इष्टहृति में क्या इस से इष्टशङ्कु आता है $\frac{मशं. इहृ}{हृ} =$ इष्टशंकु. इसमें मध्यशङ्कु को उत्थापन देने से

$\frac{त्रि. १२. इहृ}{मछाक. हृ} = \frac{त्रि. १२}{मछाक} \cdot \frac{इअन्त्या}{अन्त्या} =$ इष्टशङ्कु, तब अनुपात से $\frac{त्रि \cdot १२}{इशङ्कु}$

$=$ इछाकर्ण $= \frac{त्रि. १२. मछाक. हृ}{त्रि \cdot १२ \cdot इहृ} = \frac{मछाक. हृ}{इहृ} = \frac{मछाक. अन्त्या}{इ अन्त्या} \because \frac{हृ}{इहृ}$

$= \frac{अन्त्या}{इअन्त्या}$ इससे आचार्योक्त उपपन्न हुआ, सिद्धान्तशेखर में "आद्याऽथ द्युदलोत्थकर्णगुणिता" इत्यादि संस्कृतोपपत्ति में लिखित पद्य से श्रीपति—आचार्य (ब्रह्मगुप्त)क्त ही को कहते हैं इति ।।३५।।

इदानीं प्रकारान्तरेणेष्टहृतिमाह

द्युदलान्नतोत्क्रमज्यां स्वाहोरात्रार्धसङ्गुणां विभजेत् ।
व्यासार्धेन फलोना द्युदलान्त्यज्याऽथवा छेदः ।।३६।।

वा. भा.—यस्मिन्नभीष्टकाले छाया क्रियते गते दिनशेषे वा तस्य कालस्य

दिनार्द्धस्य चान्तरे यावत्यो घटिकाः ताः दिनदलोन्नता उच्यन्ते । तासां प्राणीकृतानामुत्क्रमेण या जीवा भवति सा नतोत्क्रमज्या उच्यते । ततस्तां द्युदलान्ननोत्क्रमज्यां स्वाहोरात्रार्धेन संगुणय्य व्यासार्धेन विभजेत् । ततो यत्फलं तेनोना द्युदलान्त्यज्या छेदो भवति । छेदेन च छायानयनानि पूर्वंदर्शनघटिका पंचदशघटिकाभ्योऽधिका भवन्ति । तदा पंचदशानां घटिकानामुत्क्रमज्या त्रिज्या भवति । शेषघटिकानां क्रमज्यां कृत्वा तया संयुता त्रिज्या शेषमुक्तवदित्यत्र वासना स्वाहोरात्रवृत्तेऽर्कोपलक्षितचिह्ने सूत्रस्यैवमग्रं बद्ध्वा द्वितीयमग्रं याम्योत्तरमंडलमध्ये नापरस्यां दिशि नीत्वा तावत्येवोच्छ्रिते स्वाहोरात्रवृत्तिप्रदेशे बध्नीयात् तत् पूर्वापरायतं सूत्रं ज्यावद्स्थितं भवति । तत्परिच्छिन्नस्य स्वाहोरात्रवृत्तधनुषो यः शरः सा नतोत्क्रमज्या द्युदलांत्यज्या सूत्रे भवति । व्यासार्धवृत्तनिष्पन्नाः । अतः स्वाहोरात्रवृत्ते परिणाम्यते । यदि व्यासार्धवृत्ते एतावती तत्स्वाहोरात्रवृत्ते कियतीति फलं स्वाहोरात्रनिष्पन्ना नतोत्क्रमज्या भवति तयोना यावद्द्युदलांत्यज्या क्रियते तावच्छेदतुल्यं द्युदलांत्यज्याखण्डमवशिष्यते सैवात्र घटिकानां स्वाहोरात्रनिष्पन्ना ज्या भवति । स्वक्षितिज्या पुनः पंचदशघटिका भवन्ति तदा रविरुन्मंडले वर्तते । तत्र नतोत्क्रमज्या त्रिज्या भवति । यावत्स्वाहोरात्रवृत्तं परिणाम्यते । तावत्स्वाहोरात्रार्धमेव फलं भवति । पंचदशभ्योऽधिका नतघटिका भवन्ति । तदा क्षितिजोन्मंडलयोरन्तरे को वर्तते । तत्रोन्मंडलादधः पुनः क्रमज्या प्रवर्तते । अत्र पंचदशघटिकाभ्योऽधिकघटिकानां क्रमज्या व्यासार्धे योज्यते । येनार्कद्युदलांतरस्थितानां घटिकानां स्वाहोरात्रवृत्ते नतोत्क्रमज्या भवति । तस्मादुपपन्नं यथा स्थितं गोले प्रदर्शयेदिति । इदानीं नतकालज्यानयनमंत्यया छेदं छायासंख्यां चार्थयाह ॥३६॥

वि. भा.—द्युदलाद्या नतोत्क्रमज्या भवेदर्थादिष्टकाले मध्याह्नाद्यो नतकालस्तस्योत्क्रमज्या या तां स्वाहोरात्रार्ध (द्युज्या) सङ्गुणां व्यासार्धेन (त्रिज्यया) विभजेत् फलेन हीना द्युदलान्त्यज्या (हृदिः) ऽथवा (प्रकारान्तरेण) छेदः(इष्टहृतिः) भवेदिति ॥३६॥

अत्रोपपत्तिः

क्षितिजाहोरात्रवृत्तयोः सम्पातोपरिगतं ध्रुवप्रोतवृत्तं नाडीवृत्ते यत्र लगति तद्बिन्दोः पूर्वापरसूत्रस्य समानान्तररेखा कार्या तदुपरि निरक्षस्वस्तिकाल्लम्बरेखाऽन्त्या, ग्रहोपरिगतध्रुवप्रोतवृत्तनाडीवृत्तयोः सम्पाताल्लम्बरेखा चेष्टान्त्या, ग्रहोपरिगतध्रुवप्रोतवृत्तनाडीवृत्तयोः सम्पातान्निरक्षोर्ध्वाधरसूत्रोपरिलम्बो नतकालज्या तन्मूलान्निरक्षस्वस्तिकं यावन्नतोत्क्रमज्याऽस्ति, नतोत्क्रमज्योनाऽन्त्येष्टान्त्या भवति, ततोऽनुपातेन 'यदि त्रिज्ययेष्टान्त्या लभ्यते तदा द्युज्यया किमिति' इष्टहृतिः

$$= \frac{\text{इष्टान्त्या. द्यु}}{\text{त्रि}} = \frac{(\text{अन्त्या—नतोत्क्रमज्या})\ \text{द्यु}}{\text{त्रि}} = \frac{\text{अन्त्या. द्यु}}{\text{त्रि}} -$$

$= \frac{\text{नतोत्क्रमज्या} \cdot \text{द्यु}}{\text{त्रि}} = \text{हृति} - \frac{\text{नतोत्क्रमज्या} \cdot \text{द्यु}}{\text{त्रि}}$ एतावताऽऽचार्योक्तमुपपद्यते, सिद्धान्तशेखरे "नतोत्क्रमज्यागुणिता भ्रमेण हृता त्रिमौर्व्याऽथ फलेन हीना । दिनार्धजान्त्या यदि वा हृतिः स्यात्" ऽनेन श्रीपतिनाऽऽचार्योक्तानुरूपमेव कथ्यत इति ।।३६।।

अब प्रकारान्तर से इष्टहृति को कहते हैं

हि. भा.—इष्टकाल में मध्यान्ह से जो नतकाल की उत्क्रमज्या है उसको द्युज्या से गुणाकर त्रिज्या से भाग देने से जो फल होता है उसको हृति में घटाने से वा (प्रकारान्तर से) इष्टहृति होती है इति ।।३६।।

उपपत्ति

क्षितिजाहोरात्रवृत्त के सम्पातोपरिगतध्रुवप्रोतवृत्त नाड़ीवृत्त में जहाँ लगता है उस बिन्दु से पूर्वापर सूत्र की समानान्तर रेखा कर देना उसके ऊपर ग्रहोपरिगत ध्रुवप्रोतवृत्त और नाड़ीवृत्त के सम्पात बिन्दु से लम्बरेखा इष्टान्त्या है, ग्रहोपरिगत ध्रुवप्रोतवृत्त और नाड़ीवृत्त के सम्पात बिन्दु से निरक्षोर्ध्वाधर सूत्र के ऊपर लम्बरेखा नतकालज्या है, नतकालज्या मूल से निरक्षखस्वस्तिक पर्यन्त नतोत्क्रमज्या है। अन्त्या में नतोत्क्रमज्या को घटाने से इष्टान्त्या होती है तब अनुपात करते हैं यदि त्रिज्या में इष्टान्त्या पाते हैं तो द्युज्या में क्या इस अनुपात से इष्टहृति आती है,

$\frac{\text{इष्टान्त्या} \cdot \text{द्यु}}{\text{त्रि}} = \frac{(\text{अन्त्या} - \text{नतोत्क्रमज्या})\text{द्यु}}{\text{त्रि}} = \frac{\text{अन्त्या} \cdot \text{द्यु}}{\text{त्रि}} - \frac{\text{नतोत्क्रमज्या} \cdot \text{द्यु}}{\text{त्रि}} = \text{हृति} - \frac{\text{नतोत्क्रमज्या} \cdot \text{द्यु}}{\text{त्रि}}$

$=$ इष्टहृति, इससे आचार्योक्त उपपन्न हुआ। सिद्धान्तशेखर में 'नतोत्क्रमज्या गुणिता भ्रमेण इत्यादि' से श्रीपति-आचार्योक्तानुरूप ही कहते हैं इति ।।३६।।

इदानीं प्रकारान्तरेणेष्टान्त्यां छायानयनभेदांश्चाह

अन्त्या नतोत्क्रमज्या हीना ज्याषट् पृथक् छेदः ।
ज्याभ्यां च सह फलानि छायानयनानि षट्त्रिंशत् ।।३७।।

वा. भा.—येयमनन्तरमेवानीतांत्या सा घटिकानामुत्क्रमजीवया हीनास्त्रिज्या भवति। तया छायानयनानि प्राग्वत् । वासनाप्यत्र द्युदलांत्यज्यसूत्रे प्रदर्श्य छेदवशतः संख्यां कृत्वा वानयोर्भेदो न संस्थानः कृतः एवं द्युदलादेकैकस्याच्च भेदात् । षट्-षट्छायानयनं पृथक्-पृथक् अतएव वीक्ष्याचार्येण कृता । तद्वैवात्तं उन्नतघटिकाभिः क्रमज्ययाष्टादशछायानयनानि । तथा नतघटिकाभिः (क) क्रमज्यान्त्यावष्टादशछायानयनान्येव षट्त्रिंशत्कुर्वन्ति । तद्यथा उन्नतकालाद्नत-

शेषाल्पाह्ना इत्यादिना एकश्छेदो जीवा। क्षयवृद्धिज्यायुतहीना ज्येत्यादिना द्वितीयछेद तथानेनै व सूत्रेणैका ज्या। अथ नतकालात् द्युदलान्नतोत्क्रमज्यामित्यादिना एकश्छेदः अन्त्या नतोत्क्रमज्याहीना ज्येत्यादिना प्राग्वदेनां स्वाहोरात्रहतां व्यासार्धेन विभजेत्। फलं द्वितीयछेदो भवत्येवं द्वाभ्यां ज्याभ्यां सह षट्छेदा इति। अथ छायानयनानि प्रदर्श्यन्ते। तद्यथा छेदोऽवलम्बकगुण इत्यादिना एकः शंक्वानयनप्रकारः विषुवत्कर्णविभक्तछेदो वा द्वादशाहतः शंकुरिति द्वितीयं एवं शंक्वानयनद्वयं व्यासार्धं छेदहतमित्यादिना एकछायानयनप्रकारः। एवं शंकुद्वयेन कर्णचतुष्टयेन षट्छायानयनानि। एकस्माद् द्वितीयादप्यन्यानि षडेवैवं द्वादश भवन्ति। तथा ज्यातो ज्या स्वाहोरात्रार्धघातहृतेत्यादिनैकः कर्णः गुणो वा घातहृतेत्यादिनैकः कर्णः गुणो वा घात इत्यादिनैकः शंकुर्वातो वार्कगुण इत्यादिना द्वितीयः शंकुः पुनरनेन शंकुद्वयेन गुणितं वा द्वादशभिर्व्यासार्धमित्यादिना छायाकारद्वयं भक्ता ज्ययाथवेत्यादिना चतुर्थः कर्णः, एवं ज्यातश्चत्वारः कर्णाः। द्वौ शंकू एभि षड्भिः षड्छायानयनानि एवं छेदानि तै द्वादशभिः सहाष्टादशछायानयनानि भवन्ति। उन्नतघटिकाभिर्नतघटिकाभिरप्यष्टादशैव। छेदज्यानां तुल्यत्वादेवं षट्त्रिंशद्वाचार्येणोपवेशिता अन्यथापि कल्पयितुं शक्यते। परमार्थतया च नतोन्नतघटिकानां क्रमोत्क्रमज्ये एव कारणमत्र। प्रथमस्तु छायाक्षेत्राणां प्रदर्शनायोन्मंडलक्षितिजांतरस्थे रवौ ज्याछेदो तौ छेदसंख्यात पतितौ न भवतो यत उन्नतघटिकाभिरानयनं प्राग्वदेव तयो सिद्धं विपरीतशोधनं चोन्मंडलादधःस्थितत्वाद्रवेर्गणितवासनया युज्यते एव। एवाघोमुखी यतस्तदा क्रमज्या। अतोऽयमेवार्थं आचार्येण सूत्रितो बालयुक्त्या। तेनोत्क्रमल्पप्रश्नभूतां वा यदि बहवश्च रदलासव इत्यादिकमार्यासूत्रं गोले प्रदर्शयेत्। स्वाहोरात्रदृक्मंडलयोरिति गतशेषनता घटिकाछायातो यो वेत्तीत्यस्य प्रश्नस्योत्तरमार्यात्रयेणाह ॥३७॥

वि० भा.—नतकालोत्क्रमज्यया हीनाऽन्त्या ज्या (इष्टान्त्या) भवतीत्येवं द्वाभ्यामन्त्येष्टान्त्याभ्यां सह छेदः (इष्टहृतिः) पृथक् षट् अर्थात् छेदस्य चत्वारः प्रकारा अन्त्यायाश्च प्रकारद्वयम्। जीवा क्षयवृद्धिज्यायुतहीनेत्यनेनैकः प्रकारः। अन्त्या नतोत्क्रमज्याहीना ज्येत्यनेन द्वितीयः प्रकारः। एवमिष्टान्त्यायाः प्रकारद्वयम्। द्वाभ्यामिष्टान्त्याभ्यां 'ज्या स्वाहोरात्रार्धगुणा व्यासार्धविभाजिताऽथवा छेदः' अनेनेष्टहृतेः प्रकारद्वयम्। ऊनाधिकस्य जीवा स्वाहोरात्रार्धसङ्गुणितेत्यनेन छेदस्यैकः प्रकारः। 'द्युदलान्नतोत्क्रमज्या' मित्यादिना द्वितीयः प्रकारः। एवमन्येष्टान्त्यया द्वाविष्टहृतेश्चत्वारो मलोनेन षड् भवन्ति 'छेदोऽवलम्बकगुणः' अनेन 'विषुवत्कर्णविभक्तश्छेदो वा' इत्यनेन शङ्कोः प्रकारद्वयम्। व्यासार्धं छेदहृतमित्यनेनच्छायाकर्णानयनस्यैकः। इच्छा द्वादशगुणितेत्यनेन द्वाभ्यां शङ्कुभ्यां छायायाः प्रकारद्वयम्। गुणितं वा द्वादशभिरित्यनेन द्वाभ्यां शङ्कुभ्यां छायाकर्णानयने प्रकारद्वयम्। छेदहृता द्युदलान्त्या दिनार्धकर्णेत्यादिना छेदतश्छायाकर्णानयने एकः प्रकारः। एवं छेदतश्छायाकर्णानयने प्रकारचतुष्टयम्। कर्णाच्छेदः शंकोश्च

द्वादशवर्गमित्यनेन कर्णतश्छायानयने प्रकारचतुष्कम् । छेदजन्यशङ्कुतः प्रकारद्वयं सिद्धमेव तेनात्र छेदतश्छायानयने षट् प्रकाराः । ज्या स्वाहोरात्रार्धघातहृतेत्यादिनैकः प्रकारः कर्णवशतः लम्बगुणो वा घातः शङ्कुरित्यादिना शङ्कुतो 'दृग्ज्या द्वादशगुणिते' त्यनेन 'गुणितं वा द्वादशभि' रित्यादिना च प्रकारद्वयम् । घातो वाऽर्कगुण इत्यादिना शङ्कुतः पुनः पूर्ववत् प्रकारद्वयम् । भक्ता ज्ययाऽथवान्त्यादिनार्धकर्णाहृता कर्ण इत्यादिना कर्णत एकः प्रकारः । इष्टान्त्यायाश्छायानयनेऽपि प्रकारषट्कम् । पूर्वमिष्टहृतेश्चत्वारो भेदा इष्टान्त्याया द्वौ भेदाविति षड्भेदा येभ्यश्छायानयने षट्त्रिंशदानयनानि भवन्तीति ।।३७।।

अत्रोपपत्तिः

क्षितिजाहोरात्रवृत्तयोः सम्पातोपरिगतं ध्रुवप्रोतवृत्तं नाड़ीवृत्ते उत्तरगोले पूर्वस्वस्तिकादधो दक्षिणगोले चोपरि लगति तद्बिन्दुभ्यां पूर्वापरसूत्रस्य समानान्तरे रेखे कार्ये तदुपरीष्टस्थानस्थितग्रहोपरिगतध्रुवप्रोतवृत्तनाड़ीवृत्तयोः सम्पाताल्लम्बरेखे गोलयोरिष्टान्त्ये। मध्यान्हकाले ग्रहो याम्योत्तरवृत्ते भवति तेन ग्रहोपरि ध्रुवप्रोतवृत्तं याम्योत्तरवृत्तमेव तस्य नाड़ीवृत्तस्य च सम्पातो निरक्षखस्वस्तिकम् । समानान्तररेखयोरुपरि निरक्षखस्वस्तिका लम्बरेखे गोलयोरन्त्ये । इष्टस्थानस्थग्रहोपरिध्रुवप्रोतवृत्तनाड़ीवृत्तयोः सम्पातान्निरक्षोर्ध्वाधररेखोपरिलम्बो नतकालज्या, तन्मूलान्निरक्षखस्वस्तिकं यावन्नतकालोत्क्रमज्या, निरक्षखस्वस्तिकात् समानान्तररेखां यावन्निरक्षोर्ध्वाधररेखाखण्डमन्त्याऽस्ति, नतकालज्यामूलात् समानान्तररेखां यावन्निरक्षोर्ध्वाधररेखाखण्डमिष्टान्त्या तुल्याऽस्ति, अन्त्यायां यदि नतकालोत्क्रमज्या विशोध्यते तदा सैवे(नतकालज्यामूलात्समानान्तररेखां यावन्निरक्षोर्ध्वाधररेखाखण्ड) ष्टान्त्या भवतीति गोले स्फुटमेवावलोक्यत इति सिद्धान्तशिरोमणा 'नतोत्क्रमज्या शर इत्यनेन हीनाऽन्त्यका वा ऽभिमतान्त्यका स्यात्' वित्यनेनाऽऽचार्योक्तानुरूपमेव कथ्यत इति ॥३७॥

अब प्रकारान्तर से इष्टान्त्या को और छायानयन भेदों को कहते हैं

हि. भा.—अन्त्या में नतकाल की उत्क्रमज्या को घटाने से इष्टान्त्या होती है, अन्त्या और इष्टान्त्या के साथ इष्टहृति पृथक् छः प्रकार की होती है; अर्थात् छेद(इष्टहृति) के चार प्रकार और अन्त्या के दो प्रकार, 'जीवा क्षयवृद्धिज्या युत हीना' इस से एक प्रकार, 'अन्त्या नतोत्क्रमज्या हीना ज्या' इस से द्वितीय प्रकार, इस तरह इष्टान्त्या के दो प्रकार, दोनों इष्टान्त्याओं से 'ज्या स्वाहोरात्रार्धगुणा व्यासार्धविभाजिताऽथवा छेदः' इस से इष्टहृति के दो प्रकार 'ऊनाधिकस्य जीवा स्वाहोरात्रार्धसंगुणिता' इस से छेद का एक प्रकार, 'चरदलान्नतोत्क्रमज्या' इत्यादि से द्वितीय प्रकार, इस तरह इष्टान्त्या के दो और इष्टहृति के चार जिनके योग से छः होते हैं । 'छेदोऽवलम्बकगुणः' इस से तथा विषुवत्कर्णविभक्तश्छेदो वा इस से शङ्कु के दो प्रकार, व्यासार्धं छेदहृतं इस से छायाकर्णानयन का एक प्रकार, दृग्ज्या द्वादश-

गुणिता' इस से दोनों शङ्कुओं से छाया के दो प्रकार 'गुणितं वा द्वादशभिः' इन दोनों शङ्कुओं से छायाकर्णानयन के दो प्रकार, 'छेदहृता द्युदलान्त्या दिनार्धकर्णेन' इत्यादि से छेद से छाया-कर्णानयन का एक प्रकार, इस तरह छेद से छायाकर्णानयन में चार प्रकार, 'कर्णकृतेः संशोध्य द्वादशवर्ग' इससे छायाकर्ण से छायानयन में चार प्रकार, छेदजनितशङ्कु से दो प्रकार सिद्ध ही हैं। इसलिये छेद से छायानयन में छः प्रकार हुये, 'ज्या स्वाहोरात्रार्धघातहृता' इत्यादि से कर्णवश एक प्रकार, 'लम्बगुणो वा घातः शङ्कुः' इत्यादि से शङ्कु से दृग्ज्या 'द्वादश गुणिता' इससे 'गुणितं वा द्वादशभिः' इत्यादि से भी दो प्रकार, 'घातोवाऽर्क गुण' इत्यादि से शङ्कु वश पुनः पूर्ववत् दो प्रकार, भक्ता ज्ययाऽथवान्त्या दिनार्धकर्णाहिता कर्ण' इत्यादि से कर्ण -वश एक प्रकार, इष्टान्त्या से छायानयन में दो प्रकार, पहले इष्टहृति के चार भेद और इष्टान्त्या के दो भेद ये दोनों मिलकर छः भेद होते हैं जिन से छायानयन में छत्तीश ३६ आनयन होते हैं इति ॥३७॥

उपपत्ति

क्षितिजाहोरात्रवृत्त के सम्पातोपरिगत ध्रुवप्रोतवृत्त नाड़ीवृत्त में उत्तर गोल में पूर्वस्वस्तिक से नीचा और दक्षिणगोल में पूर्वस्वस्तिक से ऊपर लगता है उन दोनों बिन्दुओं से पूर्वापर सूत्र की समानान्तर रेखाद्वय करना उनके ऊपर इष्ट स्थानस्थित ग्रह के ऊपर ध्रुव-प्रोतवृत्त और नाड़ीवृत्त के सम्पात बिन्दु से लम्ब रेखाद्वय दोनों गोलों में इष्टान्त्या होती है, मध्याह्नकाल में ग्रह याम्योत्तरवृत्त में रहते हैं इसलिये ग्रहोपरिगतध्रुवप्रोतवृत्त (याम्यो-त्तरवृत्त) और नाड़ीवृत्त के सम्पात बिन्दु (निरक्ष खस्वस्तिक) से समानान्तर रेखाद्वय के ऊपर लम्बरेखा गोलद्वय में अन्त्या होती है, इष्टस्थानस्थग्रहोपरिगतध्रुवप्रोतवृत्त और नाड़ीवृत्त के सम्पात बिन्दु से निरक्षोर्ध्वाधर रेखा के ऊपर लम्ब रेखा नतकालज्या है, उसके मूल से निरक्ष खस्वस्तिक पर्यन्त नतकाल की उत्क्रमज्या है, निरक्ष खस्वस्तिक से समानान्तर रेखापर्यन्त निरक्षोर्ध्वाधर रेखा का खण्ड अन्त्या है, नतकालज्या मूल से समानान्तर रेखापर्यन्त निरक्षोर्ध्वाधर रेखा खण्ड इष्टान्त्या के बराबर है, अन्त्या में यदि नतकाल की उत्क्रमज्या को घटाते हैं तो नतकालज्या मूल से समानान्तर रेखा पर्यन्त निरक्षोर्ध्वाधर रेखाखण्ड (इष्टान्त्या) होता है ये सब बातें गोल के ऊपर स्पष्ट देखने में आती हैं, सिद्धान्तशिरोमणि में भास्कराचार्य 'नतोत्क्रमज्या खर इत्यनेन' इत्यादि से आचार्योक्त के अनुरूप ही कहते हैं इति ॥३७॥

इदानीमुन्नतकालं नतकालं चाह

छायाकर्णविभक्ता विषुवत्कर्णेन सङ्गुणा त्रिज्या।
लब्धं सौम्येतरयोः क्षितिज्यया हीनसंयुक्तम् ॥३८॥

गुणितं व्यासार्धेन स्वाहोरात्रार्धभक्तलब्धधनुः।
उत्तरगोले युक्तं याम्ये हीनं चरप्राणैः ॥३९॥

दिनगतशेषप्राणाः प्रागपरदिनार्धयोर्विशोध्याप्तम् ।
व्यासार्धात् शेषोत्क्रमजीवाचापं नतप्राणाः ॥४०॥

वा. भा.—इष्टदिने इष्टकाले यां छायामुद्दिश्य कश्चित्कालं पृच्छति तस्मात्कालिकश्छायाकर्णः कार्यः ततस्तेन छायाकर्णेन विषुवत्कर्णहतां त्रिज्यां विभजेत् । लब्धं छेदो भवति । याम्योत्तरगोलयोर्यथासंख्यं क्षितिज्यया हीनं संयुतं कृत्वा व्यासार्धेन गुणयेत् । ततः स्वाहोरात्रार्धेन विभजेत् । लभ्यते तस्य प्रसंज्ञा तस्य च चापं कृत्वा चरदलप्राणेभ्यो विशोधयेत् । शेषप्राणा दिनगतशेषा भवन्ति । एवं दिनगतशेषानयनमथ नतकालानयनं विशोध्याप्तं व्यासात् । यद्याप्त-संज्ञात् त्रिज्यातो विशोधयेत् । शेषा प्राणा दिनगता शेषा भवन्ति । एवं दिनगतशेषा-नयनमथनतकालानयनं विशोध्याप्ताद् व्यासार्धात् तदाप्तसंज्ञां तत्त्रिज्यातो विशोध्य शेषस्योत्क्रमज्याद्यैश्चापं कार्यं तत्र या लिप्ताः तावती प्राणा भवन्ति । अत्रापि यद्विपरीतशोधने आप्तमानीतं तत् व्यासार्धे योजयेत् । तदुत्क्रमज्या वा क्रमज्याभिरुक्तवत्कार्यम् । तल्लिप्तासंख्या नतप्राणा भवन्त्यत्र वासना, यथाकाला-च्छायानयनं प्राग्वत्प्रदर्शितमेवं छायातो वैपरीत्येन कालानयनं सिद्धमथानेनार्यात्र-येण प्रदर्श्यंते । तद्यथा भूमध्याद्रविपृच्छाया कर्णस्य द्वादशकोटेर्विषुवत्कर्णः कर्णः इष्टशंकुकोटे इत्येवं स्थिते प्रथमे द्वादशको गुणकारो द्वितीये भागहारस्तुल्यत्वा-न्नाशे कृते छायाकर्णहता विषुवत्कर्णेन संगुण्य त्रिज्यालब्धं यत्र छेदो त्रिज्यया-हीनमुत्तरगोले दक्षिणे युक्तं क्रियते । येनोन्मंडलार्कान्तिरज्या स्वाहोरात्रनिष्पन्ना भवति तस्या व्यासार्धवृत्तपरिणमने त्रैराशिकमेवं गुणितं व्यासार्धेन स्वाहोरात्रार्ध-भक्तमिति ततो यल्लब्धं तज्ज्यारूपं व्यासार्धपरिणतं रव्युन्मंडलान्तरं तच्च चापरूपं तदेवान्तरं स्वाहोरात्रपृष्ठे भवति ।

तदुत्तरगोले चरप्राणैरुपचीयते । स्वक्षितिजस्याधः स्थितत्वात् । दक्षिणगोले न्यथा तेनोक्तमुत्तरगोले युक्तं याम्ये हीनं चरप्राणैर्दिनगतप्राणा दिनार्धयोः प्राग-परयोरिति । यत्रः पुनश्छेदः क्षितिज्ययाऽप्यल्पो भवति । तत्रोन्मंडलक्षितिजांतरे रविर्वर्तते । छेदश्च क्षितिजादुपरि रविं यावत् अतस्तत्र विशोध्य क्षितिज्यातः शेषं क्षितिज्यायाः खंडं रव्युन्मंडलान्तरस्थं भवति । तद्व्यासार्धे परिणामं कृत्वा यावच्चापं क्रियते । तावदुन्मंडलार्कयोरन्तरे स्वाहोरात्रवृत्तप्राणा भवन्ति । तांश्चरदलप्राणेभ्यो विशोध्य दिनगताः शेषा वा प्राणा भवन्ति । यत उन्मंडल-क्षितिजमंडलयोरंतरं चरदलप्राणाः अत उपपन्नं दिनगतशेषानयनं । अथ नतकाला-नयने वासना यत्तदाप्तसंज्ञातुल्यमवशिष्यते । यत्तदर्कोपलक्षितात्स्वाहोरात्रवृत्त-प्रदर्शनपूर्वापरायतं सूत्रं प्राग्वत् । खुदलान्नतोत्क्रमज्यामित्यस्य सूत्रस्य वासनाया-स्तत्सूत्रपरिच्छिन्नस्य धनुषो यः शरः स भवतीत्यर्थः तस्य ज्याखंडस्य यावदुत्क्रमेण चापलिप्तानीयन्ते तावद् दिनदलं विवस्वत उत्तरं प्राणा भवन्तीत्युपपन्नं यदाप्तं

विपरीतशोधनेन तद्युन्मंडलादवस्तदर्कान्तरज्या तेन व्यासार्धे योज्यते । येन पूर्वापरा-यतसूत्रावच्छिन्नस्य धनुषः शरो भवति । शरोत्क्रमचापेनावनताः प्राणाः प्राक्त्रिज्या-ज्यातोऽधिकाया ततो उत्क्रमज्याया क्रमेण चापमतः क्रियते । यत उन्मंडलमारभ्याहोरात्रवृत्तस्योभयतोऽपि तुल्यमवशिष्टम् । तं याम्योत्तरमंडलं यावत्तत्र च नतभावः तस्मात्सर्वमुपपन्नम् । गोले छायानयनं क्षेत्रेषु वैपरीत्येन योजयेत् क्रमोत्क्रमाभ्या-मिति । एवं छेदेन यच्छायानयनं प्रागुक्तं तद्वैपरीत्यान्नतोन्नतकालानयनमभिधायेदानीं ज्याया यच्छायानयनं तद्वैपरीत्येन नतोन्नतकालानयनार्थमार्यात्रयमाह ॥३८-३९-४०॥

वि. भा.—त्रिज्या विषुवत्कर्णेन (पलकर्णेन) गुणिता, छायाकर्णविभक्ता लब्धं सौम्येतरयोः (उत्तरदक्षिणगोलयोः) क्षितिज्यया (कुज्यया) हीनं युक्तं, व्यासार्धेन (त्रिज्यया) गुणितं स्वाहोरात्रार्धेन (द्युज्यया) भक्तं यल्लब्धं तस्य धनुः (चापम्) उत्तरगोले चरप्राणैः (चरासुभिः) युक्तं, याम्ये (दक्षिणगोले) हीनं प्रागपरदिनार्धयोः (पूर्वापरकपालयोः) दिनगतशेषप्राणाः (उन्नतासवः) भवन्ति, आप्तं (सूत्रं) व्यासार्धात् (त्रिज्यातः) विशोध्य शेषं नतकालोत्क्रमज्या, उत्क्रमज्याखण्डैस्तच्चापं पूर्वापरकपालयोर्नतप्राणाः (नतासवः) भवन्तीति ॥३८-३९-४०॥

अत्रोपपत्तिः

अथ $\frac{\text{त्रि}\cdot\text{१२}}{\text{इछाक}}$ = इष्टशङ्कु, ततोऽनुपातेनेष्टहृतिः $=\frac{\text{पक}\cdot\text{इशं}}{\text{१२}}=\frac{\text{पक}}{\text{१२}}\cdot$

$\frac{\text{त्रि}\cdot\text{१२}}{\text{इछाक}}=\frac{\text{पक}\cdot\text{त्रि}}{\text{इछाक}}$, उत्तरदक्षिणगोलयोरिष्टहृतौ कुज्याया विशोधनेन योजने च

कला भवति, सा त्रिज्यया गुणिता द्युज्यया भक्ता तदा सूत्रं भवति, तच्चापमुन्मण्डलादुन्नतकालस्तत्र चरसंस्कारेण पूर्वापरकपालयोः स्वदेश उन्नतकाल एव दिनगतशेषप्राणाः । आप्तं (सूत्रं) नतकालकोटिज्यासमं त्रिज्यातः शोध्यं तदा नतकालोत्क्रमज्या भवेत् । उत्क्रमज्याखण्डैस्तच्चापं पूर्वापरकपलयोर्नतप्राणा भवन्तीति ॥३८-३९-४०॥

अब उन्नत काल को और नतकाल को कहते हैं

हि. भा.—त्रिज्या को पलकर्ण से गुणा कर छायाकर्ण से भाग देने से जो फल होता है उसमें उत्तर और दक्षिण गोल में क्रम से कुज्या को घटाने और जोड़ने से जो फल होता है उसको त्रिज्या से गुणा कर द्युज्या से भाग देने से जो फल होता है उसके चाप में उत्तर गोल में चरासु जोड़ने से और दक्षिण गोल में हीन करने से पूर्वकपाल और पश्चिम कपाल में दिनगत काल और दिनशेषकाल होता है, पूर्वानीतफल (सूत्र) को त्रिज्या में घटाकर

जो शेष रहता है वह नतकालोत्क्रमज्या है, उत्क्रमज्याखण्डों से उसके चाप पूर्वकपाल में और पश्चिमकपाल में नतासु होते हैं इति ॥३८-३९-४०॥

उपपत्ति

$\frac{त्रि \cdot १२}{इछाक}$ = इशङ्कु, अक्षक्षेत्रानुपात से इष्टहृति = $\frac{पक \cdot इशं}{१२} = \frac{पक}{१२}$.

$\frac{त्रि.१२}{इछाक} = \frac{पक.त्रि}{इछाक}$, उत्तर गोल में और दक्षिण गोल में इष्टहृति में कुज्या को घटाने से और जोड़ने से कला होती है, उसको त्रिज्या से गुणाकर द्युज्या से भाग देने से सूत्र होता है, उसका चाप उन्मण्डल से उन्नतकाल होता है, उसमें चर संस्कार करने से पूर्वकपाल और पश्चिम कपाल में स्वदेश में उन्नतकाल होता है, पूर्वागत सूत्र (नतकाल कोटिज्या) को त्रिज्या में घटाने से नतकाल की उत्क्रमज्या होती है, उत्क्रमज्या खण्डों से उसका चाप पूर्वकपाल में और पश्चिम कपाल में नतासु प्रमाण होता है इति ॥३८-३९-४०॥

इदानीं प्रकारान्तरेणोन्नतकालं नतकालं चाह

स्वाहोरात्रार्धेन छायाकर्णेन भक्तायाः ।
विषुवत्कर्णगुणाया व्यासार्धकृतेः फलं सौम्ये ॥४१॥

क्षयवृद्धिज्याहीनं युक्तं याम्ये धनुश्चरप्राणैः ।
सौम्ये युतं विहीनं याम्ये प्रागपरयोः प्राणाः ॥४२॥

अह्नो गतावशेषाः फलमन्त्याया विशोध्य शेषस्य ।
धनुरुत्क्रमजीवाभिः पूर्वापरयोर्नत प्राणाः ॥४३॥

वा. भा.—यस्याश्छायाया दिनगतशेषानयनमिष्यते तस्याश्छायायाः छायाकर्णं कृत्वा तेन स्वाहोरात्रार्द्धं गुणयेत् । ततस्तेन स्वाहोरात्रार्धेन छायाकर्णहतेन भक्ताया कस्या व्यासार्धकृतेः किं भूतया विषुवत्कर्णगुणायाः फलं ज्या भवति । तत्फलं सौम्ये गोले क्षयवृद्धिज्याहीनं याम्ये तयैव युक्तं कृत्वा यद्भवति । तस्य धनुः क्रमेण कार्यं स्तद्धनुस्तद्दैवसिकचरदलप्राणैः सौम्ये गोलेषु युतं याम्यैर्हीनं कृत्वा प्रागपरयोः प्राणा भवन्ति । अह्नो गतावशेषं यथासंख्यमथोत्तरगोले क्षयवृद्धिज्या कलान्न शुध्यति । तद्विपरीतशोधनेन यच्चापं तच्चरदलाद्विशोध्य गता शेषा प्राणा भवन्ति एवमुन्नतकालानयनम् । अथ नतकालानयनं फलमन्त्यामपि विशोध्य यत्फलसंज्ञकं तिष्ठति । तदन्त्याया विशोध्य शेषस्योत्क्रमज्याद्धं धनुः कार्यं तत्र या लिप्ताः तेन प्राणा नता भवन्ति । अथ फलेऽन्त्याया विशोध्य व्यासार्धमधिकमेवावशिष्यते । तदाधिकस्य क्रमज्याधनुस्तं कृत्वा त्रिज्याचापे चतुरभ्यासतत्संस्थे या ज्या नताः

प्राणाः भवन्त्यत्रेयं वासना त्रैराशिकत्रयेण भूमध्या ज्यानयनं तद्यथा यदि छाया-कर्णस्य द्वादशिकाकोटिः तद्व्यासार्धकर्णस्य किमिति फलं बृहच्छंकुः ननो द्वितीयं यदि द्वादशांगुलायाः कोटिः विषुवत्कर्णः तद्बृहच्छंकुकोटेः क इति फल छेदः। ततस्तृतीय यदिग्वाहोरात्रवृत्तेः एव छेदः तद्व्यासार्धवृत्ते कियानिति फलं ज्या भवन्ति। एवं स्थिते प्रथमे द्वादशको गुणकारो द्वितीये भागहारः क्षितिजार्कान्तरस्थितस्य स्वाहोरात्रवृत्तखंडस्य व्यासार्धवृत्तनिष्पन्ना ज्या भवतीत्यर्थः। उत्तरगोले ततः क्षयवृद्धिज्या विशोध्यते। क्षितिजस्याधः स्थितत्वाद् दक्षिणे या ज्या उन्मंडलस्याधः स्थितत्वाद्येनार्कोन्मंडलान्तरज्या भवति। तस्याश्चापं तदन्तरे स्वाहोरात्रवृत्तखंडं तच्चरप्राणैरुत्तरगोले उपचीयते। दक्षिणेऽन्यथा येन क्षितिजात्प्रभृति दिनगता शेषाः प्राणा वा भवन्ति शेषं पूर्ववत्। ननकालानयने यद्यत् फलं सा ज्या तामन्त्यातो विशोध्य शेपज्याखंडं प्राच्यदर्शितपूर्वपरायतसूत्रावच्छिन्नस्य धनुषः शरो भवति। तेनोत्क्रमचापशरानयनवासना प्राग्वद्योज्याः यदा फलक्षयवृद्धिज्या न शुध्यति, तदा विपरीतशोधनादिका वासना प्राग्वत्तत्कालानयने फलमंत्याया विशोध्य यदिव्यासार्धमधिकमवशिष्यते तदपि चापकरणवासना प्राग्वदेवोपपद्यते। यथा-स्थितं सर्वं गोले प्रदर्शयेदिति। इदानीं यदुन्नतकालादंत्यायाश्छायानयनमुक्तं तद्वैपरीत्येन नतकालानयनमार्ययाह ॥४१-४२-४३॥

वि. भा.—विषुवत्कर्णगुणाया (पलकर्णगुणितायाः) व्यासार्धकृतेः स्वाहो-रात्रार्धेन (द्युज्यया) छायाकर्णेन च भक्तायाः फलं ग्राह्यं तत् सौम्ये गोले (उत्तरगोले) क्षयवृद्धिज्यया (चरज्यया) हीनं, याम्ये (दक्षिणगोले) युक्तं यद् भवेत्तस्य धनुः (चापं) सौम्ये (उत्तरगोले) चरप्राणैः (चरासुभिः) युतं, याम्ये (दक्षिणगोले) विहीनं तदा प्रागपरयोः (पूर्वापरकपालयोः) अन्हो दिवसस्य गतावशेषाः प्राणाः (उन्नतकालासवः) भवन्ति। फलं (पूर्वागतं) अन्त्यया विशोध्य शेषयोत्क्रमज्याभिः (उत्क्रमज्याखण्डैः) धनुः (चापं) कार्यं तदा पूर्वापर-कपालयोर्नतासवो भवन्तीति ॥४१-४२-४३-॥

अत्रोपपत्तिः

अथेष्टशङ्कुः $= \frac{\text{त्रि}\cdot १२}{\text{इछाक}}$ ततोऽक्षक्षेत्रानुपातेनेष्टहृतिः $= \frac{\text{पक. इशं}}{१२}$

$= \frac{\text{पक}}{१२} \cdot \frac{\text{त्रि}. १२}{\text{इछाक}} = \frac{\text{पक. त्रि}}{\text{इछाक}}$ ततो द्युज्यया यदीष्टहृतिर्लभ्यते तदा

त्रिज्यया किं समागच्छतीष्टान्त्या $= \frac{\text{पक. त्रि. त्रि}}{\text{इछाक. द्यु}} = \frac{\text{पक. त्रि}^2}{\text{इछाक. द्यु}}$ = फलम् तत उत्तर-दक्षिणगोलक्रमेण इष्टान्त्या ∓ चरज्या = सूत्रम्। एतच्चापं = सूत्रचापं, उत्तरदक्षिण-गोलयोः सूत्रचाप ± चरासु = पूर्वापरकपालयोर्दिनगतावशेषाः = उन्नतकालः। तथा

अन्त्या -- फल = अन्त्या — इष्टान्त्या = नतोत्क्रमज्या, अस्या उत्क्रमज्याखण्डैश्चापं कार्यं तदा नतासवो भवन्तीति सिद्धान्तशेखरे "यदि वा पलकर्णताडितायास्त्रिभ-जीवोत्थकृतेर्विभाजितायाः। श्रुतिसङ्गुणितश्रमेण लब्धं चरजीवोनयुतं यथोक्तव-त्तत्" ॥ अथ तस्य धनुश्चरासुयुक्तं रहितं गोलवशाद् गतावशेषाः ! तदन्त्यस्य फलं तद-न्त्यकाया नतमाहुर्विपरीतधन्व यद्वे" त्यनेन श्रीपतिना, सिद्धान्तशिरोमणौ "पल-श्रुतिघ्नस्त्रिगुणस्य वर्गो द्युष्टकर्णाहतिहृदित्यादिना" भास्कराचार्येण चाऽऽचार्योक्ता-नुरूपमेव सर्वमुक्तमिति ॥४१-४२-४३॥

अब प्रकारान्तर से उन्नत काल को और नत काल को कहते हैं

हि. भा — त्रिज्यावर्ग को पलकर्ण वर्ग से गुणाकर द्युज्या और इष्टच्छाया कर्ण के घात से भाग देनें से जो फल होता है उस में उत्तर गोल में चरज्या को घटाने से और दक्षिण गोल में जोड़ने से जो होता है उसके चाप में उत्तर गोल में चरासु को जोड़ने से दक्षिण गोल में घटाने से पूर्व कपाल में और पश्चिम कपाल में दिन के गतासु और दिनशेषासु होता है अर्थात् उन्नत काल होता है, पूर्वागत फल को अन्त्या में घटाकर जो शेष रहता है उत्क्रमज्याखण्डों से उसके चाप करने से पूर्वकपाल में और पश्चिम कपाल में नतासु प्रमाण होता है इति ॥४१-४२-४३॥

उपपत्ति

इष्टशङ्कु $= \frac{\text{त्रि. १२}}{\text{इछाक}}$, अक्षक्षेत्रानुपात से इष्टहृति $= \frac{\text{पक. इशं}}{\text{१२}} = \frac{\text{पक}}{\text{१२}} = \frac{\text{त्रि. १२}}{\text{इछाक}} =$ $\frac{\text{पक. त्रि}}{\text{इछाक}}$ अब अनुपात करते हैं यदि द्युज्या में इष्टहृति पाते हैं तो त्रिज्या में क्या इस अनुपात से इष्टान्त्या आती है । $\frac{\text{पक. त्रि. त्रि}}{\text{इछाक. द्यु}} = \frac{\text{पक. त्रि}^2}{\text{इछाक. द्यु}}$ = इष्टान्त्या = फल, उत्तर गोल और दक्षिणगोल क्रम से इष्टान्त्या ∓ चरज्या = सूत्र, इसका चाप = सूत्रचाप, उत्तर गोल में और दक्षिण गोल में सूत्रचा ± चरासु = पूर्वकपाल में और पश्चिम कपाल में उन्नत काल, तथा अन्त्या — फल = अन्त्या — इष्टान्त्या = नतोत्क्रमज्या उत्क्रमज्याखण्डों से इसके चाप करने से नतासु प्रमाण होता है, सिद्धान्तशेखर में "यदि वा पलकर्णताडिताया-स्त्रिभजीवोत्थकृतेः" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति, तथा "पलश्रु-तिघ्नस्त्रिगुणस्य वर्गो द्युज्येष्टकर्णाहतिहृत्' इत्यादि से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है इति ॥४१-४२-४३॥

इदानीं पुनः प्रकारान्तरेणाह

विषुवत्कर्णगुणान्त्या छायाकर्णोद्धृता फलोनान्त्या ।
तस्योत्क्रमजीवा धनुर्दिनार्धान्नतप्राणाः ॥४४॥

चरदलजीवोनाधिकफलक्रमज्या धनुश्चरार्धेन ।
युतहीनं पूर्वाह्णे दिवसगतं शेषमपराह्णे ॥४५॥

वा॰ भा॰—दिनार्धकर्णेनान्त्यां संगुणय्य छायाकर्णेन विभजेत् । फलं ज्या भवति तामन्त्यातो विशोध्य शेषस्योत्क्रमजीवाभिश्चापं च दिनार्धोन्नता प्राणा भवन्ति । विपरीतशोधनादिविकल्पा प्राग्वत् दिनार्धमित्येव ज्या यतो ज्नो व्यस्त-त्रैराशिकवासनेयं यदि दिनार्द्धे छायाकर्णस्यांत्यातुल्या ज्या तदा पृष्टछायाकर्ण-स्य केति । अतो दिनार्द्धकर्णेन वा संगुणिता छायाकर्णेन विभजेत् । येन फलमिष्टकालिका ज्या भवति । शेषवासना प्राग्वदिति । अर्थात् यथैव यदुन्नतकाल-छायानयनं सुकृतं तद्वैपरीत्येनोन्नतकालानयनार्थमार्यामाह ॥४४॥

चरदलजीवाक्षयवृद्धिज्या तदा फलमुत्तरगोले ऊनं कर्तव्यं दक्षिणे वा युतं तस्य तादृश सत क्रमज्याद्यैश्चापं कार्यं तच्चापं चरदलप्राणैर्युत-मुत्तरगोले कार्यम् । दक्षिणे हीनमेवं कृते या लिप्ताः तत्ते प्राणाः भवन्ति । पूर्वाह्णे यदि प्रश्न तद्दिनगता । अथापराह्णे तद्दिनशेषाः तत्रापि विपरीतशोधनं प्राग्वत् । अत्र फलं ज्योच्यते चरदलजीवाक्षयवृद्धिज्या त्रिज्यावृत्ते तेनात्र वासना क्षिति-जार्कांतरस्थेन स्वाहोरात्रखण्डेन योज्या पूर्वप्रदर्शितछायाक्षेत्रमिति । अथ यत्र-क्षितिजोन्मंडलांतरे रविर्वर्तते । तत्र नतिघटिकाभ्यः छायानयने छायातश्च नति-घटिकानयने यद्विशेषकर्म तदार्ययाह ॥४५॥

वि. भा.— अन्त्या दिनदलकर्णगुणा (दिनार्धच्छायाकर्णगुणिता) छायाकर्ण-भक्ता फलेन हीनाऽन्त्या यच्छेषं तस्योत्क्रमज्याखण्डैश्चापं कार्यं तदा दिनार्धात् नतासवो भवन्ति । चरदलजीवया हीनं युतं च फलं यद् भवति तस्य क्रमज्याखण्डै-श्चापं कार्यं चरार्धेन युतहीनं तदा पूर्वाह्णे दिनगतमपराह्णे दिवसशेषं भवतीति ॥ ४ ४५॥

अत्रोपपत्तिः

दिनार्धशङ्कुः $=\dfrac{\text{त्रि. १२}}{\text{दिना।र्धक}}$, इष्टशङ्कुः $=\dfrac{\text{त्रि. १२}}{\text{इछा।क}}$ ततोऽनुपातो यदि

दिनार्धशङ्कुना हृतिर्लभ्यते तदाऽभीष्टशङ्कुना किं समागच्छतीष्टहृतिः

$$=\frac{\text{हृति. इशं}}{\text{दिना।र्धशं}}=\frac{\text{हृति. त्रि. १२. दिना।र्धक}}{\text{त्रि. १२. इछा।क}}=\frac{\text{हृति· दिनार्धक}}{\text{इछा।क}}$$

ततोऽनुपातेनेष्टान्त्या $=\dfrac{\text{इहृति· त्रि}}{\text{द्यु}}=\dfrac{\text{हृति. दिनार्धक. त्रि}}{\text{द्यु. इछाक}}$

$= \frac{\text{अन्त्या. दिनार्धक}}{\text{इच्छाक}} =$ फलम् । ततः अन्त्या — फल = अन्त्या — इष्टान्त्या = नतोत्क्रमज्या, एतस्या उत्क्रमज्याखण्डैश्चापं कार्यं तदा नतासवो भवन्ति.। उत्तर-दक्षिणगोलक्रमेण इष्टान्त्या ∓ चरज्या = सूत्रम्, अस्य चापं चरार्धेन युतं हीनं तदा दिनगतं दिनशेषं च भवतीति, सिद्धान्तशेखरे "अन्त्यां दिनार्धश्रवणेन हत्वा भजेत् स्वकर्णेन फलोनितान्त्या। शेषस्य धन्वोत्क्रमशिञ्जिनीभिर्नता दिनार्धादथवाऽसवः स्युः" इत्यनेन श्रीपतिना, 'दिनार्धकर्णादथवाऽन्त्यकाघ्नात् इत्यादिना भास्कराचार्येण चाऽऽचार्योक्तानुरूपमेवोक्तमिति ॥४४-४५॥

अब पुनः प्रकारान्तर से कहते हैं

हि. भा.—अन्त्या को दिनार्ध कर्ण से गुणा कर इष्ट छायाकर्ण से भाग देने से जो फल होता है उसको अन्त्या में घटाने से जो शेष रहता है उसका उत्क्रमज्या खण्डों से चाप करने पर नतासु प्रमाण होता है । फल (इष्टान्त्या) में उत्तर और दक्षिण गोलक्रम से चर-ज्या को हीन और युत करने से जो होता है उसका क्रमज्या खण्डों से चाप करना उसमें चरार्ध को जोड़ने और घटाने से पूर्वाह्ण में दिनगत और अपराह्ण में दिनशेष होता है इति ॥४४-४५॥

उपपत्ति

दिर्द्धशं $= \frac{\text{त्रि} \cdot १२}{\text{दिर्द्धक}}$, इष्टशङ्कु $= \frac{\text{त्रि}. १२}{\text{इछाक}}$ अब अनुपात करते हैं यदि दिनार्धशङ्कु में हृति पाते हैं तो इष्टशङ्कु में क्या इससे इष्टहृति आती है,

$\frac{\text{हृति इशं}}{\text{दिर्द्धश}} = \frac{\text{हृति. त्रि. १२. दिर्द्धशं}}{\text{त्रि. १२. इछाक}} = \frac{\text{हृति. दिर्द्धक}}{\text{इछाक}}$ अब इससे इष्टान्त्या

$= \frac{\text{इहृति. त्रि}}{\text{द्यु}} = \frac{\text{हृति} \cdot \text{दिर्द्धक} \cdot \text{त्रि}}{\text{द्यु}. \text{इछाक}} = \frac{\text{अन्त्या. दिर्द्धक}}{\text{इछाक}} =$ फल, अन्त्या — फल = अन्त्या — इष्टान्त्या = नतोत्क्रमज्या, उत्क्रमज्याखण्डों से इसका चाप नतासुमान होता है। उत्तर गोल और दक्षिण गोल क्रम से इष्टान्त्या ∓ चरज्या = सूत्र, इसके चाप में चरासु को जोड़ने और घटाने से दिनगत और दिनशेष होता है, सिद्धान्तशेखर में 'अन्त्यां दिनार्ध-श्रवणेन हत्वा' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति 'दिनार्धकर्णादथवान्त्य-काघ्नादित्यादि से भास्कराचार्य भी आचार्योक्तानुरूप ही कहते हैं इति ॥४४-४५॥

इदानीं नवत्यधिकचापस्योत्क्रमज्यां त्रिज्यातोऽधिकाया उत्क्रमज्यायाश्चापं चाह

उत्क्रमजीवाभ्यधिकक्रमज्यया संयुतं धनुर्धनुषा. ।
व्यस्तविधुद्धो हीनाम्बरासवः पूर्ववच्छेषम्. ॥४६॥

वा. भा.—अभ्यधिकस्य क्रमज्याभ्यधिकक्रमज्या छायानयनेन वा घटिका पंचदशभ्योऽधिका भवन्ति । तासां क्रमज्येत्यर्थः । तया संयुतव्यासार्धं मुत्क्रमजीवा तदा भवतीति यावत् । एवं नतकालानयने धनुषां संयुतं कार्यम् । एतदुक्तं भवति । फलोनाऽन्त्या यदि व्यासार्धादधिका भवति तदधिकक्रमधनुषा व्यासार्धं धनुरधिकं कृत्वोत्क्रमचापं तदाऽयमर्थः सूत्रे सवासनिको व्याख्यायते । अथ तत्रस्थरवेरुन्नतकालानयने तद्विशेषकर्म तदुत्तरार्धेनाह ।

व्यस्तविशुद्धौ हीनाश्चरासवः पूर्ववच्छेषम् । लब्धं सौम्ये क्षितिज्यया हीनमित्युक्तं तत्र च क्षितिज्याधिका भवति । तदा विपरीतसाधनं कृत्वा गुणितं व्यासार्धेन स्वाहोरात्रार्द्धाद् धनुर्यद्भवति तस्य ये प्राणाः तैः सर्वदा हीनाश्चरासवः कार्याः एवं कृते तत्र काले दिनगतकालशेषो भवति । एवमादिष्टं कर्म यत्र यत्र च संभवति तत्र तत्रास्माभिः पूर्वमेव व्याख्यातो वासनया सह । उन्नतकालाच्छायानयने तत्र प्रदेशे यत्कर्म तत्पूर्वमेवोक्तमल्पः, प्रश्नामूनमित्यनयार्ययाचार्येण तथा वासनिको मया व्याख्यातः । पूर्ववच्छेषमिति स मयात्र शेष एव प्रदर्शित इति प्रायः एव छायातः कालानयनमित्यभीष्टदिनदलछायां बहुधार्कक्रान्त्यक्षान्दृष्ट्वा यो वेत्ति इत्यस्य प्रश्नस्योत्तरमार्याचतुष्टयेनाह ॥४६॥

वि. भा.—नवत्यंशकला ५४०० भ्यो यावन्तः कला अभ्यधिकास्तासां क्रमज्यया युतं व्यासार्धं (त्रिज्या) नवत्यंशकलाधिकचापस्योत्क्रमज्या स्यात् । तथा त्रिज्यातो यावदधिकोत्क्रमज्या क्रमज्याखण्डैस्तच्चापं नवत्यंशकलाभ्यां ५४०० युतं तदा चापं भवेत् । उत्तरगोले यदि चरासुभ्य उन्नतकालासवोऽल्पास्तदा व्यस्तविशुद्धिस्तस्यां सत्यां धनुषा (उन्नतकालासुभिः) चरासवो हीनास्तज्ज्या विपरीतं सूत्रसंज्ञं भवेत् । ततः शेषमिष्टहृत्यादिकं पूर्ववज्ज्ञेयं किन्तु धनर्णयोरन्तरमेव योग इति युक्त्या योगे वियोगो विधेयः ॥४६॥

अत्रोपपत्तिः

अत्रोपपत्तिस्तु व्याख्यारूपैव बोध्येति. सिद्धान्तशेखरे "तिथिभ्यो घटीभ्योऽधिकं चेन्नतं स्यात् त्रिजीवाधिकोत्यक्रमज्या समेता । भवेदुत्क्रमज्याऽधिकस्य क्रमोत्थं धनुः खाङ्कभागाधिकं व्यस्तचापम्" श्रीपतिनाप्याचार्योक्तस्यैव स्पष्टीकरणं कृतमिति विज्ञैर्विवेचनीयम् ॥४६॥

अब नवत्यंशाधिक चाप की उत्क्रमज्या को तथा त्रिज्या से अधिक उत्क्रमज्या के चाप को कहते हैं

हि. भा.—नवत्यंशकला ५४०० से जितनी कला अधिक है उसकी क्रमज्या को त्रिज्या में जोड़ने से नवत्यंश कलाधिक चाप की उत्क्रमज्या होती है, तथा त्रिज्या से उत्क्रमज्या

जितनी अधिक है क्रमज्या खण्डों से उसके चाप को नवत्यंशकला में जोड़ने से चाप होता है। उत्तर गोल में यदि चरासु से उन्नत कालासु अल्प हो तो विलोमशोधन होता है अर्थात् चरासु में उन्नत कालासु को घटाने से शेष की ज्या विपरीत सूत्रसंज्ञक होती है, इससे शेष (इष्ट हृति आदि) पूर्ववत् समझना चाहिए, किन्तु धन और ऋण का अन्तर ही योग होता है इस युक्ति से योग में वियोग करना चाहिये इति ॥४६॥

उपपत्ति

उपपत्ति व्याख्यारूप ही समझनी चाहिए, सिद्धान्तशेखर में 'तिथिघ्नो घटीभ्योऽधिकं' इत्यादि संस्कृतोपपत्तियों में लिखित श्लोक से श्रीपति ने आचार्योक्त का ही स्पष्टीकरण किया है इति ॥४६॥

इदानीं दिनार्धोन्नतनतांशसाधनं, दिनार्धच्छायानयनं मध्यच्छायानयनं
इत्यादीनां बहुसाधनत्वञ्चाह

दिनमध्यार्कक्रान्त्यक्षभागयोगान्तरं समान्यदिशोः ।
नतभागा नतभागान्नवतेः प्रोह्योन्नताः शेषाः ॥४७॥

नतभागज्या द्वादशगुणोन्नतांशज्यया हृता लब्धम् ।
इष्टदिनार्धच्छाया यथोक्तकरणैर्दिनार्धाद्वा ॥४८॥

उन्नतजीवाभक्तं व्यासार्धं द्वादशाहृतं कर्णः ।
मध्यच्छायाकर्णं द्वादशकृत्यन्तरपदं वा ॥४९॥

द्युदलान्त्या ज्या छेदो मध्यच्छाया यथोक्तकरणैर्वा ।
अन्त्या ज्या छेदाद्वैमध्यच्छायाऽथवा बहुधा ॥५०॥

वा. भा.—इष्टदिने दिनार्द्धकालिकां स्फुटार्कक्रान्तिज्यां कृत्वा नतभागाः भवन्ति। दिनमध्यार्कक्रान्तिभागास्तेषां स्वाक्षभागैः सहैकदिग्योगं भिन्नदिगन्तरं कृत्वा नतभागाः भवन्ति। तेषां योगे दिग् ज्ञायते। एवं रवियोगे च ये शेषास्तेषां या दिक् सा नतभागानां भवति। ताश्च नवतेः संशोध्य शेषभागा उन्नतभागाः भवन्ति। ततो नतभागानां ज्यां कृत्वा द्वादशभिर्गुणयेदुन्नतभागज्यया विभजेत्। फलमिष्टदिनार्धच्छायांगुलरूपा द्वादशांगुलस्य शंकोरेवं येनैव प्रमाणेन संभववृद्धिदिननतभागज्यागुणितोन्नतांशज्यया विभज्यते तस्यैव दिनार्द्धे वार्धच्छाया भवति। यथोक्तकरणैर्दिनार्धाद्वेति दिनदलप्रमाणिकां परिकल्प्यागतशेषाद्व इत्यादिभिः सूत्रैरुन्नतकालेन बहुधा छायादिनार्द्धाद्वा या भवति। अथवा व्यासार्धं द्वादशहतमुन्नतभागज्यया विभजेत् फलं दिनदलकर्णः कर्णं द्वादशकृत्योरंतरपदं वानेन प्रकारेण मध्यच्छाया भवन्ति। अथवा द्युदलांतज्यामध्याह्ने छेदं परिकल्प्य तत्प्रकारेण मध्यच्छायानयनं कार्यमथवांत्यां दिनार्धज्यां परिकल्प्य ज्यया छेदेन वा ये प्रकाराः उक्ताः तैर्वा मध्यच्छाया कार्या तस्या दक्षिणोत्तरत्वं नतभागवशेन

दक्षिणैरुत्तराभिमुखी सौम्यैश्च दक्षिणमुखी भवति। सा च दक्षिणमुखीभागा चतुर्विंशतेरूनो यत्राक्षस्तत्र संभवतीति। अत्रेयं वासना स्वदेशयाम्योत्तरमंडलावगाहिनिसहस्रकिरणेभ्यो दिनार्द्धं भवति।

स्वाक्षश्च समंडलविषुवन्मंडलयोरंतरं तत्रान्तर्गतविषुवन्मंडलादुत्तरेण सममंडलदक्षिणे च रविर्भवत्यतोऽक्षभागेभ्यः क्रांत्यंशा विशोध्यन्ते। यदा स्वाक्षा-दल्पा नतभागा भवन्ति सममंडलस्यासन्नत्वाद्रवेः यस्मात्सममंडलार्कान्तरे ये भागास्ते नताः दक्षिणेन यदिसममंडलदक्षिणगो रविरथ सममंडलं न प्रविशति तच्च क्रान्तिभागेभ्योऽक्षभागा विशोध्यन्ते। स्वाक्षस्योनत्वादुत्तरायाः क्रान्तेर्यतो विषुवदपमंडलान्तरं क्रान्तिभागेभ्योऽक्षभागाः विशोध्यन्ते। स्वाक्षस्योनत्वा-दुत्तरायाः क्रान्तेर्यतो विषुवतो नतभागाः भवन्ति। दक्षिणगोले च सममंडलाद् दक्षिणेन विषुवन्मंडलं स्वाक्षभागैः ततश्च दक्षिणोत्तररविक्रान्तिभागैः। अतस्तेषां योगः सर्वदा नतभागा भवन्ति। तेनोक्तं दिनमध्यार्कक्रान्त्यक्षभागयोगान्तर-समान्यदिशो नतभागा इति। यदान्तरोत्तराक्रान्तिरक्षभागतुल्या तदा मध्याह्ने शंक्वादीनां छायाभावः सममंडलमध्ये यतो विवस्वान् स्थितस्तदा तत्र नतभागा-तीतः नतभागा स्वेष्टादीनक्षांस्तान्। भागान्नवतेः संशोध्य शेषा उन्नता भवन्ति। यतो दक्षिणक्षितिजादुत्तरक्षितिजाद्वा याम्योत्तरमंडलगत्या सममंडलमध्यं नवतिभागाः। तस्मादुन्नतभागस्तद्वैवसिकाश्चंकभावा भवन्ति। एवं नतभागज्या दृग्ज्याक्षज्यावदुन्नता भागज्या शंकुर्लंबज्यावत्तद्वर्गमूलं कर्णो व्यासार्द्धं सर्वं याम्योत्तर-मंडले गोले प्रदर्शयेत्। सममंडलादुत्तरेण दक्षिणेन वा तत्रैवंस्थिते त्रैराशिकेन छायानयने यद्युन्नतांशज्या शंकोर्नतभागा ज्या छाया तत् द्वादशांगुलस्य शंको केति फलं दिनदलछाया। तेनोक्तं नतभागज्या द्वादशगुणोन्नतांशज्याहृता लब्धमिष्ट-दिनार्द्धछायेत्येवमिष्टशंकुप्रमाणेनापि यथादिनगतशेषादेवं दिनार्द्धतुल्यं गतकालं परिकल्प्य शेषकालेनोक्तवच्छायामानयेत्तदप्युपपद्यते कालत्वात् स्वाहोरात्रवृत्ते वासनाभेद एव अथवा कर्णं त्रैराशिकेन छायानयनं यद्युन्नतज्याशंको व्यासार्द्धं-कर्णः तद्द्वादशांगुलशंको क इति फलं दिनार्द्धछायाकर्णस्तत्कर्णकृते कोटिकृतिं विशोध्य मूलं भुजेति छाया भवति। तथोपपद्यते अथवा द्युदलांत्यज्यासूत्रं प्राक्प्रदर्शितं मध्याह्ने छेदं परिकल्प्य छेदाच्च छायानयनवासनाभिमध्यछाया-नयनं तदपि युज्यते। अथवांत्यां मध्याह्ने ज्यां परिकल्प्य द्युदलांत्यज्यासूत्रे ते मध्यज्याछेदेनोक्तछायानयनातिरिक्तत्वाच्च न्यायतः पतत्यपि युज्यते। तस्मात्सर्व-मुपपन्नं यथास्थितं गोले प्रदर्शयेदिति यथोक्तकरणैर्दिनार्द्धात्स्यान्मध्याह्ने तस्य मूलं शंकस्य प्रपंचार्थमायाहिवमनन्तरोक्तनियमं तस्यातोऽप्यक्रमेण न संक्रामति क्रान्ति-प्रथममंडलसंबंधं यो भागतोऽस्तस्य प्रागुत्तरयाम्योत्तरमंडलम् ॥४७-४८-४९-५०॥

वि. भा.—एकदिक्कयोर्मध्याह्नकालिकरविक्रान्त्यक्षांशयोर्योगो भिन्नदिक-

योस्तयोरन्तरं तदा मध्याह्ने नतांशा भवन्ति, नवतेर्नतांशान् विशोध्य शेषा उन्नतांशा बोध्या इति।।४७।।

अत्रोपपत्तिः

यदि मध्यान्हकाले खस्वस्तिकनिरक्षखस्वस्तिकयोर्मध्ये याम्योत्तरवृत्ते रविस्तदा रवितो निरक्षखस्वस्तिकं यावद्रविक्रान्तिः। खस्वस्तिकनिरक्षखस्वस्तिकयोरन्तरमक्षांशा अत्र द्वयोरन्तरेण विनतांशा रवितः खस्वस्तिकं यावत्। यदि च निरक्षखस्वस्तिकाद् दक्षिणे रविस्तदा रवितो निरक्षखस्वस्तिकं यावत्क्रान्तिः। अत्राक्षांशरविक्रान्त्योः समदिक्कयो (अक्षांशाः सर्वदा दक्षिणा, नाडीवृत्ताद्रविर्दक्षिणेऽस्त्यतः क्रान्तेरपि दिक्दक्षिणा) र्योगेन रविमध्यनतांशा भवन्ति, खस्वस्तिकात्समस्थानं यावन्नवतिरत्र नतांशशोधनेन रवितः समस्थानं यावन्मध्योन्नतांशाः स्युः। सिद्धान्तशेखरे "मध्यन्दिनोष्णकिरणापमचापभागस्वाक्षांशयोगविवरं सदृशान्यदिक्त्वे। याम्योत्तरा नतलवास्तरणेः खमध्यात् तेऽप्युन्नता निपतिता नवतेर्भवेयुरिति" श्रीपत्युक्तं सिद्धान्तशिरोमणौ "पलावलम्बावपमेन संस्कृतौ नतोन्नते ते भवतो दिवादले लवादिकं वा नवतेर्विशोधितं नतं भवेदुन्नतमुन्नतं नतम्" इतिभास्करोक्तञ्चाऽऽचार्योक्तानुरूपमेवेति ।।४७।।

अब मध्याह्नकालिक नतांश और उन्नतांश साधन को कहते हैं

हि॰ भा॰—एक दिशा में रविमध्यक्रान्ति और अक्षांश का योग करने से और भिन्न दिशा में अन्तर करने से रवि का मध्यनतांश होता है, नतांश को नवत्यंश में घटाने से शेष उन्नतांश होता है इति ।।४७।।

उपपत्ति

मध्याह्नकाल में यदि खस्वस्तिक और निरक्षखस्वस्तिक के मध्य में रवि है तब रवि से निरक्ष खस्वस्तिक पर्यन्त रवि की मध्यक्रान्ति उत्तर दिशा को है क्योंकि नाड़ीवृत्त से रवि उत्तर में है, तथा अक्षांश की दिशा सर्वदा दक्षिण है इसलिए भिन्न दिशा की रविक्रान्ति और अक्षांश का अन्तर करने से रवि से खस्वस्तिक पर्यन्त रवि का नतांश होता है, यदि निरक्ष खस्वस्तिक से रवि दक्षिण है, तब अक्षांश और क्रान्ति की दिशा एक ही दक्षिण होने के कारण दोनों का योग करने से नतांश होता है, खस्वस्तिक से समस्थान तक नवत्यंश में नतांश को घटाने से निरक्षखस्वस्तिक से समस्थानपर्यन्त मध्य उन्नतांश होता है, सिद्धान्तशेखर में "मध्यन्दिनोष्णकिरणापमचापभागस्वाक्षांशयोगविवर" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति तथा सिद्धान्तशिरोमणि में "पलावलम्बावपमेन संस्कृतौ" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से भास्कराचार्य ने भी आचार्योक्तानुरूप ही कहा है इति ।।४७।।

वि. भा.—नतभागज्या (नतांशज्या दृग्ज्या) द्वादशगुणिता, उन्नतांशज्यया (शङ्कुना) भक्ता लब्धमिष्टदिनार्धच्छाया भवति, वा दिनार्धात् सकाशाद्यथोक्त-करणैर्दृत्यादिभिर्दिनार्धच्छाया साध्येति ॥४८॥

अत्रोपपत्तिः

दृग्ज्या भुजः । शङ्कुः कोटिः । त्रिज्याकर्णः }
छायाभुजः । द्वादशाङ्गुलशङ्कुः कोटिः । छायाकर्णः कर्णः }

एतयोस्त्रिभुजयोः साजात्यादनुपातः

$\frac{\text{दृग्ज्या}.१२}{\text{शङ्कु}}$=छाया. सिद्धान्तशेखरे 'ना शङ्कुरुन्नतगुणः स च कोटिरुक्ता दृग्ज्या भुजा नतगुणस्तु भवेत् प्रभा च। अर्काप्तवर्तितनरेण हृते च दृग्ज्या त्रिज्ये दले दिनदलोत्थविभा श्रुती च" श्रीपत्युक्तमिति छायासाधनं, सिद्धान्त-शिरोमणौ "दृग्ज्या त्रिजीवे रविसङ्गुणे ते शङ्कूद्धृते भाश्रवणौ भवेताम्" भास्क-रोक्तं छायासाधनञ्चाऽऽचार्योक्तानुरूपमेवेति ॥४८॥

अब इष्ट दिनार्ध में छायानयन को कहते हैं

हि. भा.—नतांशज्या (दृग्ज्या) को बारह से गुणा कर शङ्कु से भाग देने से लब्धि इष्टदिनार्धकालिक छाया होती है, वा दिनार्ध से पूर्वकथितोपकरणों (दृति आदि) से दिनार्धच्छाया साधन करना इति ॥४८॥

उपपत्ति

दृग्ज्या भुज, शङ्कु कोटि, त्रिज्या कर्ण }
छाया भुज, द्वादशाङ्गुलशङ्कु कोटि, छायाकर्ण. कर्ण }

ये दोनों त्रिभुज सजातीय हैं इसलिए अनुपात करते हैं

$\frac{\text{दृग्ज्या}.\ १२}{\text{शङ्कु}}$=छाया, सिद्धान्तशेखर में 'ना शङ्कुरुन्नतगुणः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति तथा सिद्धान्त शिरोमणि में "दृग्ज्या त्रिजीवे" इत्यादि से भास्क-राचार्य ने भी छायासाधन आचार्योक्तानुरूप ही कहा है इति ॥४८॥

वि. भा.—व्यासार्धं (त्रिज्या) द्वादशगुणितं, उन्नतजीवा (मध्यशङ्कु) भक्तं तदा मध्यच्छायाकर्णो, भवेत् । कर्णद्वादशकृत्यन्तरपदं (छायाकर्णद्वादश-वर्गान्तरमूलं) वा (प्रकारान्तरेण) मध्यच्छाया भवेदिति ॥४९॥

अत्रोपपत्तिः

छायाक्षेत्रानुपातेन $\frac{\text{त्रि}\cdot १२}{\text{शङ्कु}}$=छायाकर्ण ततः $\sqrt{\text{छायाक}^2 - १२^2}$ = छाया, इति ॥४६॥

अब प्रकारान्तर से मध्यच्छायानयन को कहते हैं

हि. भा.—त्रिज्या को बारह से गुणा कर मध्यशंकु से भाग देने से मध्यच्छाया कर्ण होता है, छायाकर्ण और द्वादश (१२) क_ वर्गान्तर मूल प्रकारान्तर से मध्यच्छाया होती है इति ॥४६॥

उपपत्ति

पूर्व श्लोक की उपपत्ति में प्रदर्शित छायाक्षेत्रों के सजातीयत्व से अनुपात करते हैं $\frac{\text{त्रि}.१२}{\text{मशंकु}}$=मछायाकर्ण, ∴ $\sqrt{\text{छायाक}^2 - १२^2}$=मध्यच्छाया, इति ॥४६॥

वि. भा.—यथोक्तकरणैः (दिनगतशेषाल्पस्येत्यादिप्रकारैः) मध्यान्हे द्युदलान्त्या (हृतिः), ज्या (इष्टान्त्या) छेदः (इष्टहृतिः) मध्यच्छाया प्रसिद्धा, इति सर्वं वा भवति, अथवा—अन्त्या ज्या छेदाद्यैः (अन्त्येष्टान्त्येष्टहृत्यादिभिः) पूर्वकथितविधिनाऽनेकधा मध्यच्छाया साध्येति ॥५०॥

अत्रोपपत्तिस्तु श्लोकोक्तोपकरणैर्ज्ञेयेति ॥५०॥

अब हृति आदियों के बहुसाधनत्व को कहते हैं

पूर्व कथित उपकरणों (दिनगतशेषाल्पस्य इत्यादि प्रकार से) से मध्यान्हकाल में हृति, इष्टान्त्या, छेद (इष्टहृति) मध्यच्छाया ये सब होते हैं। अथवा अन्त्या, ज्या (इष्टान्त्या) छेद (इष्टहृति) आदि से पूर्व कथित विधि से अनेक प्रकार मध्यच्छाया साधन करना इति ॥५०॥

उपपत्ति

श्लोक में कथित उपकरणों से अनेक प्रकार मध्यच्छायानयन करना चाहिए इति ॥५०॥

इदानीं समशङ्कुसाधनमाह

विषुवत्कर्णेन गुणा विषुवच्छायोद्धृतोत्तरा क्रान्तिः ।
[illegible] शङ्कुः सममण्डलस्थेऽर्के ॥५१॥

वा. भा.— यत्र चोत्तरा क्रान्तिः स्वदेशाक्षज्या ऊना भवति। तद्देशे तदा सममंडलप्रवेशो भवति। तत्प्रवेशकाले च शंक्वानयनार्थं प्रागार्याद्धं तेन यतथः क्रान्तिज्या विषुवत्कर्णगुणा विषुवच्छायाहृता सममंडलप्रवेशो भवेत्। बृहच्छंकु र्भवतीत्यर्थः। अत्र वामनागोले अर्कोदयास्तसूत्रं स्वाहोरात्रवृत्तं च विन्दस्य प्रदर्शयेत् तद्यथा सममंडलमेव तत्र काले दृङ्मण्डलं तस्य स्वाहोरात्रेण सह यत्र संपातः तत्रावलम्बकसूत्रमवलंबते। तच्च भूविनिर्गतप्रागपरायतसूत्रस्पृगेव भवति। तावानेव शंकुः सममंडलप्रवेशकाले स्वदेशप्राच्यपररेखा स्थापितापि तावानेतन्मूलस्य सोदयास्तसूत्रेण सह यावदन्तरं तावच्छंकुतलं तच्चाग्रातुल्यं भवति। अतस्त्रैराशिकद्वयेन समंडलशंक्वानयनमेतत्। यदि लंबककोटेर्व्यासार्धकर्णस्तत्क्रान्तिज्याकोटेः क इति फलमर्काग्रा तावदेव सममंडलप्रदेशकाले शंकुतलं ततो द्वितीयं त्रैराशिकं यदि स्वाक्षज्याशंकुतलस्य लंबकः शंकुस्तदग्रातुल्यशंकुतलस्य कः शंकुरित्येवावलंबकस्थाने द्वादशिकाकोटिः अक्षज्यास्थाने विषुवच्छायाभुजा व्यासार्द्धस्थाने विषुवत्कर्णः। तेन प्रथमत्रैराशिके द्वादशको भागहारो द्वितीये गुणाकारः तुल्यत्वान्नतयोः क्रान्तिज्याया विषुवत्कर्णे गुणाकारो विषुवच्छाया भागहार फलं सममंडलशंकुर्भवति। अथोत्तराक्रान्तिज्याक्षज्यातोऽधिका भवति। सममंडलादुत्तरेणैव मध्याह्नं करोति। तत्रसममंडलप्रदेशाभावो दक्षिणाभिमुखी च दिनार्धछाया। तदाऽक्षज्यातुल्योत्तराक्रान्तिज्या भवति। तदा मध्याह्ने एव सममंडलं प्रदर्शयति रवि तत व्यासार्द्धमंडलशङ्कु अथ दक्षिणक्रान्तिज्या भवति। तदा सममंडलात् दक्षिणेनोदयास्तमयौ तत्र सममंडलेन एव.........इत्येतत्सर्वं गोले प्रदर्शयेत्। स्वाहोरात्रोपमंडलसंपातेषु रव्युपलक्षितं चिह्नं कृत्वा निरक्षदेशे च कदाचिदपि सममंडलप्रदेशोनाशंक्यते विषुवद्दिवसे मुक्ता भगोलस्याक्षोत्तरभावादिति। अथवा प्रकारद्वयेन सममंडलशंक्वानयनार्थमार्यामाह ॥५१॥

वि. भा.—उत्तरा क्रान्तिः (क्रान्तिज्या) यद्यक्षज्याया अल्पा तदा क्रान्तिज्या पलकर्णगुणा पलभया भक्ता तदाऽर्के सममण्डलस्थे शङ्कुः (समशङ्कुः) भवेत् ॥५१॥

अत्रोपपत्तिः

पलभा भुजः। द्वादशकोटिः। पलकर्णः कर्णः इत्यक्षक्षेत्रमेकम्। क्रान्तिज्या भुजः। कुज्योनतद्धृतिः कोटिः। समशङ्कुः कर्ण इति द्वितीयमक्षक्षेत्रमनयोः सजातीयत्वादनुपातः $\frac{\text{पलक·क्रान्तिज्या}}{\text{पलभा}}$=समशङ्कु, यदोत्तराक्रान्तिरक्षांशाल्पा तदैव रवेः सममण्डलप्रवेशो भवति, सिद्धान्तशिरोमणौ भास्करेण 'मार्तण्डः सममण्डलं प्रविशति स्वल्पेऽपमे स्वात्तकादित्यादिना' सूत्रेण सममण्डलप्रवेशसंबंधे प्राचार्योक्तानुरूपमेव कथ्यत इति ॥५१॥

अब समशंकु साधन को कहते हैं

हि. भा.—उत्तर क्रान्तिज्या यदि अक्षज्या से अल्प है तब क्रान्तिज्या को पलकर्ण से गुणा कर पलभा से भाग देने से रवि के सममण्डल (पूर्वापरवृत्त) में रहने पर शङ्कु (समशंकु) होता है इति ॥५१॥

उपपत्ति

पलभा भुज, द्वादशाङ्गुलशङ्कुकोटि, पलकर्ण कर्ण }
क्रान्तिज्याभुज, कुज्योनतद्धृति कोटि, समशंकु कर्ण }
दोनों अक्षक्षेत्र सजातीय हैं इसलिए अनुपात करते हैं

$\frac{\text{पलक.क्रान्तिज्या}}{\text{पलभा}}$ = समशङ्कु । जब उत्तराक्रान्ति अक्षांश से अल्प होती है तब ही रवि के सममण्डल में प्रवेश होता है । सिद्धान्तशिरोमणि में भास्कराचार्य ने 'मार्त्तण्डः सममण्डलं प्रविशति स्वल्पेऽपमे स्वात्पलात् इससे' रवि के सममण्डलप्रवेश के सम्बन्ध में आचार्योक्त के अनुरूप ही कहा है इति ॥५१॥

इदानीं प्रकारान्तरेण समशङ्कुसाधनमाह

सूर्यज्या जिनभागज्यया गुणाऽक्षज्ययाऽथवा भक्ता ।
अग्रा द्वादशगुणिता विषुवच्छाया विभक्ता वा ॥५२॥

वा. भा.—सूर्यज्यां जिनभागज्यया गुणितां नवरदचन्द्रैरित्यर्थः, अक्षज्यया विभजेत् । फलं सममंडलशंकुर्भवति । वासनात्र त्रैराशिकत्रयं यदि व्यासार्द्धतुल्यया सूर्यज्यया जिनभागज्या तदिष्टसूर्यज्यया केति फलं क्रांतिज्या ततो द्वितीयं यदि लंबककोटिव्यासार्द्धकर्णः तत्क्रान्तिज्याकोटे क इति फलमग्रा ततस्तृतीय यद्यक्षज्यातलस्य लंबकशंकुः तदग्राशंकुतलस्य क इति । एवं स्थिते प्रथमत्रैराशिके व्यासार्धंभागहाराद्वितीये गुणकारः तयोर्नाशे कृते इति द्वितीये त्रैराशिक लम्बकः तृतीये गुणकारः तयोर्नाशे कृते सूर्यज्यया जिनभागज्या गुणकारस्थितेऽक्षज्या भागहारश्च फलं सममंडलशंकुर्भवति द्वितीयानयने त्रैराशिकं यदि विषुवच्छाया शंकुतलस्य द्वादशकः शंकुः तदग्राशकुतलस्य कः शंकुरिति फलं सममंडलशंकुर्भवति । संस्थानवासना प्राग्वत्प्रदर्शयेद् गोले इति सममंडलकर्णो च योऽक्षसंबज्यां जानातीत्यस्य प्रश्नस्योत्तरमार्यामाह ॥५२॥

वि. भा.—सूर्यज्या (रविभुजज्या) जिनज्यया गुणाऽक्षज्यया भक्ताऽथवा (प्रकारान्तरेण) समशङ्कुर्भवेत् । वा अग्रा द्वादशगुणिता पलभया भक्ता तदा समशङ्कुर्भवेदिति ॥५२॥

अत्रोपपत्तिः

यदि त्रिज्यया जिनज्या लभ्यते तदा रविभुजज्यया किं समागच्छति

क्रान्तिज्या $= \frac{\text{जिज्या}\cdot\text{भुज्या}}{\text{त्रि}}$, अक्षज्या भुजः । लम्बज्या कोटिः त्रिज्या कर्णः

इत्यक्षक्षेत्रं प्रथमम् । क्रान्तिज्या भुजः । कुज्योनतद्धृतिः कोटिः । समशङ्कुः कर्णः इत्यक्षक्षेत्रं द्वितीयमनयोः सजातीयत्वादनुपातो यद्यक्षज्या त्रिज्या लभ्यते तदा क्रान्तिज्यया किं समागच्छति समशङ्कुः $= \frac{\text{त्रि} \times \text{क्रांज्या}}{\text{ज्या}} = \frac{\text{त्रि}}{\text{अज्या}} \cdot \frac{\text{जिज्या}\cdot\text{भुज्या}}{\text{त्रि}}$

$= \frac{\text{जिज्या.भुज्या}}{\text{अज्या}}$, तथा पलभा भुजः । द्वादशकोटिः । पलकर्णः कर्ण इत्यक्षक्षेत्रं

प्रथमम् । अग्रा भुजः । समशंकुः कोटिः । तद्धृतिः कर्ण इत्यक्षक्षेत्रं द्वितीयमनयोः सजातीयत्वादनुपातो यदि पलभया द्वादशकोटिस्तदाऽग्रया किं समागच्छति

समशङ्कुः $= \frac{१२\cdot\text{अग्रा}}{\text{पलभा}}$ एतेनाऽऽचार्योक्तं सर्वमुपपन्नम् । सिद्धान्तशेखरे श्रीपतिना 'दोर्ज्या रवेः पृथगथो जिनभागमौर्व्या क्षुण्णां विभज्य पललम्बकशिञ्जिनीभ्याम् । आद्यं फलं हि सममण्डलशङ्कुसंज्ञमित्यनेन' ऽऽचार्योक्तानुरूपमेव समशङ्कोरानयनमभिहितमिति ॥५२॥

अब प्रकारान्तर से समशंकुसाधन को कहते हैं

हि. भा.—रवि भुजज्या को जिनज्या से गुणाकर अक्षज्या से भाग देने से वा (प्रकारान्तर से) समशंकु होता है, वा अग्रा को बारह से गुणाकर पलभा से भाग देने से समशङ्कु होता है इति ॥५२॥

उपपत्ति

यदि त्रिज्या में जिनज्या पाते हैं तो रवि भुजज्या में क्या इससे क्रान्तिज्या आती है

$\frac{\text{जिज्या.भुज्या}}{\text{त्रि}}$ = क्रांज्या, अक्षज्या भुज, लम्बज्या कोटि, त्रिज्या कर्ण यह प्रथम अक्षक्षेत्र है, क्रान्तिज्या भुज, कुज्योनतद्धृति कोटि, समशङ्कु कर्ण यह द्वितीय अक्षक्षेत्र है, दोनों सजातीय हैं इसलिये अनुपात करते हैं यदि अक्षज्या में त्रिज्या पाते हैं तो क्रान्तिज्या में क्या इससे समशंकु आता है $\frac{\text{त्रि.क्रांज्या}}{\text{अज्या}}$ = समशङ्कु $= \frac{\text{त्रि}}{\text{अज्या}}, \frac{\text{जिज्या.भुज्या}}{\text{त्रि}} = \frac{\text{जिज्या.भुज्या}}{\text{अज्या}}$, तथा

पलभा भुज, द्वादश कोटि, पलकर्ण कर्ण यह प्रथम अक्षक्षेत्र; अग्रा भुज, समशंकु कोटि, तद्धृति कर्ण यह द्वितीय अक्षक्षेत्र; दोनों अक्षक्षेत्र सजातीय हैं इसलिये अनुपात करते हैं यदि पलभा में द्वादश कोटि पाते हैं तो अग्रा में क्या इससे समशंकु आता है $\frac{१२.\text{अग्रा}}{\text{पभा}}$ = समशंकु इससे आचार्योक्त उपपन्न होता है, सिद्धान्तशेखर में श्रीपति ने 'दोर्ज्या रवेः पृथगधो जिनभाग-मौर्व्या, इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से समशंकु का साधन आचार्योक्तानुरूप ही कहा है इति ॥५२॥

इदानीं सममण्डलच्छायाकर्णसाधनमाह

द्वादशविषुवच्छायागुणिते पृथगक्षलम्बजीवे वा ।
क्रान्तिहृते सममण्डलकर्णौ प्राग्वत् पृथक् छाये ॥५३॥

वा. भा.—अक्षज्यां द्वादशहतां क्रान्तिज्यया विभजेत् । फलं सममंडलप्रवेशकाले छायाकर्णो भवति । अथवा लम्बज्यां विषुवच्छायासंगुण्य क्रान्तिज्यया विभजेत् । फलं सममंडलप्रवेशे छायाकर्णः ततस्तच्छायानयनं प्राग्वच्छायया चोक्तवद्घटिकानयनमिति, अत्र भागहारफलयोर्व्यपने छायानयनं त्रैराशिकत्रयं भक्रान्त्यानयनं यत्रतः प्रकल्पितं तद्यथा यदिसमंडलकर्णस्य द्वादशकः शङ्कुः तद्ववरित्रफलं सममंडलशङ्कुः । ततो द्वितीयं यदिलम्बकशंकोरक्षतुल्यं शंकुतलं तदस्य कियदिति फलमर्काग्रातुल्यं शङ्कुतुल्यं ततस्तृतीयं यदिव्यासार्द्धकर्णस्य लंबककोटिः तदग्राकर्णस्य द्विगुणं कृत्वा त्रिज्यावर्गाद्विशोधयेत् । शेषस्य पदं कोणशंकुर्भवति । उत्तराया क्रान्तिज्याया उत्तरयो विदिशोः दक्षिणादक्षिणयोश्चेत्येवं शंकुमानीय यच्छायाप्राग्वत्कार्या सा कोणछाया भवति यथा आत्मीय छाया तच्च नतोन्नतघटिकानयनमपि प्राग्वदित्यत्र वासना तद्यथा गोले स्वक्षितिजे यथा भूमध्यार्धभेदिपूर्वापरायतं सूत्रं तिष्ठति दक्षिणोत्तरायतं च (ख) अपरं सूत्रद्वयं भूमध्यार्धभेद्यग्रे विन्यसेत् । एकमैशानीनैर्ऋत्यायत द्वितीयमाग्नेयी च यथायतं ततश्चतुर्ष्वपि कोणेषु सूत्राणि बद्धान्यानि चत्वारि सूत्राणि ज्यासंस्थानानि कोणात्कोणे बध्नीयादेवं समचतुरस्रक्षेत्रमुपपन्नं भवति । कर्णद्वयसहितं कर्णसंपातश्च भूगोलमध्ये ततः पूर्वापराय दक्षिणोत्तरायतसूत्राभ्यामवस्थितानि चत्वारि समचतुरस्राणि क्षेत्राणि प्रकल्प्यान्यान्यस्मिन्नपि क्षेत्रे तानि चतसृणामपि विदिशां सम्बद्धानि भवन्ति । भूमध्यविनिर्गतकोणप्रतिसूत्रकर्णयुतानि । यथा तद्दैवसिकमग्रासूत्रमोलाध्यायप्रदर्शितविधिना स्वक्षितिजे दक्षिणोत्तरायतं पूर्वापरयोः बद्धं तदग्रयोश्च पूर्वापरायतमुदयास्तसूत्रं बध्नीयात् । ततः स्वक्षितिजे स्वाहोरात्रवृत्तं विन्यस्य दृङ्मंडलं कोणाव-

गाहि विन्यसेत् । उपर्यधश्च जनितस्वस्तिकद्वयमेवमवस्थिते व्यक्तराशि तेन वामनां प्रदर्शयेत् । मध्यमाहरणबीजसूत्रेण कुट्टकाध्यायोपनिबद्धो नोनभवः छिन्नः शोध्यः, यस्माद्वर्गाणि तद्यस्नद्वर्गाहतरूपाणामव्यक्तार्धकृतिसंयुतानां यत्पद-मव्यक्तार्धोनं तद्वर्गविभक्तमव्यक्त इति । अत्र तावद् दक्षिणगोलस्थे रवावाग्नेय्यां शंकुं प्रदर्शयेत् । तद्यथा तत्कोणदृङ्मंडलस्वाहोरात्रयोर्यत्र संपातः तत्रावलंबकसूत्रं बद्ध्वाऽवलम्बयेत् तेनावलम्बकसूत्रेण कोणसूत्रस्य यः प्रदेशः स्पृष्टः तत्र शङ्कुमूलं तस्य शंकुमूलस्य स्वोदयास्तसूत्रेण सह यावदन्तरं तावच्छंकुतलं यावच्च प्राच्यपरसूत्रोदयास्तसूत्रयोरन्तरं तावत्यर्काग्रा शंकुतलयोगो भुजो भवति । प्राच्यपरा शंकुमूलयोरंतरं तदेव बाहु भवति । कोणप्रवेशकाले समचतुरस्रेति तदेवं प्रथमं स्थिते राशिके व्यासार्धं गुणकारः तृतीये भागहारः तयोर्नाशे कृते द्वितीयेऽवलम्बको भागहारः तृतीये गुणकारः तयोश्च नाशे कृते अक्षज्या द्वादशगुणा यावच्छायाकर्णेन विभज्यते तावत्फलं क्रान्तिज्या भवति । यावच्चाक्षज्या द्वादश वधः क्रान्तिज्यया विभज्यते तावत्फलं छायाकर्णो भवतीत्युपपन्नम् । यावानेव द्वादशाकाक्षज्ययोर्वधः तावानेव विषुवच्छायालंबज्ययोर्वधो भवति । भागहारश्चैक एव अत्र फलेन कश्चिद्भवति । ततोऽपि सममंडलछायाकर्णानयनं सिद्धं शेषं प्राग्वद्योज्यम् संस्थानादिकमिति यो जानाति कोणशंकुछायार्घटिका इत्यस्य प्रश्नस्योत्तरमार्यात्रयेणाह ॥५३॥

वि. भा.—अक्षज्या लम्बज्ये पृथक् द्वादशपलभागुणिते क्रान्तिज्यया भक्ते तदा सममण्डलकर्णौ भवतः । ततः पूर्ववत् पृथक् छाये भवत इति । ५३॥

अत्रोपपत्तिः

अथाऽक्षक्षेत्रानुपातेन $\frac{\text{त्रि}\cdot\text{क्रांज्या}}{\text{अक्षज्या}}$=समशङ्कु । ततो यदि समशङ्कुना त्रिज्याकर्णस्तदा द्वादशाङ्गुलशङ्कुना किं समागच्छति सममण्डलकर्णः=

$\frac{\text{त्रि}\cdot 12}{\text{समश}} = \frac{\text{त्रि}.12}{\frac{\text{त्रि}.\text{क्रांज्या}}{\text{अज्या}}} = \frac{12.\text{अज्या}}{\text{क्रांज्या}}$ हरभाज्यौ लम्बज्यया गुणितौ तदा $\frac{12.\text{अज्या}.\text{लंज्या}}{\text{लंज्या}.\text{क्रांज्या}}$

$= \frac{\text{पलभा}.\text{लंज्या}}{\text{क्रांज्या}}$ = सममण्डलकर्णः, एतावताऽऽचार्योक्तमुपपन्नं सर्वमिति सिद्धान्त-शेखरे 'लम्बाक्षजीवे पलभा रविघ्ने त्वपक्रमज्या विहृते क्रमेण । यद्वा भवेतां समवृत्त-कर्णौ ताभ्यां प्रभे पूर्ववदेव साध्ये इत्यनेन' श्रीपतिनाऽऽचार्योक्तानुरूपमेवोक्तमिति, सूर्यसिद्धान्ते 'लम्बाक्षजीवे विषुवच्छाया द्वादशसंगुणे । क्रान्तिज्याप्ते तु तौ कर्णौ सममण्डलगे रवौ' इत्यनेन तदेव कथ्यते इति ॥५३॥

अब सममण्डल छायाकर्णानयन को कहते हैं

हि. भा.—अक्षज्या और लम्बज्या को पृथक्-पृथक् द्वादश और पलभा से गुणाकर क्रान्तिज्या से भाग देने से दो प्रकार के सममण्डल कर्ण होते हैं उनसे पूर्ववत् छाया-साधन करना चाहिए इति ॥५३॥

उपपत्ति

अक्षक्षेत्र के अनुपात से $\frac{\text{त्रि.क्रांज्या}}{\text{अक्षज्या}}$ = समशंकु, इससे अनुपात करते हैं यदि समशंकु में त्रिज्या कर्ण पाते हैं तो द्वादशाङ्गुलशङ्कु में क्या इससे सममण्डलकर्ण आता है, $\frac{\text{त्रि.१२}}{\text{सशं}} = \frac{\text{त्रि.१२}}{\frac{\text{त्रि.क्रांज्या}}{\text{अज्या}}} = \frac{\text{अज्या.१२}}{\text{क्रांज्या}}$ = सममण्डलकर्ण हर और भाज्य को लम्बज्या से गुणने से $\frac{\text{अज्या·१२·लंज्या}}{\text{लज्या·क्रांज्या}} = \frac{\text{पभा·लंज्या}}{\text{क्रांज्या}}$ = सममण्डलकर्ण, इससे आचार्योक्त उपपन्न हुआ, सूर्यसिद्धान्त में भी 'लम्बाक्षजीवे विषुवच्छाया द्वादशसङ्गुणे। क्रान्तिज्याप्ते तु तौ कर्णौ सममण्डलगे रवौ' इससे तथा सिद्धान्तशेखर में "लम्बाक्षजीवे पलभा रविघ्ने त्वपक्रमज्याविहृते क्रमेण। यद्वा भवेतां" इत्यादि से श्रीपति भी आचार्योक्तानुरूप ही कहते हैं इति ॥५३॥

इदानीं कोणशङ्कोरानयनमाह

अर्काग्रावर्गोनं त्रिज्यावर्गार्धमर्ककृतिगुणितम् ।
आद्योऽन्योऽग्राद्वादशविषुवच्छायावधो हृतयोः ॥५४॥

विषुवच्छायाकृत्या द्व्यगसंयुतयाऽन्यकृतियुतादाद्यात् ।
पदमन्ययुतविहीनं सौम्येतरगोलयोः शङ्कुः ॥५५॥

विदिशोः सौम्येतरयोरुत्तरगोले पदोनयुक्तोऽन्यः ।
सममण्डलदक्षिणगेनच्छाया नाडिकाः प्राग्वत् ॥५६॥

वा. भा.—अत्र तावत्कोणशंकूनां प्रभवं प्रदर्शयेत् तद्यथा यत्राक्षभा-प्रयुक्तानि सप्तांगलानि विषुवच्छाया तत पंचपंचाशदक्षभागाः तत्र मिथुनान्त-गरविरैशान्यामुदेति। धनुर्मकरांतगश्चाग्नेयं तस्मात् देशादुत्तरेण चतसृषु अपि दिक्षु कदाचित्कोणशंकवः संभवन्ति। रवावुत्तरगोलस्थे दक्षिणगोलस्थे च कदाचि-त्कोणच्छायापि संभवति। तस्माद् देशाद् दक्षिणेन यत्र चतुर्विंशतिरक्षभागाः

ततश्चोत्तरेणोत्तरगोलस्थे रवावाग्नेयीनैर्ऋत्योरेव कोणशंकुसम्भवः नैशानी-वायव्योः दक्षिणगोले च यत्र भागश्चतुर्विंशतेरयोनाक्षः तत्रोत्तरगोलस्थेऽर्के कदाचिदाग्नेयनैर्ऋत्यो शंकुसम्भवः कदाचिदैशानीवायव्योः स्वाक्षज्या नोनाधिकायां यथासंख्यं क्रान्तिज्यामित्यर्थः । दक्षिणगोलस्थे वाग्नेयीनैर्ऋत्योरेव तेषां कोणशंकूनां प्रदर्शनार्थमिदमार्यात्रयम् । तद्यथेष्टदिनेऽर्काग्रां कृत्वा तस्य वर्गः कार्यः ततोनं त्रिज्या-वर्गार्धेषु विशोध्य ततोऽर्ककृत्या वेदकृतचंद्रसंख्यया गुणयेत् । एवं कृते यो राशि सपद्यते तस्याद्य इति संज्ञा । ततोऽर्काग्रा द्वादशस्वदेशविषुवच्छायां तिसृणामपि यो वधो भवति । तस्यान्य इति संज्ञा । ततः स्वदेशविषुवच्छायाकृत्या द्वयगसंयुतया अनया द्वावपि विभजेत् पृथक् पृथक् । तयोः फले तयो स्फुटावाद्यन्यौ कर्मयोग्यौ भवतः । ततस्तस्य कृतिं कृत्वा तया माद्यो युतकार्यस्तस्मात्मूल तस्य पदसंज्ञा भवति । एवं तावत्कर्मसामान्यं सर्वेषु कोणशंकुषु विशेषश्चात्र पदमपि युतविहीनं यथासंख्यं याम्योत्तरगोलयोः स्थितेऽर्के शकुविदिशो सौम्योत्तरयो भवति । यदा सममंडलैशान्योरंतरप्रहविम्बिः रवे सम्मंडलं यदुत्तरेणैव याति । तथा पदमन्येन युतं कृत्वैशानीप्रवेशशंङ्कुर्भवति । वायव्यप्रवेशेऽपि स एव तुल्यान्ताद् दिनगतशेषया यदा पुनः सममडलाद् दक्षिणेनाग्नेयोत्तरेणार्कोदयं सममंडलाद् दक्षिणेनैव याति । तदा पदमन्येन विहीन कृत्वाग्नौ प्रवेशशकुर्भवति । नैऋते स एव प्राग्वत् यदा च सममंडलादुत्तरेणैव प्रविष्टः प्रागपरयोः सममडल-प्रवेशद्वयं कृत्वा अस्तमेति तदा सूर्यमंडलमेनदुत्तरगोले पदोनयुनान्यः सम-मंडलदक्षिणग इति । तत्रैवं यत्रैशानीसममंडलोदितः सममंडल प्राप्य दक्षिण-विदिशे प्रवेशं करोति तदैवोक्तवत्कर्म कृत्वा पदान्यावानीय ततः पदेनान्या युक्त-कार्या स च शंकुर्भवति ।

अथ यत्रैशानीमर्थात् क्रमोत्तरेण विवस्वानुदेति तत्रार्काग्रा वर्गा त्रिज्या-वर्गार्धान्न शुध्यति । तेन तत्र विपरीतशोधनं कृत्वा शेषस्य द्वादशवर्गाहतस्य कंति वर्गान्न शुध्यति । तेन तत्र विपरीतशोधनं कृत्वा शेषेति संज्ञा । शेषकर्म प्राग्वत्कृत्वा पादान्यावानीय तत्र एकत्र पदेनोनान्यः कार्यः स एवैशानीवायव्योः शंकुर्भवत्यत्र पदेन युक्तोऽन्यश्च कार्यः । स आग्नेयीनैर्ऋत्योः शंकुर्भवति । अथ यत्राग्नेयीमतिक्रम्य दक्षिणेनार्कोदयः तत्रार्ककर्णावर्गः त्रिज्यार्धवर्गान्न शुध्यति । यदि नाम तत्राग्नेयादिभिन्नं प्रयोजनं कोणशंकोरसंभवाति त्वेव साक्षे देशे कोणशंक्वानयनं निरक्षदेशे पुनः क्रान्तिज्यावर्गं क्षेत्रकस्य भूमध्यविनिर्गत-शंकुमूलावच्छिन्न कोणसूत्रकर्णखंडकस्य द्वितीयोऽपि बाहुः तावानेवातो भुजवर्गः द्विगुणः शंकुमूलभूमध्यांतरस्य वर्गो भवति । कोणशंकोर्दृग्ज्यावर्गो भवतीत्यर्थः तात्त्रिज्यावर्गादपास्य शेषस्य मूलं कोणशंकुर्यतः कोणशंकुः कोटिः तच्छाया भुजः व्यासार्धं कर्णः तस्मादुपपन्नं स्वाक्षदिशंकुतलं जायते, तच्च न जायते । शंकुर्यतः कोणशंकुरेव परिकल्प्यते तेन वैराशिकं यदि द्वादशकस्य शंकोर्विषुवच्छायातुल्यं

शंकुतलं तद्यावच्छंको: किमिति फलं यावत्कस्य द्वादशांशविषुवच्छायातुल्यं
शंकुतलं तद्यावच्छंको: किमिति फलं यावत्कस्य द्वादशांशा विषुवच्छायातुल्यं
शंकुतलप्रमाणं तदग्रेऽर्काग्रातुल्यानि रूपाणि विन्यसेत्तदेवं शंकुतलाग्रा योगः कृतो भवति। स एव भुजस्तस्य यावद्वर्गः क्रियते तावत्प्रथमे स्थाने ये वर्गा विषुवच्छाया कृत्वा तुल्या भवंति । तेषामधश्छेदर्ककृतिः ये स्थाने यावकाः भवन्ति । द्विगुणविषुवच्छाया कृततुल्या भवन्ति । तेषामधश्छेदोऽर्ककृतिः द्वितीयस्थानेऽर्काग्रातुल्यानि रूपाणि भवन्ति । एवं भुज्यावर्गः कृतो भवति ।

तं त्रिज्यावर्गाद्विशोध्यावशेषा द्विगुणाः क्रियन्ते। येन शंकुवर्गो भवति। इत्येवं विधिना भुजवर्गास्त्रिज्यावर्गाद्विशोध्यन्ते। शोधिते च जातौ राशियौ वर्गराशिर्यावकराशिश्च द्वावप्यृणगतौ भवतः। अर्काग्रावर्गश्च रूपराशिरतः साक्षा त्रिज्यावर्गाद्विशोध्यते इत्यर्थः। एवं कृते जातं शंकुवर्गार्धं यावगार्धं यावगात् ऋणगता विषुवच्छायाकृतितुल्यास्तेषां द्वादशवर्गछेदः प्रथमस्थाने द्वितीयस्थाने यावकात् ऋणगत्या द्विगुणविषुवच्छायार्काग्रावधतुल्यास्तेषां द्वादशको छेदः तेन पुनर्द्वादशभिः संगुणिते येन प्रथमराशि सवर्णा भवति । द्वादशकृतिछेद इत्यर्थः। अस्य राशेरधुनैव प्रयोजनं भविष्यति। कृत्वार्धमेवाचार्येणोपनिबद्धं वासना-गुप्तये यावद्यार्धं क्रियते तावद् वर्गद्वादशकैकगुणा विषुवच्छायावध इति तृतीय-स्थानेऽर्काग्रावर्गेन त्रिज्यावर्गार्धस्यावशेषाणि रूपाणि सकलान्येव भवन्ति। तानि वार्ककृतिर्गुणितानि सवर्णानि भवन्ति। पूर्वराशेरतः तथैव कृत्वा यो राशिर्भवति तस्याद्येतिसञ्ज्ञा । तेनोक्तमग्रावर्गोनं त्रिज्यावर्गार्धमर्ककृतिगुणितमाद्येति । वर्ग-स्यापि शंकुवर्गार्धात्मकस्यैक एव छेदो कृतिसंख्या सचार्धः क्रियते येन सकल-शंकोर्वर्गो भवति। छेदोऽर्धे कृते मानाद् द्विगुणो भवतीत्यर्थः। स चार्धकृतो द्वयग संख्यो जातः एवं प्रथमपक्षद्वितीयपक्षे च यावगं विन्यसेत्। ततो यावक एवं शंकुः द्वितीयपक्षश्च प्रथमपक्षछेदेन द्विसप्तत्या सवर्णितो जातो द्वयगसंख्यो यावर्गः एवं समवस्थिते सूत्रवर्गाव्यक्तः शोध्यः यस्माद् रूपाणि तदव्यस्तादित्यतः प्रथम-पक्षे यावर्गः ऋणगता विषुवच्छाया कृत्वा तुल्या यावद्विशोध्यते । द्वितीयपक्षे यावर्गेभ्योऽधस्तेभ्यस्तावदमी भवन्ति। तेन तयो राश्योर्योग सर्वा विषुवच्छाया कृतिः तद्द्वयगसंयुता भवति। प्रथमपक्षे यावता अन्यसंज्ञा अष्टगुणितास्तेपि द्वितीयपक्षे शून्याद्यावद्विशोध्यन्ते तावत्तेऽपि धनिनो भवन्ति। द्वितीय पक्षे रूपराशिश्च शून्यं तत्प्रथमपक्षरूपेभ्यो विशोध्य तावत्येव रूपाण्येवावशिष्यन्ते आद्यसंज्ञकानि। एवं कृतेपि पक्षयोः साम्यं तेन त्रयाणामपि राशीनां सर्वदा प्रवर्तको विषुवच्छाया कृते या कृते संयुता यास्तुल्याः परिकल्पितस्तेन सदाप्रवर्तने कृते यावर्गस्थाने सर्वमेव रूपं भवति।

तत्त्विहाग्नेय्यां धनगतां यावकस्थाने स्फुटान्यो भवति। स चापोह धनगत-कस्थाने स्फुटाद्यो भवति। सोपीह धनगतरूप इत्येव स्थिते सूत्रं वर्ग... मव्यक्तार्ध-

कृतिसंयुतानां यत् पदमव्यक्तार्धं तद्वर्गविभक्तमन्य इत्यत एकेन वर्गेण रूपाणि हतानि तावत्येव सर्वदा भवन्ति । स्फुटाद्यनुन्यानि अव्यक्तार्धं च स्फुटान्यन-स्तस्य कृतिं कृत्वा तया संयुतानां रूपाणां यत्पदं तदव्यक्तार्धेनान्यसंज्ञकेनोनं कृत्वा तद्वर्गविभक्तं क्रियते । सर्वदा वर्गस्थाने रूपमेकेन विभक्ते तदेवमित्याद्य-घनतत्त्वाद्राशीनां पदमन्यहीनं कोणशंकुस्तेनोक्तं हृतवर्गे विषुवच्छायाकृत्या-दाद्यवर्गसंयुता यान्यकृतियुतादाद्यात्पदमन्यविहीनं दक्षिणगोलस्थेऽर्के शंकुर्विदिशि दक्षिणायामिति तदुपपन्नं यदा सममंडलैशान्यान्तरेभ्यो उदिते रवौ सममंडला-दुत्तरेणैव मध्याह्नं कृत्वास्तमेति । तत्रैशानां शंक्वानयनं शंकुतलमग्रातो विशोध्य शेषो भुजो भवति । तत्र प्राग्वद्दिनास्तकोणदृङ्मंडलस्वाहोरात्रसंपातादवलंबित-सूत्रस्य कोणशंक्वभिधानस्य कोणसूत्रेण यदन्तरं तस्य शंकुमूलस्य प्राच्यपरा च तावदन्तरं भवतीत्यर्थः । तस्य वर्गा त्रिज्यावर्गाद्विशोध्य······शेषस्य द्विगुणस्य मूलमैशानां शंकुर्भवति । तेन यावकशंकोः तदेव शंकुतलस्याग्रे······विन्यस्य शंकु-तलाष्टवर्गागतं कार्यम् । एवं कृतेऽग्रा शंकुतलेनोना भुजा भवति । तस्य वर्गे······ प्रथमस्थाने यावर्गाः विषुवच्छायाकृत्या तुल्या भवन्ति । धनगता ऋणवर्गो यतो धनमर्धंश्चार्ककृतिछेदेन द्वितीयस्थाने द्वितीयविषुवच्छायाग्रावधतुल्या यावका ऋणगता भवति । धनर्णयोर्वधो यतः ऋणं भवति । तदधो द्वादशछेदः । तृतीयस्थानेऽग्रा रूपाणां वधोऽग्रावनमेवम् ।

वि. भा.—रव्यग्रावर्गहीनं त्रिज्यावर्गार्धं द्वादशवर्गगुणितमाद्यसंज्ञकम् । अग्रा द्वादशपलभाघातोऽन्यसंज्ञकः, द्व्यगसंयुतया विषुवच्छायाकृत्या (द्विसप्ततियुत-पलभावर्गेण) हृतयोः (भक्तयोः) आद्यान्ययोर्नामनी विशिष्टाऽद्यान्यौ भवतः । अन्यवर्गयुतादाद्यान्मूलं ग्राह्यमन्येन युतं हीनं तदोत्तरदक्षिणगोलयोः कोणशङ्कु-र्भवेत् । शेषस्य व्याख्या स्फुटैवास्तीति ॥५४-५५-५६॥

अत्रोपपत्तिः

कोणवृत्ताहोरात्रवृत्तयोः सम्पातात् (कोणवृत्तस्थरवेः) क्षितिजधरातलो-परि यो लम्बः स कोणशङ्कुः । तन्मूलात्पूर्वापररेखोपरि यो लम्बः स भुजः । भुजमूलात्केन्द्रं यावद् वा कोणशङ्कुमूलाद्याम्योत्तररेखोपरिलम्बः कोटिः, भुकेन्द्रा-त्कोणशङ्कुमूलपर्यन्तं दृग्ज्या कर्णः । भुजो भुजः । कोटिः कोटिरिति त्रिभुजे कर्णकोटयोरुत्पन्नः कोणः $=४५$, तेन कर्णभुजयोरुत्पन्नकोणोऽपि $=४५$, अतो भुजकोटी समे भवतस्तेन भुजवर्गो द्विगुणितो दृग्ज्यावर्गो भवतीति । अथात्र कल्प्यते

कोणशङ्कुप्रमाणम् $=य$, तदाऽनुपातेन शङ्कुतलम् $=\frac{पभा.य}{१२}$, अग्राशङ्कुतलयोः

संस्कारेणोत्तरदक्षिणगोलयोः क्रमेण भुजमानम् $= अ \mp \frac{पभा.य}{१२}$ । अत्र भ $=$

अग्रा, भुजवर्गः $= \left(\text{अ} \mp \frac{\text{पभा.य}}{१२}\right)^{२} = \text{अ}^{२} \mp \frac{२\,\text{अ.पभा.य}}{१२} + \frac{\text{पभा}^{२}.\text{य}^{२}}{१४४}$ द्विगुणित-स्तदा दृग्ज्यावर्ग $= \frac{१४४\text{अ}^{२} \mp २४\text{अ.पभा.य} + \text{पभा}^{२}.\text{य}^{२}}{७२} = \text{त्रि}^{२} - \text{य}^{२}$ समशोधना-दिना $(७२ + \text{पभा}^{२})\,\text{य}^{२} \mp २४\,\text{अ.पभा.य} = ७२\text{त्रि}^{२} - १४४\text{अ}^{२} = १४४\left(\frac{\text{त्रि}^{२}}{२} - \text{अ}^{२}\right)$ पक्षौ $(७२ + \text{पभा}^{२})$ भक्तौ तदा $\text{य}^{२} \mp \frac{२४\text{अ.पभा.य}}{७२ + \text{पभा}^{२}} = \frac{१४४\left(\frac{\text{त्रि}^{२}}{२} - \text{अ}^{२}\right)}{७२ + \text{पभा}^{२}}$ अत्र $१४४\left(\frac{\text{त्रि}^{२}}{२} - \text{अ}^{२}\right)$ = आद्यसंज्ञकः। $१२.\text{अ.पभा}$ = अन्यसंज्ञकः तदा $\text{य}^{२} \mp \frac{२\,\text{अन्य}}{७२ + \text{पभा}^{२}} = \frac{\text{आद्य}}{७२ + \text{पभा}^{२}} = \text{य}^{२} \mp २\,\text{अन्य}' = \text{आद्य}'$, पक्षयोः $\text{अन्य}'^{२}$ योजनेन $\text{य}^{२} \mp २\,\text{अन्य}' + \text{अन्य}'^{२} = \text{आ}' + \text{अन्य}'^{२}$ मूलेन $\text{य} \mp \text{अन्य}' = \sqrt{\text{आ}' + \text{अन्य}'^{२}}$ ततः $\text{य} = \sqrt{\text{आ}' + \text{अन्य}'^{२}} \pm \text{अन्य}'$ एतेनाऽऽचार्योक्तमुपपन्नम्। यदा $\frac{\text{त्रि}^{२}}{२} < \text{अ}^{२}$ तदोत्तर-गोले आद्यस्य ऋणत्वात् कोणशङ्कुचतुष्टयमुत्पद्यते, दक्षिणगोले तु कोणशङ्कोर-भावः, सिद्धान्तशेखरे—

अग्राकृत्या विहीनं त्रिगुणकृतिदलं वेदशक्रघ्नमाद्यः
सूर्याग्राक्षप्रमाणामभिहतिरपरो भक्तयोरक्षभायाः।
कृत्या द्व्यग्रद्व्याढ्यया तौ परकृतिसहितादाद्यतो यत्पदं
स्यादन्येनाढ्यं विहीनं वनदयमककुब्गोलयोः कोणशङ्कुः॥

उत्तरेतरविदिङ्नरो भवेदुत्तरे तु पदहीनयुक् परः।
दक्षिणेन सममण्डलात्ततो भाश्रुतीष्टघटिकाश्च पूर्ववत्॥

श्रीपत्युक्तमिदं कोणशङ्कोरानयनमाचार्योक्तानुरूपमेव, सूर्यसिद्धान्तेऽपि "त्रिज्यावर्गार्धतोऽग्रज्यावर्गोनात् द्वादशाहतात्। पुनर्द्वादशनिघ्नादित्यादिनाऽयमेव कोणशङ्कोरानयनप्रकार उक्तः, सिद्धान्तशिरोमणौ "अग्राकृतिं द्विगुणितां त्रिगुणस्य वर्गादित्यादिना" भास्करेण विदिताऽग्रां समं भुजं मत्वाऽसकृत्प्रकारेण कोणशङ्कुः साधितोऽर्थात् द्विगुणिताऽग्रावर्गः (द्विगुणितभुजवर्गः) दृग्ज्यावर्गसमः, त्रिज्यावर्गे द्विगुणिताग्रा वर्गे विशोधितेऽवास्तवः कोणशङ्कुवर्गस्तन्मूलं गृहीत्वा ततः शङ्कुतलमानीय यथाग्रा संस्क्रियते तदाऽवास्तवभुजो भवेदेवमसकृत्कर्मणा

वास्तवकोणशङ्कुज्ञानं भवेत्। पर यदिभुजमानम् $=\text{ज्या}४५=\sqrt{\frac{\text{त्रि}^2}{२}}$ तदाऽस्य प्रकारस्य व्यभिचारो भवेद्यथा-भु$^2=२$अग्रा$^2=$त्रि$^2=२$ज्या^{2} तत $\sqrt{\text{त्रि}^2-२\text{अग्रा}^2}$ $=\sqrt{\text{त्रि}^2-\text{त्रि}^2}=०=$कोणशङ्कु, ततः शङ्कुतलम् $=०$ अग्रायामेतस्य संस्कारेण पूर्वभुज एव भवेदतोऽग्रेऽसकृत्कर्मणः प्रवृत्तेरभावः। यदि च भुजः $>$ज्या ४५ तदा कोणशङ्कुप्रमाणमृणात्मकं भवेत्। ततो भुजमानम् $=$ज्या ४५ स्वीकृत्याग्रा-प्रमाणं यद्यानीयते तदा ततोऽल्पायामग्रायामुत्तरगोले भास्करोक्तव्यभिचारो भवेत्, यथा. भास्करोक्त्या $\sqrt{\text{त्रि}^2-२\text{अ}^2}=$ कोणशङ्कुः, ततः शङ्कुतलम् $=$ $\frac{\text{पभा}}{१२}\sqrt{\text{त्रि}^2-२\text{अ}^2}$ अतो भुजः $=\frac{\text{पभा}\sqrt{\text{त्रि}^2-२\text{अ}^2}}{१२}-\text{अ}=\text{ज्या}४५$, ततश्छेदगमादिना

पभा$\sqrt{\text{त्रि}^2-२\text{अ}^2}=१२.\text{ज्या}४५+\text{अ}.१२=१२(\text{अ}+\text{ज्या}४५)$ वर्गकरणेनपभा^{2}.त्रि^{2} $-$पभा^{2} २अ$^2=१४४\,(\text{अ}^2+२\text{अ}.\,\text{ज्या}\,४५+\text{ज्या}^2\,४५)=$पक्षौ द्वाभ्यां भक्तौ तदा

$\text{पभा}^2.\,\frac{\text{त्रि}^2}{२}-\text{पभा}^2.\text{अ}^2=७२\text{अ}^2+१२^2.\text{अ}.\text{ज्या}४५+७२\text{ज्या}^2४५=\text{पभा}^2.\text{ज्या}^2४५$

$-$पभा^{2}.अ^{2}समशोधनेन

$\text{पभा}^2.\text{ज्या}^2४५-७२\,\text{ज्या}^2\,४५=\text{पभा}^2.\,\text{अ}^2+१२^2\text{अ}.\text{ज्या}\,४५+७२\,\text{अ}^2$.तुल्यगुणक पृथक्करणेन $=\text{ज्या}^2४५(\text{पभा}^2-७२)=\text{अ}^2\,(\text{पभा}^2+७२)+१२.^2\,\text{अ}.\text{ज्या}\,४५$ ततः

$\frac{\text{ज्या}^2४५(\text{पभा}^2-७२)}{\text{पभा}^2+७२}=\text{अ}^2+\frac{१२^2.\text{अ}.\text{ज्या}४५}{\text{पभा}^2+७२}$ वर्गपूर्तिकरणेन

$\frac{\text{ज्या}^2\,४५\,(\text{पभा}^2-७२)}{\text{पभा}^2+७२}+\frac{(७२.\text{ज्या}४५)^2}{(\text{पभा}^2+७२)^2}=\text{अ}^2+\frac{१२^2.\text{अ}.\text{ज्या}४५}{\text{पभा}^2+७२}+\frac{(७२.\text{ज्या}४५)^2}{(\text{पभा}^2+७२)^2}$

प्रथमपक्षे समच्छेदादिना,

$\frac{\text{ज्या}^2४५.\,\text{पभा}^4}{(\text{पभा}^2+७२)^2}=\text{अ}^2+\frac{२.७२\text{अ}.\text{ज्या}४५}{\text{पभा}^2+७२}+\frac{(७२.\text{ज्या}४५)^2}{(\text{पभा}^2+७२)^2}$, मूलेन

$\frac{\text{ज्या}४५.\text{पभा}^2}{\text{पभा}^2+७२}=\text{अ}+\frac{७२.\,\text{ज्या}\,४५}{\text{पभा}^2+७२}$ ततः अ $=\frac{\text{ज्या}४५.\text{पभा}^2}{\text{पभा}^2+७२}-\frac{७२.\text{ज्या}४५}{\text{पभा}^2+७२}=$

$\frac{\text{ज्या}\,४५\,(\text{पभा}^2-७२)}{\text{पभा}^2+७२}$ एतेनोपपद्यते म.म. सुधाकरद्विवेदिसूत्रम्।

भुजात्स्वोनाऽग्रप्रभावर्गनिघ्नो बाह्वाक्ष्यंशज्या द्विकार्कैर्विभक्ता।
[illegible] फलाप्त्येष्टा न्यूना स्यात्तिथ्यं सौम्यगोले ॥

दक्षिणगोले व्यभिचारश्च सिद्धान्तशिरोमणेष्टिप्पण्यां संशोधकेन "अक्षप्रभाकृतिविहीनहृगाद्रिनिघ्नः पञ्चाग्निभागजगुणा विहृता द्विकाश्वैरित्यादिना" प्रदर्शितोऽस्ति.।

अथ कुत्र कोणशङ्कुचतुष्टयं भवतीति प्रदर्श्यते

यत्र देशे परमाग्रा=ज्या ४५° तद्देशीयपलभाप्रमाणमानीयते । कल्प्यते पलभामानम्=य, तदा पक^2=य^2+१२^2 ततः $\frac{(य^2+१२^2)\ ज्या^2जि}{१२^2}$= परमाग्रा^{2} =ज्या^{2}४५ छेदगमेन य^2. ज्या^{2}जि+१२^2. ज्या^{2}जि=१२^2. ज्या^{2}४५ समशोधनेन य^2. ज्या^{2}जि=१२^2. ज्या^{2}४५—१२^2. ज्या^{2}जि=१२^2 (ज्या^{2}४५—ज्या^{2}जि) ∴य^2= $\frac{१२^2\ (ज्या^2४५—ज्या^2जि)}{ज्या^2जि}$ मूलेन य=$\frac{१२\sqrt{ज्या^2४५—ज्या^2जि}}{ज्या\ जि}$=१७।५।२२ एतेन सिद्धं यद्यत्र देशे पलभा=१७।५।२२ तत्र परमाग्रा=ज्या ४५° यत्र देशे १७।५।२२ आभ्याऽधिका: पलभास्तत्र दक्षिणगोले कोणशङ्कोरभावो भवेद्यतस्तत्र २ य अग्रा > त्रि^{2} उत्तरगोले तु तत्र कोणशङ्कुचतुष्टयमुत्पद्यत एतेन भास्करोक्तभाष्यमप्युपपन्नं भवतीति ॥५४-५५-५६॥

अब कोणशङ्कु के आनयन को कहते हैं

हि. भा.—त्रिज्या वर्गार्ध में रवि को अग्रावर्ग घटाकर बाहर के वर्ग से गुणा कर जो हो उसका नाम आद्य है, अग्रा, द्वादश, और पलभा के घात का नाम अन्त्य है, पलभावर्ग में बहत्तर (७२) जोड़कर आद्य और अन्त्य में भाग देने से विशिष्ट आद्य और अन्त्य होता है, आद्य (विशिष्ट आद्य) में अन्त्य (विशिष्ट अन्त्य) वर्ग जोड़कर मूल लेना, उसमें अन्त्य (विशिष्ट अन्त्य) को जोड़ना और घटाना तब उत्तरगोल में और दक्षिण गोल में कोणशङ्कु होता है । शेष की व्याख्या स्पष्ट है इति ॥५४-५५-५६॥

उपपत्ति

कोणवृत्तस्थ रवि से क्षितिजधरातल के ऊपर जो लम्ब होता है उसका नाम कोणशङ्कु है, उसके मूल से पूर्वापर रेखा के ऊपर लम्ब भुज संज्ञक है, भुजमूल से भूकेन्द्र पर्यन्त वा कोणशङ्कु मूल से याम्योत्तर रेखा के ऊपर लम्ब कोटि संज्ञक है, भूकेन्द्र से कोणशङ्कुमूलपर्यन्त दृग्ज्याकर्ण, भुज-भुज, कोटि-कोटि इस त्रिभुज में कर्ण और कोटि से उत्पन्न कोण=४५° इसलिये कर्ण और भुज से उत्पन्न कोण भी=४५° अतः भुज =कोटि इसलिये २भु^{2}=दृग्ज्या^{2}, यहां कल्पना करते हैं कोणशङ्कु प्रमाण=य, तब अनुपात से शङ्कुतल=$\frac{पभा\cdot य}{१२}$, अग्रा और शङ्कुतल के संस्कार से उत्तरगोल में और

दक्षिणगोल में क्रम से $\text{भुज} = \text{अ} \mp \frac{\text{पभा}\cdot\text{य}}{१२}$, यहां $\text{अ} = \text{अग्रा}$। $\text{भुजवर्ग} = \left(\text{अ} \mp \frac{\text{पभा}\cdot\text{य}}{१२}\right)^{२}$

$= \text{अ}^{२} \mp \frac{२\ \text{अ}\cdot\text{पभा}\cdot\text{य}}{१२} + \frac{\text{पभा}^{२}\cdot\text{य}^{२}}{१४४}$ द्विगुणित करने से $२\ \text{भु}^{२} = \text{दृग्ज्या}^{२} = \text{त्रि}^{२} - \text{य}^{२}$

$= \frac{१४४\text{अ}^{२} \mp २४\text{अ}\cdot\text{पभा}\cdot\text{य} + \text{पभा}^{२}\cdot\text{य}^{२}}{७२}$ छेदगम और समशोधन से $(\text{पभा}^{२} + ७२)\text{य}^{२} \mp$

$२४\text{अ}\cdot\text{पभा}\cdot\text{य} = ७२\ \text{त्रि}^{२} - १४४\ \text{अ}^{२} = १४४\left(\frac{\text{त्रि}^{२}}{२} - \text{अ}^{२}\right)$ दोनों पक्षों में $(\text{पभा}^{२} + ७२)$

इससे भाग देने से $\text{य}^{२} \mp \frac{२४\text{अ}\cdot\text{पभा}\cdot\text{य}}{\text{पभा}^{२} + ७२} = \frac{१४४\left(\frac{\text{त्रि}^{२}}{२} - \text{अ}^{२}\right)}{\text{पभा} + ७२}$ यहाँ $१४४\left(\frac{\text{त्रि}^{२}}{२} - \text{अ}^{२}\right)$

$=$ आद्य संज्ञक, $१२\cdot\text{अ}\cdot\text{पभा} =$ अन्यसंज्ञक, तब $\text{य}^{२} \mp \frac{२\ \text{अन्य}}{\text{पभा}^{२} + ७२} = \frac{\text{आद्य}}{\text{पभा}^{२} + ७२}$

$= \text{य}^{२} \mp २\ \text{अन्य}' = \text{आद्य}'$ दोनों पक्षों में $\text{अन्य}'^{२}$ जोड़ने से $\text{य}^{२} \mp २\ \text{अन्य}' + \text{अन्य}'^{२} = \text{आद्य}'$

$+ \text{अन्य}'^{२}$ मूल लेने से $\text{य} \mp \text{अन्य}' = \sqrt{\text{आद्य}' + \text{अन्य}'^{२}}$ $\therefore \text{य} = \sqrt{\text{आद्य}'\ \text{अन्य}'^{२}} \pm \text{अन्य}'$

इससे आचार्योक्त उपपन्न हुआ। जब $\frac{\text{त्रि}^{२}}{२} < \text{अ}^{२}$ तब उत्तरगोल में आद्य का मान ऋण होने से चार कोणशङ्कु उत्पन्न होते हैं, और दक्षिण गोल में कोणशङ्कु का अभाव होता है, सिद्धान्तशेखर में "अग्राकृत्याविहीनं त्रिगुणकृतिदलं" इत्यादि संस्कृतोपपत्ति में लिखित श्लोकों से श्रीपति के कोणशङ्कुसाधन आचार्योक्त के अनुरूप ही हैं, सूर्यसिद्धान्त में भी 'त्रिज्यावर्गार्धतोऽग्राज्यावर्गोनात्' इत्यादि से यही कोणशङ्कु का आनयन कहा गया है, सिद्धान्तशिरोमणि में 'अग्राकृति द्विगुणितां त्रिगुणस्य वर्गात्' इत्यादि से भास्कराचार्य ने विदित अग्रा के बराबर भुज को मानकर असकृत् प्रकार से कोणशङ्कु का साधन किया है अर्थात् द्विगुणित अग्रावर्ग $= २\text{भु}^{२} = \text{दृग्ज्या}^{२}$, त्रिज्यावर्ग में द्विगुणित अग्रावर्ग को घटाने से अवास्तव कोणशङ्कु वर्ग रहता है, उसका मूल लेकर शङ्कुतल साधन करना उस (शङ्कुतल) को अग्रा में संस्कार करने से अवास्तव भुज होता है, इस तरह असकृत् कर्म करने से वास्तव कोणशङ्कु ज्ञात होता है, लेकिन यदि भुज = अग्रा ४५°

$= \sqrt{\frac{\text{त्रि}^{२}}{२}}$ तब इस प्रकार का व्यभिचार होता है जैसे, $२\ \text{भु}^{२} = २\ \text{अग्रा}^{२} = \text{त्रि}^{२} =$ $\text{दृग्ज्या}^{२}$ अतः $\sqrt{\text{त्रि}^{२} - २\ \text{अग्रा}^{२}} = ० =$ कोणशङ्कु, इससे शङ्कुतल भी $= ०$, इसको अग्रा में संस्कार करने से पूर्व भुज ही होता है, इसलिये आगे असकृत्कर्म की प्रवृत्ति ही नहीं होगी,

यदि भुज $>$ ज्या ४५ तब कोणशङ्कु का मान ऋणात्मक होता है, इसलिये भुज $=$ ज्या ४५ स्वीकार कर यदि अग्रा का मान लाते हैं तो उससे अल्प अग्रा में उत्तरगोल में भास्करोक्त प्रकार का व्यभिचार होता है, यथा भास्करोक्ति से $\sqrt{\text{त्रि}^2 - २\,\text{अ}^2} =$ कोणशङ्कु, इससे

शङ्कुतल $= \dfrac{\text{पभा}}{१२}\sqrt{\text{त्रि}^2 - २\text{अ}^2}$ इससे भुज $= \dfrac{\text{पभा}}{१२}\sqrt{\text{त्रि}^2 - २\text{अ}^2} - \text{अ} = \text{ज्या}४५^{\circ}$

छेदगम आदि से,

$\text{पभा}\sqrt{\text{त्रि}^2 - २\text{अ}^2} = १२.\text{ज्या } ४५ + \text{अ}\cdot १२ = १२\,(\text{अ} + \text{ज्या}४५)$ वर्ग करने से

$\text{पभा}^2.\ \text{त्रि}^2 - \text{पभा}^2\cdot २\text{अ}^2 = १४४\ (\text{अ}^2 + २\text{अ}\cdot\text{ज्या}४५ + \text{ज्या}^2\ ४५)$ दोनों पक्षों को दो से भाग देने से

$\text{पभा}^2\cdot\ \dfrac{\text{त्रि}^2}{२} - \text{पभा}^2.\text{अ}^2 = ७२\text{अ}^2 + १२^2\cdot\text{अ}\cdot\text{ज्या}४५ + ७२\cdot\text{ज्या}^2४५ = \text{पभा}^2\cdot\text{ज्या}^2४५$
$- \text{पभा}^2\cdot\text{अ}^2$ समशोधन करने से

$\text{पभा}^2\cdot\text{ज्या}^2४५ - ७२\quad \text{ज्या}^2४५ = \text{पभा}^2.\text{अ}^2 + १२^2.\text{अ}.\text{ज्या}४५ + ७२\quad \text{अ}^2$ तुल्यगुणक को अलग करने से

$$\text{ज्या}^2४५\ (\text{पभा}^2 - ७२) = \text{अ}^2\ (\text{पभा}^2 + ७२) + १२^2\cdot\text{अ}\cdot\text{ज्या}४५$$

$\therefore \dfrac{\text{ज्या}^2४५\ (\text{पभा}^2 - ७२)}{\text{पभा}^2 + ७२} = \text{अ}^2 + \dfrac{१२^2\cdot\text{अ}\cdot\text{ज्या}४५}{\text{पभा}^2 + ७२}$ वर्ग पूरा करने से

$$\frac{\text{ज्या}^2४५\,(\text{पभा}^2 - ७२)}{\text{पभा}^2 + ७२} + \left(\frac{७२.\text{ज्या } ४५}{\text{पभा}^2 + ७२}\right)^2 = \text{अ}^2 + \frac{१२^2.\text{अ}.\text{ज्या}४५}{\text{पभा}^2 + ७२} + \left(\frac{७२.\text{ज्या}४५}{\text{पभा}^2 + ७२}\right)^2$$

प्रथम पक्ष में समच्छेदादि करने से $\dfrac{\text{ज्या}^2४५\cdot\text{पभा}^4}{(\text{पभा}^2 + ७२)^2} = \text{अ}^2 + \dfrac{२\cdot ७२\text{अ}\cdot\text{ज्या}४५}{\text{पभा}^2 + ७२}$

$+ \dfrac{(७२\cdot\text{ज्या}४५)^2}{(\text{पभा}^2 + ७२)^2}$ मूल लेने से $\dfrac{\text{ज्या}४५ \times \text{पभा}^2}{\text{पभा}^2 + ७२} = \text{अ} + \dfrac{७२\cdot\text{ज्या}४५}{\text{पभा}^2 + ७२}$

$\therefore \text{अ} = \dfrac{\text{ज्या}४५.\text{पभा}^2}{\text{पभा}^2 + ७२} - \dfrac{७२\cdot\text{ज्या}४५}{\text{पभा}^2 + ७२} = \dfrac{\text{ज्या}४५\ (\text{पभा}^2 - ७२)}{\text{पभा}^2 + ७२}$ इससे "युग्माश्वोना-ऽग्रप्रभावर्गनिघ्नी" इत्यादि संस्कृतोपपत्ति में लिखित म. म. पण्डितसुधाकरद्विवेदी का सूत्र उपपन्न हुआ ।। दक्षिणगोल में व्यभिचार सिद्धान्तशिरोमणि की टिप्पणी में 'अग्र-प्रभाकृतिविहीन' इत्यादि से संशोधन किया गया है ।

किस देश में किस गोल में चार कोणशङ्कु होते हैं उसके लिये विचार करते हैं

जिस देश में परमाग्रा $=$ ज्या४५ उस देश की पलभा साधन करते हैं, कल्पना करते हैं पलभा मान $=$ य तब पक^2 $=$ य$^2 + १२^2$ $\therefore \frac{(\text{य}^2 + १२^2)\ \text{ज्या}^2\text{जि}}{१२^2} =$ परमाग्रा$^2 =$ ज्या^{2}४५ छेदगम करने से य$^2\cdot$ज्या^{2}जि $+ १२^2\cdot$ज्या^{2}जि $= १२^2\cdot$ज्या^{2}४५ समशोधन से य$^2\cdot$ज्या^{2}जि $= १२^2\cdot$ ज्या^{2}४५ $- १२^2\cdot$ ज्या^{2}जि $= १२^2$ (ज्या^{2}४५ — ज्या^{2}जि) $\therefore$ य$^2 = १२^2 \frac{(\text{ज्या}^2४५ - \text{ज्या}^2\text{जि})}{\text{ज्या}^2\text{जि}}$

मूललेने से $\text{य} = \frac{१२\sqrt{\text{ज्या}^2४५ - \text{ज्या}^2\text{जि}}}{\text{ज्याजि}} = १७।५।२२$ इससे सिद्ध हुआ कि जिस देश में पलभा $=$ १७।५।२२ होगी उस देश में परमाग्रा $=$ ज्या४५ होगी, १७।५।२२ इससे अधिक पलभा जिस देश में होगी उस देश में दक्षिणगोल में कोणशङ्कु का अभाव होगा। क्योंकि वहाँ २ अग्रा $>$ त्रि^{2}, उत्तरगोल में कोणशङ्कु चतुष्टय (चार कोणशङ्कु) उत्पन्न होते हैं, इससे भास्करोक्त भाष्य उपपन्न होता है इति ॥५४-५५-५६॥

इदानीं भुजद्वयज्ञानात्पलभाज्ञानमाह

प्राच्यपराशङ्कुतलान्तरद्वयव्यस्तकर्णवधविवरम् ।
समदिशि विषुवच्छायान्यदिगैक्यं कर्णविवरहृतम् ॥५७॥

सु. भा.—प्राच्यपराशङ्कुतलान्तरं शङ्कुमूलप्राच्यपरान्तरम् । अर्थात् द्वादशाङ्गुलशङ्कोर्भुजः। एवं भुजद्वयस्य व्यस्तकर्णवधस्य समदिशि विवरमन्य-दिश्यैक्य कर्णयोर्विवरेण हृतं विषुवच्छाया भवति ।

अत्रोपपत्तिः। 'भाद्वयस्य भुजयोः समाशयोर्व्यस्तकर्णहतयोर्यदन्तरम्' इत्यादि भास्करविधिना स्फुटा ॥५७॥

वि. भा.—प्राच्यपराशङ्कुतलान्तरं शङ्कुमूलपूर्वापरान्तरमर्थाद्भुजः। एवं भुजद्वयस्य व्यस्तकर्णवधस्य समदिशि (एकदिशायां) विवरं (अन्तर) अन्यदिशि (भिन्नदिशायां) ऐक्यं (योगः) कर्णान्तरेण भक्तं तदा विषुवच्छाया (पलभा) भवतीति ॥५७॥

अत्रोपपत्तिः

अत्र पलभामानम् $=$ य, छायाकर्णगोले भुजः $=$ भु। तथा छायाकर्णगोले द्वितीय-भुजः $=$ भु$'$। छायाकर्णौ क, क$'$ तदा कर्णवृत्ताग्रा $=$ य $\pm$ भु। य $\pm$ भु$'$ $=$ कर्णवृत्ताग्रा ततस्त्रिज्यागोलेऽग्रा $= \frac{(\text{य} \pm \text{भु})\ \text{त्रि}}{\text{क}} =$ अ। एवं $\frac{(\text{य} \pm \text{भु}')\ \text{त्रि}}{\text{क}'} = \frac{\text{य.त्रि} \pm \text{भु}'\text{.त्रि}}{\text{क}'} =$

त्रिज्यागोलेऽग्रा$=$अ$=\frac{\text{य.त्रि}\pm\text{त्रि}\cdot\text{भु}'}{\text{क}'}$ छेदगमेन य.त्रि.क$\pm$भु'.त्रि.क$=$य·त्रि.क

$\pm$त्रि.भु'.क वा य.क$\pm$भु'.क$=$य·क'$\pm$भु.क' समशोधनेन भु'.क$\mp$भु'.क$=$य.क'$\backsim$

य.क$=$य (क'$\backsim$क) $\therefore$ $\frac{\text{भु.क}'\mp\text{भु}'.\text{क}}{\text{क}'\backsim\text{क}}=$य· एतेनोपपन्नमाचार्योक्तम् सिद्धान्त-शेखरे "छायाग्रेन्द्रचपरान्तरद्वयविपर्यस्तस्वकर्णाहतिप्रोद्भूतं विवरं दिशोः सदृशयोरैक्यं च भिन्नाशयोः। तद्भक्तं श्रवणान्तरेण विषुवच्छाया स्फुटा जायते" श्रीपतेरयं प्रकारः, सिद्धान्तशिरोमणौ "भाद्वयस्य भुजयोः समाशयोर्व्यस्तकर्णहतयोर्यदन्तरम्। ऐक्यमन्यककुभोः पलप्रभा जायते श्रुतिवियोगभाजितम्" भास्कराचार्यप्रकारोऽप्याचार्योक्तानुरूप एवेति ॥५७॥

अब भुजद्वयज्ञान से पलभा ज्ञान को कहते हैं

हि. भा.—शङ्कुमूल और पूर्वापर रेखा का अन्तर भुज है, इस तरह भुजद्वय और व्यस्तवर्ण (उलटाकर्ण) घात अर्थात् प्रथम भुज और द्वितीयछायाकर्णघात तथा द्वितीयभुज प्रथमछायाकर्णघात के एक दिशा में अन्तर भिन्न दिशा में योग को छाया कर्णान्तर से भाग देने से पलभा होती है इति ॥५७॥

उपपत्ति

कल्पना करते हैं पलभा$=$य। छायाकर्णगोल में भुज$=$भु। छायाकर्णगोल में द्वितीयभुज$=$भु'। छायाकर्णद्वय$=$क। क' तब कर्णवृत्ताग्रा$=$य$\pm$भु। कर्णवृत्ताग्रा'$=$य $\pm$भु' इससे त्रिज्या गोल में अग्रा$=\frac{(\text{य}\pm\text{भ})\ \text{त्रि}}{\text{क}}=$अ। एवं $\frac{(\text{य}\pm\text{भु}')\ \text{त्रि}}{\text{क}'}$ $=\frac{\text{य.त्रि}\pm\text{भु}'.\text{त्रि}}{\text{क}'}=$त्रिज्यागोल में अग्रा$=\frac{\text{य.त्रि}\pm\text{भ.त्रि}}{\text{क}}=$अ, छेदगम से य.क$\pm$भु.क' $=$य.क'$\pm$भु'.क समशोधन से भु.क'$\mp$भु'.क$=$य.क'$\backsim$य·क$=$य (क'$\backsim$क)

$\therefore$ य$=\frac{\text{भु.क}'\mp\text{भु}'.\text{क}}{\text{क}'\backsim\text{क}}$ इससे आचार्योक्त उपपन्न हुआ। सिद्धान्तशेखर में "छायाग्रेन्द्रयपरान्तरद्वयविपर्यस्तस्वकर्णाहति इत्यादि संस्कृतोपपत्ति में लिखित श्रीपतिप्रकार, तथा सिद्धान्तशिरोमणि में "भाद्वयस्य भुजयोः समाशयोः" इत्यादि भास्करोक्त प्रकार आचार्योक्तानुरूप ही है इति ॥५७॥

इदानीं प्रकारान्तरेण पलभाज्ञानमाह

छायावृत्ताग्रोना सौम्येन युतान्तरेण याम्येन ।
विषुवच्छायाऽजादिषु तुलादिषु तथाऽन्तरं हीनम् ॥५८॥

सु. भा.—छायावृत्ताग्रा यथादिक्का कर्णवृत्ताग्रा सौम्येन अन्तरेण द्वादशाङ्गुलशङ्कुतलप्राच्यपरान्तरेणार्थाद् भुजेनोना याम्येन भुजेन च युता। एवमजादिषु राशिषु अर्थादुत्तरगोले। तुलादिषु चार्थाद्दक्षिणगोले तथैव तदन्तरं भुजमानं हीनच्छायावृत्ताग्रया तदा विषुवच्छाया भवतीत्यर्थः।

अत्रोपपत्तिः। बृहच्छङ्कुतलाग्रासंस्कारेण भुजो भवति। लघुशङ्कौ तु शङ्कुतल विषुवती। अग्रा छायाकर्णवृत्ताग्रा यथा दिक्का। उत्तरगोले सममण्डलप्रवेशात् पूर्वं छायावृत्ताग्रा पलभोना सौम्यो भुजोऽतः सौम्येन भुजेनोना छायावृत्ताग्रा पलभा। सममण्डलप्रवेशादुपरि पलभातश्छायावृत्ताग्रा शुद्धा भवति ततोऽवशिष्टं दक्षिणो भुजोऽतस्तेन युना साऽग्रा विषुवती भवति। दक्षिणगोले सर्वदा विषुवतीच्छायावृत्ताग्रयोर्योगेन भुजमानमतस्तच्छायावृत्ताग्रया हीनं पलभा भवेदिति स्फुटमेव ॥५८॥

वि. भा.—छायावृत्ताग्रा (कर्णवृत्ताग्रा)यथा दिक्काऽजादिषु (मेषादिषु)राशिषु अर्थादुत्तरगोले सौम्येन(उत्तरेण) अन्तरेण (द्वादशाङ्गुलशङ्कुमूलपूर्वापरान्तरेणार्थाद् भुजेन) ऊना (हीना), याम्येन (दक्षिणेन) भुजेन युता तदा विषुवच्छाया (पलभा) भवति, तथा तुलादिषु राशिष्वर्थाद्दक्षिणगोले तदन्तरं (भुजमानं) हीनं छायावृत्ताग्रया तदा विषुवच्छाया भवतीति ॥५८॥

अत्रोपपत्तिः

छायाकर्णगोले शङ्कुतलं पलभातुल्यं भवति कथमिति प्रदर्श्यते,

$\frac{\text{पभा. इशं}}{१२}$ = शङ्कुतलम् । ∵ $\frac{\text{१२. त्रि}}{\text{छाक}}$ = इशं अत उत्थापनेन $\frac{\text{पभा. १२. त्रि}}{\text{१२. छाक}}$ = शङ्कुतलम् । छायाकर्णगोले शङ्कुतलम् = $\frac{\text{पभा. १२. त्रि. छाक}}{\text{१२. छाक. त्रि}}$ = पभा, शङ्कुतलाग्रासंस्कारेण भुजो भवति, छायाकर्णवृत्ताग्रा यथा दिक्का, उत्तरगोले रवेः समप्रवेशात् पूर्वं छायावृत्ताग्रा शङ्कुतलतुल्यया पलभया हीना तदोत्तरभुजो भवेदत उत्तरेण भुजेन हीना छायाकर्णवृत्ताग्रा पलभा भवेत्। समप्रवेशादुपरि पलभायां छायाकर्णवृत्ताग्रा शुद्धा भवति, ततोऽवशिष्टं दक्षिणे भुजोऽतस्तेन युताऽग्रा पलभा भवति, दक्षिणगोले सर्वदैव छायाकर्णवृत्ताग्रा पलभयोर्योगेन भुजो भवत्यतश्छायाकर्णवृत्ताग्रया हीनं भुजमानं पलभा भवेदिति सिद्धान्तशेखरे "यद्वाच्छायावलयविहिता सैव सौम्यान्तरेण

हीना युक्ता नियतममुना दक्षिणेनाक्षभा स्यात् । एवं मेषप्रभृतिषु गते भास्करे भेषु षट्सु जूकादिस्थे द्युतिमति तथैवान्तरं वर्जितं स्यात्" श्रीपत्युक्त मिदमाचार्योक्तश्लोकान्तरमात्रमेवेति ॥५८॥

अब प्रकारान्तर से पलभा ज्ञान को कहते हैं

हि॰ भा.—मेषादि छः राशिओं में अर्थात् उत्तर गोल में उत्तर अन्तर अर्थात् द्वादशाङ्गुल शङ्कु मूल और पूर्वापर रेखा के अन्तर (भुज) को छायाकर्ण वृत्ताग्रा में घटाने से तथा दक्षिण अन्तर (दक्षिण भुज) को जोड़ने से पलभा होती है, तुलादि छः राशियों में अर्थात् दक्षिण गोल में उस अन्तर (भुजमान) में छायाकर्णवृत्ताग्रा को हीन करने से पलभा होती है इति ॥५८॥

उपपत्ति

छायाकर्णगोल में शङ्कुतल, पलभा के बराबर होता है जैसे, $\frac{\text{पभा. इशं}}{१२}$ = शङ्कुतल, ∵ $\frac{\text{त्रि. }१२}{\text{छाक}}$ = इशं अतः उत्थापन देने से $\frac{\text{पभा. त्रि. }१२}{१२\text{. छाक}}$ = शङ्कुतल, इसको छायाकर्ण गोल में परिणामन करने से $\frac{\text{पभा. त्रि. }१२\text{. छक}}{१२\text{. छाक. त्रि}}$ = पभा = छायाकर्णगोलीयशङ्कुतल, उत्तरगोल में समप्रवेश से पहले छायावृत्ताग्रा में शङ्कुतल तुल्य पलभा को घटाने से उत्तर भुज होता है इसलिये छायावृत्ताग्रा में उत्तर भुज को घटाने से पलभा होती है, सम प्रवेश से ऊपर पलभा में छायाकर्णवृत्ताग्रा घटाने से शेष दक्षिण भुज होता है इसलिए इस भुज को उस अग्रा में जोड़ने से पलभा होता है, दक्षिण गोल में सदा छायाकर्णवृत्ताग्रा और पलभा का योग करने से भुज होता है अतः भुज में छायाकर्ण वृत्ताग्रा को घटाने से पलभा होती है, सिद्धान्तशेखर में "अग्राच्छायावलयविहिता सैव सौम्यान्तरेण" इत्यादि संस्कृतोपपत्ति में लिखित श्रीपति-प्रकार आचार्योक्त के अनुरूप ही है इति ॥५८॥

इदानीं मिष्टच्छायावृत्ते पलभाग्रयो संस्थानमाह

इष्टच्छायावृत्ते तदग्रयोर्यदुदयास्तमयसूत्रम् ।
अनुपातात्तच्छङ्कोर्विषुवच्छायान्तरमिहाग्रा ॥५९॥

सु. भा.—इष्टच्छायावृत्ते पूर्वापराशयोर्ये तदग्रे अर्थाच्छायावृत्ते परिणते अग्रे तयोर्गतं सूत्रमुदयास्तसूत्रम् । तच्छङ्कोः । तस्य रवेः शङ्कुस्तच्छङ्कुस्तस्यानुपातात् प्रपातात्मूलादुदयास्तसूत्रपर्यन्तमन्तरं विषुवच्छाया भवति । एवमिहास्मिन् छायावृत्ते भुजविषुवद्भ्यामग्रा च ज्ञेया इति फलितार्थो बोध्यः ।

अत्रोपपत्तिः । महाशङ्कावुदयास्तसूत्रात् शङ्कुमूलपर्यन्तं शङ्कुतलं लघुद्वादशाङ्गुलशङ्कौ चाक्षक्षेत्रसाजात्याच्छायावृत्तीयोदयास्तसूत्राल्लघुशङ्कुमूल-पर्यन्तमन्तरं पलभेति सर्वं गोलविदां स्फुटमेवेति ॥५९॥

वि. भा.—इष्टच्छायावृत्ते तदग्रयोर्याम्यापूर्वापरदिशोः परिणताग्रयोर्गतं सूत्र-मुदयास्तसूत्रम् । शङ्कोरनुपातादर्थाच्छङ्कुमूलात्तदन्तरं (उदयास्तसूत्रपर्यन्तमन्तर) विषुवच्छाया (पलभा) भवति, इह (अस्मिन् छायावृत्ते) भुजपलभाभ्यामग्रा च बोध्येति ॥५९॥

अत्रोपपत्तिः

छायाव्यासार्धवृत्तपरिणतयोः पूर्वापरदिशोरग्रयोर्गतं सूत्रमुदयास्तसूत्र-संज्ञकम् । तत्रोदयास्तसूत्रशङ्कुमूलयोरन्तरं शङ्कुतलम् । छायावृत्ते शङ्कुतलं पलभातुल्यमेव भवति, तेन छायावृत्तीयोदयास्तसूत्रे रचिते यथानियमं द्वादशा-ङ्गुलशङ्कौ स्थापिते च तयोरन्तरं गणितेन पलभातुल्यं स्वरूपेणाङ्गुलादिना मापिते च प्रत्यक्षतः पलभातुल्यं भवतीति । सिद्धान्तशेखरे 'इष्टप्रभाया वलये तदग्रया सूत्रं हि यत् स्यादुदयास्तसंज्ञितम् । त्रैराशिकेनास्य नरस्य चान्तरं पलप्रभाऽसौ प्रकटैव लक्ष्यते" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति ॥५९॥

अब इष्टछायावृत्त में पलभा और अग्रा की संस्थिति को कहते हैं

हि. भा.—इष्टछायावृत्त में परिणत पूर्व और पश्चिम दिशा की अग्राओं का अग्रगत सूत्र उदयास्त सूत्र है, शङ्कु मूल से उसका अन्तर पलभा होती है, और इस छायावृत्त में भुज और पलभा से अग्रा समझनी चाहिए इति ॥५९॥

उपपत्ति

छाया व्यासार्धवृत्त में परिणत पूर्व और पश्चिम दिशा की अग्राओं का अग्रगत सूत्र उदयास्त सूत्र है, शङ्कुमूल से उदयास्त सूत्र के ऊपर लम्ब शङ्कुतल है, परन्तु छायावृत्त में शङ्कुतल और पलभा तुल्य होती है, (इसके लिये पूर्व श्लोक की उपपत्ति देखिये) अतः आचार्योक्त युक्तियुक्त है, सिद्धान्तशेखर में "इष्टप्रभाया वलये" इत्यादि संस्कृतोपपत्ति में लिखित श्रीपति प्रकार आचार्योक्तानुरूप ही है इति ॥५९॥

इदानीं भुजच्छायाभ्यां क्रान्तिज्यानयनमाह

शङ्कुप्राच्यपरान्तरविषुवच्छायाहृतुसान्तरं बाह्ये ।
उदयेऽपयं लम्बगुणं कुज्याकर्णोद्धृतं क्रान्तिः ॥६०॥

सु. भा.—शङ्कुप्राच्यपरान्तरं लघुशङ्कुसंबंधी भुजः । विषुवच्छाया पलभा

प्रसिद्धा । याम्ये याम्यभुजेऽनयोरङ्गुलान्तरमुदगुत्तरभुजेऽनयोरैक्यं यत्तल्लम्बगुणं लम्बज्यागुणं छायाकर्णोद्धृतं फलं क्रान्तिः क्रान्तिज्या स्यादिति ।

अत्रोपपत्तिः । उत्तरगोले पूर्वविधिना याम्यो भुजः=वि—कअग्रा=भु । अतः कर्णवृत्ताग्रा=वि—भु । दक्षिणगोले सर्वदा याम्यो भुजः=वि+कअ=भु । अतः कर्णवृत्ताग्रा=भु—वि । एवं याम्ये भुजे भुजपलभयोरन्तरं कर्णवृत्ताग्रा फलिता । उत्तरगोले सौम्यो भुजः=कअ—वि=भु । अतः कअ=वि+भु । एवं कर्णवृत्ताग्रानयनमुपपन्नम् । कर्णवृत्ताग्रा त्रिज्यागुणा छायाकर्णहृता जाताऽग्रा $=\frac{\text{कअ}\cdot\text{त्रि}}{\text{छाक}}$ । इयं लम्बज्यागुणा त्रिज्याभक्ताऽक्षक्षेत्रसाजात्याज्जाता क्रान्तिज्या $=\frac{\text{लंज्या}\cdot\text{कअ}}{\text{छाक}}$ । अत उपपद्यते क्रान्तिज्यानयनम् ॥६०॥

वि. भा.—शङ्कुप्राच्यपरान्तरं (लघुद्वादशाङ्गुलसम्बन्धी भुजः) विषुवच्छाया (पलभा), याम्ये (दक्षिणभुजे) ऽनयोरङ्गुलान्तरं, उदक् (उत्तरभुजे) अनयोरैक्यं यत्तल्लम्बगुणं (लम्बज्यागुणितं), छायाकर्णभक्तं तदा क्रान्तिः (क्रान्तिज्या) भवेदिति ॥६०॥

अत्रोपपत्तिः

उत्तरगोले (५८ श्लोकोक्त्या) दक्षिणभुजः=पभा-कर्णवृत्ताग्रा=भु अतः कर्णवृत्ताग्रा=पलभा—भु । एतेन दक्षिणे भुजे भुजपलभयोरन्तरं कर्णवृत्ताग्रा निष्पन्ना, उत्तरगोले उत्तरभुजः =कर्णवृत्ताग्रा—पलभा,=भु, अतः कर्णवृत्ताग्रा= पलभा+भु, ततोऽनुपातेना 'यदि छायाकर्णेन कर्णवृत्ताग्रा लभ्यते तदा त्रिज्यया किमिति' ऽनेनाग्रा$=\frac{\text{कर्णवृत्ताग्रा.त्रि}}{\text{छाक}}$ ततो यदि त्रिज्यया लम्बज्या लभ्यते तदाऽग्रया किमित्यनुपातेन क्रान्तिज्या$=\frac{\text{लंज्या.अग्रा}}{\text{त्रि}}=\frac{\text{लंज्या.कर्णवृत्ताग्रा.त्रि}}{\text{छाक.त्रि}}$

$=\frac{\text{लंज्या.कर्णवृत्ताग्रा}}{\text{छाक}}$ एतेनाऽऽचार्योक्तमुपपन्नम् । सिद्धान्तशेखरे "रैखानरान्तरपलप्रभयोर्भवेद्यत् याम्येऽन्तरं युतिरुदक्द्युतिवृत्तजाऽग्रा । लम्बाहता भवति कर्णहृताऽपमज्येति" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव, सूर्यसिद्धान्तेऽपि "इष्टाग्राघ्नी तु लम्बज्या स्वकर्णाङ्गुलभाजितेत्यादि" ब्रह्मगुप्तो (आचार्य) क्तसदृशमेवेति ॥६०॥

अब भुज और छाया से क्रान्तिज्यानयन को कहते हैं

हि. भा.—दक्षिणभुज में पलभा और लघुद्वादशाङ्गुल सम्बन्धी भुज के अन्तर को

और उत्तर भुज में इन दोनों के योग को लम्बज्या से गुणाकर छायाकर्ण से भाग देने से क्रान्तिज्या होती है इति ॥६०॥

उपपत्ति

उत्तर गोल में (५८ श्लोकोक्ति से) दक्षिणभुज=पभा—कर्णवृत्ताग्रा=भु, अतः कर्णवृत्ताग्रा=पभा—भु इससे दक्षिण भुज में भुज और पलभा का अन्तर कर्णवृत्ताग्रा सिद्ध हुई, उत्तरगोल में उत्तरभुज=कर्णवृत्ताग्रा—पभा=भु अतः कर्णवृत्ताग्रा=पभा+भु, अब अनुपात करते हैं यदि छायाकर्ण में कर्णवृत्ताग्रा पाते हैं तो त्रिज्या में क्या इससे अग्रा आती है $\frac{\text{कर्णवृत्ताग्रा.त्रि}}{\text{छाक}}$=अग्रा, इससे अनुपात करते हैं यदि त्रिज्या में लम्बज्या पाते हैं तो अग्रा में क्या, इससे क्रान्तिज्या आती है, $\frac{\text{लंज्या.अग्रा}}{\text{त्रि}}=\frac{\text{लंज्या.कर्णवृत्ताग्रा.त्रि}}{\text{छाक.त्रि}}=$ $\frac{\text{लंज्या. कर्णवृत्ताग्रा}}{\text{छाक}}$=क्रांज्या इससे आचार्योक्त उपपन्न हुआ, सिद्धान्तशेखर में "रेखानरान्तरपलप्रभयोः" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति आचार्योक्तानुरूप ही कहते हैं, सूर्यसिद्धान्त में भी "इष्टाग्राघ्नी तु लम्बज्या स्वकर्णाङ्गुलभाजिता" इत्यादि आचार्योक्तसदृश ही है इति ॥६०॥

इदानीं क्रान्तिज्यातो रव्यानयनमाह

क्रान्तिर्व्यासार्धगुणा जिनभागज्याहृता धनुरर्काद्यौ ।
कक्यादौ चक्रार्धात् प्रोह्य तुलादौ समार्धेन ॥६१॥
चक्रात् प्रोह्य मृगादौ स्फुटोऽसकृद् धनमृणे धनेऽथर्णकम् ।
अस्माद् देशान्तरयुगयुगतो मध्यमः प्राग्वत् ॥६२॥

सु. भा.—क्रान्तिः क्रान्तिज्या व्यासार्धेन त्रिज्यया गुणा जिनज्यया हृतार्कदोर्ज्या भवति । तद्धनुर्मेषस्यैः प्रथमपादेऽर्काद्यौ राशित्रये स्फुटः सूर्यः । कर्क्यादौ राशित्रये तद्धनुश्चक्रार्धात् प्रोह्य शेषं स्फुटार्कः । एवं तुलादौ राशित्रये तद्धनुषा समार्धेन समः स्फुटोऽर्कः । मृगादौ राशित्रये च चक्राद् द्वादशराशिभ्यस्तद्धनुः प्रोह्य शेषं स्फुटोऽर्को ज्ञेयः तत्रासकृद्ग्रहणे मन्दफले धनं धने च ऋणं मन्दफलं देयं तदा स्वदेशे मध्यमोऽर्को भवति । अस्माद् देशान्तरयुगयुगतः । अर्थात् प्राग्देशान्तरफलसहितात् पश्चिमदेशान्तरफलरहितादस्मात् स्वदेशीयमध्यमार्कात् प्राग्वदुक्तरीत्या मध्यमः स्यादित्यर्थः ।

अत्रोपपत्तिः । विपरीतक्रियया स्फुटा । 'तद्धनुराद्ये चरणे वर्षस्यार्कः प्रजायते अन्येषु' इत्यादिभास्करविधिना पदवशाद्रविज्ञानं सुगममिति ॥६१-६२॥

वि. भा.—क्रान्तिः (क्रांतिज्या) व्यासार्धं (त्रिज्या) गुणा, जिनज्यया भक्ता तदा रविभुजज्या भवति, तद्धनुः (चापं) अजादौ (मेषादिराशित्रये प्रथमपदे) स्फुटो रविर्भवेत् । कर्क्यादिराशित्रये (द्वितीयपदे) तच्चापं चक्रार्धात् (राशिषट्कात्) विशोध्य शेषं स्फुटो रविः । तुलादौ राशित्रये (तृतीयपदे) सभार्धेन (राशिषट्कसहितेन) तच्चापेन तुल्यः स्फुटो रविर्भवति, मृगादौ राशित्रये (चतुर्थपदे) तच्चापं चक्रात् (द्वादशराशिभ्यः) विशोध्य शेषं स्फुटो रविर्भवेत् । तत्रासकृद्दणे मन्दफले धनं, धने च ऋणं मन्दफलं देयं स्वदेशे मध्यमो रविर्भवति, अस्माद्देशान्तरयुगयुगतोऽर्थात् प्राग्देशान्तरफलयुतात् पश्चिमदेशान्तरफलरहितात् स्वदेशीयमध्यमरवितः प्राग्वत् गणितागतो मध्यम इति ॥६१-६२॥

अत्रोपपत्तिः

यदि जिनज्यया त्रिज्या लभ्यते तदा रविक्रान्तिज्यया किमिति क्रान्तिक्षेत्रानुपातेन समागच्छति रविभुजज्या तत्स्वरूपम् $=\frac{\text{त्रि. क्रांज्या}}{\text{जिज्या}}$ अस्याश्चापं रविभुजांशा भवेयुः । प्रथमपदे त्वयमेव स्फुटरविः, द्वितीयपदे चक्रार्धाद्विशोधनेन तृतीयपदे चक्रार्धयोजनेन चतुर्थपदे च चक्राद्विशोधनेन स्फुटो रविर्भवतीति गोले प्रत्यक्षमेव दृश्यते, सिद्धान्तशिरोमणौ "तद्धनुराद्ये चरणे वर्षस्यार्कः प्रजायतेऽन्येषु" इत्यादिना भास्करेणाऽऽचार्योक्तानुरूपमेव कथ्यते। किन्तु भास्करादिभिराचार्यैः पदज्ञानमृतुवर्णनद्वारा प्रदर्शितमस्ति तन्न समीचीनमित्येतदर्थं सिद्धान्ततत्त्वविवेके कमलाकरेण- "ऋतुचिह्नैरिदं पूर्वैरुक्तं सर्वत्र तन्नहि । केवलं कुकविप्रीत्यै पदज्ञप्त्यै न तद्रवेः" त्यादिना सोपहासं प्रत्याख्यातम् । तथा तज्ज्ञानार्थं स्वकीयप्रकारश्च "आद्ये पदेऽपचयिनी पलभाल्पिका स्यात् छायाल्पिका भवति वृद्धिमती द्वितीये । छायाधिका भवति वृद्धिमती तृतीये तुर्ये पुनः क्षयवती तदनल्पिका च" प्रदर्शितः, अस्य युक्तिः—मेषादिगे सायनभागसूर्ये दिनार्धजा भा पलभा भवेत्सेतिभास्करोक्तेर्विषुवद्दिने मध्याह्ने या छाया सा पलभा, तस्माद्दिनादारभ्य प्रतिदिनं निरक्षादुत्तरे देशे "$\frac{\text{नतांशज्या १२}}{\text{नतांशकोज्या}}=\frac{\text{दृग्ज्या. १२}}{\text{शङ्कु}}=$छाया" इति छायास्वरूपदर्शनान्मध्यनतांशस्यापचयान्मध्यशङ्कोरुपचयान्मध्यच्छायाया उत्तरोत्तरमपचयो भवेत् । तेन मध्यच्छायायाः पलभाल्पाया उत्तरोत्तरमपचये रवेः प्रथमपदं भवेदेवेति । द्वितीयपदे मध्यनतांशा उत्तरोत्तरमुपचीयमाना भवन्ति तेन मध्यच्छायायामुत्तरोत्तरं वृद्धिमत्यां पलभातोऽल्पायां रवेर्द्वितीयपदं भवेदेव । तृतीयपदे पलभाधिका मध्यच्छायो-

रोत्तरं वृद्धिमती भवति (रवेर्दक्षिणगमनात्)। चतुर्थे पदे नतांशस्योत्तरोत्तरम-पचयात् पलभाधिका छायाऽपचीयते, निरक्षाद्दक्षिणे देशे प्रथमपदे मध्यनतांशोपचया-न्मध्यच्छायोपचयः। तत्र छायाग्रं दक्षिणदिश्येव भवेत् (खमध्यस्थितत्वाद्रवेः क्रान्तेः रवे-रदर्शनात्)। द्वितीयपदे मध्यनतांशापचयान्मध्यच्छायापचयः (रवेरुत्तरोत्तरं दक्षिणगमनात्) तृतीयपदे चतुर्थपदे च नतांशोपचयापचययोर्नियमो नास्ति तेन तत्रैकेन नियमेन मध्यच्छायया पदज्ञानं न भवितुमर्हति, तेनैव हेतुने "वृद्धि प्रयान्ती यदि दक्षिणाग्राच्छाया तथापि प्रथमं पदं स्यात्। क्रमं व्रजन्तीमथ तां विलोक्य रवेर्विजानीहि पदं द्वितीयम्" त्युक्तम्। सिद्धान्तशेखरे प्रकारस्यास्य चमत्कारकार-कस्योल्लेखदर्शनात् "आद्ये पदेऽपचयिनी पलभाल्पिका स्यादित्यादि" प्रकारः कमलाकरस्य नास्ति, वस्तुतोऽयं प्रकारः श्रीपतेरेवेति ॥६१-६२॥

अब क्रान्तिज्या से रवि के आनयन को कहते हैं

हि. भा.—क्रान्तिज्या को त्रिज्या से गुणा कर जिनज्या से भाग देने से रवि भुजज्या होती है, उसका चाप मेषादि तीन राशियों (प्रथमपद) में स्फुट रवि होता है, कर्कादि तीन राशियों (द्वितीय पद) में उस चाप को छः राशियों में घटाने से तुलादि तीन राशियों (तृतीय पद) में चाप में छः राशि जोड़ने से, मकरादि तीन राशियों (चतुर्थ पद) में चाप को बारह राशि में घटाने से स्फुट रवि होता है, शेष की व्याख्या स्पष्ट है इति ॥६१-६२॥

उपपत्ति

यदि जिनज्या में त्रिज्या पाते हैं तो रवि की क्रान्तिज्या में क्या इस क्रान्तिक्षेत्र के अनुपात से रविभुजज्या आती है,

$\frac{\text{त्रि.क्रांज्या}}{\text{जिज्या}}$ = रविभुजज्या, इसका चाप प्रथम पद में स्फुट रवि होता है। द्वितीय पद में उस चाप को छः राशि में घटाने से तृतीय पद में चाप में छः राशि जोड़ने से, चतुर्थ पद में चाप को बारह राशि में घटाने से स्फुट रवि होता है। यह गोल में प्रत्यक्ष देखा जाता है, सिद्धान्तशिरोमणि में "तदनुराद्यं चरखे वर्धरयार्कः प्रयातेऽन्येषु" इत्यादि से भास्करा-चार्य आचार्योक्ति के अनुरूप ही कहते हैं, लेकिन भास्करादि आचार्यों ने रवि का पदज्ञान ऋतुवर्णन द्वारा किया है जो ठीक नहीं है इसके लिये सिद्धान्ततत्त्वविवेक में कमलाकर ने "ऋतुचिन्हैरिदं पूर्वैः" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से उसका निराकरण किया है। तथा उसके वास्तव ज्ञान के लिये अपना प्रकार 'आद्ये पदेऽपचयिनी पलभाऽल्पिका स्यात्' इत्यादि दिखलाया है। इसकी युक्ति इस प्रकार है—विषुवद् दिन में मध्याह्नकाल में द्वादशांगुल शङ्कु की जो छाया होती है वह पलभा है, उस दिन से लेकर प्रत्येक दिन निरक्ष देश से उत्तर देश में $\frac{\text{नतांशज्या. १२}}{\text{नतांश कोज्या}} = \frac{\text{दृग्ज्या. १२}}{\text{शङ्कु}}$ = छाया, इस छायास्वरूप को

देखने से मध्यनतांश के अपचय (ह्रास) से मध्यशङ्कु के उपचय (वृद्धि) से मध्यच्छाया का उत्तरोत्तर अपचय होता है इसलिए पलभा से अल्प मध्यच्छाया का उत्तरोत्तर अपचय होने से रवि का प्रथम पद होता ही है, द्वितीय पद में मध्यनतांश उत्तरोत्तर बढ़ता है जबतक तुलादि सम्पात में रवि जाता है, इसलिये पलभा से अल्प उत्तरोत्तर वृद्धिमती मध्यच्छाया होने से द्वितीय पद होता है, तृतीय पद में मध्यच्छाया पलभा से अधिक उत्तरोत्तर उपचित होती है (रवि के दक्षिण गमन के कारण से), चतुर्थ पद में पुनः उत्तरगमन प्रवृत्तिसे उत्तरोत्तर नतांश का अपचय होता है इसलिए पलभा से अधिक छाया अपचयमती होती है, अतः "आद्ये पदेऽपचयिनी" इत्यादि युक्तियुक्त कहा गया है। निरक्ष देश से दक्षिण देश में प्रथम पद में मध्यनतांश के उपचय से मध्यच्छाया का उपचय होता है लेकिन वहां स्वखस्वस्तिक से उत्तर में रवि के रहने के कारण छायाग्र दक्षिण दिशा ही में होता है इसलिये "वृद्धि प्रयान्ती यदि दक्षिणाग्रा" इत्यादि संस्कृतोपपत्ति में लिखित पद्य युक्तियुक्त कहा गया है. द्वितीय पद में रवि के उत्तरोत्तर दक्षिण गमन के कारण मध्यनतांश के अपचय से मध्यच्छाया का अपचय होता है, तृतीय पद में और चतुर्थ पद में नतांश के उपचय और अपचय के अनियम से वहां मध्यच्छाया द्वारा एक नियम से पदज्ञान नहीं होता है, ये सब बातें गोल को देखने से स्पष्ट हैं, सिद्धान्तशेखर में "आद्ये पदेऽपचयिनी" इत्यादि चमत्कृतियुक्त प्रकार देखा जाता है। इस से सिद्ध होता है कि यह रवि का पदज्ञान-प्रकार वस्तुतः श्रीपति ही का है, कमलाकर का नहीं है इति ॥६१-६२॥

इदानीं चन्द्रशृङ्गोन्नतौ रविशङ्क्वर्थं विशेषमाह

शशिशृङ्गोन्नत्यर्थं रात्रेर्गतशेषनाडिका शङ्कुः।
विपरीतगोलविधिना रात्र्यर्धान्तराभिर्वा ॥६३॥

सु. भा.—पश्चिमदिशि शृङ्गोन्नत्यर्थं रात्रेर्गतनाडिकाभिरुन्नताभिः प्राग्दिशि च रात्रिशेषनाडिकाभिरुन्नताभिः 'गतशेषाल्पस्याह्नः' इत्यादिना विपरीतगोलविधिना रवेः शङ्कुः साध्यः। यदि नताभिर्नाडीभिरर्कशङ्कुरपेक्षितस्तदा रात्र्यर्धान्तराभिर्नतनाडिकाभिः स शङ्कुरानेयः।

अत्रोपपत्तिः। 'निशावशेषैरसुभिर्गतैर्वा' इत्यादि भास्करशृङ्गोन्नतविधिना स्फुटा। दृश्यशृङ्गोन्नतौ रवेः क्षितिजाधःस्थितत्वादधोयाम्योत्तरवृत्तान्नतकालोऽपेक्षितोऽतो रात्र्यर्धान्तरतो नतनाडिकासाधनायातिदेशं चकाराऽऽचार्यः ॥६३॥

वि. भा.—पश्चिमायां दिशि चन्द्रशृङ्गोन्नत्यर्थं रात्रेर्गतनाडिकाभिः (उन्नताभिः) पूर्वस्यां दिशि रात्रिशेषनाडिकाभिः (उन्नताभिः) 'गतशेषाल्पस्याह्नः' इत्यादिना विपरीतगोलविधिना रवेः शङ्कुः साध्यः। यदि नताभिर्नाडीभि-

रविशङ्कुरपेक्षितस्तदा राज्यर्धार्कान्तराभिर्नतनाडिकाभिः शङ्कुः साध्य इति ॥ ६३ ॥

अत्रोपपत्तिः

क्षितिजादधः स्थिते रवावेव चन्द्रशृङ्गोन्नतिर्दृश्या भवतीत्यधो याम्योत्तर-वृत्तान्नतकालज्ञानाय राज्यर्धार्कान्तरतो नतनाडिकासाधनमुक्तमाचार्येण, सिद्धान्त-शेखरे "हिमांशुशृङ्गोन्नतये तु रात्रेर्गतावशेषैरसुभिर्नतैर्वा । प्रसाधयेदुक्तवदेव शङ्कुं स्वसाधनैर्गोलविपर्ययेण" श्रीपत्युक्तमिदं, सिद्धान्तशिरोमणौ "निशावशे-षैरसुभिर्गतैर्वा यथाक्रमं गोलविपर्ययेण । रवेरधः शङ्कुरिति" भास्करोक्तञ्चाऽऽचा-र्योक्त्यनुरूपमेवेति ॥ ६३ ॥

अब चन्द्रशृङ्गोन्नति में रविशङ्कु के लिये विशेष कहते हैं

हि. भा.—पश्चिम दिशा में चन्द्रशृङ्गोन्नति के लिये रात्रि की गतघटी (उन्नत घटी) से, पूर्व दिशा में रात्रि की शेष घटी (उन्नत घटी) से 'गतशेषाल्पस्याह्नः' इत्यादि से विपरीत (उल्टा) गोलविधि से रवि का अधः शङ्कुसाधन करना । नतनाड़ी से भी आचार्य कथित विधि से शङ्कु साधन करना चाहिये इति ॥६३॥

उपपत्ति

क्षितिज से नीचे रवि के रहने ही से चन्द्र शृङ्गोन्नति दृश्य होती है, इसलिये अधोयाम्योत्तरवृत्त से नतकाल ज्ञान के लिये राज्यर्ध और रवि के अन्तर से नतनाड़ी का साधन आचार्य ने कहा है । सिद्धान्तशेखर में 'हिमांशुशृङ्गोन्नतये तु रात्रेः इत्यादि सं० उपपत्ति में लिखित श्लोक से श्रीपति तथा सिद्धान्तशिरोमणि में 'निशावशेषैरसुभिः' इत्यादि संस्कृत-उपपत्ति में लिखित पद्य से भास्कराचार्य ने भी आचार्योक्ति के अनुरूप ही कहा है इति ॥ ६३ ॥

इदानीमुदयास्तसूत्रमाह

क्षितिजेऽग्रा प्राच्यपराक्रान्तिस्त्रिज्यागुणाऽवलम्बहृता ।
द्विगुणमुदयास्तसूत्रं तत् त्रिज्याकृतिवियुक्तपदम् ॥६४॥

सु. भा.—क्रान्तिः क्रान्तिज्या त्रिज्यागुणाऽवलम्बेन लम्बज्यया हृता तदाऽग्रा स्यात् । इयमग्रा क्षितिजे प्राच्यपरा भवति । अर्थात् क्षितिजे प्राचि प्रतीच्यां च प्रागपरस्वस्तिकाभ्यां यथा दिक्काऽग्रा भवतीत्यर्थः । तत्त्रिज्याकृतिवियुक्तपदं द्विगुणमुदयास्तसूत्रं भवेदिति ।

अत्रोपपत्तिः। कुज्या भुजः। क्रान्तिज्या कोटिः। अग्रा कर्णः। इत्यक्षक्षेत्रं प्रसिद्धम्। ततो यदि लम्बज्याकोट्या त्रिज्या कर्णस्तदा क्रान्तिज्याकोट्या किं

जाताग्रा $= \frac{\text{क्रांज्या} \cdot \text{त्रि}}{\text{लंज्या}}$। अग्रावर्गोनात्त्रिज्यावर्गात्पदमग्रा कोटिज्या तद् द्विगुणमे-

वोदयास्तसूत्रं प्रसिद्धमिति ॥६४॥

वि. भा.—क्रान्तिः (क्रान्तिज्या) त्रिज्यागुणिता लम्बज्यया भक्ता तदाऽग्रा स्यात्। इयं क्षितिजे प्राच्यपरा (पूर्वापरा) भवत्यर्थात् पूर्वस्यां दिशि पश्चिमायां दिशि च पूर्वस्वस्तिकपश्चिमस्वस्तिकाभ्यां यथा दिक्का भवति, तत् त्रिज्यावर्गान्तर-मूलं द्विगुणं तदोदयास्तसूत्रं भवतीति ॥६४॥

अत्रोपपत्तिः

यदि लम्बज्यया त्रिज्या लभ्यते तदा क्रान्तिज्यया किमित्यक्षक्षेत्रानुपातेन

समागच्छत्यग्रा $= \frac{\text{त्रि} \cdot \text{क्रांज्या}}{\text{लंज्या}}$ त्रिज्यावर्गेऽग्रावर्गविशोधिते पदे च गृहीतेऽग्राकोटिज्या

$= \sqrt{\text{त्रि}^2 - \text{अग्रा}^2}$ एतद् द्विगुणमेवोदयास्तसूत्रं भवतीति। सिद्धान्तशेखरे "पूर्वा-

पराया क्षितिजे कृताग्रा तत् त्रिज्यकावर्गविशेषमूलम्। द्विनिघ्नमुक्तं खलु याम्यसौम्यं गोलप्रवीणैरुदयास्तसूत्रम्" श्रीपत्युक्तमिदं सिद्धान्तशिरोमणौ 'क्ष्माजे द्युरात्रसम-मण्डलमध्यभागजीवाऽग्रका भवति पूर्वपराशयोः सा" भास्करोक्तमिदं चाऽऽचार्यो-क्तानुरूपमेवेति ॥६४॥

अब उदयास्तसूत्र को कहते हैं

हि. भा.—क्रान्तिज्या को त्रिज्या से गुणा कर लम्बज्या से भाग देने से अग्रा होती है, यह अग्रा पूर्व दिशा में और पश्चिम दिशा में पूर्वस्वस्तिक और पश्चिम स्वस्तिक से यथादिक् होती है, इसके और त्रिज्या के वर्गान्तरमूल को द्विगुणित करने से उदयास्त सूत्र होता है इति ॥६४॥

उपपत्ति

यदि लम्बज्या में त्रिज्या पाते हैं तो क्रांतिज्या में क्या इस अक्षक्षेत्रानुपात से अग्रा

आती है, $\frac{\text{त्रि} \cdot \text{क्रांज्या}}{\text{लंज्या}}$ = अग्रा, त्रिज्या वर्ग में अग्रा वर्ग को घटाकर मूल लेने से अग्राकोटिज्या

होती है। इसको द्विगुणित करने से उदयास्त सूत्र होता है, सिद्धान्तशेखर में 'पूर्वापरा या

क्षितिजे कृताग्रा' इत्यादि सं उपपत्ति में लिखित श्लोक से श्रीपति तथा सिद्धान्तशिरोमणि में 'क्षमाजे द्युरात्रममण्डलमध्यभागजीवाऽग्रका' इत्यादि से भास्कराचार्य भी आचार्योक्तानुरूप ही कहते हैं इति ॥६४॥

इदानीं शङ्कुतलानयनमाह

अक्षज्याशङ्कुवधाल्लम्बकलब्धोदयास्तमयसूत्रात् ।
दक्षिणतः शङ्कुतलं दिवसे रात्रौ तदुत्तरतः ॥६५॥

सु. भा.—स्पष्टार्थम् ।

अत्रोपपत्तिः । अक्षवशतो दिवाऽहोरात्रवृत्तानि दक्षिणतो रात्रावुत्तरतो नतान्यतो दिवा शङ्कुतलं दक्षिणं रात्रावुत्तरं भवति । अक्षक्षेत्रानुपातेन शङ्कुतलानयनं स्फुटम् ॥६५॥

वि. भा.—अक्षज्याशङ्कुघातात् लम्बज्यया भक्ताल्लब्धं शङ्कुतलं भवति, तद् दिने उदयास्तसूत्राद् दक्षिणतो रात्रावुत्तरतश्च भवतीति ॥६५॥

अत्रोपपत्तिः

ग्रहात् क्षितिजधरातलोपरि यो लम्बः स शङ्कुः । शङ्कुमूलादुदयास्तसूत्रपर्यन्तं शङ्कुतलम् । क्षितिजादुपरि दक्षिणतोऽहोरात्रवृत्तस्य गतत्वाद् दिने तच्छङ्कुतलमुदयास्तसूत्राद् दक्षिणतः क्षितिजादधश्चाहोरात्रवृत्तस्योत्तरतो गतत्वाद्रात्रावुत्तरत उदयास्तसूत्राच्छङ्कुतलं भवतीति गोलोपरि स्फुटं दृश्यते । अक्षक्षेत्रानुपातेना 'यदि लम्बज्ययाऽक्षज्या लभ्यते तदा शङ्कुना किमिति' अनेन शङ्कुतलम् $= \frac{\text{अज्या. शं}}{\text{लंज्या}}$

सिद्धान्तशेखरे "पलज्यया शङ्कुगुणितात् स्वशङ्कोर्लम्बेन भक्तात् फलमाप्यते यत् । याम्योत्तरं शङ्कुतलं भवेत्तद् दिवारजन्योरुदयास्तसूत्रात्" श्रीपत्युक्तमिदं, सिद्धान्तशिरोमणौ 'सूत्राद् दिवाशङ्कुतलं यमाशं याम्यां गत हि द्युनिशं कुजोर्ध्वे । अतश्च सौम्यां निशि सौम्यमस्मात् सयुक्तियुक्तं नृतलं निरुक्तम्" भास्करोक्तमिदं चाऽऽचार्योक्तानुरूपमेवेति ॥६५॥

अब शङ्कुतलानयन को कहते हैं

हि. भा.—अक्षज्या और शङ्कु के घात को लम्बज्या से भाग देने से फल शङ्कुतल होता है वह दिन में उदयास्तसूत्र से दक्षिण और रात्रि में उत्तर होता है ॥६५॥

उपपत्ति

यदि लम्बज्या में अक्षज्या पाते हैं तो शङ्कु में क्या इस अक्षक्षेत्रानुपात से शङ्कुतल

आता है $\frac{\text{अज्या. शं}}{\text{लज्या}}$ = शङ्कुतल। ग्रहस्थान से क्षितिज धरातल के ऊपर जो लम्ब होता है वह शङ्कु है, शङ्कु मूल से उदयास्तसूत्रपर्यन्त शङ्कुतल है, क्षितिज से ऊपर अहोरात्र वृत्त के दक्षिण जाने से दिन में वह शङ्कुतल उदयास्त सूत्र से दक्षिण होता है, क्षितिज से नीचे (रात्रि में) अहोरात्रवृत्त के उत्तर जाने से वह शङ्कुतल उदयास्त सूत्र से उत्तर होता है, यह विषय गोल के ऊपर स्पष्ट देखने में आता है, सिद्धान्तशेखर में 'पलज्यया सङ्गुणि-तात्'' इत्यादि से सं उपपत्ति में लिखित श्लोक से श्रीपति तथा सिद्धान्तशिरोमणि में 'सूत्राद् दिवाशङ्कुतलं यमाशं'' इत्यादि सं उपपत्ति में लिखित श्लोक से भास्कराचार्य भी आचार्योक्तानुरूप ही कहते हैं इति ॥६५॥

इदानीमध्यायोपसंहारमाह

दिग्लम्बाक्षस्वोदयलग्नच्छायादिषूपदिष्टेषु ।
षट्षष्ट्यार्याणां त्रिप्रश्नाध्यायस्तृतीयोऽयम् ॥६६॥

सु. भा.—स्पष्टार्थम् ।

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते ।
हृदि तं विनिधाय नूतनोऽयं रचितः प्रश्नविधौ सुधाकरेण ॥

इति श्रीकृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्तनूतनतिलके त्रिप्रश्नाधिकारस्तृतीयः ॥६६॥

वि. भा.—कथितेषु दिग्ज्ञानलम्बांशाक्षांशस्वदेशोदयमानलग्नच्छायादिसाधनेषु आर्याछन्दोबद्धषट्षष्टिप्रमितश्लोकैरयं तृतीयस्त्रिप्रश्नाध्यायः समाप्तिं गत इति॥६६॥

इति ब्राह्मस्फुटसिद्धान्ते त्रिप्रश्नाध्यायस्तृतीयः

हि भा.—पूर्वकथित दिग्ज्ञान-लम्बांश-अक्षांश-स्वदेशीयराश्युदयमान-लग्न-छायादिकों के साधन में छियासठ आर्याछन्द के श्लोकों से यह तीसरा त्रिप्रश्नाध्याय समाप्त हुआ ॥६६॥

इति ब्राह्मस्फुटसिद्धान्त में त्रिप्रश्ना नामक तृतीय अध्याय समाप्त हुआ



ब्राह्मस्फुटसिद्धान्तः

७

चन्द्रग्रहणाधिकारः

ब्राह्मस्फुटसिद्धान्तः

चन्द्रग्रहणाधिकारः

अथ चन्द्रग्रहणाधिकारो व्याख्यायते तत्रादौ तदारम्भप्रयोजनमाह

कालज्ञानं प्रायः पर्वज्ञानार्थमिष्यते सद्भिः ।
शशिभास्करग्रहणयोर्वास्तवभेदाः स्फुटा भेदैः ॥१॥

दिग्वर्णवलनवेलानिमीलनोन्मीलनस्थितिविमर्दैः ।
स्पर्शच्छायामोक्षग्रासेष्टग्रासपरिलेखाः ॥२॥

भेदाश्चतुर्दश तयोरिन्द्वर्कग्रहणयोः परिज्ञानात् ।
यस्माद् भेदज्ञानं तस्मात् ग्रहणे प्रवक्ष्यामि ॥३॥

सु. भा.—सद्भिः सद्गणकैः प्रायो बाहुल्येन पर्वज्ञानार्थं कालज्ञानमिष्यते । तद्विपरीतेनार्थात् पर्वज्ञानात् कालज्ञानं च स्फुटम् । कालज्ञानाद्यज्ञादिक्रिया स्फुटेति फलितार्थः । शशिभास्करग्रहणयोर्ज्ञानार्थं ये वास्तवभेदा दिग्देशकालावरणाद्यास्ते भेदैर्वक्ष्यमाणैः स्फुटाः । चतुर्दशभेदाश्च दिग्वर्णवलनवेलाद्याः स्फुटाः । (दिग्भेदश्च-न्द्रस्य प्राक् प्रग्रहणं रवेः पश्चात् । वर्णभेदश्चन्द्रस्यार्धाल्पार्धाधिग्रासे धूम्रादयो वर्णा रवेः सर्वदा कृष्णः । वलनभेदश्चन्द्रग्रहे स्पर्शमोक्षोद्भववलने प्राक्पश्चिमतो देये रविग्रहे पश्चिमपूर्वतः । वेलासमयश्चन्द्रग्रहे सदा तिथ्यन्त एव मध्यग्रहः सूर्यग्रहे स नियमो नैव । निमीलनोन्मीलने च शशिसूर्यग्रहणयोर्मिथो व्यस्ता अतो भवत इति तत्रापि भेदः । स्थितिश्च चन्द्रग्रहे महती रविग्रहे लघुरिति । एवं विमर्द-कालश्च चन्द्रग्रहे महान् रविग्रहे लघुः । स्पर्शः स्पर्शकालनिर्णयश्च चन्द्रग्रहे स्थित्यर्धाद्रविग्रहे लम्बनसंस्कृतस्थित्यर्धात् । छायाभेदश्च प्रग्रहणादिषु स्वस्वश-ङ्कुभेदात् प्रसिद्धः । मोक्षभेदश्च चन्द्रग्रहे पश्चाद्रविग्रहे प्राक् मोक्षः । ग्रासभेदश्चन्द्र-ग्रहे शरतो रविग्रहे नतिसंस्कृताच्छरतः । इष्टग्रासभेदश्चन्द्रग्रहे तत्कालशराद्-गणितागतस्थित्यर्धाच्च रविग्रहे नतिसंस्कृतशरात् स्पष्टस्थित्यर्धाच्च । परिलेख-भेदश्च चन्द्रग्रहे गणितागतशरात् रविग्रहे नतिसंस्कृतात् । एवमत्र दिक् १ । वर्ण २ । वलन ३ । वेला ४ । निमीलन ५ । उन्मीलन ६ । स्थिति ७ । विमर्द ८ । स्पर्श ९ । छाया १० । मोक्ष ११ । ग्रास १२ । इष्टग्रास १३ । परिलेख १४ ।

चतुर्दशभेदाः।) यस्मादिन्द्वर्कग्रहणयोः परिज्ञानादिति चतुर्दशभेदज्ञानं भवति तस्माच्छशिरविग्रहणे अहं प्रवक्ष्यामीति ॥१-२-३॥

वि. भा.—सद्भिः (वेदज्ञैः सद्गणकैर्वा) प्रायः (बाहुल्येन) पर्वज्ञानार्थं कालज्ञानमिष्यते (अमावास्यापूर्णिमादिपर्वणां प्रारम्भान्तसमयौ प्रधानतया वेदविहितकर्मानुष्ठानाय तद्विदां प्रयोजनीभूतौ भवतोऽतएव ज्योतिःशास्त्रेऽपि मुख्यतया तत्तत्पर्वणामेव कस्मिन् काले आरम्भः कस्मिन् कालेऽन्त इत्यस्यैवात्र-गमः क्रियत इति भावः) चन्द्रसूर्यग्रहणयोर्ज्ञानार्थं ये वास्तवभेदाः (दिग्देश-कालावरणाद्याः) तेऽधोलिखितभेदैः स्फुटा भवन्ति। दिग्भेदः (चन्द्रग्रहणे प्राक् प्रग्रहणं, सूर्यग्रहणे च पश्चात्), वर्णभेदः (चन्द्रग्रहणे-अर्धग्रासार्धाधिकग्राससर्व-ग्रासादिषु चन्द्रस्य कृष्ण-कृष्णरक्त-पिशङ्गवर्णादयो भवन्ति। सूर्यग्रहणे सूर्यस्य वर्णः सर्वदा कृष्ण एव भवति) वलनभेदः (स्पार्शिकमौक्षिकवलने पूर्वपश्चिमतश्चन्द्र-ग्रहणे, सूर्यग्रहणे च पश्चिमपूर्वतः) वेला (समयभेदः) चन्द्रग्रहणे सर्वदा तिथ्यन्त एव प्रग्रहः, सूर्यग्रहणे स नियमो नास्ति, निमीलनोन्मीलने (चन्द्रग्रहणे सूर्यग्रहणे च परस्परं वैपरीत्येन भवत इति तत्रापि भेदः) स्थितिभेदः (चन्द्रग्रहे महती स्थितिः, सूर्यग्रहे लघुरिति), विमर्दकालभेदः (चन्द्रग्रहणे महान् सूर्यग्रहणे चाल्पः) स्पर्शः (स्पर्शकालनिर्णयः) चन्द्रग्रहणे स्थित्यर्धात्, सूर्यग्रहणे च लम्बन-संस्कृतस्थित्यर्धात्) छायाभेदः (स्वस्वशङ्कुभेदात् प्रग्रहणादिषु भवेदेव) मोक्षभेदः (चन्द्रग्रहे पश्चिमतः सूर्यग्रहे च पूर्वतो मोक्षः) ग्रासभेदः (चन्द्रग्रहे शरात्—सूर्यग्रहे च नतिसंस्कृतशरतः) इष्टग्रासभेदः (चन्द्रग्रहे तत्कालशराद् गणितागतस्थित्यर्धाच्च, सूर्यग्रहणे नतिसंस्कृतशरात्—स्फुटस्थित्यर्धाच्च,) परिलेखभेदः (चन्द्रग्रहणे गणिता-गतशरात्—सूर्यग्रहणे च नतिसंस्कृतशरात्) एवमत्र चतुर्दश भेदा भवन्ति, यतो रविचन्द्रयोर्ग्रहणज्ञानाच्चतुर्दशभेदज्ञानं भवत्यतश्चन्द्रसूर्यग्रहणे अहं प्रवक्ष्यामीति ॥१-२-३॥

हि. भा.—अच्छे गणक लोग प्रायः पर्वज्ञान के लिये समयज्ञान को कहते हैं अर्थात् अमावास्या—पूर्णिमा आदि पर्वों के आरम्भ और अन्त समय प्रधान रूप से वेदोक्त कर्मा-नुष्ठान के लिए सद्गणकों वा वेदज्ञों को प्रयोजनीभूत होते हैं अतएव ज्योतिःशास्त्र में भी मुख्य रूप से उन पर्वों का किस समय में आरम्भ होता है और किस समय में अन्त होता है इसी का ज्ञान किया जाता है, चन्द्रग्रहण और सूर्यग्रहण के ज्ञान के लिये जो वास्तव भेद (दिक् देशकालादि) हैं वे निम्नलिखित भेदों से स्फुट होते हैं, दिग्भेद (चन्द्रग्रहण में पूर्व-दिशा में प्रग्रहण होता है और सूर्यग्रहण में पश्चिम में होता है) वर्णभेद (चन्द्रग्रहण में अर्धग्रास-अर्धाधिकग्रास-सर्वग्रासादियों में चन्द्र के वर्ण कृष्ण-कृष्णरक्त-कपिलवर्ण आदि होते हैं, सूर्य ग्रहण में सूर्य का वर्ण सदा कृष्ण ही होता है) वलनभेद (चन्द्रग्रहण में स्पार्शिक वलन और मौक्षिक वलन पूर्व और पश्चिम से सूर्यग्रहण में पश्चिम और पूर्व) वेला (समय) भेद (चन्द्रग्रहण में सदा तिथ्यन्त ही में प्रग्रह होता है, सूर्यग्रहण में यह नियम

नहीं है। निमीलन भेद और उन्मीलनभेद (वे चन्द्रग्रहण में और सूर्यग्रहण में परस्पर विपरीत होते हैं) स्थिति भेद (चन्द्रग्रहण में स्थिति महती होती है और सूर्यग्रहण में लघु) विमर्दकाल (चन्द्रग्रहण में महान् और सूर्यग्रहण में अल्प) स्पर्श (स्पर्शकालनिर्णय) भेद (चन्द्रग्रहण में स्थित्यर्ध से और सूर्यग्रहण में लम्बन संस्कृतस्थित्यर्ध से) छायाभेद (अपने-अपने शङ्कुभेद से अपग्रहादियों में होते ही हैं) मोक्षभेद (चन्द्रग्रहण में पश्चिम से और सूर्यग्रहण में पूर्व से मोक्ष होता है) ग्रासभेद (चन्द्रग्रहण में शर से और सूर्यग्रहण में नतिसंस्कृतशर से) इष्टग्रासभेद (चन्द्रग्रहण में तात्कालिकशर से और गणितागत स्थित्यर्ध से भी, सूर्यग्रहण में नतिसंस्कृतशर से और स्फुटस्थित्यर्ध से भी) परिलेख भेद (चन्द्रग्रहण में गणितागतशर से और सूर्यग्रहण में नतिसंस्कृतशर से) इस तरह यहां चौदह भेद होते हैं, जिस कारण से चन्द्रग्रहण और सूर्यग्रहण के ज्ञान से उन चौदह भेदों का ज्ञान होता है। इस हेतु से मैं चन्द्रग्रहण और सूर्यग्रहण को कहता हूं इति ॥१-२-३॥

इदानीं तात्कालिकीकरणमाह

तिथिगतगम्ये भुक्तिगुणे भुक्त्यन्तरहृते फलोनयुतौ।

रविशशिनौ समलिप्तौ पातस्तात्कालिको भवति ॥४॥

सु. भा.—तिथिगतगम्ये तिथिगतगम्यकले भुक्तिगुणे रविभुक्त्या चन्द्रभुक्त्या च गुणे। उभयत्र रविचन्द्रभुक्त्यन्तरेण हृते। गतचालने फलोनौ गम्ये फलयुतौ रविशशिनौ। एवं तौ तात्कालिकौ तिथ्यन्ते समलिप्तौ भवतः। एवं पातगत्या पातोऽपि तात्कालिको भवति।

अत्रोपपत्तिः। तिथिगतगम्ये कले षष्टिगुणे रविचन्द्रगत्यन्तरभक्ते गतैष्या घटिकास्ता गतिगुणाः षष्टिहृताश्चालनकलाः स्युः। एवमत्र षष्टितुल्ययोर्गुणहरयो-र्नाशाद्यथोक्ता क्रियोत्पद्यते ॥४॥

वि. भा.—तिथिगतगम्ये (तिथिगतगम्यकले) भुक्तिगुणे (चन्द्रगत्या रविगत्या च गुणिते) भुक्त्यन्तरहृते (रविचन्द्रयोर्गत्यन्तरेण भक्ते) गतचालने फलेन हीनौ, गम्यचालने फलेन युतौ चन्द्ररवी, तिथ्यन्ते तात्कालिकौ समलिप्तौ चन्द्ररवी भवतः। एवं स्वगत्या पातोऽपि तात्कालिको भवतीति ॥४॥

अत्रोपपत्तिः

यदि रविचन्द्रगत्यन्तरकलायां षष्टिघटिका लभ्यन्ते तदा तिथिगतकलायां गम्यकलायां च किमित्यनुपातेन तिथिगतघट्यो गम्यघट्यश्च समागच्छन्ति, ततः षष्टिघटिकायां स्वस्वगतिकला लभ्यन्ते तदा तिथिगतघट्यां तिथिगम्यघट्यां

च किमिति जाताश्चालनकलाश्चन्द्रस्य $= \frac{६० \times \text{तिथिगक}}{\text{रविचन्द्रगत्यन्तरक}} \times \frac{\text{चंगकला}}{६०} =$

$\frac{\text{तिथिगक} \times \text{चंगकला}}{\text{रविचन्द्रगत्यन्तरक}}$, एवं गम्यचन्द्रचालनकलाः $= \frac{६० \times \text{तिथिगम्यक}}{\text{रविचन्द्रगत्यन्तरक}} \times \frac{\text{चंगकला}}{६०}$

$= \frac{\text{तिथिगम्यक} \times \text{चंगक}}{\text{रविचन्द्रगत्यन्तरक}}$, एवमेव रवेर्गतचालन कलाः $= \frac{६० \times \text{तिथिगतक}}{\text{रविचन्द्रगत्यन्तरक}} \times$

$\frac{\text{रविगक}}{६०} = \frac{\text{तिथिगतक} \times \text{रविगक}}{\text{रविचन्द्रगत्यन्तरक}}$,

रवेर्गम्यचालनकला : $= \frac{६० \times \text{तिथिगम्यक}}{\text{रविचन्द्रगत्यन्तरक}} \times \frac{\text{रविगक}}{६०} = \frac{\text{तिथिगम्यक} \times \text{रविगक}}{\text{रविचन्द्रगत्यन्तर-}}$

एतेनाऽऽचार्योक्तमुपपन्नमिति ॥४॥

अब तात्कालिकीकरण को कहते हैं

हि. भा.—तिथिगत कला को और तिथिगम्यकला को चन्द्रगति और रविगति से पृथक् गुणाकर रवि और चन्द्र के गत्यन्तर से भाग देने से जो फल हो गतचालन में उन फलों को चन्द्र और रवि में हीन करना और गम्यचालन में युत करना तब तिथ्यन्त में तात्कालिक चन्द्र और रवि समलिप्तिक (समान कलात्मक) होते हैं, इस तरह अपनी गति से पात (चन्द्रपात) भी तात्कालिक होता है इति ॥४॥

उपपत्ति

यदि रवि और चन्द्र की गत्यन्तर कला में साठ घटी पाते हैं तो तिथिगतकला और तिथिगम्यकला में क्या इस अनुपात से तिथिगतघटी और तिथिगम्यघटी आती हैं, $\frac{६० \times \text{तिथिगतक}}{\text{रविचन्द्रगत्यन्तरक}}$ = तिथिगतघटी, $\frac{६० \times \text{तिथिगम्यक}}{\text{रविचन्द्रगत्यन्तरक}}$ = तिथिगम्यघटी पुनः अनुपात करते हैं, यदि साठ घटी में अपनी-अपनी गतिकला पाते हैं तो तिथिगत घटी में और तिथिगम्य घटी में क्या इस अनुपात से चन्द्र की गतचाल कला $= \frac{६० \times \text{तिथिगतक}}{\text{रविचन्द्रगत्यन्तरक}}$

$\times \frac{\text{चंगक}}{६०} = \frac{\text{तिथिगतक} \times \text{चंगक}}{\text{रविचन्द्रगत्यन्तरक}}$

एवं चन्द्रगम्यचालन कला $= \frac{६० \times \text{तिथिगम्यक}}{\text{रविचन्द्रगत्यन्तरक}} \times \frac{\text{चंगक}}{६०} = \frac{\text{तिथिगम्यक} \times \text{चंगक}}{\text{रविचन्द्रगत्यन्तरक}}$, इसी तरह

रवि की गतचालन कला $= \frac{६० \times \text{तिथिगत कला}}{\text{रविचन्द्रगत्यन्तरक}} \times \frac{\text{रविगक}}{६०} = \frac{\text{तिथिगतक} \times \text{रविगक}}{\text{रविचन्द्रगत्यन्तरक}}$, रवि की गम्यचालनकला $= \frac{६० \times \text{तिथिगम्यक}}{\text{रविचन्द्रगत्यन्तरक}} \times \frac{\text{रविगक}}{६०} = \frac{\text{तिथिगम्यक} \times \text{रविगक}}{\text{रविचन्द्रगत्यन्तरक}}$, इससे आचार्योक्त उपपन्न हुआ ॥४॥

इदानीं तिथ्यन्ते शरकलानयनमाह

खत्रिघन २७० गुणा व्यासार्धभाजिता चन्द्रपातयोगज्या।
विक्षेपकलाः सौम्याः षड्राश्यूनेऽधिके याम्याः ॥५॥

सु. भा.—षड्राश्यूने चन्द्रपातयोगे सौम्या अधिके याम्या विक्षेपकला भवन्ति। शेषं स्पष्टार्थम्।

अत्रोपपत्तिः। 'सपाततात्कालिकचन्द्रदोर्ज्या खभैर्हते' त्यादिभास्करविधिना स्फुटा ॥५॥

वि. भा.—चन्द्रपातयोगज्या (सपाततात्कालिकचन्द्रभुजज्या) खत्रिघन २७० गुणा, व्यासार्ध (त्रिज्या) भक्ता फलं विक्षेप (शर) कला भवन्ति, ताश्चन्द्रपातयोगे षड्राश्यल्पे सौम्याः (उत्तराः) भवन्ति, चन्द्रपातयोगे षड्राश्यधिके सति याम्याः (दक्षिणाः) भवन्तीति ॥५॥

अत्रोपपत्तिः

क्रान्तिविमण्डलयोः सम्पातः पातः, पातस्थानान्नवत्यंशेन वृत्तं कार्यं तस्मिन् वृत्ते क्रान्तिविमण्डलयोरन्तर्गतं चापं चन्द्रपरमशरः, विमण्डले यत्र चन्द्रबिम्बकेन्द्रमस्ति तदुपरिगतं कदम्बप्रोतवृत्तं यत्र क्रान्तिवृत्ते लगति तत्र चन्द्रस्थानम्। चन्द्रबिम्बकेन्द्राच्चन्द्रस्थानं यावत्कदम्बप्रोतवृत्ते चन्द्रमध्यमशरः। पातस्थानाच्चन्द्रबिम्बकेन्द्रं यावच्चन्द्रविमण्डलीयभुजांशाः। पातस्थानाच्चन्द्रस्थानं यावच्चन्द्रस्थानीयभुजांशाः (सपाततात्कालिकचन्द्रभुजांशाः), पातस्थानान्नवत्यंशवृत्तं परमान्तरवृत्तम्। पातस्थानात्परमान्तरवृत्तविमण्डलयोः सम्पातं यावद्विमण्डले नवत्यंशाः। पातस्थानादेव परमान्तरवृत्तक्रान्तिवृत्तयोः सम्पातं यावत् क्रान्तिवृत्ते नवत्यंशाः। परमान्तरवृत्ते क्रान्तिविमण्डलयोरन्तरे चन्द्रपरमशरांशाः, इति भुजमध्यस्पन्नमेक त्रिभुजम्। पातस्थानाच्चन्द्रबिम्बकेन्द्रं यावद्विमण्डले विमण्डलीयभुजांशाः कर्णः, सपाततात्कालिक चन्द्रभुजांशाः क्रान्तिवृत्ते कोटिः। चन्द्रबिम्बकेन्द्रस्थानयोरन्तरे कदम्बप्रोतवृत्ते चन्द्रमध्यमशरो भुज इति भुजमध्यस्थं द्वितीयं चापीयं चाप-त्रिभुजमेतयोश्चापीयत्वात्त्रिभुजयोर्क्षेत्रसजातीयत्वादनुपातः क्रियते, यदि त्रिज्यया

चन्द्रपरमशरज्या लभ्यते तदा चन्द्रविमण्डलीयभुजज्यया किमित्यनुपातेनाऽऽगच्छति चन्द्रमध्यमशरज्या तत्स्वरूपम् $= \frac{\text{चन्द्रपरमशरज्या. चन्द्र विमण्डलीयभुज्या}}{\text{त्रि}}$

अत्र विमण्डलीयभुजांशस्याज्ञानाद्विदितस्थानीयभुजांश समा एव विमण्डलीय भुजांशा: स्वीकृता आचार्येण, तदा $\frac{\text{चन्द्रपरमशरज्या. सपाततात्कालिकचंभुजज्या}}{\text{त्रि}} =$ चन्द्रमध्यमशरज्या, तथा ज्याचापयोरभेदत्वमपि स्वीकृतम् तदा—

$\frac{\text{चन्द्रपरमशर. सपाततात्कालिचन्द्रभुज्या}}{\text{त्रि}} =$ चन्द्रमध्यमशर: । चन्द्रस्य परमशरांशा: $= २७०$, तत: $\frac{२७० \times \text{सपाततात्कालिकचन्द्रभुज्या}}{\text{त्रि}} =$ चन्द्रमध्यमशर:, अयं शर: सपातचन्द्रगोलदिग्भवत्येतावताऽऽचार्योक्तमुपपन्नम् । इदमानयनं न समीचीनं यत: स्थानीयविम्बीयचन्द्रभुजांशयो: समत्वं स्वीकृतं शरज्याचापयोरभेदत्वं च स्वीकृतमाचार्येण, ततो वास्तवानयनं क्रियते, स्थानीयचन्द्रभुजांशविमण्डलीय-भुजांश-शरांशैरुत्पन्नचापीयजात्यत्रिभुजे स्थानीयचन्द्रभुजांशविमण्डलीयभुजांश-योरुत्पन्नकोण: $=$ चन्द्रपरमशर:, तदा मध्यजा दोर्ज्या त्रिज्यागुणा प्रान्त्यस्पर्श-रेखाहृतिर्भवेदनेन स्थाने श्रवणकोणयोस्तत्कोटिमेव गृह्णीयादित्यनेन च परमश-कोज्या. त्रि $=$ स्पविमण्डलीयभुको $\times$ स्प स्थानीय. भुजांश तत:

$\frac{\text{परमशकोज्या· त्रि}}{\text{स्प स्थानीय भुजांश}} =$ स्पविमण्डलीयभुको, एतेन चन्द्रस्य विमण्डलीयभुजांशज्ञानं भवेदेव, तदोक्तचापीयजात्यत्रिभुजे भुजकोटिज्याकोटिकोटिज्ययोर्घातस्य त्रिज्या-कर्णकोटिज्ययोर्घातेन समत्वात्

त्रि. विमण्डलीयभुकोज्या $=$ शरकोज्या. स्थानीयभुकोज्या $=$ शरकोज्या. सपाततात्कालिकचन्द्रभुकोज्या, तत: $\frac{\text{त्रि. विमण्डलीयभुकोज्या}}{\text{सपाततात्कालिक चं भुकोज्या}} =$ शरकोज्या

अस्याश्चापं नवतेर्विशोध्यं तदा चन्द्रस्य मध्यमशरो भवेदिति । सिद्धान्तशिरोमणौ भास्कराचार्येण "सपाततात्कालिकचन्द्रदोर्ज्याखिभै २७० र्हता व्यासदलेन भक्ता। सपातशीतद्युतिगोलदिक् स्याद्विक्षेप इन्दो: स च बाणसंज्ञ" त्यनेनाऽऽचार्योक्तानुरूप-मेवोक्तम्, सिद्धान्तशेखरे श्रीपतिना "पातोनितस्य समलिप्तकशीतरश्मेर्जीवा कृतेषु ५४ गुणिता त्रिभजर्त्तु ६८३ भक्ता । क्षेपो भवत्यनेन, चन्द्रशरानयनं कृतमिदम-प्याचार्योक्तानुरूपमेव, केवलमत्र पातस्य चक्रशुद्धत्वात् सपातचन्द्रभुजज्यास्थाने विपातचन्द्रभुजज्या गृहीता, तथा विपातचन्द्रभुजज्याया गुणकस्य चन्द्रपरमशर

२७० म्य, श्रीपत्युक्तत्रिज्याया ३४१५ भाजकरूपायाश्च पञ्चभिरपवर्तने श्रीपत्युक्त-पद्यमुपपन्नं भवतीति ॥ ५ ॥

अब तिथ्यन्त में चन्द्रशरकलानयन को कहते हैं।

हि. भा.—सपात तात्कालिक चन्द्रभुजज्या को दो सौ सत्तर २७० से गुणा कर त्रिज्या से भाग देने से फल चन्द्रशर कला होती है, सपात चन्द्र के छः राशि से कम रहने से उस (शरकला) की दिशा उत्तर होती है, तथा छः राशि से अधिक रहने से शरकला की दिशा दक्षिण होती है इति ॥ ५ ॥

उपपत्ति ।

क्रान्तिवृत्त और विमण्डल के सम्पात पात संज्ञक है, पात स्थान से नवत्यंश व्यासार्ध वृत्त उन दोनों (क्रान्तिवृत्त और विमण्डल) वृत्तों के परमान्तर वृत्त है, क्रान्तिवृत्त और विमण्डल के अन्तर्गत परमान्तर वृत्तीय चाप परमशर है, विमण्डल में जहां चन्द्रबिम्ब केन्द्र है उसके ऊपर कदम्ब प्रोत वृत्त करने से क्रान्तिवृत्त में जहां लगता है वह चन्द्र स्थान है, चन्द्रबिम्ब केन्द्र से चन्द्र स्थान तक कदम्बप्रोतवृत्त में चन्द्र के मध्यमशर है, पात स्थान से चन्द्रबिम्ब केन्द्र तक चन्द्र के विमण्डलीय भुजांश कर्ण, पातस्थान से चन्द्रस्थान तक सपात चन्द्रभुजांश कोटि, चन्द्र मध्यमशर भुज इन तीनों भुजों से उत्पन्न एक चापीय जात्य त्रिभुज तथा पातस्थान से परमान्तर वृत्त और विमण्डल के सम्पात पर्यन्त विमण्डल में नवत्यंश, पातस्थान ही से परमान्तरवृत्त और क्रान्तिवृत्त के सम्पात पर्यन्त क्रान्तिवृत्त में नवत्यंश, परमान्तर वृत्त में चन्द्र परमशर, इन तीनों भुजों से उत्पन्न द्वितीय चापीय जात्य त्रिभुज, इन दोनों चापीय जात्य त्रिभुजों के ज्याक्षेत्र जातीय है इसलिये अनुपात करते हैं यदि त्रिज्या में चन्द्र परमशरज्या पाते हैं तो विमण्डलीय चन्द्र भुजज्या में क्या इस अनुपात से चन्द्र-मध्यम शरज्या आती है $\frac{\text{चन्द्रपरमशज्या. चन्द्रविमण्डलीय भुज्या}}{\text{त्रि}}$ = चंमध्यमशरज्या,

परन्तु यहां चन्द्र विमण्डलीय भुजांश विदित नहीं है, गणितागत सपात चन्द्रभुजांश विदित है इसलिए आचार्य ने चन्द्र विमण्डलीय भुजांश तुल्य ही सपात चन्द्र भुजांश को स्वीकार किया है तब $\frac{\text{चंपरमशज्या. सपातचंभुज्या}}{\text{त्रि}}$ = चंमध्यमशरज्या, तथा ज्या और चाप में

अभेदत्व भी स्वीकार किया है तब $\frac{\text{चंपरमश} \times \text{सपात चंभुज्या}}{\text{त्रि}}$ = चंमध्यमशर, =

$\frac{२७० \times \text{सपात चंभुज्या}}{\text{त्रि.}}$ यह शर सपात चन्द्र गोल दिशा का होता है अर्थात् सपात चन्द्र

जिस गोल में रहते हैं उसी गोल का होता है इससे आचार्योक्त उपपन्न हुआ, परन्तु यह आनयन ठीक नहीं है क्योंकि विमण्डलीय चन्द्र भुजांश कर्ण चाप है और सपात चन्द्रभुजांश कोटि चाप

है इन दोनों का आचार्य ने तुल्य मान लिया हैं तथा चंपरमशरज्या = चंपरमशर, एवं चंमध्यशरज्या = चंमध्यमशर स्वीकार किया है, जो कि अनुचित है, अतः वास्तवानयन करते हैं। चन्द्र विमण्डलीय भुजांश, सपात चन्द्रभुजांश, और चन्द्रमध्यमशर इन तीनों अवयवों से उत्पन्न चापीय जात्य त्रिभुज में चन्द्र विमण्डलीय भुजांश और सपात चन्द्र भुजांश से उत्पन्न कोण = चंपरमशर, तब उक्त त्रिभुज में 'मध्यजा दोर्ज्या त्रिज्या गुणा प्रान्त्यस्पर्श रेखा हृतिर्भवेत्' इससे तथा 'तत्कोटिमेव गृह्णीयात् स्थाने श्रवणकोणयोः' इससे भी चंपरमशकोज्या. त्रि = स्पचंविमण्डलीय भुकोज्या. स्पसपातचं भुज्या अतः $\frac{\text{चंपरमशकोज्या. त्रि}}{\text{स्पसपात चभुज्या}}$ = स्पचंविमण्डलीय भुकोज्या, स्पर्शरेखा खण्डों से इसका चाप कर के नवत्यंश में से घटाने से चन्द्र विमण्डलीय भुजांश का ज्ञान हो जायगा, तब पूर्व कथित चापीय जात्य त्रिभुज में भुजकोटिज्या और कोटि कोटिज्या का घात त्रिज्या और कर्ण कोटिज्या के घात के बराबर होता है इस नियम से त्रि. चंविमण्डलीय भुकोज्या = चंशर कोज्या सपात चं भुकोज्या ∴ $\frac{\text{त्रि. चंविमण्डलीय भुकोज्या}}{\text{सपात चं भुकोज्या}}$ = चंशर कोज्या, इसके चाप को नवत्यंश में से घटाने से चन्द्रमध्यमशर होता है, सिद्धान्तशिरोमणि में भास्कराचार्य ने "सपाततात्कालिकचन्द्रदोर्ज्या" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से आचार्योक्त के अनुरूप ही कहा है, सिद्धान्त शेखर में श्रीपति "पातोनितस्य समलिप्तशीतरश्मेः" इत्यादि संस्कृतोपपत्ति में लिखित पद्य से चन्द्र का शरानयन किया है यह भी आचार्योक्त के अनुरूप ही है केवल श्रीपति ने पात के चक्र (बारह राशि) में शुद्ध होने के कारण सपात चन्द्र भुजज्या स्थान में विपातचन्द्रभुजज्या ग्रहण किया है, और विपात चन्द्र भुजज्या के गुणक चन्द्रपरमशर २७० को तथा श्रीपत्युक्त त्रिज्या = ३४१५ हर को पांच से अपवर्त्तन कर देने से श्रीपति का पद्य उपपन्न होता है इति ॥ ५ ॥

इदानीं रविचन्द्रतमसां बिम्बान्याह

रविशशिभुक्ती भवदशगुणे नखैः स्वजिनैर्हृते माने।
तत्त्वाष्टगुणितभुक्तयोर्विवरं षष्ट्याहृतं तमसः ॥ ६ ॥

सु० भा०—रविशशिभुक्ती भवदशगुणे नखैः स्वरजिनैर्हृते अर्थाद्रविगतिरेकादशगुणा नख २० हृता। चन्द्र गतिर्दशगुणा स्वरजिनै २४७ हृता तदा रविचन्द्रयोर्मानि बिम्बमाने भवतः। तत्त्वाष्टगुणितभुक्त्योः पञ्चविंशति गुणरविगतेरष्ट गुणितचन्द्रगतेश्च विवरं षष्ट्याहृतं तमसो राहोर्विम्बमानं भवेत्।

अत्रोपपत्तिः। 'भानोर्गतिः स्वदशभागयुतार्धिता' वेत्यादिभास्करविधिना

रविं = $\frac{११ \text{ रग}}{२०}$ । चंविं = $\frac{३ \text{ चंग}}{७४} = \frac{\text{चंग}}{\frac{७४}{३}} = \frac{१० \text{ चंग}}{\frac{७४०}{३}} = \frac{१० \text{ चंग}}{२४७}$ स्वल्पा-न्तरात् । 'भानोर्गतिः शरहृता रविभिर्विभक्ता' इत्यादि भास्करविधिना राहुबिं = $\frac{२ \text{ चंग}}{१५} - \frac{५ \text{ रग}}{१२} = \frac{८ \text{ चंग} - २५ \text{ रग}}{३०}$ । अत उपपन्नं सर्वम् ॥ ६ ॥

वि. भा.—रविशशिभुक्ती (रविचन्द्रयोर्गती) भवदशगुणे (एकादशदशगुणिते) नखैः स्वरजिनै २४७ भक्ते ऽर्थाद्रविगतिरेकादशगुणा विंशत्या भक्ता, चन्द्रगतिर्दशगुणा स्वरजिनै २४७ भक्ता तदा माने (रविचन्द्रयोर्बिम्ब प्रमाणे) भवतः । तत्त्वाष्टगुणित-भुक्त्योः (पञ्चविंशति गुणित रविगतेरष्टगुणित चन्द्रगतेश्च) विवरं (अन्तरं) षष्टि (६०) भक्तं तदा तमसः (राहोः) बिम्बमानं भवेदिति ॥ ६ ॥

अत्रोपपत्तिः

भानोर्गतिः स्वदशभागयुतार्धिता वेत्यादि भास्करोक्त्या रविबिं = $\frac{\text{रग} + \frac{\text{रग}}{१०}}{२} = \frac{१० \text{ रग} + \text{रग}}{२०} = \frac{११ \text{ रग}}{२०}$ विधोस्त्रिगुणिता युगशैलभक्ते ति भास्करोक्त-विधिना चंविं = $\frac{३ \text{ चंग}}{७४} = \frac{३ \text{ चंग} \times १०}{७४ \times १०} = \frac{३ \text{ चंग} \times १०}{७४०} = \frac{\text{चंग} \times १०}{\frac{७४०}{३}} = \frac{\text{चंग} \times १०}{२४७}$

स्वल्पान्तरात् ।

अथ दिवाकर निशानाथ परलम्बन संयुतिः । रविबिम्बार्धरहिता भूभा बिम्ब-दलं भवेदिति संशोधकोक्त विधिना रपलं + चंपलं — रविं$\frac{१}{२}$ = भूभाबिं$\frac{१}{२}$, गतिकलाभ्या-स्तिथ्यंशः परलम्बन लिप्तिकेत्युक्तेः परमलम्बनोत्थापनात् $\frac{\text{रग}}{१५} + \frac{\text{चंग}}{१५} - \frac{११ \text{ रग}}{२० \times २}$ = भूभाबिं$\frac{१}{२}$ = $\frac{\text{रग}}{१५} + \frac{\text{चंग}}{१५} - \frac{११ \text{ रग}}{४०} = \frac{\text{रग}}{१५} - \frac{११ \text{ रग}}{४०} + \frac{\text{चंग}}{१५} = \frac{८ \text{ रग} - ३३ \text{ रग}}{१२०} + \frac{\text{चंग}}{१५} = -\frac{२५ \text{ रग}}{१२०} + \frac{\text{चंग}}{१५} = -\frac{५ \text{ रग}}{२४} + \frac{\text{चंग}}{१५} = \frac{\text{चंग}}{१५} - \frac{५ \text{ रग}}{२४}$ द्विगुणी करणेन

$\frac{२ \text{ चंग}}{१५} - \frac{५ \text{ रग}}{१२}$ भूभाबिं……(१) अत्र प्रथम खण्डे हर भाज्यौ चतुर्भि-

गुणितौ तथा द्वितीयखण्डे हर भाज्यौ पञ्चभिर्गुणितौ तदा $\frac{८ \text{ चंग}}{६०} - \frac{२५ \text{ रग}}{६०} = \frac{८ \text{ चंग} - २५ \text{ रग}}{६०}$ एतावताऽऽचार्योक्तं सर्वमुपपन्नम् । (१) एतेन च "भानोर्गतिः शरहता रविभिर्विभक्ता चन्द्रस्य लोचनगुणा तिथि भाजितेत्यादि" भास्करोक्तं भूभा बिम्बानयनमुपपद्यते । सिद्धान्तशेखरे "रुद्रैः ११ पंक्त्या १० रविशशिगती ताड़िते वा विभक्ते कृत्या २० भूभृज्जलधिनयनैः २४७ स्ते तयोर्मान लिप्ताः । वाणैर्द्वाभ्यामथ विनिहतेऽर्के १२ दिनैः १५ स्ते विभक्ते लब्ध्योर्यद्वा भवति विवरं सैंहिकेयस्य बिम्बम्" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव, आचार्योक्तभूभाबिम्बम् = $\frac{८ \text{ चंग}}{६०} - \frac{२५ \text{ रग}}{६०} = \frac{२ \text{ चंग}}{१५} - \frac{५ \text{ रग}}{१२}$ = श्रीपत्युक्त भूभाबिं, "भानोर्गतिः स्वदशभागयुतार्धिता वा चन्द्रस्य बिम्बं विधोस्त्रिगुणिता युगशैल ७४ भक्ता" भास्कराचार्योक्तमिदं रविचन्द्रयोर्बिम्बकलानयनं तथा "भानोर्गतिः शर ५ हता रवि १२ भिर्विभक्ता चन्द्रस्य लोचन २ गुणा तिथि १५ भाजिता च । लब्धान्तरं भवति वाऽवनि भा प्रमाणम् ॥ इति भूभाबिम्बानयनं च श्रीपत्यनुरूपमेवेति ॥ ६ ॥

अब रवि चन्द्र और भूभा के बिम्बानयन को कहते हैं ।

हि. भा.—रवि गति को ग्यारह से गुणा कर बीस २० से भाग देने से रवि बिम्ब का मान होता है, चन्द्रगति को दस से गुणा कर दो सौ सैंतालीस २४७ से भाग देने से चन्द्रबिम्ब का मान होता है, पचीस गुणित रविगति और आठ गुणित चन्द्रगति के अन्तर को साठ ६० से भाग देने से भूभा का बिम्बमान होता है इति ॥ ६ ॥

उपपत्ति

'भानोर्गतिः स्वदशभागयुतार्धिता वा' इत्यादि भास्करोक्त विधि से रविंबि = $\frac{\text{रग} + \frac{\text{रग}}{१०}}{२} = \frac{१० \text{ रग} + \text{रग}}{२०} = \frac{११ \text{ रग}}{२०}$ बिम्बं बिधोस्त्रिगुणिता युगशैलभक्ता इस भास्करोक्ति से चंबिं = $\frac{३ \text{ चंग}}{७४} = \frac{३ \text{ चंग} \times १०}{७४ \times १०} = \frac{३ \text{ चंग} \times १०}{७४०} = \frac{\text{चंग} \times १०}{\frac{७४०}{३}} = \frac{\text{चंग} \times १०}{२४७}$

स्वल्पान्तर से, भूभा बिम्बानयन के लिये "दिवाकर निशानाथ परलम्बन संयुतिः । रविबिम्बार्धरहिता भूभा बिम्बदलं भवेत्" इस संशोधकोक्त विधि से रपलं + चंपलं − रविं $\frac{१}{२}$ = भूभाबिं $\frac{१}{२}$

परन्तु $\text{रगलं} = \frac{\text{रग}}{१५}$, $\text{चगलं} = \frac{\text{चग}}{१५}$, तथा $\text{रविबिं}\frac{१}{२} = \frac{११\ \text{रग}}{२०\times२} = \frac{११\ \text{रग}}{४०}$

इन में उत्थापन करने से $\frac{\text{रग}}{१५} + \frac{\text{चग}}{१५} - \frac{११\ \text{रग}}{४०} = \frac{\text{रग}}{१५} - \frac{११\ \text{रग}}{४०} + \frac{\text{चग}}{१५} =$

$\frac{८\ \text{रग} - ३३\ \text{रग}}{१२०} + \frac{\text{चग}}{१५} = -\frac{२५\ \text{रग}}{१२०} + \frac{\text{चग}}{१५} = -\frac{५\ \text{रग}}{२४} + \frac{\text{चग}}{१५} = \frac{\text{चग}}{१५} - \frac{५\ \text{रग}}{२४}$

$= \text{भूभाबिं}\frac{१}{२}$, द्विगुणित करने से $\frac{२\ \text{चग}}{१५} - \frac{५\ \text{रग}}{१२} = \text{भूभाबिं}$ ...(१) यहां प्रथम खण्ड के हर और भाज्य को चार से गुणने से तथा द्वितीय खण्ड के हर और भाज्य को पांच से गुणने से $\frac{८\ \text{चग}}{६०} - \frac{२५\ \text{रग}}{६०} = \frac{८\ \text{चग} - २५\ \text{रग}}{६०} =$ भूभाबिं इससे आचार्योक्त सब उपपन्न हुए। (१) इससे "भानोर्गतिः शरहृता रविभिर्विभक्ता" इत्यादि भास्करोक्त भूभा बिम्बानयन उपपन्न होता है; सिद्धान्त शेखर में "रुद्रैः ११ पंक्त्या १० रविशशि गती ताडिते" इत्यादि संस्कृतोपपत्ति में लिखित श्रीपति प्रकार आचार्योक्त के अनुरूप ही है, आचार्योक्त भूभाबिं = $\frac{८\ \text{चग}}{६०} - \frac{२५\ \text{रग}}{६०} = \frac{२\ \text{चग}}{१५} - \frac{५\ \text{रग}}{१२}$ श्रीपत्युक्त भूभाबिं "भागानोर्गतिः स्वदशभागयुतार्धघता वा" इत्यादि संस्कृतोपपत्ति में लिखित, भास्कराचार्योक्त रवि और चन्द्र के बिम्बकलानयन तथा "भानोर्गतिः शरहृता रविभिर्विभक्ता" इत्यादि संस्कृतोपपत्ति में लिखित पद्य में भूभाबिम्बानयन श्रीपत्युक्त के अनुरूप ही है इति ॥ ६ ॥

इदानीं ग्रासमानमाह

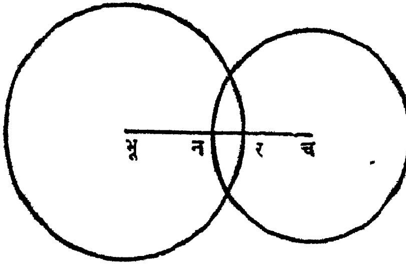
छाद्यच्छादक मानैक्यार्धं विक्षेप होनितं छन्नम् ।
सर्वग्रहणं ग्राह्यादधिके खण्डग्रहणमूने ॥ ७ ॥

सु० भा०—स्पष्टार्थेयमार्या ।

अत्रोपपत्तिः । 'यच्छाद्यसञ्छादकमण्डलैक्यखण्डं शरोनं स्थगितप्रमाण' मित्यादि भास्करविधिना स्फुटा ॥ ७ ॥

वि. भा.—**छाद्यच्छादकमानैक्यार्धं (ग्राह्यग्राहक बिम्बयोर्योगार्धं चन्द्रग्रहणे चन्द्रभूभा बिम्बयोर्योगार्धं सूर्यग्रहणे सूर्यचन्द्र बिम्बयोर्योगार्धमित्यर्थः) विक्षेपहीनितं (चन्द्रशरेण रहितं) तदा छन्नं (ग्रासमानं) भवेत् । ग्राह्यात् (छाद्यबिम्बात्) अधिके ग्रासमाने सर्वग्रहणं भवति, छाद्यबिम्बादल्पे ग्रासमाने खण्डग्रहणं भवतीति ॥ ७ ॥**

अत्रोपपत्तिः



भू=भूभा बिम्बकेन्द्रम् । च=चन्द्रबिम्बकेन्द्रम् । भूच=चन्द्रशरः । भूर=भूभाबिम्बव्यासार्धम् । चन=चन्द्रबिम्बव्यासार्धम् । नर=ग्रासमानम् ।
भूर+चन = भूर+रच +नर= भूच+नर=चन्द्रशर+ग्रास+ भूभाबिम्बव्यासार्धं + चन्द्रबिम्बव्यासार्धं =मानैक्यार्धम्

अतः मानैक्यार्ध − चन्द्रशर=ग्रासमानम् । चन्द्रबिम्बादधिके एतद्ग्रासमाने सर्वग्रहणं भवेदेवेति । सिद्धान्तशिरोमणौ "यच्छाद्यसंछादकमण्डलैक्य खण्डं शरोन" मित्यादिना भास्करेण, क्षेपोभवत्यथ पिधान पिधेय बिम्बयोगार्धमूनममुनेत्यादिना श्रीपतिनाप्याचार्योक्तानुरूपमेवोक्तमिति ॥ ७ ॥

अब ग्रासानयन को कहते हैं ।

हि. भा.—छाद्य छादक मानैक्यार्ध (चन्द्रग्रहण में चन्द्रबिम्ब और भूभा बिम्ब के योगार्ध, सूर्यग्रहण में सूर्यबिम्ब और चन्द्रबिम्ब के) योगार्ध में से चन्द्रशर को घटाने से शेष ग्रास मान होता है, ग्राह्य बिम्ब से ग्रासमान अधिक रहने से सर्व ग्रहण होता है, ग्राह्य बिम्ब से ग्रासमान अल्प रहने से खण्ड ग्रहण होता है इति ॥ ७ ॥

उपपत्ति

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । भू=भूभा बिम्ब केन्द्र, च=चन्द्रबिम्ब केन्द्र, भूच=चन्द्रशर, भूर=भूभा बिम्बव्यासार्ध, चन=चन्द्रबिम्बव्यासार्ध, नर=ग्रासमान, भूर+चन=भूर+रच+नर=भूच+नर=चन्द्रशर+ग्रासमान=भूभाबिम्बव्यासार्ध+चन्द्रबिम्बव्यासार्ध=मानैक्यार्ध, अतः मानैक्यार्ध—चन्द्रशर=ग्रासमान । चन्द्रबिम्ब (ग्राह्य बिम्ब) से अधिक ग्रासमान होने से सर्व ग्रहण होता ही है, यह क्षेत्र स्वरूप देखने से स्पष्ट है इति, सिद्धान्त शिरोमणि में भास्कराचार्य "यच्छाद्य संछादकमण्डलैक्यखण्ड" इत्यादि से तथा सिद्धान्त शेखर में श्रीपति ने "क्षेपो भवत्यथ पिधानपिधेयबिम्बयोगार्धमूनममुना स्थगितं वदन्ति" इस प्रकार आचार्योक्त के अनुरूप ही कहा है इति ॥ ७ ॥

इदानीं स्थित्यर्धविमर्दार्धयोरानयनमाह

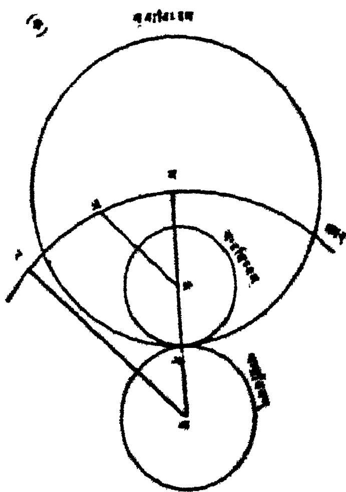
छाद्येन युतोनस्य च्छादकमानस्य तद्दलकृतिभ्याम् ।
विक्षेपकृतिं प्रोह्य पदे तिथिवत् स्थितिविमर्दार्धे ॥ ८ ॥

मु० भा०—पदे तिथिवत् । अर्थात्पदे षष्टिगुणे रविचन्द्रगत्यन्तरेण हृते स्थितिविमर्दार्धे भवतः । शेषं स्पष्टार्थम् ।

अत्रोपपत्तिः । 'मानार्धयोगान्तरयोः कृतिभ्यां' मित्यादि भास्करविधिना स्फुटा ॥ ८ ॥

वि. भा.—छाद्येन (छाद्यमानेन) यनोनस्य (महितस्य रहितस्य च) छादकमानस्यार्थात् छाद्यच्छादकबिम्बयोगस्यान्तरस्य च दलकृतिभ्यामर्थान्मानैक्यार्धं वर्गमानान्तरार्धवर्गाभ्यां विक्षेपकृतिं (शरवर्गं) प्रोह्य (त्यक्त्वा) तत्पदे (मूले) तिथिवत् कृते सती अर्थात् षष्ट्या गुणिते रविचन्द्रयोर्गत्यन्तरेण भक्ते तदा स्थित्यर्धविमर्दार्धे भवेतामिति ॥ ८ ॥

अत्रोपपत्तिः



यदा भूभा चन्द्रबिम्बयोर्बहिः स्पर्शो भवति तदा चन्द्र केन्द्रोपरिगतं कदम्बप्रोतवृत्तं क्रान्तिवृत्ते यत्र लगति ततो भूभा बिम्बाकेन्द्रं यावत् क्रान्तिवृत्ते स्थित्यर्धकला, चन्द्र केन्द्रोपरिगतकदम्बप्रोतवृत्तक्रान्तिवृत्तसम्पाताच्चन्द्र - केन्द्रं यावत् कदम्ब प्रोतवृत्ते स्पार्शिकशरः। तथा यदाऽन्तःस्पर्शो भवति तदा चन्द्र केन्द्रोपरिगतं कदम्बप्रोतवृत्तं क्रान्तिवृत्ते यत्र लगति ततो भूभाबिम्बकेन्द्रं यावत्क्रान्ति वृत्ते विमर्दार्धं कला, कदम्बप्रोतवृत्ते चन्द्रकेन्द्रात्क्रान्तिवृत्तं यावदन्तःस्पर्शकालिक (संमीलनकालिक) शरः । चन्द्रकेन्द्रभूभाकेन्द्रगतं वृत्तं कार्यं भू=भूभाबिम्बकेन्द्रम् । चं=बहिः स्पर्शकालिक (स्पार्शिक) चन्द्रबिम्ब केन्द्रम् । चर=स्पार्शिकशरः । रभू=स्थित्यर्धकला, चं'=अन्तःस्पर्शकालिक (संमीलनकालिक) चन्द्रबिम्ब केन्द्रम् । चं'श=संमीलन कालिकशरः । शभू=विमर्दार्धकला, न=स्पर्श बिन्दुः । भूचं=चन्द्रबिम्ब भूभाबिम्बकेन्द्र गतवृत्ते केन्द्रान्तरम् । चंन=चन्द्र बिम्बव्यासार्धम् । भून=भूभाव्यासार्धम्, भूचं=चन्द्रबिम्बभूभाबिम्बयोर्मानैक्यार्धम् । भूचं'=चन्द्रबिम्बभूभाबिम्बयोर्मानार्धान्तरम् । अक्षभार्येण भूरचं त्रिभुजं भूचं'श त्रिभुजं च सरलाकारं मत्वा स्थित्यर्धविमर्दार्ध घट्योरानयनं कृतं यथा

$\sqrt{\text{भूचं}^2 - \text{चंर}^2} = \text{भूर} = \sqrt{\text{मानैक्यार्ध}^2 - \text{स्पार्शिकशर}^2} =$ स्थित्यर्धकला, ततोऽनुपातेना 'यदि रविचन्द्रयोर्गत्यन्तरेण षष्टि घटिका लभ्यन्ते तदा स्थित्यर्धकलायां किमित्य' नेन समागच्छन्ति स्थित्यर्ध घट्यः $= \frac{६० \times \text{स्थि}\frac{१}{२}\text{ कला}}{\text{गत्यन्तर कला}}$, तथा भूचंश त्रिभुजे $\sqrt{\text{भूचं}^2 - \text{चंश}^2} = \text{भूश} = \sqrt{\text{मानार्धान्तर}^2 - \text{संमोलनकालिकशर}^2} =$ विमर्दार्धकला, ततः पूर्ववदनुपातेन विमर्दार्धघट्यः $= \frac{६० \times \text{विमर्दार्धकला}}{\text{गत्यन्तर कला}}$ परमत्र स्पार्शिक संमीलन कालिकशरयोरज्ञानाद्विदितमध्यग्रहणकालिकशरवशेनैव स्थित्यर्धविमर्दार्धयोरानयनं कृतं तन्न युक्तम्। सिद्धान्तशेखरे "मानार्धसंयोग वियोगवर्गौ विक्षेपकृत्या रहितौ विधाय। ये शेषमूले तिथिवत् कृते ते क्रमाद् भवेतां स्थितिमर्दखण्डे" श्रीपतेः श्लोकश्चायं, सिद्धान्तशिरोमणौ "मानार्धयोगान्तरयोः कृतिभ्यां शरस्य वर्गेण विवर्जिताभ्याम्। मूले खषट् ६० संगुणिते विभक्ते भुक्तचन्तरेण स्थितिमर्दखण्डे" भास्कराचार्यस्यायं श्लोकश्चाऽऽचार्योक्तानुरूप एवेति ॥ ७ ॥

अब ग्रासानयन को कहते हैं।

हि. भा.—ग्राह्य विम्ब और ग्राहक बिम्ब के योगार्ध (मानैक्यार्ध) और अन्तरार्ध के वर्गों में से शर वर्ग को घटाकर मूल लेना तब उन दोनों को साठ से गुणा कर रवि और चन्द्र के गत्यन्तर से भाग देने से स्थित्यर्ध और विमर्दार्ध होते हैं इति ॥ ७ ॥

उपपत्ति

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये। भूभाबिम्ब और चन्द्र बिम्ब के बहिः स्पर्श काल में चन्द्र केन्द्रोपरिगत कदम्बप्रोतवृत्त और क्रान्तिवृत्त के सम्पात से भूभाकेन्द्र पर्यन्त क्रान्तिवृत्त में स्थित्यर्ध कला है, चन्द्र केन्द्रोपरि गत कदम्ब प्रोत वृत्त और क्रान्तिवृत्त के सम्पात से चन्द्रकेन्द्र तक कदम्बप्रोतवृत्त में स्पार्शिक शर हैं। एवं भूभाबिम्ब और चन्द्रबिम्ब के अन्तःस्पर्श (संमीलन) काल में चन्द्र केन्द्रोपरिगत कदम्बप्रोतवृत्त और क्रान्तिवृत्त के सम्पात से भूभा बिम्ब केन्द्र पर्यन्त क्रान्ति वृत्त में विमर्दार्ध कला हैं, कदम्ब प्रोत वृत्त में चन्द्रकेन्द्र से क्रान्तिवृत्त पर्यन्त अन्तःस्पर्शकालिक (संमीलनकालिक) शर हैं, चन्द्रकेन्द्र और भूभाकेन्द्र गतवृत्त कर देना, भू = भूभा बिम्ब केन्द्र, चं = बहिःस्पर्शकालिक (स्पार्शिक) चन्द्रकेन्द्र, चंर = स्पार्शिकशर, रभू = स्थित्यर्धकला, चं = अन्तःस्पर्शकालिक (संमीलन कालिक) चन्द्रबिम्ब केन्द्र, चंश = संमीलन कालिकशर, शभू = विमर्दार्धकला, न = स्पर्श बिन्दु, भूचं = चन्द्रबिम्ब और भूभा बिम्ब के केन्द्रगत वृत्त में केन्द्रान्तर, चंन = चन्द्रबिम्ब

व्यासार्ध, भून = भूभाबिम्ब व्यासार्ध, भूचं = चन्द्रबिम्ब और भूभाबिम्ब के मानैक्यार्ध, भूचं' = चन्द्रबिम्ब और भूभाबिम्ब के मानान्तरार्ध, यहां आचार्य ने भूरचं त्रिभुज को तथा भूचंश त्रिभुज को सरलाकार मान कर स्थित्यर्ध और विमर्दार्ध का आनयन किया है जैसे भूरच जात्य त्रिभुज में $\sqrt{भूचं^2 - चंर^2}$ = भूर = $\sqrt{मानैक्यार्ध^2 - स्पार्शिकशर^2}$ = स्थित्यर्धक, तब अनुपात करते हैं यदि रवि और चन्द्र की गत्यन्तरकला में साठ घटी पाते हैं तो स्थित्यर्धकला में क्या इससे स्थित्यर्ध घटी आती हैं, $\frac{६० \times स्थि३ कला}{गत्यन्तर कला}$ = स्थि३ घटी, तथा भूचं'श जात्य त्रिभुज में $\sqrt{भूचं'^2 - चं'श^2}$ = भूश = $\sqrt{मानान्तरार्ध^2 - संमीलन कालिकशर^2}$ = विमर्दार्धकला, इससे पूर्ववत् अनुपात से विमर्दार्ध घटी = $\frac{६० \times विमर्दार्ध कला}{गत्यन्तर कला}$ लेकिन यहां स्पार्शिक शर और संमीलन कालिकशर विदित नहीं हैं, विदित है मध्यग्रहण कालिकशर, इसलिये मध्यग्रहण कालिकशर तुल्य ही स्पार्शिक शर और संमीलन कालिकशर मानकर पूर्वोक्तरीति से स्थित्यर्ध और विमर्दार्ध का आनयन किया गया हैं जो ठीक नहीं हैं, सिद्धान्त शेखर में "मानार्ध-संयोगवियोगवर्गौ" इत्यादि संस्कृतोपपत्ति में लिखित श्रीपति का श्लोक तथा सिद्धान्त शिरोमणि में "मानार्धयोगान्तरयोः कृतिभ्याम्" इत्यादि भास्कराचार्य का श्लोक आचार्योक्त के अनुरूप ही हैं इति ।। ७ ।।

इदानीं स्थिति विमर्दार्धयोः स्फुटीकरणमाह ।

षष्टया विभाजिता स्थितिविमर्ददलनाडिकागुणा स्वगतिः ।
आदौ रवीन्दुपातेष्वृणमसकृत् तेषु धनमन्ते ।। ९ ।।

सु० भा०—स्पष्टार्थम् । अत्रोपपत्तिः । 'स्थित्यर्धनाडीगुणिता स्वभुक्ति' रित्यादिना 'एवं विमर्दार्धफलोनयुक्ते' त्यादिना च भास्करविधिना स्फुटा ।। ९ ।।

वि. भा.—स्वगतिः (रविगतिः, चन्द्रगतिः, पातगतिश्च) स्थितिविमर्ददलनाडिका गुणा (स्थित्यर्धघटीभिर्विमर्दार्धघटीभिश्च पृथक् पृथक् गुणिता) षष्ट्या ६० भक्ताऽऽदौ रविचन्द्रपातेषु ऋणम्, अन्ते तेषु धनं कार्यमर्थादाद्यस्थित्यर्धे धनमन्त्यस्थित्यर्धे ऋणं तथाऽऽद्यविमर्दार्धे धनमन्त्यविमर्दार्धे ऋणम्, एवमसकृद्वारं वारं पूर्वोक्त- कर्मणि कृते स्थित्यर्धविमर्दार्धे स्फुटे भवत इति ।। ९ ।।

अत्रोपपत्तिः ।

यदि षष्टिघटीभिश्चन्द्रगतिकला लभ्यन्ते तदा स्थित्यर्धघटीभिः किमि-

त्यनुपातेन स्थित्यर्धघटीसम्बन्धिनी चन्द्रगतिकला समागच्छति, पातस्याप्येवं स्थित्यर्धघटीसम्बन्धिनी गतिरानेया, आनीतफलाभ्यां क्रमेण हीनयुतौ चन्द्रपातौ पूर्वापेक्षया तौ विशिष्टौ भवतस्ततस्त्रिघन गुणाव्यासार्धभाजिता चन्द्रपातयोगज्ये-त्यादिना चन्द्रशरमानीय "छाद्येन युतोनस्य छादकमानस्ये" त्यादिना स्थिति-विमर्दार्धे आनेतव्ये ततः "षष्ट्या विभाजिता स्थितिविमर्ददलनाडिका गुणा स्वगति" रित्यनेन स्थित्यर्धघटीसम्बन्धिनीं चन्द्रगतिकलां पातगतिं चानीय तद्धीनयुतौ चन्द्रपातौ कार्यौ तौ च पूर्वापेक्षया विशिष्टौ भवत एवमसकृत्कर्मणा स्फुटं स्थित्यर्धं भवेत्। एवमेवाऽसकृत्कर्मणा स्फुटं विमर्दार्धं भवतीति, सिद्धान्त-शेखरे श्रीपतिने "स्थिति विमर्ददलाख्यघटीहृता दिनकरेन्दु तमोमयभुक्तयः। गगनषट्क ६० हृताः प्रथमान्त्ययोः क्षयधने भवतस्त्वसकृत्ततः" त्यनेन, सिद्धान्त-शिरोमणौ भास्कराचार्येण "स्थित्यर्धनाडी गुणिता स्वभुक्तिः षष्ट्याहृता तद्रहितौ युतौ च। कृत्वेन्दु पातावसकृच्छराभ्यां स्थित्यर्धमाद्यं स्फुटमन्तिमं च॥ एवं विमर्दार्धफलोनयुक्तसपातचन्द्रोद्भवसायकाभ्याम्। पृथक् पृथक् पूर्ववदेव सिद्धे स्फुटे स्त आद्यान्त विमर्दखण्डे" त्यनेन चाऽऽचार्योक्तानुरूपमेवोक्तमिति ॥९॥

अब स्थित्यर्ध और विमर्दार्ध के स्फुटीकरण को कहते हैं।

हि. भा.—अपनी गति (रविगति, चन्द्रगति, पातगति) को स्थित्यर्ध घटी और विमर्दार्ध घटी से पृथक् पृथक् गुणा कर साठ से भाग देने से जो फल हो उनको रवि, चन्द्र और पात में से ऋण करना, अन्त में धन करना अर्थात् आद्य स्थित्यर्ध में धन और अन्त्य स्थित्यर्ध में ऋण, तथा आद्य विमर्दार्ध में धन और अन्त्य विमर्दार्ध में ऋण करना चाहिये, इसतरह बार बार पूर्वोक्त कर्म करने से स्थित्यर्ध और विमर्दार्ध स्फुट होते हैं इति ॥ ९ ॥

उपपत्ति।

यदि साठ घटी में चन्द्रगति कला पाते हैं तो स्थित्यर्ध घटी में क्या इस अनुपात से स्थित्यर्ध घटी सम्बन्धिनी चन्द्रगति कला आती है, पात की भी स्थित्यर्ध घटी सम्बन्धिनी गति इसी प्रकार लाना, इन लाये हुये फलों को क्रम से चन्द्र और पात में से हीन और युत करने से पूर्व की अपेक्षा विशिष्ट चन्द्र और पात होते हैं, इनसे "त्रिघनगुणा व्यासार्ध-भाजिता चन्द्रपातयोगज्या" इत्यादि से चन्द्रशर लाकर "छाद्येन युतोनस्य छादकमानस्य' इत्यादि से स्थित्यर्ध और विमर्दार्ध लाना चाहिये, तब "षष्ट्या विभाजिता स्थितिविमर्ददल-नाडिका गुणा स्वगतिः" इससे स्थित्यर्ध घटी सम्बन्धिनी चन्द्रगति कला और पातगति ले-आकर चन्द्र और पात में हीन और युत करने से पूर्व की अपेक्षा विशिष्ट चन्द्र और पात होते हैं इस तरह असकृत्कर्म से स्फुट स्थित्यर्ध होता हैं, इसी तरह असकृत्कर्म से स्फुट

विमर्दार्ध होता है, सिद्धान्तशेखर में "स्थिति विमर्द दल..." इत्यादि से मध्यस्थिति-पति में लिखित पद्य से श्रीपति, तथा सिद्धान्तशिरोमणि में "ग्रासावधेर्भागीग्रास स्वभुक्तिः षष्ट्या हता तद्विहितौ युतौ च" इत्यादि पद्यों से भास्कराचार्य भी आचार्योक्त के अनुरूप ही कहते हैं इति ॥ ९ ॥

इदानीं निमीलनोन्मीलनकालानयनमाह ।

स्पर्शान्निमीलनं स्थितिदले विमर्दार्धहीनिते पश्चात् ।
मोक्षादर्वागुन्मीलनं विमर्दस्तदैक्यार्धः ॥ १० ॥

सु० भा०—स्थितिदले स्पर्शस्थित्यर्धे विमर्दार्धहीनिते काले स्पर्शात् पश्चात् निमीलनं भवति । एवं मोक्षस्थित्यर्धे उन्मीलनविमर्दार्धहीनिते काले मोक्षादर्वाक् पूर्वमुन्मीलनं भवति । तयोर्निमीलनोन्मीलनयोः कालयोर्योगार्धो विमर्दः । अर्थाद्योगार्ध कालपर्यन्तमेव छादकबिम्बे छाद्यबिम्बस्य निमज्जनं भवति ।

अत्रोपपत्तिः । स्थित्यर्धं विमर्दार्धं परिभाषातः स्फुटा ॥ १० ॥

वि. भा.—स्थितिदले (स्पर्शस्थित्यर्धे) विमर्दार्धहीनिते काले स्पर्शात् पश्चात् निमीलनं भवति । मोक्षस्थित्यर्धे उन्मीलनविमर्दार्धहीनिते काले मोक्षात् अर्वाक् (पूर्वं) उन्मीलनं भवति । तदैक्यार्धः (तयोर्निमीलनोन्मीलनयोः कालयोर्योगार्धः) विमर्दोऽर्थाद्योगार्धकालपर्यन्तमेव छादकबिम्बे छाद्यबिम्बस्य निमज्जनं भवतीति ॥१०॥

अत्रोपपत्तिः ।

स्थित्यर्धविमर्दार्धपरिभाषातः स्फुटेति ॥ १० ॥

अब निमीलन और उन्मीलन कालसाधन को कहते हैं ।

हि. भा.—विमर्दार्ध रहित स्पर्शस्थित्यर्ध-काल में स्पर्श से पीछे निमीलन होता है, मोक्ष स्थित्यर्ध में उन्मीलन विमर्दार्ध घटाने से मोक्ष से पहले उन्मीलन होता है, निमीलन-काल और उन्मीलन-काल का योगार्ध विमर्द होता है अर्थात् योगार्ध काल ही तक छादक-बिम्ब में छाद्य-बिम्ब का निमज्जन (अन्तः स्थिति) होता है इति ॥१० ॥

उपपत्ति—स्थित्यर्ध और विमर्दार्ध की परिभाषा से स्पष्ट है ॥ १० ॥

इदानीमिष्टग्रासानयनमाह ।

भुक्त्यन्तरमिष्टोनस्थितिदलघटिकागुणं हृतं षष्ट्या ।
बाहुः प्राग्वत् तत्फलहीनयुतैः सूर्यशशिपातैः ॥ ११ ॥

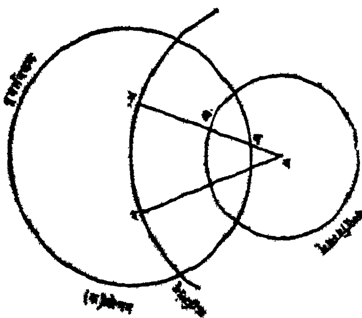
तात्कालिकविक्षेपः कोटिस्तद्वर्गयुतिपदं कर्णः ।
मानैक्यार्धात् कर्णं विशोध्य तात्कालिको ग्रासः ॥ १२ ॥

सु० *भा०*—इष्टं स्पार्शिकादिकं तत् सजातीयं स्थितिदलं च गृहीत्वान्तरं कर्त्तव्यम् । शेषं स्पष्टार्थम् ।

अत्रोपपत्त्यर्थं भास्करभुजानयनं द्रष्टव्यम् ॥ ११-१२ ॥

वि. भा.—भुक्त्यन्तरं (रविचन्द्रयोर्गत्यन्तरं) इष्टोनस्थितिदलघटिकागुणं (इष्टरहितस्थित्यर्धघष्ट्या गुणितं) षष्ट्या हृतं (षष्टिभक्तं) तदा बाहुः (भुजः) भवत्यर्थात् स्पर्शादनन्तरं यावतीष्विष्टघटिकासु ग्रासज्ञानमपेक्षितं तावतीभिर्घटीभी रहितेन स्थित्यर्धेन गुणितं रविचन्द्रयोर्गत्यन्तरं षष्टिभक्तं तदा भुजो भवतीति, ततः फलेनानेन सूर्यचन्द्रपातान् प्रचाल्य तात्कालिकश्चन्द्रशरः साध्यः सचकोटिः, तयोः (भुजकोट्योः) वर्गयोगमूलं कर्णः स्यात् । मानैक्यार्धात् कर्णं विशोध्य शेषस्तात्कालिको ग्रासः (इष्टग्रासो) भवतीति ॥ ११-१२ ॥

अत्रोपपत्तिः



स्पर्शानन्तरं यावतीभिर्घटिकाभिर्ग्रासज्ञानमपेक्षितं तावतीभिर्घटीभी रहितं स्थित्यर्धं कार्यं शेषेणाऽनुपातो यदि षष्टिघटीभी रविचन्द्रयोर्गत्यन्तरकला लभ्यन्ते तदेष्टोनस्थित्यर्धघटीभिः किमित्यनुपातेन यत्फलं स भुजो भवति, अनुपातागत फलेन सूर्यचन्द्रपातान् प्रचाल्य तात्कालिकश्चन्द्रशरः साध्यः सा कोटिः, तयोर्वर्गयोगमूलं कर्णः स्यात् । मानैक्यार्धात् कर्णस्य संशोधनेष्टग्रासो भवेत् । चं=चन्द्रकेन्द्रम् । भू=भूभाकेन्द्रम् । भचं=भूभाचन्द्र केन्द्रयोरन्तरम्=कर्णः । चंर= चन्द्रकेन्द्रोपरिगत कदम्ब प्रोतवृत्ते

चन्द्रशरः=कोटिः । भर=भुजः, एतच्चापीयजात्यत्रिभुजं सरलाकारकं स्वीकृत-माचार्येण, तदा $\sqrt{\text{कोटि}^2+\text{भुज}^2}$ =कर्ण, पश=इष्टग्रासः । भूप+चंग=भूभाव्या$\frac{1}{2}$+चंव्या$\frac{1}{2}$=मानैक्यार्ध=भूप+पचं+पश = भूचं+इष्टग्रास=कर्ण+ इष्टग्रास=मानैक्यार्ध, ∴मानैक्यार्ध—कर्ण=इष्टग्रासः ।

सिद्धान्त शेखरे "इष्टन्यूनस्थितिदलगुणा भुक्तिविश्लेषलिप्ता षष्ट्याभक्ता भवति हि भुजः कोटिरिष्टेन्दुवाणः । तद्वर्गैक्योद्भवमपि पदं कर्ण एतेन हीनं मानैक्यार्धं स्फुटमिह भवेद्वाञ्छितं छन्नमानम्" ऽनेन श्रीपतिना, सिद्धान्त शिरोमणौ "कोटिश्च तत्काल शरोऽथकोटीदोर्वर्गयोगस्य पदं श्रुतिः स्यात् । मानैक्यखण्डं श्रुतिवर्जितं सद्ग्रासप्रमाणं भवतीष्टकाले" श्लोकेनानेन भास्कराचार्येणाप्याचार्योक्तमेवोक्तमिति ॥ ११-१२ ॥

अब इष्टग्रासानयन को कहते हैं ।

हि. भा.—रवि और चन्द्र के गत्यन्तर को इष्ट रहित स्थित्यर्ध घटी से गुणा कर साठ से भाग देने से भुज होता है, इस फल करके सूर्य, चन्द्र और पात को चालन देकर तात्कालिक चन्द्रशर साधन करना वह कोटि हैं उन दोनों (भुज और कोटि) का वर्गयोग मूल कर्ण होता हैं, मानैक्यार्ध (छाद्य और छादक बिम्ब के व्यासार्ध योग) में से कर्ण को घटाने से जो शेष रहता हैं वह इष्टग्रास होता है इति ॥११-१२ ॥

उपपत्ति ।

स्पर्श के बाद जितनी इष्ट घटी में ग्रास-ज्ञान अपेक्षित हो उस इष्ट घटी को स्थित्यर्ध में से घटा देना, शेष से अनुपात करते हैं, यदि साठ घटी में रवि और चन्द्र की गत्यन्तर कला पाते हैं तो इष्टोन स्थित्यर्ध घटी में क्या इससे जो फल होता हैं वह भुज है, अनुपातागत फल से चालित रवि, चन्द्र और पात से तात्कालिक चन्द्रशर साधन करना वह कोटि हैं इन दोनों (भुज और कोटि) का वर्गयोग मूल कर्ण होना है, मानैक्यार्ध में से कर्ण को घटाने से इष्ट ग्रास होता हैं, जैसे संस्कृतोपपत्ति में लिखित (क)क्षेत्र को देखिये, चं=चन्द्रकेन्द्र, भू=भूभाकेन्द्र, भूचं=भूभा और चन्द्र के केन्द्रान्तर=कर्ण चंर=चन्द्रकेन्द्रोपरिगत कदम्बप्रोतवृत्त में चन्द्रशर=कोटि, भूर=भुज, भूरचं चापीय जात्य त्रिभुज को सरल-जात्य त्रिभुज स्वीकार कर $\sqrt{\text{भुज}^2+\text{कोटि}^2}$=कर्ण, पश=इष्टग्रास, भूप+चंश=भूभाव्या$\frac{1}{2}$+चंव्या$\frac{1}{2}$=मानैक्यार्ध=भूप+पचं+पश=भूचं+इष्टग्रास=कर्ण+इग्रा । अतः मानैक्यार्ध –कर्ण=इष्टग्रास, इससे आचार्योक्त उपपन्न हुआ ।

सिद्धान्त शेखर में "इष्ट न्यून स्थिति दलगुणा भुक्तिविश्लेषभक्ता:" इत्यादि से श्रीपति तथा "कोटिश्च तत्कालशरोऽथ कोटी" इत्यादि से सिद्धान्त-शिरोमणि में भास्कराचार्य ने भी आचार्योक्त के अनुसार ही कहा है, परन्तु यह आनयन ठीक नहीं हैं उपपत्ति देखने ही से स्पष्ट है इति ॥ ११-१२ ॥

इदानीमिष्टग्रासात्कालानयनमाह –

असकृद्ग्रासकलोनप्रमाणयुतिदलकृतेर्विशोध्य कृतिम् ।
तात्कालिकविक्षेपस्य शेषमूलं कृतं तिथिवत् ॥ १३ ॥

प्रग्रहणस्थित्यर्धात् प्रोह्य प्रग्रहणतो भवेत् कालः ।
मौक्षं विशोध्य मोक्षस्थित्यर्धात् प्राग् भवेन्मोक्षात् ॥ १४ ॥

सु० भा०—ग्रासकलोनप्रमाणयुतिदलकृतेर्ग्रासोनमानैक्यार्धवर्गात् तात्कालिकशरस्य कृतिं विशोध्य शेषमूलं तिथिवदसकृत् कृतम् । अर्थात् शेषमूलं षष्ट्या गुणं रविचन्द्रगत्यन्तरहृतं फलकालेन रविचन्द्र पातान् प्रचाल्य तात्कालिकविक्षेपं प्रसाध्य तस्मात् पुनर्ग्रासकलोनप्रमाणेत्यादिनाऽसकृद्यः शेषमूलकालः स्थिरीभवति तं प्रग्रहणस्थित्यर्धात् स्पार्शिकस्थित्यर्धात् प्रोह्य हित्वा ग्रहणतः स्पर्शादनन्तरं कालो भवेदर्थात् स्पर्शानन्तरमेतावतीष्टकाले तावानिष्टग्रासो भवति । एवं तमेव कालं मौक्षं मोक्षसम्बन्धिनं मोक्षस्थित्यर्धाद्विशोध्य शेषं मोक्षात् प्रागेवेष्टकालो भवेत् । अर्थात् मोक्षात् प्राक् तावतीष्टकाले तावानेवेष्टग्रासो भवेत् । एवमिष्टग्रासाद्द्विधेष्टकाल उत्पद्यते । एकः स्पर्शानन्तरमन्यो मोक्षात् प्रागिति ।

अत्रोपपत्तिः । तत्कालशरस्याज्ञानान्मध्यकालिकशरात् कर्म कृतमतोऽसकृद्विधिना स्फुटकालसाधनमुचितम् । शेषोपपत्ति 'र्ग्रासो न मानैक्यदलस्य वर्गाद् विक्षेपकृत्या रहिता' दित्यादिभास्करविधिना स्फुटा ॥ १३-१४ ॥

वि. भा.—ग्रासकलोनप्रमाणयुतिदलकृतेः (ग्रासरहितमानैक्यार्धवर्गात्) तात्कालिकशरस्य कृतिं (वर्गं) विशोध्य (हित्वा) शेषस्य मूलं तिथिवदसकृत् कृतमर्थात् शेषमूलं षष्टिगुणं रविचन्द्रयोर्गत्यन्तरभक्तं फलकालेन रविचन्द्रपातान् प्रचाल्य तात्कालिकचन्द्रशरं संसाध्य तस्मात् पुनर्ग्रासकलोनप्रमाणयुतिदलकृतेरित्यादिनाऽसकृद्य शेषमूलं कालः स्थिरीभवति तं प्रग्रहणस्थित्यर्धात् (स्पार्शिकस्थित्यर्धात्) प्रोह्य (हित्वा) प्रग्रहणतः (स्पर्शादनन्तरं) कालो भवेदर्थात्स्पर्शानन्तरमेतावतीष्टकाले तावानिष्टग्रासो भवति, एवं तमेव कालं मौक्षं (मोक्षसम्बन्धिनं मोक्षस्थित्यर्धात् विशोध्य शेषं मोक्षात् प्राक् (पूर्वं) इष्टकालो भवेदर्थात् मोक्षात् प्राक् तावतीष्ट काले तावानेवेष्टग्रासो भवेत् । एवमिष्टग्रासाद् द्विधेष्टकाल उत्पद्यते, एकः स्पर्शानन्तरमन्यो मोक्षात्पूर्वमिति ॥ १३-१४ ॥

अत्रोपपत्तिः

तत्तत्कालिकशराज्ञानान्मध्यग्रहणकालिकशरादेवेष्टकालज्ञानं कृतमतोऽसकृद्विधिना स्फुटस्येष्टकालस्य साधनं कर्त्तव्यमेव। पूर्वमिष्टग्रासानयने 'मानैक्यार्ध—कर्ण=इष्टग्रासः' सिद्धोऽतो मानैक्यार्ध—इष्टग्रास=कर्ण, एतद्वर्गे तात्कालिकचन्द्रशरस्य वर्गशोधनेन यच्छेषं तन्मूलं षष्ट्या गुणितं रविचन्द्रयोर्गत्यन्तरेण भक्तं लब्धं स्पार्शिकस्थित्यर्धात् मौक्षिकस्थित्यर्धाद्वा शोधयेत्तदा गृहीतेष्टग्रासस्य कालो भवेदेवमसकृच्छरवर्गहीनान्मूलं षष्टिगुणितं रविचन्द्रगत्यन्तरभक्तं फलकालेन रविचन्द्रपातान् प्रचाल्य तात्कालिकचन्द्रशरं संसाध्य ततः पुनः 'ग्रासकलोनप्रमाणयुतिदलकृते' रित्यादिना वारं वारं यः कालः स्थिरो भवेत्तं स्पार्शिकस्थित्यर्धाच्छोधयेत्तदा स्पर्शानन्तरं गतः कालो भवेत्। तमेव कालं मौक्षिकस्थित्यर्धाद्विशोध्य शेषं मोक्षात्पूर्वमिष्ट कालो भवतीति। सूर्य सिद्धान्तेऽप्येवेष्ट ग्रासात्कालानयनमस्ति, सिद्धान्तशिरोमणौ "ग्रासोनमानैक्यदलस्य वर्गाद्विक्षेपकृत्या रहितात्पदं यत्। गत्यन्तरांशैर्विहृतं फलोनं स्थित्यर्धकं स्वं भवतीष्टकालः" इत्याचार्योक्तानुरूपमेवेतिज्ञेयं विज्ञैरिति ॥ १३-१४ ॥

अब इष्ट ग्रास से कालसाधन को कहते हैं।

हि. भा.—ग्रास रहित मानैक्यार्ध वर्ग में से तात्कालिक चन्द्रशरवर्ग को घटा कर शेष का मूल लेकर उससे तिथिवत् असकृत्कर्म करना चाहिये अर्थात् शेष मूल को साठ से गुणा कर रवि और चन्द्र के गत्यन्तर से भाग देने से जो फल काल हो उनसे रवि, चन्द्र और पात को चला कर तात्कालिक चन्द्रशर साधन कर उससे फिर 'ग्रासकलोनप्रमाणयुतिदलकृतेः' इत्यादि से असकृत् करने से जो काल स्थिरीभूत हो उसको स्पार्शिक स्थित्यर्ध में से घटाने से स्पर्श के बाद काल होता है अर्थात् स्पर्श के अनन्तर इतने काल में इतने इष्टग्रास होते हैं। इसीतरह मोक्ष सम्बन्धी काल को मोक्षस्थित्यर्ध में से घटाने से शेष मोक्ष से पूर्व इष्टकाल होता है अर्थात् मोक्ष से पहले इतने काल में इतने इष्ट ग्रास होते हैं इस तरह इष्ट ग्रास से दो तरह का इष्टकाल होता है, एक स्पर्श काल के अनन्तर और दूसरा मोक्ष से पूर्व इति ॥ १३-१४ ॥

उपपत्ति।

स्पर्शादि कालिक शर विदित न रहने के कारण मध्यग्रहण कालिक शर ही से इष्ट कालानयन किया गया है जो कि ठीक नहीं है, इसलिये असकृत्प्रकार से स्फुट इष्ट कालानयन करना उचित ही है, पहले इष्ट ग्रासानयन में मानैक्यार्ध—इष्टग्रास=कर्ण इसके वर्ग

में से तात्कालिक चन्द्रशर वर्ग को घटा कर जो शेष रहता हैं उसके मूल को साठ से गुणा कर रवि और चन्द्र के गत्यन्तर से भाग देने से जो लब्ध हो उसको स्पार्शिक स्थित्यर्ध में से वा मौक्षिक स्थित्यर्ध मे से घटा देना तब गृहीत इष्ट ग्रास सम्बन्धी काल होता हैं, इसतरह असकृत् (बार बार) कर्ण वर्ग में से तात्कालिक चन्द्रशर वर्ग को घटाकर शेष के मूल को साठ से गुणा कर रवि और चन्द्र के गत्यन्तर से भाग देने से जो फल काल हो उससे रवि, चन्द्र और पात को चला कर तात्कालिक चन्द्रशर साधन करना पुनः उससे "ग्रासकलोनप्रमाणयुतिदल-कृतेः" इत्यादि से बार बार जो काल स्थिर हो उसको स्पार्शिक स्थित्यर्ध में से घटा देना तब स्पर्श के बाद गत काल होता हैं, उसी काल को मौक्षिक स्थित्यर्ध में से घटाने से शेष मोक्ष से पूर्व इष्टकाल होता हैं, सूर्य सिद्धान्त में भी इसी तरह इष्ट ग्रास से कालानयन है, सिद्धान्त-शिरोमणि में "ग्रासोनमानैक्य दलस्य वर्गाद्विक्षेप कृत्या" इत्यादि संस्कृतोपपत्ति में लिखित पद्यों से भास्कराचार्य ने भी आचार्योक्तानुरूप ही कहा है इति ॥ १३-१४ ॥

इदानीं स्पर्शादिव्यवस्थामाह

स्फुटतिथ्यन्ते मध्यं प्रग्रहणं स्थितिदलोनकेऽभ्यधिके ।
मोक्षो निमीलनोन्मीलने विमर्दार्धहीनयुते ॥ १५ ॥

सु० भा०— स्पष्टार्थमुपपत्तिश्च स्फुटा 'मध्यग्रहः पर्वविरामकाले' इति भास्क-रोक्तमेतदनुरूपमेव ॥ १५ ॥

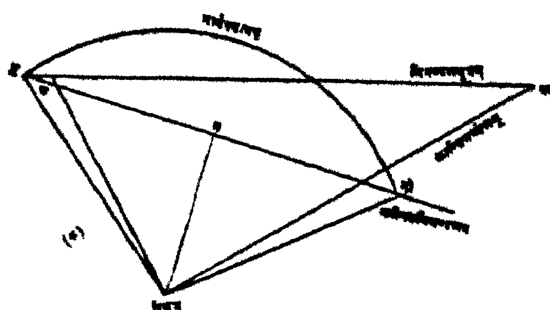
वि. भा.— स्फुटतिथ्यन्ते (स्फुट पूर्णान्तिकाले अमान्ते वा) मध्यग्रहणं भवति मध्यग्रहणतः पूर्वं स्थित्यर्धकाले प्रग्रहणं (स्पर्शः) भवति, मध्यग्रहणानन्तरं स्थित्यर्ध-काले मोक्षो भवति। मध्यग्रहणतः पूर्वं विमर्दार्धं काले निमीलनं (सर्वग्रासः) मध्यग्रहणात्परं विमर्दार्धकाले उन्मीलनं (सर्वग्रासावसानं) भवति, रविचन्द्रयो-रुभयोरपि ग्रहणं पञ्च प्रकारं भवतीति ॥ १५ ॥

अत्रोपपत्तिः

पा=पातः। स्थि=पूर्णान्तिकाले भूभा=स्थिर भूभा, चं=पूर्णान्तिकाले चन्द्रः= स्थिरचन्द्रः। स्थिचं=पूर्णान्तिकाले शरः पूर्णान्ति कालिकचन्द्रविमण्डलीयभुजांशक्रांति-वृत्तीय भुजांशशरैरुत्पन्नं चापीयजात्यत्रिभुजं सरलाकारकंमत्वा स्थिर भूभा स्थिरचन्द्र-

वशेनैकस्य कल्पितविमण्डलसंज्ञकस्य रचना मया वटेश्वरसिद्धान्ते प्रदर्शिताऽस्ति, तद्रचनाप्रकारस्तत एव बोध्यः ।

तद्रचनाक्रमदर्शनेनेदमपि सिद्धमस्ति यच्चलितचन्द्रभूभयोर्यदन्तरं तदेव स्थिरभूभाकल्पितचन्द्रयोरन्तरं भवति, स्थिरभूभातः कल्पितविमण्डलोपरि-लम्बः स्थम, म बिन्दावेव स्थिरभूभा—मबिन्दुस्थकल्पितचन्द्रयोरन्तरस्य (कयोरपि चलितभूभाचन्द्रयोरन्तरतुल्यस्य) परमाल्पान्तरत्वान्मध्यग्रहणं भवितु-मर्हति, परमत्र 'म' बिन्दुः पूर्णान्तादन्यत्रास्त्यतः पूर्णान्ते मध्यग्रहणं 'मध्यग्रहः



पर्वविरामकाले इत्यनेन' भास्करेण श्रीपतिनाऽऽचार्येण च यत्कथितं तन्न युक्तम् । स्थिरभूभाकेन्द्रं केन्द्रं मत्वा मानैक्यार्धेन यद्वृत्तं तत्पूर्णान्ताभिमुखं कल्पितविमण्डले यत्र लगति तत्र स्पर्शस्तद्विरुद्धदिशि यत्र लगति तत्र मोक्षः । मध्यग्रहणपूर्णान्तकाल-योरन्तरानयनमपि वटेश्वरसिद्धान्ते प्रदर्शितमस्ति मया तदपि तत एवावगन्तव्यं शेषं सर्वं स्फुटमिति ॥१५॥

अब स्पर्शादि व्यवस्था को कहते हैं

हि. भा.—स्फुट पूर्णान्तकाल में वा अमान्तकाल में (चन्द्र और सूर्य के) मध्य-ग्रहण होता है, मध्यग्रहण से पूर्व स्थित्यर्ध काल में स्पर्श होता है, मध्यग्रहणानन्तर स्थित्यर्ध काल में मोक्ष होता है, मध्यग्रहण से पूर्व विमर्दार्ध काल में निमीलन (सर्वग्रास) होता है, मध्यग्रहण के बाद विमर्दार्ध काल में उन्मीलन (सर्वग्रासान्त) होता है, चन्द्रग्रहण और सूर्यग्रहण पांच प्रकार के होते हैं इति ॥१५॥

उपपत्ति

संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । पा=पात, स्थि=पूर्णान्तकालिक-भूभाकेन्द्र=स्थिरभूभा, चं=पूर्णान्तकालिकचन्द्र=स्थिरचन्द्र, विमं=पूर्णान्तकालिकविमण्डल,

पूर्णान्तकालिकचन्द्रविमण्डलीयभुजांश—क्रान्तिवृत्तीयभुजांश और शर इनसे उत्पन्न चापीयजात्य त्रिभुज को सरलजात्य त्रिभुज मानकर स्थिरभूभा और स्थिरचन्द्र वश से एक कल्पित विमण्डल नाम के चन्द्रमार्ग की रचना मैंने वटेश्वरसिद्धान्त में दिखलायी है, उसका रचना प्रकार उसी से समझना चाहिये। उस (कल्पित विमण्डल) के रचना क्रम को देखने से यह भी सिद्ध होता है कि चलित भूभा और चलित चन्द्र का अन्तर स्थिरभूभा और कल्पित चन्द्र के अन्तर के बराबर होता है, स्थिरभूभा से कल्पित विमण्डल के ऊपर लम्ब= स्थिम, म बिन्दु में ही स्थिरभूभा और म बिन्दुस्थ कल्पित चन्द्र का अन्तर किसी भी चलित भूभा और चलित चन्द्र के अन्तर के बराबर होगा परन्तु यह परमाल्पान्तर है इसलिये इसी (म) बिन्दु में मध्यग्रहण होना उचित है, लेकिन यह (म) बिन्दु पूर्णान्त से अन्यत्र है इसलिये पूर्णान्त में मध्यग्रहण 'मध्यग्रह: पर्वविरामकाले' इससे भास्कराचार्य, श्रीपति तथा आचार्योक्त पूर्णान्तकाल में मध्यग्रहण का होना ठीक नहीं है, स्थिरभूभा केन्द्र को केन्द्र मानकर मानैक्यार्ध व्यासार्ध से जो वृत्त होता है वह पूर्णान्ताभिमुख कल्पित विमण्डल में जहाँ लगता है वहाँ स्पर्श तथा विरुद्ध दिशा में कल्पित विमण्डल में जहाँ लगता है वहाँ मोक्ष होता है, वटेश्वरसिद्धान्त में 'मध्यग्रहण और पूर्णान्त काल का अन्तरानयन भी' मैं (१) ने दिखलाया है वह उसी से समझना चाहिए, शेष सब बातें स्पष्ट हैं इति ॥२५॥

इदानीमक्षजवलनसाधनमाह

प्राक्पश्चान्नतविषुवज्ज्ययोर्वधात् त्रिज्ययाप्तचापं यत् ।
उत्तरयाम्ये पूर्वा विषुवद्वृत्तात् त्रिभे ग्राह्या ॥१६॥

सु. भा.—प्राक् प्राक्कपाले पश्चात् पश्चिमकपाले यो नत: सममण्डलीयनतभागास्तेषां या ज्या। या च विषुवज्ज्याऽक्षज्या तयोर्वधात् त्रिज्यया यदाप्तं तस्य चापांशस्त्रिभे ग्रहाद्राशित्रयान्तरे उत्तरयाम्ये प्राक्पश्चान्नतक्रमेण ग्राह्या आह्यवृत्तीया विषुवद्वृत्तस्य पूर्वा भवति सममण्डलादित्यग्रेण सहान्वय:।

अत्रोपपत्ति:। 'तेषां क्रमज्या पलशिञ्जिनीभक्ता द्युमौर्व्या' इत्यादिभास्करविधिना स्फुटा। आचार्येण द्युज्यास्थाने त्रिज्या स्थूला गृहीता। नतशब्देन यद्यहोरात्रे नतकालो गृह्यते तदा वलनवासनयाऽत्यन्तं स्थूलमाचार्योक्तमक्षवलनं भवेदिति चापीयत्रिकोणमित्या वलनानयनेन स्फुटम् ॥१६॥

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(१) वटेश्वरसिद्धान्त के टीकाकार (पण्डित मुकुन्दमिश्र; ज्योतिषविभागाध्यक्ष (गवर्नमेण्ट संस्कृत कालेज मुजफ्फरपुर) ग्राम के संकेत—ग्राम देपुरा, पो. औ. (बेनीपट्टी) जिला—दरभङ्गा, बिहार।

वि. भा.—प्राक् (पूर्वकपाले) पश्चात् (पश्चिमकपाले) यो नतः (सममण्डलीयनतांशः) तस्य, या ज्या, या च विषुवज्ज्या (अक्षज्या) तयोर्वधात् त्रिज्यया-भक्तात् यदाप्तं (यल्लब्धं) तच्चापांशैस्त्रिभे (ग्रहाद्राशित्रयान्तरे) उत्तरयाम्ये प्राक् पश्चान्नतक्रमेण ग्राह्या (ग्राह्यवृत्तीया) विषुवद् वृत्तस्य पूर्वा। सममण्डलादित्यग्रेण सहान्वयः) भवतीति ॥१६॥

अत्रोपपत्तिः

क्रान्तिवृत्ते यत्र ग्रहस्थानमस्ति तदुपरिगतं ध्रुवप्रोतवृत्तं समप्रोतवृत्तञ्च कार्यं ग्रहा- (ग्रहस्थान) भवत्यंशेन (ग्रहक्षितिजवृत्तसंज्ञकं) वृत्तं कार्यं तस्मिन् वृत्ते ध्रुवप्रोतवृत्तं समप्रोतवृत्तयोरन्तर्गतं चापं नाडीवृत्तपूर्वापरवृत्तयोरन्तर्गतं चापं वा ग्रहलग्नकोणो (ध्रुवप्रोतवृत्तसमप्रोतवृत्तयोरुत्पन्नः) वाऽऽक्षवलनसंज्ञकम्। सममण्डलप्राचीतो नाडीमण्डलप्राची यावद्वलति तत् वल, वल्लसंवरणे संवलने चेति धातोर्वलतीति वलनमिति सञ्चलनमेव वलनमिति। खस्वस्तिकस्थे ग्रहे सममण्डलीयनतांशा (ग्रहोपरिगतसमप्रोतवृत्तपूर्वापरवृत्तसम्पातात् खस्वस्तिकं यावत्) भावः नाडीवृत्तपूर्वापरवृत्तयोः सम्पात (पूर्वस्वस्तिक) स्थे ग्रहे सममण्डलीय-नतांशा नतांशा नवत्यंशतुल्यास्तत्र नतकालो दिनार्धसमः। खस्वस्तिकस्थे ग्रहे च नत-कालाऽभावोऽतोऽत्रान्तरेऽनुपातो यदि दिनार्धतुल्ये नतकाले नवत्यंशतुल्याः सममण्ड-लीयनतांशा लभ्यन्ते तदेष्टनतकाले किमित्यनुपातेनेष्टसममण्डलीयनतांशाः समागच्छन्ति, परमयमनुपातो न समीचीनः। अथ ग्रहाद् ध्रुवं यावद् द्युज्याचाप-मेको भुजः। समस्थानाद् ग्रहं यावत्समप्रोतवृत्ते द्वितीयो भुजः। याम्योत्तर-वृत्तेऽक्षांशास्तृतीयो भुज इति भुजत्रयैरुत्पन्नचापीयत्रिभुजे समस्थानलग्नकोणः =१८०—सममण्डलीयनतांशः, ग्रहलग्नकोणोऽक्षवलनम्। ततोऽनुपातेन 'यदि

द्युज्यया सममण्डलीयनतांशज्या { ज्या (१८०—सममण्डलीयनतांश) }

लभ्यते तदाऽक्षज्यया किमिति' नेन समागच्छत्यक्षवलनज्या =

$\frac{\text{समनतांशज्या·अक्षज्या}}{\text{द्यु.}}$ अत्राऽऽचार्येण सममण्डलीयनतांशज्यास्थाने सममण्डलीय-नतांशोत्क्रमज्या तथा द्युज्यास्थाने च त्रिज्या गृहीता, या च न समीचीना, साधिता-ऽऽक्षवलनज्यायाश्चापं कार्यं तदाऽऽक्षवलनं (पूर्वकपाले उत्तरं पश्चिमकपाले च दक्षिणं) भवति, शिष्यधीवृद्धिदे तन्त्रे लल्लाचार्येण "स्पर्शादिकालजनतोत्क्रम-शिञ्जिनीभिः क्षुण्णाऽक्षभा पलभवश्रवणेन भक्ता। चापानि पूर्वनतपश्चिमयोः क्रमेण सौम्येतराणि समवेहि यथा क्रमेण" अनेन, सिद्धान्तशेखरे श्रीपतिना "नतोत्क्रमज्याऽक्षगुणाभिघातात् त्रिभज्यकाप्तस्य च कार्मुकं यत्। उदक् च याम्यं च कपालयोस्तु तदाक्षमाचावलनं वदन्ति" अनेन चोत्क्रमज्याप्रकारेणाऽक्ष-

वलनानयनं कृतं यत् खण्डनं सिद्धान्तशिरोमणौ भास्कराचार्येण "यैरुत्क्रमज्याविधिनैतदुक्तं सम्यक् न ते गोलगतिं विदन्ति" नेन कृतं यत् समीचीनमस्ति कैश्चित् 'खाङ्काहतं स्वद्युदलेन भक्तं स्पर्शादिकालोत्थनतं लवाः स्युरित्यादिना पूर्वसाधितं' सममण्डलीयनतांशमानं सूक्ष्मं तत्साधितं वलनं सूक्ष्मं कथ्यते, तन्न युक्तम् । सूर्यसिद्धान्तेऽपि 'नतज्याऽक्षज्यया क्षुण्णेत्यादि' साधितमाक्षवलनं न समीचीनमिति, उत्क्रमज्यया साधितं वलनं न समीचीनमेतदर्थं वटेश्वरसिद्धान्तो विलोक्य इति ॥१६॥

अब आक्षवलनानयन को कहते हैं

हि. भा.—पूर्वकपाल में और पश्चिम कपाल में जो सममण्डलीय नतांश है उसकी ज्या और अक्षज्या के घात में त्रिज्या से भाग देने से जो लब्ध होता है उसका चापांश करके ग्रह से तीन राशि पर पूर्वनत और पश्चिमनत क्रम से उत्तर और दक्षिण में ग्राह्य वृत्तीय सममण्डल से नाड़ीवृत्त की पूर्वा दिशा होती है, यहाँ अग्रिम श्लोक के, 'सममण्डलात्' इस के साथ सम्बन्ध है ॥१६॥

उपपत्ति

क्रान्तिवृत्त में जहाँ ग्रहस्थान है उसके ऊपर ध्रुवप्रोतवृत्त और समप्रोतवृत्त कर दिया, ग्रह (ग्रहस्थान) से नवत्यंश व्यासार्ध से ग्रहक्षितिजसंज्ञक वृत्त कर दिया, ध्रुवप्रोत वृत्त और समप्रोतवृत्त के अन्तर्गत ग्रहक्षितिज वृत्तीय चाप वा नाड़ीवृत्त और पूर्वापरवृत्त के अन्तर्गत ग्रहक्षितिजवृत्तीय चाप वा ग्रहलग्नकोण (ध्रुवप्रोतवृत्त और समप्रोतवृत्त से उत्पन्न कोण) आक्षवलन है, खस्वस्तिक में ग्रह के रहने से सममण्डलीय नतांश (ग्रहोपरिगत समप्रोतवृत्त और पूर्वापरवृत्त के सम्पात से खस्वस्तिक पर्यन्त) का अभाव होता है, नाड़ीवृत्त और पूर्वापरवृत्त के सम्पात (पूर्वस्वस्तिक) में ग्रह के रहने से सममण्डलीय नतांश नवत्यंश के बराबर होता है और नतकाल दिनार्ध के बराबर होता है, इन दोनों के मध्य में ग्रह के रहने से अनुपात करते हैं यदि दिनार्ध तुल्य नतकाल में नवत्यंश तुल्य सममण्डलीय नतांश पाते हैं तो इष्ट नतकाल में क्या इस अनुपात से इष्ट सममण्डलीय नतांश प्रमाण आता है, लेकिन यह अनुपात ठीक नहीं है, ग्रह से ध्रुव पर्यन्त द्युज्या चापांश प्रथमभुज, ग्रह से समस्थानपर्यन्त उपकोटि द्वितीय भुज, अक्षांश (ध्रुव और समस्थान के अन्तर्गत याम्योत्तरवृत्तीय चाप) तृतीय भुज, इन तीनों भुजों से उत्पन्न चापीय त्रिभुज में समस्थानलग्नकोण=१८०—सममण्डलीयनतांश, ग्रहलग्नकोण= आक्षवलन, तब अनुपात करते हैं यदि द्युज्या में तत्संमुखकोणज्या= { ज्या (१८०—सममण्डलीय नतांश) } =सममण्डलीय नज्या, पाते हैं तो अक्षज्या में इससे क्या

लग्नकोणज्या (आक्षवलनज्या आती है $\frac{\text{सममण्डलीय नज्या}\cdot\text{अक्षज्या}}{\text{द्यु}}$ = आक्षवलनज्या,

यहाँ आचार्य ने सममण्डलीयनतांशज्या के स्थान में सममण्डलीयनतांशोत्क्रमज्या तथा द्युज्या के स्थान में त्रिज्या का ग्रहण किया है जो नितान्त अनुचित है, साधित आक्षवलनज्या का चाप करने से आक्षवलन पूर्व कपाल में उत्तर और पश्चिम कपाल में दक्षिण होता है, शिष्यधीवृद्धिदे में लल्लाचार्य "स्पर्शादिकालजनतोत्क्रमशिञ्जिनीभिः" इत्यादि संस्कृतो-पपत्ति में लिखित पद्यों से तथा सिद्धान्तशेखर में श्रीपति ने "नतोत्क्रमज्याऽक्षगुणाभि-घातात्" इत्यादि से उत्क्रमज्या प्रकार से आक्षवलनानयन किया है जिसका खण्डन सिद्धान्त-शिरोमणि में भास्कराचार्य ने "यैरुत्क्रमज्या त्रिधिनैतदुक्त" इत्यादि से किया है जो कि बिल्कुल ठीक है, कोई कोई "खाङ्काहतं स्वद्युदलेन भक्तं" इत्यादि से साधित भास्करीय आक्षवलन को ठीक कहते हैं सो अनुचित है सूर्यसिद्धान्त में भी "नतज्याऽक्षज्याक्षुण्णा" इत्यादि से साधित आक्षवलन ठीक नहीं है इति ॥१६॥

इदानीमायनवलनानयनमाह

सममण्डलाद्विषुवतो ग्राह्यात् त्रिगृहाधिकादुदग्याम्यैः ।
क्रान्त्यंशैरपमण्डलपूर्वास्याश्चन्द्रविक्षेपः ॥१७॥

सु. भा.—सममण्डलादिति पूर्वेण श्लोकेन सहान्वयः । ग्राह्याच्चन्द्रग्रहे चन्द्रात् सूर्यग्रहे सूर्यात् किंविशिष्टात् त्रिगृहाधिकात् राशित्रयसहिताद्ये क्रान्त्यं-शास्तैरुदग्याम्यैर्विषुवतो नाडीवृत्तात् त्रिभान्तरेऽपमण्डलपूर्वा क्रान्तिमण्डलीया तात्कालिकी पूर्वा स्यादिति । अस्याः क्रान्तिवृत्तपूर्वायाः सकाशाद्याम्योत्तरश्चन्द्र-विक्षेपो भवति इति प्रसिद्धोऽर्थः ।

अत्रोपपत्तिः । सत्रिभग्रहक्रान्तिज्या द्युज्यावृत्तेऽयनवलनं भवति । आचार्येण स्थूलाद् द्युज्या त्रिज्यामिता गृहीता । अतः क्रान्तिज्यैवायनं वलनम् । तच्चापांशाः सत्रिभग्रहदिक्का उत्तरयाम्या अयनवलनांशा भवन्तीति सर्वं भास्करीयवलन-वासनातः स्फुटम् ॥१७॥

वि. भा.—सममण्डलादिति पूर्वश्लोकेन सहान्वयः । ग्राह्यात् (चन्द्रग्रहणे चन्द्रात्, सूर्यग्रहणे सूर्यात्) त्रिगृहाधिकात्, (राशित्रयसहितात्) ये क्रान्त्यंशा-स्तैरुदग्याम्यैर्विषुवतः (नाडीवृत्तात्) त्रिभान्तरेऽपमण्डलपूर्वा (क्रान्तिवृत्तीया) तात्कालिकी पूर्वा स्यात् । अस्याः (क्रान्तिवृत्तपूर्वायाः) याम्योत्तरः(दक्षिण उत्तरश्च) चन्द्रविक्षेपः (चन्द्रशरः) भवतीति ॥१७॥

अत्रोपपत्तिः

ध्रु=ध्रुवः । क=कदम्बम् । ग्र=क्रान्तिवृत्ते ग्रहः । ग्रहोपरि ध्रुवप्रोतवृत्तं कदम्बप्रोतवृत्तञ्च कार्यं, ग्रहान्नवत्यंशेन ग्रहक्षितिजं कार्यमेतस्मिन् वृत्ते ध्रुवप्रोतकदम्बप्रोतवृत्तयोरन्तर्गतं चापं नाडीवृत्तक्रान्तिवृत्तयोरन्तर्गतं चापं वा ग्रहलग्नकोणः कदम्बप्रोतवृत्तध्रुवप्रोतवृत्तयोरुत्पन्नो वाऽऽयनवलनम् ।

(क)

कपसन=ग्रहक्षितिजम् । स=सत्रिभग्रहः । कप=सज=∠पग्रक=आयनवलनम् । मध्रुसन=सत्रिभग्रहोपरिगतं ध्रुवप्रोतवृत्तम् ।

>ग्रकच=ग्रहकोटिः ध्रुग्र=द्युज्याचापम् । कध्रु=जिनांशाः, कध्रुग्रचापीयत्रिभुजे कोणानुपातेना 'यदि द्युज्यया ग्रहकोटिज्या लभ्यते तदा जिनज्यया किमिति' नेन समागच्छति ग्रहलग्नकोणज्याऽर्थादायनवलनज्या

$=\frac{\text{ग्रकोज्या.जिज्या}}{\text{द्यु}}$, ततो द्युज्याग्रे परिणमनार्थमनुपातो यदि त्रिज्ययेयमायनवलनज्या लभ्यते तदा द्युज्यया किमित्यनेनागच्छति द्युज्याग्रीयायनवलनज्या

$=\frac{\text{ग्रकोज्या-जिज्या}}{\text{त्रि.}}$, अथ सत्रिभग्रहः=९०+ग्र ततः सत्रिभग्रहज्या=ज्या

(९०+ग्र) चापज्या चापोनभार्धांशज्ययोस्तुल्यत्वात् ज्या (९०+ग्र)=ज्या (१८०—९०—ग्र)=ज्या (९०—ग्र)=ग्रहकोटिज्या=सत्रिभग्रहज्या

$\therefore \frac{\text{ग्रकोज्या-जिज्या}}{\text{त्रि}}=\frac{\text{सग्रज्या-जिज्या}}{\text{त्रि}}$=सत्रिभग्रहक्रान्तिज्या=द्युज्याग्रीयायवज्या

त्रिज्याग्रीयायनवलनज्या तु पूर्वाऽऽनीतैवास्ति, त्रिज्याद्युज्ययोः स्वल्पान्तरात्तुल्यां स्वीकृत्य त्रिज्यापरिणामनमकृत्वैव सत्रिभग्रहक्रान्तिज्यातुल्यैवाऽऽयनवलनज्या स्वीकृता भास्करतः प्राचीनैः सर्वैः सिद्धान्तकारैः । लल्लस्तु भुजज्यायास्तदुत्क्रमज्यायाश्चाभावत्वपरमत्वयोरेकत्रैव सद्भावादुत्क्रमज्ययैव बहूनां विषयाणां (सिद्धान्तोक्तानां) साधनं कुर्वन् वलनानयनमप्युत्क्रमज्ययैव चकार लल्लोक्तसाधनमेव युक्तियुक्तमिति बुध्वा श्रीपतिनाऽपि वलनानयनं तथैवोक्तमित्यनुमीयते। यथा लल्लोक्तम्—"आद्यात् सराशित्रितयाद् भजज्या व्यस्ता

ततः प्राग्वदपक्रमज्या। तस्या धनुः सत्रिगृहेन्दुदिक् स्यात् क्षेपो विपातस्य विषोदिशि स्यात्" श्रीपत्युक्तञ्च "त्रिभवनसहिताच्च ग्राह्यतो व्यस्तजीवा रविनमरमचापं संस्कृतं स्वेषुणा यत्" एभिर्महानुभावैरायनवलने गम्भरतराऽपि कृतः स च युक्तिराहित्यान्न युक्तः। आचार्योक्ताऽऽयनवलनज्या क्रान्तिज्यैवाऽस्ति तच्चापादाः सत्रिभग्रहदिक्का उत्तरयाम्या आयनवलनांशा भवन्ति, भास्कराचार्येण 'युताऽयनांशोडुपकोटिशिञ्जिनी जिनांशमौर्व्या गुणिता विभाजिता। द्युजीवया लब्धफलस्य कार्मुकं भवेच्छशाङ्कायनदिक्कमायनम्" नेन समीचीनमायनवलनसाधनं कृतमिति ॥१७॥

अब आयन वलन के साधन को कहते हैं

हि. भा.—तीन राशि युक्त ग्राह्य (चन्द्रग्रहण में चन्द्र से सूर्य ग्रहण में सूर्य से) से जो क्रान्त्यंश हो उससे उत्तर और दक्षिण नाड़ीवृत्त से तीन राशि के अन्तर पर क्रान्तिवृत्तीय तात्कालिक पूर्वा दिशा होती है, इस क्रान्तिवृत्तीय पूर्व दिशा से दक्षिण और उत्तर चन्द्रशर होता है इति ॥१७॥

उपपत्तिः

संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये। ध्रु=ध्रुव, क=कदम्ब, ग्र=क्रान्तिवृत्त में ग्रह=चन्द्र, ग्रह के ऊपर ध्रुवप्रोतवृत्त और कदम्ब प्रोतवृत्त कीजिए, ग्रह को केन्द्र मानकर नवत्यंश व्यासार्ध से ग्रहक्षितिज संज्ञक वृत्त कीजिए, इस वृत्त में ध्रुवप्रोतवृत्त और कदम्बप्रोतवृत्त के अन्तर्गत चाप या नाड़ीवृत्त और क्रान्तिवृत्त के अन्तर्गत चाप या ग्रहलग्न कोण (ध्रुवप्रोतवृत्त और कदम्बप्रोतवृत्त से उत्पन्न) आयन वलन है। कप-सन=ग्रहक्षितिज, स=सत्रिभग्रह,=सत्रिभचन्द्र, कप=वन=<ध्रुग्रक=आयनवलन, ध्रुसन=सत्रिभग्रह के ऊपर ध्रुव प्रोतवृत्त, <ग्रकध्रु=ग्रहकोटि=चन्द्रकोटि, ध्रुग्र=द्युज्याचाप, कध्रु=जिनांश, तब कध्रुग्र चापीय त्रिभुज में कोणानुपात 'यदि द्युज्या में ग्रहकोटिज्या पाते हैं तो जिनज्या में क्या' से ग्रहलग्न कोणज्या अर्थात् आयनवलनज्या=

$\frac{\text{ग्रकोज्या. जिज्या}}{\text{द्यु}}$ 'इसको द्युज्यात्र में परिणामन के लिये अनुपात करते हैं यदि त्रिज्या में यह वलनज्या पाते हैं तो द्युज्या में क्या इस से द्युज्यागी आयन वलनज्या आती है,

$\frac{\text{ग्रकोज्या. जिज्या}}{\text{त्रि}}$=द्युज्यागी आयन वलनज्या, सत्रिभग्रह=९०+ग्र ∴ सत्रिभग्रहज्या=ज्या (९०+ग्र) चापज्या और चापोन चापार्धज्या बराबर होती है इसलिए ज्या (९०+ग्र)=ज्या (१८०—९०—ग्र)=ज्या (९०—ग्र)=ग्रहकोटिज्या=सत्रिभग्रहज्या

∴ $\frac{\text{ग्रकोज्या. जिज्या}}{\text{त्रि}}=\frac{\text{सत्रिग्रज्या. जिज्या}}{\text{त्रि}}$=सत्रिभग्रहक्रान्तिज्या=द्युज्यागी आयनवलनज्या,

त्रिज्याग्री श्रायनवलनज्या (वास्तव श्रायनवलनज्या) पहले लाई हुई

$\frac{\text{क्रांज्या.त्रिज्या}}{\text{द्यु}}$ है, यहां आचार्य ने त्रिज्या और द्युज्या को बराबर स्वीकार कर त्रिज्या परिणामन को नहीं कर के सत्रिभ क्रान्तिज्या तुल्य ही आयनवलनज्या स्वीकार किया है। भास्कराचार्य से प्राचीनाचार्यों ने भी यही किया है। लल्लाचार्य ने शिष्यधीवृद्धिद में 'भुजज्या और उसकी उत्क्रमज्या के एक ही स्थान में अभावत्व और परमत्व से बहुत विषयों के साधन उत्क्रमज्या ही से करते हुए वलनानयन भी उत्क्रमज्या ही से किया है। लल्लोक्तसाधन को युक्तियुक्त समझ कर श्रीपति भी उन्हीं का अनुसरण करते हैं। जैसे लल्लाचार्य कहते हैं "ग्राह्यात् सराशित्रितयाद् भुजज्या" इत्यादि संस्कृतोपपत्ति में लिखित पद्य से श्रीपति भी "त्रिभवन सहिताच्च ग्राह्यतो व्यस्तजीवा इत्यादि संस्कृतोपपत्ति में लिखित पद्य से लल्लोगत के अनुसार ही कहते हैं। इन आचार्यों ने (लल्ल और श्रीपति) आयनवलन में शर संस्कार भी किया है जो युतिशून्यत्व के कारण ठीक नहीं है। आचार्योक्त आयन वलनज्या क्रान्तिज्या ही है उसका चापांश सत्रिभग्रह की दिशा उत्तर और दक्षिण आयनवलनांश होता है, भास्कराचार्य ने सिद्धान्तशिरोमणि में "युतायनांशोडुपकोटिशिञ्जिनी" इत्यादि से आयनवलन का साधन ठीक किया है इति ॥१७॥

इदानीं स्पष्टवलनमाह

एकान्यदिशोर्युतिवियुतेर्ज्या प्रग्रहणमध्यमोक्षेषु ।
एवं निमीलनोन्मीलनेष्टकालेष्वतोऽन्यदिशाम् ॥१८॥

सु. भा.—एकदिशोरक्षजायनवलनचापयोर्युतेरन्यदिशोर्वियुतेर्ज्या स्पर्शमध्यमोक्षकालेषु वलनं स्फुटं भवति। एवं निमीलनोन्मीलनेष्टकालेषु स्फुटं वलनं साध्यम्। अतोऽस्माद्वलनादन्यदिशामानयनं कार्यम्। अर्थादेकस्माद्वृत्ताद्यावद्भिरंशैरन्यवृत्तस्य पूर्वा चलति तावद्भिरंशैरन्या दिशश्च चलन्ति इति तासामानयनं सुगमम्।

अत्रोपपत्तिः। 'तयोः पलोत्थायनयोः समाशयो' रित्यादिभास्करविधिना स्फुटा। तत्र भास्करेण मानैक्यार्धवृत्ते स्फुटं वलनं परिणाम्यते। आचार्येण च त्रिज्यावृत्ते यथागतं तथैव स्थापितमिति। इदं स्फुटं वलनं परिलेखार्थमुपयुक्तं। परिलेखविधिं चाग्रे वक्ष्यत्याचार्यः॥१८॥

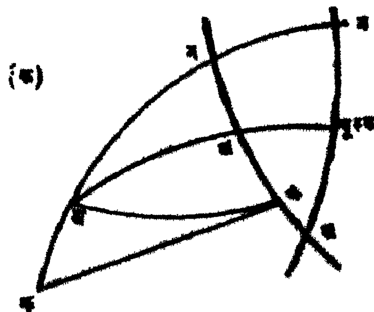
वि. भा.—एकदिशोराक्षायनवलनचापयोर्युतेरन्यदिशोर्वियुतेर्यद् भवति तज्ज्या स्पर्शमध्यमोक्षेषु स्फुटवलनज्या भवति, एवं निमीलनोन्मीलनेष्टकालेषु स्फुटं वलनं साध्यम्। अतोऽस्माद्वलनादन्यदिशामानयनं कार्यमर्थादेकस्माद् वृत्ताद्या-

यद्भिरंशैरन्यवृत्तस्य पूर्वा चलति तावद्भिरंशैरन्या दिशश्चलन्तीति तासामानयनं कार्यमिति ॥१८॥

अत्रोपपत्तिः

ग्रहोपरिगतं कदम्बप्रोतवृत्तं समप्रोतवृत्तञ्च कार्यं ग्रहान्नवत्यंशेन ग्रहक्षितिजं कार्यमेतस्मिन् वृत्ते कदम्बप्रोतवृत्तसमप्रोतवृत्तयोरन्तर्गतं चापं क्रान्तिवृत्तपूर्वापरवृत्तयोरन्तर्गतं चापं वा, कदम्बप्रोतवृत्तसमप्रोतवृत्तयोरुत्पन्नो ग्रहलग्नकोणो वा स्पष्टवलनम् । ग्रहोपरिगतं ध्रुवप्रोतवृत्तं कार्यं तदा ध्रुवप्रोतवृत्तसमप्रोतवृत्तयोरुत्पन्नो ग्रहलग्नकोण आक्षवलनम् । ग्रहोपरिगतध्रुवप्रोतवृत्तकदम्बप्रोतवृत्तयोरुत्पन्नो ग्रहलग्नकोण आयनवलनम्, एतयोः कोणयोर्योगान्तरेण कदम्बप्रोतवृत्तसमप्रोतवृत्तयोरुत्पन्नकोणः स्फुटं वलनं भवति । सिद्धान्तशेखरे "पलवलनमनेन स्पष्टमेकीकृतं स्यात् सदृशदिशि वियुक्तं भिन्नदिक्त्वे कृतज्यम्" अनेन श्रीपतिना, लल्लाचार्येण च "अपक्रमक्षेपपलोद्भवानां युतिः क्रमादेकदिशां कलानाम् । कार्यो वियोगोऽन्यदिशां ततो ज्या ग्राह्या भवेत्सा वलनस्य जीवा, अनेन, भास्कराचार्येण चानयोः पलोत्थायनयोः समाशयायुर्तेर्वियुक्तेस्तु विभिन्नकाष्ठयोरित्यादिना' अनेन स्पष्टवलनमाचार्योक्तानुरूपमेव कथ्यते, केवल लल्लाचार्येण श्रीपतिना चाऽऽयनाक्षवलनयोर्योगान्तररूपे स्पष्टवलने शरस्यापि संस्कारः कृतो यश्च न समीचीनः। भास्कराचार्येण साधितं स्फुटं वलनं मानैक्यार्धवृत्ते परिणामितम् आचार्येण च त्रिज्यावृत्ते यथागतं तथैव स्थापितम्। स्फुटं वलनपरिलेखार्थमुपयुक्तम् ।

एकानुपातेन स्पष्टवलनानयनं भवतीति प्रदर्श्यते



क्रान्तिवृत्तपूर्वापरवृत्तयोः सम्पातः सन्धिग्रहसंज्ञकः = सं सं बिन्दुतो नवत्यंशेन वृत्तं कार्यं तत् क्रान्तिवृत्तपूर्वापरवृत्तयोः परमान्तरवृत्तम् । ल = लग्नम् = क्रान्तिवृत्तक्षितिजवृत्तयोः सम्पातः । पू = पूर्वस्वस्तिकम् । पूल = लग्नाग्राचापम् । स = समस्थानम् । क = कदम्बः । सल = लग्नाग्राकोटिचापम् । नम = क्रान्तिवृत्तपूर्वापरवृत्तयो. परमान्तरम् = कस, संल = सन्धिग्रहलग्नान्तरम् । ∠ सलन = वित्रिभोन्नतांशाः । तदा सलन चापीयजात्यत्रिभुजे

$$\frac{\text{लग्नाग्राकोटिज्या} \times \text{वित्रिभशङ्कु}}{\text{त्रि}} = \text{परमान्तरकोटिज्या अस्याश्चापं नवत्योर्विशोध्यं}$$

तदा परमान्तरं=नम भवेत् । ततः संनम, संलपू चापीयजात्यत्रिभुजयोर्ज्याक्षेत्र-साजात्यादनुपातेन $\frac{\text{त्रि} \times \text{लग्नाग्रा}}{\text{परमान्तरज्या}}$ =सन्धिग्रहलग्नान्तरज्या, अस्याश्चापं लग्ने हीनितं तदा सन्धिग्रहो भवेत् । ग्र=ग्रहः, संग्र=सन्धिग्रहग्रहान्तरंविदितमेव । ग्रन =सन्धिग्रहग्रहान्तरकोटिः=<सकग्र, सग्र=उपकोटिचापम् । तदा कसग्र चापीय त्रिभुजेऽनुपात $\frac{\text{सन्धिग्रहग्रहान्तरकोटिज्या} \times \text{परमान्तरज्या}}{\text{उपकोटिज्यासार्धं}}$ =ज्या<ग्र=स्पष्टवलनज्या, अस्याश्चापं स्पष्टवलनं भवेदिति ।।१८।।

अब स्पष्टवलनानयन को कहते हैं

हि. भा.—एक दिशा का आक्षवलन और आयनवलन का योग करने से तथा भिन्न दिशा का, उन दोनों का अन्तर करने से जो होता है उसकी ज्या स्पर्शकाल, मध्यग्रहण और मोक्षकाल में स्फुटवलनज्या होती है, इसी तरह निमीलनकाल - उन्मीलनकाल और इष्टकाल में स्फुटवलन साधन करना । इस वलन से अन्यदिशा का आनयन करना अर्थात् एक वृत्त से जितने अंश में अन्यवृत्त की पूर्वा दिशा चलती है उतने अंश में अन्य दिशा चलती है इति ।।१८।।

उपपत्ति

ग्रह के ऊपर समप्रोतवृत्त-कदम्बप्रोतवृत्त और ध्रुवप्रोतवृत्त कीजिये, ग्रह को केन्द्रमानकर भवद्यंश से ग्रह क्षितिज कीजिए, इसमें समप्रोतवृत्त और कदम्बप्रोतवृत्त के अन्तर्गत चाप स्पष्टवलन है, ग्रहोपरिगतसमप्रोतवृत्त और ध्रुवप्रोतवृत्त से उत्पन्न ग्रहलग्नकोण आक्षवलन है तथा ध्रुवप्रोतवृत्त और कदम्बप्रोतवृत्त से उत्पन्न ग्रहलग्नकोण आयनवलन है, दोनों का योगान्तर करने से समप्रोतवृत्त और कदम्बप्रोतवृत्त से उत्पन्न ग्रहलग्न कोण स्पष्टवलन होता है, सिद्धान्तशेखर में "पलवलनमनेन स्पष्टमेकीकृतं" इत्यादि से श्रीपति ने, "अपक्रम-क्षेपपलोद्भवानाम्" इत्यादि से लल्लाचार्य ने, तथा "तयोः पलोत्थायनयोः समाशयोः" इत्यादि से सिद्धान्तशिरोमणि में भास्कराचार्य ने भी आचार्योक्तानुरूप ही स्पष्टवलन कहा है, केवल लल्ल और श्रीपति ने आयनवलन और आक्षवलन के योगान्तररूप स्पष्टवलन में शर संस्कार भी किया है जो कि अनुचित है, भास्कराचार्य ने साधित स्पष्टवलन का मानैक्यार्धवृत्त में परिणामन किया है, आचार्य ने त्रिज्यावृत्त में साधित स्पष्टवलन को ज्यों का त्यों रक्खा है, परिलेख के लिये स्पष्टवलन की जरूरत होती है ।

एकानुपात से स्पष्टवलनानयन को दिखलाते हैं

यहाँ संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । क्रान्तिवृत्त और पूर्वापरवृत्त का

सम्पात सन्धिग्रह है=सं म बिन्दु से नवत्यंश व्यासार्धवृत्त क्रान्तिवृत्त और पूर्वापरवृत्त का परमान्तरवृत्त है, ल=लग्न,=क्रान्तिवृत्त और क्षितिजवृत्त का सम्पात बिन्दु । पु=पूर्वस्वस्तिक, पुल=लग्नाग्राचाप, स=समस्थान, क=कदम्ब.

सल=लग्नाग्राकोटिचाप, नम=क्रान्तिवृत्त और पूर्वापरवृत्त का परमान्तर=चच, संल=सन्धिग्रहलग्नान्तर <सलन=त्रिभलग्न का उन्नतांश, तब सलन चापीयजात्य त्रिभुज में अनुपात से

$$\frac{\text{लग्नाग्राकोटिज्या}\cdot\text{त्रिभलग्नशङ्कु}}{\text{त्रि}}$$ =परमान्तरकोटिज्या, इसके चाप को नवत्यंश में घटाने

से परमान्तर=नम होता है, तब संनम, संसपु दोनों चापीय जात्य त्रिभुजों के ज्याक्षेत्र सजातीय हैं इसलिये अनुपात से

$$\frac{\text{त्रि}\times\text{लग्नाग्रा}}{\text{परमान्तरज्या}}$$ =सन्धिग्रह और लग्न की अन्तरज्या, इसके चाप को लग्न में घटाने से

सन्धिग्रह होता है, ग्र=ग्रह, संग्र=सन्धिग्रह और ग्रह का अन्तर यह विदित है, ग्रन=सन्धिग्रह और ग्रह की अन्तरकोटि=<सकग्र सग्र=उपकोटिचाप, तब कसग्र चापीय त्रिभुज में अनुपात करते हैं

$$\frac{\text{सन्धिग्रहग्रहान्तरकोटिज्या}\times\text{परमान्तरज्या}}{\text{उपकोटिज्यासार्ध}}$$ =ज्या<ग्र=स्पष्टवलनज्या, इसका चाप

करने से स्पष्ट वलन होता है ॥१८॥

इदानीं ग्रहणे चन्द्रवर्णमाह

आद्यन्तयोः सधूम्रः कृष्णः खण्डग्रहेऽर्धतोऽभ्यधिके ।
ग्रासे स कृष्णताम्रः सर्वग्रहणे कपिलवर्णः ॥१९॥

सु. भा.—आद्यन्तयोश्चन्द्रः स धूम्रो वर्णो भवति । अर्धाद् ग्रहणादौ ग्रहणान्ते च चन्द्रो धूम्रवर्णो भवति । कृष्णताम्रः कृष्णरक्तो बिम्बाभ्यन्तरच्छविरित्यर्थः । शेषं स्पष्टार्थम् । स्वल्पच्छन्ने धूम्रवर्णः तुषारोऽस्त्याविर्भावस्य रोक-मेतदनुरूपमेव ॥१९॥

वि. भा.—आद्यन्तयोः (ग्रहणादौ ग्रहणान्ते च) चन्द्रः सधूम्रो (धूम्रवर्ण-सहितः) भवति । खण्डग्रहणे चन्द्रः कृष्णवर्णो भवति, अर्धतोऽभ्यधिके ग्रासे (अर्धाधिके ग्रहणे) कृष्णताम्रः (कृष्णरक्तो बिम्बाभ्यन्तरच्छविरिति) सर्वग्रहणे चन्द्रः कपिलवर्णो भवतीति ॥१९॥

अत्रोपपत्तिः

वर्णसंयोगेन वर्णान्तरमुत्पद्यते, भूभाकृष्णा, चन्द्रबिम्बं पीतमतस्तयोः संयोगे न्यूनाधिक्यस्थितिवशेन भिन्नं भिन्नं वर्णान्तरं दृग्गोचरीभूतं भवति। सूर्यग्रहणे हि छाद्यच्छादकयोः(सूर्यचन्द्रमसोः) संयोगाभावात् वर्णान्तरं नैव जायते, सूर्यसिद्धान्ते, शिष्यधीवृद्धिदे, सिद्धान्तशिरोमणौ चैवमेव रविचन्द्रयोर्ग्रहणे वर्ण उक्तोस्ति सिद्धान्तशेखरेऽपि "आदावन्ते वहलविलसद्धूमधूम्रो विधुः स्यादर्धच्छन्नः कलयति पुनः कालतां कज्जलस्य । अर्धादूर्ध्वं कवलिततनुः कृष्णताम्रः पिशङ्गः सर्वग्रासे भवति सविता सर्वदा कृष्ण एव" श्रीपतिनाऽनेनैवमेवोच्यत इति ॥ १९ ॥

अब ग्रहण में चन्द्रवर्ण को कहते हैं

हि. भा.—ग्रहण के आदि में और अन्त में चन्द्र का धूम्र (धूम्रां) वर्ण होता है खण्ड ग्रहण में कृष्ण वर्ण होता है। अर्वाधिक ग्रहण में कृष्णताम्र (कालापनयुक्त लाल) वर्ण होता है, सर्वग्रहण में चन्द्र का कपिल वर्ण होता है इति ॥१९॥

उपपत्ति

वर्ण के संयोग से वर्णान्तर बनता है, भूभा कृष्णवर्ण है और चन्द्रबिम्ब पीत (पीला) वर्ण है इस लिये दोनों का संयोग होने से न्यूनाधिक्य स्थितिवश से भिन्न-भिन्न वर्णान्तर देखने में आता है, सूर्यग्रहण में छाद्य और छादक (सूर्य और चन्द्र) के संयोगाभाव से वर्णान्तर उत्पन्न नहीं होता है, सूर्यसिद्धान्त, शिष्यधीवृद्धिद, सिद्धान्तशिरोमणि, सिद्धान्तशेखर में इसी तरह ग्रहण में वर्ण कहा है इति ॥१९॥

इदानीमस्याध्यायस्योपसंहारमाह

मानविमर्दस्थितिदलवलनेष्टग्राससमकलाद्येषु ।
चन्द्रग्रहणाध्यायो विंशतिरार्याश्चतुर्थोऽयम् ॥२०॥

सु. भा.—समकलः पूर्णान्तिकालो मध्यग्रहसमयः। शेषं स्पष्टार्थम् ॥२०॥

इति श्रीकृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्तनूतनतिलके चन्द्रग्रहणाधिकारश्चतुर्थः ॥

वि. भा.—छाद्यच्छादकबिम्बमानम्। विमर्दार्धम्। स्थित्यर्धम्। वलनानि (आक्षायनस्पष्टवलनसंज्ञकानि) इष्टग्रासः, समकलः (पूर्णान्तिकालो मध्यग्रहण समयः) एतदाद्येषु विषयेषु, विंशतिसंख्यका आर्या यत्र तादृशोऽयं चतुर्थश्चन्द्रग्रहणाध्यायोऽस्तीति ॥२०॥

इति श्रीब्रह्मगुप्तविरचिते ब्राह्मस्फुटसिद्धान्ते

चन्द्रग्रहणाधिकारश्चतुर्थः समाप्तः

अब इस अध्याय के उपसंहार को कहते हैं

हि. भा.—मान (छाद्य बिम्ब और छादक बिम्ब के मान) विमर्दार्ध, स्थित्यर्ध, वलन (आक्षवलन, आयनवलन और स्पष्टवलन) इष्टग्रास, मध्यग्रहण समय, एतदादि विषयों में बीस आर्या श्लोक हैं जिसमें ऐसा चौथा चन्द्रग्रहणाध्याय है इति ॥२०॥

इति श्रीब्रह्मगुप्तविरचित ब्राह्मस्फुटसिद्धान्त में चन्द्रग्रहणाधिकार (चतुर्थाधिकार) समाप्त हुआ ॥



ब्राह्मस्फुटसिद्धान्तः

७

सूर्यग्रहणाधिकारः

ब्राह्मस्फुटसिद्धान्तः

सूर्यग्रहणाधिकारः

अथ सूर्यग्रहणाधिकारो व्याख्यायते तत्रादौ तदारम्भप्रयोजनमाह

दृग्गणितैक्यं न भवति यस्मात् पञ्चज्यया रविग्रहणे ।
तस्माद्यथा तदैक्यं तथा प्रवक्ष्यामि तिथ्यन्ते ॥१॥

सु. भा.—उदयज्या अग्रा । मध्यज्या=खलग्ननतांशज्या । रविशङ्कुः । दृग्गतिः=वित्रिभशङ्कुः । दृक्क्षेपः=वित्रिभनतांशज्या । एवमार्यभटादिभिः पञ्चज्यया रविग्रहणे यदानयनमुपनिबद्धं तद्यस्माद् दृग्गणितैक्यं न भवति तस्माद्यथा तयोर्दृग्गणितयोरैक्यं स्यात् तथाऽऽनयनमहं प्रवक्ष्यामीति । तिथ्यन्ते इत्यस्याग्रे सम्बन्धः । सम्प्रति प्रसिद्धसूर्यसिद्धान्तेऽपि पूर्वोक्तपञ्चज्ययैवार्कग्रहणा॰ नयनम् । पौलिशे च चन्द्रस्यापि पृथक् सूर्यग्रहणे पञ्चज्याः साधिता इति दशज्या-विधानेन तत्र रविग्रहणमुपनिबद्धम् । तथा च स्वटीकायां चतुर्वेदाचार्यः—

'पञ्चज्यया पञ्चज्याविधानेन रविग्रहणं यदाचार्यैरुपनिबद्धम् । तद्यथा । उदयज्या, मध्यज्या, शङ्कुज्या, दृग्गतिज्या, दृक्क्षेपज्या च । ताभिरार्यभटादि-भिस्तथा पौलिशतन्त्रे पञ्चज्याश्चन्द्रमसः स्वदिनगतशेषचरदलक्रान्त्यादिभिः कल्पिताः । एवं तत्र दशज्याविधानेन रविग्रहणं यदुपनिबद्धं तादृशममान्ते भवति । ये च तत्र दोषास्तानाचार्य एव वक्ष्यति तन्त्रपरीक्षाध्याये वयमपि तत्रैव व्याख्या-स्यामः' ।

वि. भा.—यस्मात् कारणात् रविग्रहणे (सूर्यग्रहणे) पञ्चज्यया (उदयज्या, मध्यज्या, रविशङ्कुः, वित्रिभशङ्कुः, दृक्क्षेपः) ऽऽर्यभटादिभिर्यदानयनमुपनिबद्धं ततो दृग्गणितैक्यं (द्वाभ्यां दृग्गणिताभ्यां समत्वं) न भवति, तस्मात् कारणात् यथा तदैक्यं (तयोर्दृग्गणितयोः समत्वं) भवेत्तथाऽऽनयनमहं प्रवक्ष्यामि, तिथ्यन्ते इत्यस्याग्रे सम्बन्धः । उदयज्या=अग्रा, मध्यज्या=दशमलग्ननतांशज्या, वित्रिभ-शङ्कुः=दृग्गतिः, दृक्क्षेपः=वित्रिभनतांशज्या सूर्यसिद्धान्तेऽपि पूर्वोक्तपञ्चज्य-यैव सूर्यग्रहणसाधनम् । पौलिशसिद्धान्ते तु सूर्यग्रहणे चन्द्रस्यापि पृथक् पञ्चज्याः साधिताः सन्ति तेन तत्र दशज्याविधानेन सूर्यग्रहणमुपनिबद्धमिति ॥१॥

अब सूर्यग्रहणाधिकार प्रारम्भ किया जाता है, पहले उसके आरम्भ करने का प्रयोजन कहते हैं

हि. भा.—जिस कारण से सूर्यग्रहण में पञ्चज्या (उदयज्या, मध्यज्या, रविशङ्कु, वित्रिभशङ्कु, दृक्क्षेप) से आर्यभटादि आचार्यों ने जो आनयन किया है उससे दृग्गणितैक्य (वेधोपलब्ध और गणितागत विषयों की तुल्यता) नहीं होता है उस कारण से जैसे उनका ऐक्य (वेधोपलब्ध और गणितागत विषयों के समत्व) हो वैसे मैं आनयन को कहता हूं, तिथ्यन्ते इसका आगे से सम्बन्ध है, उदयज्या = अग्रा, मध्यज्या = दशमलग्ननतांशज्या वित्रिभशङ्कु = दृग्गति, दृक्क्षेप = वित्रिभनतांशज्या, सूर्यसिद्धान्त में भी पूर्वोक्त पञ्चज्या ही से सूर्यग्रहण का आनयन है, पौलिशसिद्धान्त में सूर्यग्रहण में चन्द्र की पृथक् पञ्चज्या साधित है इसलिए वहां दशज्या विधान से सूर्यग्रहण उपनिबद्ध है इति ॥१॥

इदानीं लम्बननत्योर्भावाभावस्थानमाह

वित्रिभलग्नसमेऽर्के न लम्बनं तदधिकोनके भवति ।
तस्य क्रान्तिज्योदक् यदाऽक्षजीवा समा न तदा ॥२॥

अवनतिरतोऽन्यथा भवति सम्भवे तदुदयैर्विलग्नसमम् ।
तदुदितघटिकास्तच्छङ्कुस्तच्चरप्राणैः ॥३॥

सु. भा.—तिथ्यन्ते गणितागतदर्शान्तकाले पूर्वविधिना त्रिप्रश्नोक्तेन लग्नं कृत्वा वित्रिभं कार्यम् । तेन वित्रिभलग्नेन समेऽर्के रवौ सति लम्बनं न भवति । तस्माद्वित्रिभादधिके वोने रवौ लम्बनं भवतीत्यर्थत एव सिध्यति । एवं तस्य वित्रिभस्योत्तरा क्रान्तिज्या यदा स्वदेशाक्षजीवा समा तदाऽवनतिर्न भवति अतोऽन्यथा चावनतिर्भवति । लम्बनावनत्योः सम्भवे च तदुदयैः स्वदेशीयराश्युदयैर्विलग्नसमं कृत्वाऽर्थादूनस्य भोग्योऽधिकभुक्तयुक्तो मध्योदयाढ्य इति त्रिप्रश्नोक्तविधिं कृत्वा तदुदितघटिकास्तस्य वित्रिभस्य गता घटिकाः साध्याः । ततस्तच्चरप्राणैर्वित्रिभचरासुभिस्तच्छङ्कुर्वित्रिभशङ्कु 'दिनगतशेषाल्पस्य' इत्यादिविधिना साध्यः ।

अत्रोपपत्तिः । लम्बनाभावे 'न लम्बनं वित्रिभलग्नतुल्ये रवा' वित्यादिभास्करविधिना स्फुटा । एवमवनतेरानयनस्य दृक्क्षेपाधीनत्वाद्यदा दृक्क्षेपाभावस्तदाऽवनतेरभावः आचार्येण स्वल्पाक्षदेशे याम्योत्तरवृत्त एव स्वल्पान्तराद्वित्रिभस्थितिं प्रकल्प्य तस्य द्युदलवत् क्रान्त्यक्षसंस्कारेण नतांशाभावस्थानमानीतमुत्तरक्रान्तिसमेऽक्षे । वित्रिभोदितघटिकादिज्ञानं च त्रिप्रश्नोक्त्या सुगमम् ॥२-३॥

वि. भा.—तिथ्यन्ते (गणितागतामान्तकाले) त्रिप्रश्नोक्तेन विधिना लग्नं साध्यं तत् त्रिभोनं (वित्रिभं) कार्यम् । वित्रिभलग्नेन तुल्ये रवौ लम्बनं न भवति,

तदधिकोनके(तस्माद्वित्रिभादधिकेऽल्पे च) रवौ लम्बनं भवति तथा तस्य(वित्रिभस्य) यदोदक्क्रान्तिज्या (उत्तरा क्रान्तिज्या) ऽक्षजीवा समा (स्वदेशीयाक्षज्या तुल्या) तदाऽवनतिर्न भवति, अतोऽन्यथाऽवनतिर्भवति, सम्भवे (लम्बननत्योः सत्त्वे) तदुदयैः (स्वदेशीयराश्युदयमानैः) विलग्नसमं कृत्वाऽर्थादूनस्य भोग्योऽधिकभुक्तयुक्तो मध्योदयाढ्य इति त्रिप्रश्नोक्तविधिं कृत्वा तदुदितघटिकाः(तस्य वित्रिभस्य गता घटिकाः) साध्याः। ततस्तच्चरप्राणैः (वित्रिभचरासुभिः) तच्छङ्कुः (वित्रिभशङ्कुः) 'दिनगतशेषाल्पस्य' इत्यादि विधिना साध्य इति ॥२-३॥

अत्रोपपत्तिः

लग्नोत्पन्ननवत्यंशवृत्तं दृक्क्षेपवृत्तं तद्यत्र क्रान्तिवृत्ते लगति तदेव वित्रिभलग्नम्। तत्तुल्ये रवौ स्पष्टलम्बनाभावो भवेत्। रव्युपरि-लम्बितरव्युपरि च गतं कदम्बप्रोतवृत्तद्वयं यत्र-यत्र क्रान्तिवृत्ते लगति तदन्तर्गतक्रान्तिवृत्तीयचापमेव रविस्पष्टलम्बनम्। परन्तु वित्रिभस्थे रवौ तदुपरिगतं दृग्वृत्तं तथा रव्युपरिलम्बितरव्युपरि च गतं कदम्बप्रोतवृत्तमेकमेव दृक्क्षेपवृत्तं भवेत्तेन तत्र स्पष्टलम्बनाभावः प्रत्यक्षमेव दृग्गोचरो भवत्यतो "वित्रिभलग्नसमेऽर्के न लम्बनमित्याचार्योक्तं युक्तियुक्तमिति ॥२-३॥

अथ लम्बनस्य धनर्णव्यवस्था

गर्भीयामान्तकाले स्थानाभिप्रायेण रविचन्द्रावेकस्मिन्नेव बिन्दौ भवतस्तेनैकस्मिन्नेव दृग्वृत्ते लम्बितरविचन्द्रौ भवतः। लम्बितरवितो लम्बितचन्द्रः पृष्ठेऽवलम्बितो भवत्यतो वित्रिभादूने रवौ लम्बितरव्युपरिगतं कदम्बप्रोतवृत्तं यत्र क्रान्तिवृत्ते लगति तस्मादधोभागे लम्बितचन्द्रोपरिगतं कदम्बप्रोतवृत्तं क्रान्तिवृत्ते लगि-

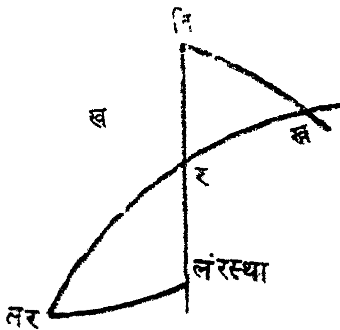
ख=खस्वस्तिकम्। क=कदम्बः।
वि=वित्रिभम्। लंर=लम्बितरविः।
लंच=लम्बितचन्द्रः।
लंरस्था=लम्बितरविस्थानम्।
लंचंस्था=लम्बितचन्द्रस्थानम्।

ष्यति तेनात्र शीघ्रगतिग्रहाच्चन्द्रस्थानान्मन्दगतिग्रहस्य लम्बितरविस्थानस्याग्रेस्थितत्वाद्युतिर्गम्याऽतो गर्भीयामान्तात्पृष्ठीयामान्तः स्पष्टलम्बनान्तरेण द पश्चा

भवेदतो गर्भीयामान्तकाले स्पष्टलम्बनान्तरयोजनेन पृष्ठीयामान्तकालो भवेत् । वित्रिभादधिके रवौ लम्बितरवितोऽग्रेलम्बितश्चन्द्रस्तेन लम्बितरव्युपरिगतकदम्बप्रोतवृत्तक्रान्तिवृत्तयोः सम्पातात् लम्बितचन्द्रोपरिगतकदम्बप्रोतवृत्तक्रान्तिवृत्तयोः सम्पात उपरि भवेदतो मन्दगतिग्रहाल्लम्बितरविस्थानाच्छीघ्रगतिग्रहस्य लम्बितचन्द्रस्थानरूपस्याऽग्रे स्थितत्वाद्युतिर्गतेत्यतो गर्भीयामान्ते स्पष्टलम्बनान्तरमृणं कार्यं तदा पृष्ठीयामान्तकालो भवेदतः । "तदधिकोनके भवति" आचार्योक्तमिदं युक्तियुक्तम् ।

अथ नतिसम्बन्धे विचारः

ख = खस्वस्तिकम् । वि = वित्रिभम् ।



र=क्रान्तिवृत्ते रविः । लंर=लम्बितरविः । लंरस्था=लम्बितरविस्थानम् । रवितो लम्बितरवियावद् दृग्लम्बनम् । लम्बितरवितो लम्बितरविस्था नंयावन्नतिः । रवितो लम्बित रविस्थानं यावत् क्रान्तिवृत्ते, रविस्पष्टलम्बनम् । खर= रविनतांशाः । खवि=दृक्क्षेपचापम् । तदा खविर, दृग्लम्बननतिस्पष्टलम्बनांशैरुत्पन्नचापीयजात्यत्रिभुजस्य च ज्याक्षेत्रसाजात्यादनुपातो यदि दृग्ज्यया दृक्क्षेपो लभ्यते तदा दृग्लम्बनज्यया किमित्यनेनाऽऽगच्छति रविनतिज्या $=\frac{\text{दृक्क्षेप} \times \text{दृलंज्या}}{\text{दृग्ज्या}}$ नतेरानयनस्य दृक्क्षेपाधीनत्वाद्यदा दृक्क्षेपाभावस्तदा नतेरभावः । आचार्येण स्वल्पाक्षदेशे स्वल्पान्तराद्याम्योत्तरवृत्त एव वित्रिभस्थितिं प्रकल्प्य दिनार्धवत् क्रान्त्यक्षांशयोः संस्कारेण नतांशाभावस्थानमानीतमुत्तरक्रान्तितुल्येऽक्षांशेऽत आचार्योक्तं 'तस्य क्रान्तिज्योदक् यदाऽक्षजीवा समा न तदा" युक्तियुक्तमिति । सूर्यसिद्धान्ते "मध्यलग्नसमे भानौ हरिजस्य न सम्भवः । अक्षोदक् मध्यमक्रान्तिसाम्येनावनतेरपि" प्यनेन, सिद्धान्तशेखरे श्रीपतिना 'वित्रिभोदयसमे न लम्बनं भास्करे समधिकोनके भवेत् । चेत् समा तदपमज्यकोत्तराऽक्षज्ययाऽस्त्यवनतिस्तदा नहि' ऽप्यनेन, सिद्धान्तशिरोमणौ भास्कराचार्येण "न लम्बनं वित्रिभलग्नतुल्ये, रवौ तदूनेऽभ्यधिके च तत्स्यादेवं धनर्णं क्रमतश्च वेद्यम्". ऽप्यनेनाऽऽचार्योक्तानुरूपमेवोक्तमिति दिक् ॥२-३॥

अधुना प्रसङ्गात् दृग्लम्बनस्य परमत्वं कुत्र भवेदिति विचार्यते

भूकेन्द्राद् भूपृष्ठाच्च स्वकक्षास्थरविकेन्द्रगते रेखे यत्र-यत्र चन्द्र-

कक्षायां लग्ने तदन्तर्गतचन्द्रगोलीयदृग्वृत्तचापं रविलम्बनम् एवं भूकेन्द्राद् भूपृष्ठाच्च चन्द्रकक्षास्थचन्द्रकेन्द्रगते रेखे यत्र-यत्र रविकक्षायां लग्ने तदन्तर्गतरविगोलीयदृग्वृत्तचापं चन्द्रलम्बनमेतावता त्रिभुजमुत्पद्यते भूकेन्द्राद् ग्रहकेन्द्रं यावद् ग्रहकर्ण एकोऽवयवः। भूपृष्ठाद् ग्रहकेन्द्रं यावत् पृष्ठकर्णो द्वितीयोऽवयवः। भूव्यासार्धं तृतीयोऽवयवः। एतस्मिन् त्रिभुजे पृष्ठकर्णभूव्यासार्धयोरुत्पन्नकोणः = १८० पृष्ठीयनतांशकोणज्याकोणोनभार्धांशज्ययोस्तुल्यत्वात् ज्या (१८०—पृष्ठीयनतांश) = ज्या-पृष्ठीयनतांश = पृष्ठीयदृग्ज्या, तदाऽनुपातो यदि ग्रहकर्णेन पृष्ठीयदृग्ज्या लभ्यते तदा भूव्यासार्धेन किं समागच्छति ग्रहदृग्लम्बनज्या तत्स्वरूपम् = $\frac{\text{पृदृग्ज्या} \times \text{भूव्या}\frac{1}{2}}{\text{ग्रकर्ण}}$

अत्र ग्रकर्ण, भूव्यासार्धयोः स्थिरत्वात्सिद्धं यद्यत्र पृष्ठीयदृग्ज्यायाः परमत्वं भवेत्तत्रैव दृग्लम्बनज्यायाः परमत्वं भवेत्। परं पृष्ठीयदृग्ज्यायाः परमत्वं तु पृष्ठक्षितिजस्थे ग्रहे भवत्यतः पृष्ठक्षितिज एव दृग्लम्बनस्य परमत्वं भवेदिति॥

अथ नतेः परमत्वं कुत्र भवेदिति विचार्यते

अथ $\frac{\text{दृक्क्षेप} \times \text{दृलंज्या}}{\text{दृज्या}}$ = नतिः स्वल्पान्तरात्। तथा सम्बन्धानुपातेना 'त्रिज्यातुल्यपृष्ठीयदृग्ज्यायां यदि परमलम्बनज्या लभ्यते तदेष्टपृष्ठीयदृग्ज्यायां किमिति, नेनेष्टदृग्लम्बनज्या = $\frac{\text{परलंज्या} \times \text{पृदृज्या}}{\text{त्रि}}$ अत उत्थापनेन

$\frac{\text{दृक्क्षेप} \times \text{पलंज्या}\cdot\text{पृदृज्या}}{\text{दृज्या} \times \text{त्रि}}$ = नतिः, अत्र यदि पृदृज्या = दृज्या तदैव 'कक्षयोरन्तरं यत् स्याद्वित्रिभे सर्वतोऽपि तत्, भास्करोक्तमिदं समीचीनं भवितुमर्हति, परं पृदृज्या = दृग्ज्या सर्वदा न भवत्यतो भास्करोक्तं तन्न समीचीनमिति ज्ञेयम्। अथ पूर्वोक्तनतिस्वरूपे यदि दृक्क्षेपमानं स्थिरं कल्प्येत तदा $\frac{\text{पृदृज्या}}{\text{दृज्या}}$ ऽस्य परमत्वं यत्र भवेत्तत्रैव नतेरपि परमत्वं भवितु मर्हति, $\frac{\text{पृदृज्या}}{\text{दृज्या}}$ अस्य परमत्वं कुत्र भवेत्तदर्थं विचार्यते। पृष्ठीयनतांशाः = पृन। गर्भीयनतांशाः = न। दृग्लम्बनम् = लं, तदा पृन = न + लं चापयोरिष्टयोरित्यादिना ज्या (न + लं) = पृदृज्या = $\frac{\text{दृज्या} \times \text{लंकोज्या} + \text{शं} \times \text{लंज्या}}{\text{त्रि}}$, छेदगमेन पृदृज्या·त्रि = दृज्या × लंकोज्या + शं × लंज्या, परं $\frac{\text{पलंज्या}\cdot\text{पृदृज्या}}{\text{त्रि}}$ = लंज्या अत उत्थापनेन पृदृज्या· त्रि = दृज्या· लंकोज्या +

$\frac{\text{शं.पलज्या. पृदृज्या}}{\text{त्रि}}$ ततः पृदृज्या. त्रि^{2}=दृज्या. लंकोज्या. त्रि+शं. पलंज्या पृदृज्या

समशोधनेन

पृदृज्या.त्रि^{2}—शं. पलंज्या·पृदृज्या=पृदृज्या (त्रि^{2}—शं.पलंज्या)=दृज्या· लंकोज्या. त्रि. ∴ $\frac{\text{पृदृज्या}}{\text{दृज्या}}=\frac{\text{लंकोज्या. त्रि}}{\text{त्रि}^2\text{—श.पलंज्या}}$ एतत्स्वरूपावलोकनेन सिद्धं यद्यदा शङ्कुदृग्लम्बनकोटिज्ययोः परमत्वं भवेत्तदैवा $\frac{\text{पृदृज्या}}{\text{दृज्या}}$ स्यापि परमत्वं भवितुमर्हति, परं शङ्कोर्दृग्लम्बनकोटिज्यायाश्च परमत्वं वित्रिभस्थान एव भवत्यतो वित्रिभ एवा- $\frac{\text{पृदृज्या}}{\text{दृज्या}}$ ऽस्य परमत्वान्नतेरपि परमत्वं सिद्धमिति, एतावता म. म. पण्डित श्रीसुधाकरोक्तसूत्रमवतरति "कुगभेनभ्रांशगुणेन भक्तः स्वपृष्ठनभ्रांशगुणः फलं चेत्। महत्तमं तत्र नतिः पराभवेत् दृक्क्षेपमानं बुध नो चलं चेत्" इति ॥

अथ पूर्वसिद्धस्वरूपम् $=\frac{\text{पृदृज्या}}{\text{दृज्या}}=\frac{\text{लंकोज्या.त्रि}}{\text{त्रि}^2\text{—श. पलज्या}}$ खस्वस्तिकगते रवौ शं=त्रि, दृग्लम्बनकोज्या=त्रि, अतः खस्वस्तिके $\frac{\text{पृदृज्या}}{\text{दृज्या}}=\frac{\text{त्रि.त्रि}}{\text{त्रि}^2\text{—त्रि.पलज्या}}=$ $\frac{\text{त्रि}^2}{\text{त्रि (त्रि—पलज्या)}}=\frac{\text{त्रि}}{\text{परमलम्बनकोट्युत्क्रमज्या}}$ परं खस्वस्तिकगते रवौ पृदृज्या=०। दृज्या=० ∴ $\frac{\text{पृदृज्या}}{\text{दृज्या}}=\frac{0}{0}=\frac{\text{त्रि}}{\text{परमलंको उज्या}}$ परं परमलं- कोउज्या<त्रि ∴ $\frac{\text{त्रि}}{\text{परमलंकोउज्या}}>1$ वा $\frac{\text{पृदृज्या}}{\text{दृज्या}}=\frac{0}{0}>1$ इति गणित- वैचित्र्यं बुधैर्विभावनीयमिति ॥२-३॥

अब लम्बन और नति के भावाभावस्थान को कहते हैं

हि. भा.—तिथ्यन्त (गणितागत अमान्त काल) में त्रिप्रश्न में कथित विधि से लग्न साधन करना उसमें तीन राशि घटाने से वित्रिभलग्न होता है, वित्रिभलग्न के तुल्य रवि के रहने से लम्बन नहीं होता है अर्थात् लम्बनाभाव होता है, वित्रिभ से रवि के अधिक और अल्प रहने से लम्बन होता है, तथा जब वित्रिभ की उत्तर क्रान्तिज्या स्वदेशीय अक्षज्या के बराबर होती है तब नति का अभाव होता है, इससे अन्यथा नति होती है, लम्बन और नति के सम्भव रहने पर देशीय राश्युदयमानों से "ऊनस्य भोग्योऽधिकभु- क्तयुक्तो मध्योदयाढ्यः" यह त्रिप्रश्नोक्तविधि कर के वित्रिभ की नतघटी साधन करना'

तदनन्तर वित्रिभ की चरासु से 'दिनगतशेषाल्पस्य' इत्यादि विधि से वित्रिभशङ्कु का साधन करना चाहिये ।॥२-३॥

उपपत्ति

लग्नोत्पन्न नवत्यंशवृत्त (दृक्क्षेपवृत्त) क्रान्तिवृत्त में जहां लगता है वही वित्रिभलग्न है, वित्रिभलग्न के बराबर रवि के रहने से स्पष्टलम्बनाभाव होता है, रवि के ऊपर और लम्बित रवि के ऊपर कदम्बप्रोतवृत्तद्वय क्रान्तिवृत्त में जहां-जहां लगता है तदन्तर्गत क्रान्तिवृत्तीय चाप (रवि से लम्बित रविस्थान पर्यन्त) रवि का स्पष्ट लम्बन है, परन्तु वित्रिभस्थान में रवि के रहने से उसके ऊपर दृग्वृत्त तथा रवि के ऊपर और लम्बित रवि के ऊपर कदम्ब प्रोतवृत्त एक ही दृक्क्षेपवृत्त होता है इसलिये वहां स्पष्ट लम्बनाभाव होता है, अतः "वित्रिभलग्नसमेऽर्केन लम्बनम्" यह आचार्योक्त युक्ति-युक्त है इति ॥

गर्भीयामान्तकाल में स्थानाभिप्रायिक रवि और चन्द्र एक ही विन्दु में होते हैं, इसलिए एक ही दृग्वृत्त में लम्बितरवि और लम्बित चन्द्र होते हैं, लम्बित रवि से लम्बितचन्द्र पृष्ठ में लम्बित होते हैं इसलिए वित्रिभ से रवि के अल्प रहने पर लम्बित रव्युपरिगत कदम्बप्रोतवृत्त क्रान्तिवृत्त में जहाँ लगता है उससे अधोभाग में लम्बितचन्द्रपरिगत कदम्बप्रोत-वृत्त क्रान्तिवृत्त में लगेगा इसलिए यहां शीघ्रगतिग्रह (लम्बितचन्द्रस्थान) से मन्दगतिग्रह (लम्बितरविस्थान) के आगे रहने के कारण युति गम्य होती है अतः गर्भीयामान्त से पृष्ठीयामान्त स्पष्टलम्बनान्तर कर के पश्चात् होता है इसलिये गर्भीयामान्तकाल में स्पष्टलम्बनान्तर जोड़ने से पृष्ठीयामान्तकाल होता है, वित्रिभ से रवि के अधिक रहने पर लम्बित रवि से लम्बितचन्द्र अधोभाग में होते हैं, इसलिये लम्बित रव्युपरिगत कदम्बप्रोतवृत्त और क्रान्तिवृत्त के सम्पात से लम्बितचन्द्रोपरिगतकदम्बप्रोतवृत्त और क्रान्तिवृत्त का सम्पात ऊपर होता है अतः मन्दगतिग्रह (लम्बित रविस्थान) से शीघ्रगतिग्रह (लम्बित-चन्द्र स्थान) के आगे रहने के कारण युति गत होती है, इसलिये गर्भीयामान्त काल में स्पष्टलम्बनान्तर को ऋण करने से पृष्ठीयामान्तकाल होता है अतः 'तदधिकोनके भवति' यह आचार्योक्त युक्ति-युक्त है, यहां संस्कृतोपपत्तिस्थ (क) क्षेत्र को देखिये. ॥२-३॥

अब नति के सम्बन्ध में विचार करते हैं

यहां संस्कृतोपपत्तिस्थ (ख) क्षेत्र को देखिये, ख=खस्वस्तिक, वि=वित्रिभ, र= क्रान्तिवृत्त में रवि, लंर=लम्बित रवि, लंरस्था=लम्बित रविस्थान, रवि से लम्बित रविस्थान पर्यन्त दृग्लम्बन है, लम्बित रवि से लम्बितरविस्थान पर्यन्त रवि की नति है, रवि से लम्बित रविस्थान पर्यन्त रवि का स्पष्टलम्बन है, खर=रविनतांश, खवि=दृक्क्षेपचाप, खविर, तथा दृग्लम्बन—नति, स्पष्टलम्बनोत्पन्न चापीयजात्य त्रिभुज का ज्याक्षेत्र सजातीय है इसलिये अनुपात करते हैं यदि दृग्ज्या में दृक्क्षेत्र पाते हैं तो दृग्लम्बनज्या में

क्या इससे रवि की नतिज्या आती है, नति का आनयन दृक्क्षेप के अधीन है इसीलिये दृक्-क्षेप का अभाव रहने से नति का भी अभाव होना निश्चित है, आचार्य स्वल्पाक्ष देश में स्वल्पान्तर से याम्योत्तर वृत्त ही में वित्रिभ की स्थिति मानकर दिनार्धकाल की तरह क्रान्ति और अक्षांश के संस्कार से उत्तर क्रान्तितुल्य अक्षांश में नतांशाभाव स्थान लाये हैं इसलिए 'तस्य क्रान्तिज्योदक् यदाक्षजीवा समा न तदा' यह आचार्योक्त युक्तियुक्त है। सूर्यसिद्धान्त-शिरोमणि में भास्कराचार्य ने "न लम्बनं वित्रिभलग्नतुल्ये" इत्यादि से आचार्योक्त के अनुरूप ही कहा है ॥

अब प्रसङ्ग से दृग्लम्बन का परमत्व कहाँ होता है इसके लिये विचार करते हैं

भूकेन्द्र से और भूपृष्ठ से स्वकक्षास्थ रविकेन्द्रगत रेखाद्वय चन्द्रकक्षा में जहाँ-जहाँ लगता है तदन्तर्गत चन्द्रगोलीय दृग्वृत्तचाप रविलम्बन है, इसी तरह भूकेन्द्र से और भूपृष्ठ से चन्द्रकक्षास्थ चन्द्रकेन्द्रगत रेखाद्वय रविकक्षा में जहाँ जहाँ लगता है तदन्तर्गत रविगोलीय दृग्वृत्तचाप चन्द्रलम्बन है, इस तरह एक त्रिभुज बनता है, भूकेन्द्र से ग्रहकेन्द्र (रविकेन्द्र या चन्द्रकेन्द्र) पर्यन्त ग्रहकर्ण एक भुज, भूपृष्ठ से ग्रहकेन्द्र (रविकेन्द्र या चन्द्रकेन्द्र) पर्यन्त पृष्ठकर्ण द्वितीयभुज, भूव्यासार्ध तृतीयभुज इन भुजों से उत्पन्न त्रिभुज में पृष्ठकर्ण और भूव्यासार्ध से उत्पन्न कोण=१८०—पृष्ठीयनतांश, कोणज्या और कोणोन-भार्धांशज्या बराबर होती है इसलिये ज्या (१८०—पृष्ठीयनतांश)=पृष्ठीय दृग्ज्या, तब अनुपात करते हैं यदि ग्रहकर्ण में पृष्ठीय दृग्ज्या पाते हैं तो भूव्यासार्ध में क्या इससे ग्रहलग्नकोणज्या (दृग्लम्बनज्या) आती है, उसका स्वरूप यह है

$\frac{\text{पृदृग्ज्या} \cdot \text{भूव्या}\frac{1}{2}}{\text{ग्रकर्ण}}$ =दृलंज्या, इसमें ग्रहकर्ण और भूव्यासार्ध स्थिर है अतः सिद्ध हुआ कि पृष्ठीय दृग्ज्या का परमत्व जहाँ हो, वहीं दृग्लम्बनज्या का भी परमत्व होगा, लेकिन पृष्ठीय दृग्ज्या का परमत्व पृष्ठ क्षितिज में ग्रह के रहने से होता है अतः पृष्ठ क्षितिज ही में दृग्लम्बन का परमत्व सिद्ध हुआ।

अब नति का परमत्व कहाँ होता है विचार करते हैं

$\frac{\text{दृक्क्षेप} \times \text{दृलंज्या}}{\text{दृज्या}}$ =नति स्वल्पान्तर से, तथा सम्बन्धानुपात 'त्रिज्यातुल्य पृष्ठीय दृग्ज्या में यदि परमलम्बनज्या पाते हैं तो इष्टपृष्ठीयदृग्ज्या में क्या' से इष्टदृग्लम्बनज्या आती है, $\frac{\text{पलंज्या} \cdot \text{पृदृज्या}}{\text{त्रि}}$ =दृलंज्या इसको नति के स्वरूप में उत्थापन देने से

$\frac{\text{दृक्क्षेप} \cdot \text{पलंज्या} \cdot \text{पृदृज्या}}{\text{दृज्या} \cdot \text{त्रि}}$ यहाँ यदि पृदृज्या=दृज्या तब ही "कक्षयोरन्तरं यत् स्यादिति

सर्वतोऽपि तत्" यह भास्करोक्त समीचीन हो सकता है परन्तु सर्वदा पृदृज्या=दृज्या नहीं होती है अतः भास्करोक्त वह समीचीन नहीं है। पूर्वोक्त नतिस्वरूप में यदि दृक्क्षेप को स्थिर माना जाय तब $\frac{\text{पृदृज्या}}{\text{दृज्या}}$ इसका परमत्व जहाँ होगा वहीं नति का भी परमत्व होगा, परन्तु $\frac{\text{पृदृज्या}}{\text{दृज्या}}$ इसका परमत्व कहाँ होता है इसके लिये विचार करते हैं। पृष्ठीय-नतांश=पृन, गर्भीयनतांश=न, दृग्लम्बन=लं, तब पृन=न+लं, चापयोरिष्टयोरित्यादि से ज्या (न+लं)=पृदृज्या=$\frac{\text{दृज्या}\cdot\text{लंकोज्या}+\text{शं}\cdot\text{लंज्या}}{\text{त्रि}}$ छेदगम से पृदृज्या·त्रि=दृज्या. लंकोज्या+शं·लंज्या लेकिन $\frac{\text{पलंज्या}\cdot\text{पृदृज्या}}{\text{त्रि}}$=लंज्या, उत्थापन देने से पृदृज्या·त्रि= दृज्या.लंकोज्या+$\frac{\text{शं.पलंज्या}\cdot\text{पृदृज्या}}{\text{त्रि}}$ अतः पृदृज्या.त्रि^{2}=दृज्या.लंकोज्या.त्रि+शं.पलंज्या· पृदृज्या समशोधन करने से पृदृज्या.त्रि^{2}—शं.पलंज्या.पृदृज्या=पृदृज्या (त्रि^{2}—शं.पलंज्या) =दृज्या.लंकोज्या.त्रि, अतएव $\frac{\text{पृदृज्या}}{\text{दृज्या}}=\frac{\text{लंकोज्या.त्रि}}{\text{त्रि}^{2}-\text{शं.पलज्या}}$ इस स्वरूप को देखने से सिद्ध होता है कि जहाँ शङ्कु और लम्बन कोटिज्या का परमत्व होगा वहीं $\frac{\text{पृदृज्या}}{\text{दृज्या}}$ इसका भी परमत्व होगा, परन्तु शङ्कु और लम्बनकोटिज्या का परमत्व वित्रिभ स्थान ही में होता है अतः वित्रिभ स्थान ही में नति का परमत्व सिद्ध हुआ, इससे म. म. पण्डित श्री सुधाकर द्विवेदी जी का सूत्र उपपन्न होता है "कुगर्भनत्रांशगुणेन भक्त" इत्यादि संस्कृतोपपत्तिस्थ सूत्र को देखिये॥

पूर्वसिद्धस्वरूप = $\frac{\text{पृदृज्या}}{\text{दृज्या}}=\frac{\text{लंकोज्या.त्रि}}{\text{त्रि}^{2}-\text{शं.पलंज्या}}$ खस्वस्तिक में रवि के रहने से शं=त्रि, लंकोज्या=त्रि, इसलिये खस्वस्तिक में $\frac{\text{पृदृज्या}}{\text{दृज्या}}=\frac{\text{त्रि.त्रि}}{\text{त्रि}^{2}-\text{त्रि}\cdot\text{पलंज्या}}$ $=\frac{\text{त्रि}^{2}}{\text{त्रि}\,(\text{त्रि}-\text{पलंज्या})}=\frac{\text{त्रि}}{\text{परलम्बनकोट्युत्क्रमज्या}}$ लेकिन खस्वस्तिक में रवि के रहने से पृदृज्या=० तथा दृज्या=०, $\therefore \frac{\text{पृदृज्या}}{\text{दृज्या}}=\frac{0}{0}=\frac{\text{त्रि}}{\text{परलम्बनकोउज्या}}$ लेकिन परलम्बन-

कोउज्या < त्रि $\therefore \frac{\text{त्रि}}{\text{परलम्बन कोउज्या}} > १$ वा $\frac{\text{पृदृज्या}}{\text{दृज्या}} = \frac{०}{०} > १$ इस गणितविचित्रता को समझना चाहिये ॥२-३॥

इदानीं लम्बनानयनमाह

त्रिज्याकृतेश्चतुर्गुणशङ्कुहृतायाः फलेन भक्तायाः ।
तात्कालिकार्कराशित्रयोनलग्नान्तरज्यायाः ॥४॥

लम्बनघटिकालब्धं लग्नात् तात्कालिकात् त्रिराश्यूनात् ।
ऋणमधिकेऽर्के हीने घनमसकृत् पञ्चदश्यन्ते ॥५॥

सु. भा.—स्पष्टार्थमार्याद्वयम् ।

अत्रोपपत्तिः । 'त्रिभोनलग्नं तरणिं प्रकल्प्ये' त्यादिभास्करविधिना स्फुटा । वास्तवलम्बनादिज्ञानाय मदीयं ग्रहणकरणं विलोकनीयम् ॥४-५॥

वि. भा.—त्रिज्याकृतेः (त्रिज्यावर्गात्) चतुर्गुणशङ्कुहृतायाः (चतुर्गुणित-वित्रिभशङ्कुभक्तायाः) फलेन भक्तायाः तात्कालिकार्कराशित्रयोनलग्नान्तरज्यायाः (तात्कालिकरविवित्रिभान्तरज्यायाः) लब्धं लम्बनघटिकाः (स्पष्टलम्बननाड्यः) भवेयुः । त्रिराश्यूनात् (राशित्रयहीनात्) तात्कालिकाल्लग्नादर्थाद्वित्रिभलग्नात् अर्के (रवौ) ऽधिके पञ्चदश्यन्ते (पूर्णान्ते) ऋणं वित्रिभलग्नाद्रवौ हीने (अल्पे) पूर्णान्ते धनमेवमसकृत्कार्यं तदा स्पष्टः पूर्णान्तकालो भवेदिति ॥४-५॥

अत्रोपपत्तिः

ख=खस्वस्तिकम् । वि=वित्रिभम् । खवि=वित्रिभनतांशाः । स्थावि=ग्रहवित्रिभान्तरम्=अं स्था=ग्रहस्थानम् । स्था'=लम्बितग्रहस्थानम् । क=

कदम्बः । कस्था' वृत्तोपरि खस्वस्तिकाल्लम्बचापम्=खप, पबिन्दुतः कस्था'

वृत्तोपरिलम्बचापम्=अन । स्थास्थाꞌ=स्पष्टलम्बनम्=लं स्थाविꞌ=अं+लं, तदा कविस्था, कखप चापीयजात्यत्रिभुजयोर्ज्याक्षेत्रसाजात्यादनुपातेन

$\frac{\text{ज्या (अं+लं)·विशं}}{\text{त्रि}}$=ज्याखप=लम्बचापज्या, ततः खलंप, अलंन चापीय-

जात्यत्रिभुजयोर्ज्याक्षेत्रसाजात्यात् $\frac{\text{लम्बचापज्या.दृलंज्या}}{\text{पृदृज्या}}$=ज्या अन। अत्र खलं=

पृष्ठीयनतांशाः। अलं=दृग्लम्बनम्। लम्बचापज्याया उत्थापनेन $\frac{\text{ज्या (अं+लं)विशं}}{\text{त्रि}}$

$\times\frac{\text{दृलंज्या}}{\text{पृदृज्या}}$, तथा $\frac{\text{पलंज्या·पृदृज्या}}{\text{त्रि}}$=दृलंज्या उत्थापनेन $\frac{\text{ज्या (अं+लं).विशं}}{\text{त्रि}}$

$\times\frac{\text{पलंज्या.पृदृज्या}}{\text{पृदृज्या.त्रि}}=\frac{\text{ज्या (अं+लं).विशं.पलंज्या}}{\text{त्रि.त्रि}}$=ज्याअन, अस्था=शरः। कअ=

शरकोटिः, ततः कअन, कस्थास्थाꞌ त्रिभुजयोर्ज्याक्षेत्रसाजात्यादनुपातेन

$\frac{\text{ज्या (अं+लं).विशं}}{\text{त्रि}}\times\frac{\text{पलंज्या}}{\text{त्रि}}\times\frac{\text{त्रि}}{\text{शरकोज्या}}$=ज्यास्थास्थाꞌ=स्पष्टलम्बनज्या,

अत्राचार्येण स्वल्पान्तरात् पलंज्या=पलं, स्पष्टलम्बनज्या=स्पष्टलम्बन=लं

स्वीकृतस्तदा $\frac{\text{ज्या (अं+लं).विशं}}{\text{त्रि}}\times\frac{\text{पलं}}{\text{शकोज्या}}$= स्पलं=लं घट्यात्मककरणेन

$\frac{\text{६० × स्पलंकला}}{\text{गत्यन्तरकला}}$=स्पलंघटी=$\frac{\text{ज्या (अं+लं).विशं}}{\text{त्रि}}\times\frac{\text{६० × पलं}}{\text{गत्यन्तर × शकोज्या}}$ परन्तु

$\frac{\text{६० × पलं}}{\text{गत्यन्तरकला}}$=४ घटी, अतः $\frac{\text{ज्या (अं+लं). विशं}}{\text{त्रि}}\times\frac{\text{४}}{\text{शकोज्या.}}$ अत्राऽऽचार्येण

(१)

शकोज्या=त्रि, लं=० स्वीकृतं तदा स्पष्टलम्बनघटी=$\frac{\text{ज्याअं. विशं. ४}}{\text{त्रि}^2}$=

$\frac{\text{ज्याअं}}{\frac{\text{त्रि}^2}{\text{४ विशं}}}=\frac{\text{ज्याअं}}{\text{फल}}$, $\frac{\text{त्रि}^2}{\text{४ विशं}}$=फल, परमत्राऽऽचार्येण यस्य स्पष्टलम्बन-

स्याऽऽनयनं क्रियते तस्यैव मानं शून्यं कल्पितं तथा शरकोटिज्या=त्रि स्वीकृता,

ज्याचापयोरभेदत्वजनितदोषोऽपि वर्त्तत एवात आचार्योक्तमिदमानयनं न समीचीनमित्येतावताऽऽचार्योक्तमप्युपपद्यते ।

एतेनैव "वेदघ्नशङ्कुविहृतात् त्रिगुणस्य वर्गाल्लब्धेन वित्रिभदिनेशविशेषजीवा । भक्ता विलम्बनमिदं ह्युदितं दिनेशे न्यूनाधिके धनमृणं त्रिगृहोनलग्नात्" सिद्धान्तशेखरे श्रीपत्युक्तमाचार्योक्तानुरूपमप्युपपद्यते (१) एतेन च "त्रिभोनलग्नार्कविशेषशिञ्जिनी कृता हृता व्यासदलेन भाजिता । हृतात् फलाद्वित्रिभलग्नशङ्कुना त्रिजीवयाप्तं घटिकादिलम्बनम्" भास्करोक्तमप्युपपन्नं भवति,

$$\text{पूर्वोक्त स्थलं घटी} = \frac{\text{ज्याग्रं}}{\frac{\text{त्रि}^2}{४\ \text{विशं}}} = \frac{\text{ज्याग्रं}}{\frac{\left(\frac{\text{त्रि}}{२}\right)^2}{\text{विशं}}} = \frac{\text{ज्याग्रं}}{\frac{\text{एकराशिज्या}^2}{\text{विशं}}} = \frac{\text{ज्याग्रं}}{\frac{\text{एकराशिज्या}^2}{\text{दृग्गतिज्या}}}$$

$$= \frac{\text{ज्याग्रं}}{\text{छेद}}\ \text{अत्र}\ \frac{\text{एकराशिज्या}^2}{\text{दृग्गतिज्या}} = \text{छेदः ।}$$

एतेन "एकज्यावर्गतश्छेदो लब्धं दृग्गतिजीवया । मध्यलग्नार्कविश्लिष्टज्याछेदेन विभाजिता" रवीन्द्वोर्लम्बनं ज्ञेयं प्राक् पश्चात् घटिकादिकम्" सूर्यसिद्धान्तोक्तं स्पष्टलम्बनानयनमुपपद्यते । परमतेष्वानयनेषु न कश्चिद्भेद इति विज्ञैर्ज्ञेयः ।

अथात्र वास्तवानयनं क्रियते

अथ $\frac{\text{पलंज्या. पृदृज्या}}{\text{त्रि}} = \text{दृलंज्या}$ । परन्तु पृदृज्या $=$ ज्या (न $+$ लं)। अत्र

गर्भीयनतांशाः $=$ न दृग्लम्बनम् $=$ लं

चापयोरिष्टयोरित्यादिना $\frac{\text{पलंज्या}}{\text{त्रि}} \quad \frac{(\text{दृज्या. लंकोज्या} + \text{लंज्या. शं})}{\text{त्रि}} = \text{लंज्या}$

छेदगमेन पलंज्या. दृज्या. लंकोज्या $+$ पलंज्या. लंज्या. शं $=$ त्रि^{2} लंज्या समशोधनेन

त्रि^{2} लंज्या $-$ पलंज्या. लंज्या. शं $+$ पलंज्या. दृज्या. लंकोज्या $=$ लंज्या (त्रि^{2} $-$ पलंज्या. शं)

अतः $\frac{\text{लंज्या}}{\text{लंकोज्या}} = \frac{\text{पलंज्या. दृज्या}}{\text{त्रि}^2 - \text{पलंज्या. शं}}$, पक्षौ द्वादशभिर्गुणितौ तदा

$$\frac{\text{लज्या. १२}}{\text{लंकोज्या}} = \frac{\text{पलंज्या. दृज्या. १२}}{\text{त्रि}^2 - \text{पलंज्या} \times \text{शं}}$$

$$=\frac{\dfrac{\text{पलंज्या. दृज्या. १२}}{\dfrac{\text{पलंज्या. शं}}{\text{त्रि}^2}}}{\text{शं. पलंज्या}}-१=\frac{\dfrac{\text{इछाया}}{\text{त्रि}^2}}{\text{शं. पलंज्या}}-१=\text{ दृग्लम्बनतुल्याक्षदेशीयपलभा}$$

अतो येऽक्षांशास्तदेव दृग्लम्बनमतेन म. म. पण्डित श्रीसुधाकरोक्तसूत्रमवतरति ।

"त्रिज्याकृतिः परमलम्बनमौर्विकाप्तान्ना भाजिता च विधुना रहिताऽथ तेन । भक्तेष्टभा फलमितां पलभां प्रकल्प्य साध्या पलांशकलिकेष्टविलंबनं वा" एतद्वशेन स्पष्टलंबनज्ञानं भवेदिति ॥४-५॥

अब स्पष्टलम्बनानयन को कहते हैं

हि. भा.—त्रिज्यावर्ग में चतुर्गुणित वित्रिभशङ्कु वर्ग से भाग देने से जो फल हो उस से तात्कालिक रवि और वित्रिभ की अन्तर ज्या को भाग देने से जो लब्धि होती है वह स्पष्टलम्बन घटी होती है, तात्कालिक वित्रिभलग्न से रवि के अधिक रहने पर पूर्णान्त काल में ऋण करना और वित्रिभ से रवि के अल्प रहने पर पूर्णान्त काल में पूर्वानीत लम्बन घटी को धन करना इस तरह असकृत् (बार-बार) करने से स्पष्ट पूर्णान्त काल होता है इति ॥४–५॥

उपपत्ति

यहां संस्कृतोपपत्तिस्थ(क) क्षेत्र को देखिये । ख = खस्वस्तिक, वि = वित्रिभ, खवि = वित्रिभनतांश, स्था = ग्रहस्थान स्थावि = वित्रिभार्कान्तर = अं, स्था' = लम्बितग्रहस्थान, क = कदम्ब, कस्था वृत्त के ऊपर खस्वस्तिक से लम्बचाप = खप ग्र बिन्दु से कस्था' वृत्त के ऊपर लम्बचाप = ग्रन, स्थास्था' = स्पष्टलम्बन = लं, स्था'वि = अं + लं, दृ लं = पृष्ठीयनतांश, ग्रलं = दृग्लम्बन, ग्रस्था = शर, कग्र = शरकोटि, तब कविस्था' कखप दोनों चापीय जात्य त्रिभुज के ज्याक्षेत्र सजातीय होने के कारण $\frac{\text{ज्या (अं + लं). विशं}}{\text{त्रि}}$ = ज्या खप लम्बचापज्या, फिर खलंप, ग्रलंन दोनों चापीयजात्य त्रिभुजों के ज्याक्षेत्र के सजातीय रहने के कारण

$\frac{\text{लम्बचापज्या. दृलंज्या}}{\text{पृदृज्या}}$ = ज्याग्रन, लम्बचापज्या के उत्थापन से

$\frac{\text{ज्या(अं + लं)·विशं}}{\text{त्रि}}\times\frac{\text{दृलंज्या}}{\text{पृदृज्या}}$ = ज्याग्रन, तथा $\frac{\text{पलंज्या. पृदृज्या}}{\text{त्रि}}$ = दृलंज्या उत्थापन देने से

$\frac{\text{ज्या}(\text{ग्रं}+\text{लं}).\text{विशं}}{\text{त्रि}} \times \frac{\text{पलंज्या}.\text{पृद्दज्या}}{\text{पृद्दज्या}.\text{त्रि}} = \frac{\text{ज्या}(\text{ग्रं}+\text{लं})\cdot\text{विशं}}{\text{त्रि}} \times \frac{\text{पलंज्या}}{\text{त्रि}}$, तब.कग्रन, कस्या-

स्या चापीयजात्य त्रिभुजों के सजातीयत्व से $\frac{\text{ज्या}(\text{ग्रं}+\text{लं}).\text{विशं}}{\text{त्रि}} \times \frac{\text{पलंज्या}}{\text{त्रि}} \times \frac{\text{त्रि}}{\text{शकोज्या}} =$

ज्यास्थास्था = स्पष्टलम्बनज्या, यहां आचार्य ने स्वल्पान्तर से पलंज्या = पलं, स्पष्टलम्बनज्या = स्पष्टलम्बन, = लं. स्वीकार किया है, तब. $\frac{\text{ज्या}(\text{ग्रं}+\text{लं}).\text{विशं}}{\text{त्रि}} \times \frac{\text{पलं}}{\text{शकोज्या}} = \text{स्पलं}$

घट्यात्मक करने से $\frac{६० \times \text{स्पष्टलम्बन कला}}{\text{गत्यन्तरकला}} = \text{स्पष्टलंघटी} = \frac{\text{ज्या}(\text{ग्रं}+\text{लं}).\text{विशं}}{\text{त्रि}} \times$

$\frac{६० \times \text{पलं}}{\text{गत्यन्तर} \times \text{शरकोज्या}}$ परन्तु $\frac{६० \times \text{पलं}}{\text{गत्यन्तर}} = ४\text{घटी}$, अतः $\frac{\text{ज्या}(\text{ग्रं}+\text{लं}).\text{विशं}}{\text{त्रि}} \times \frac{४}{\text{शकोज्या}}$

(१)

यहां आचार्य ने शकोज्या = त्रि, लं = ० स्वीकार किया है, तब स्पष्टलंघटी = $\frac{\text{ज्या ग्रं विशं}.४}{\text{त्रि}.\text{त्रि}} =$

$\frac{\text{ज्याग्रं}}{\frac{\text{त्रि}^२}{४\text{विशं}}} = \frac{\text{ज्याग्रं}}{\text{फल}}$, $\frac{\text{त्रि}^२}{४\text{विशं}} = \text{फल}$, लेकिन यहां आचार्य ने जिस स्पष्टलम्बन का आनयन किया है उसी का मान शून्य मान लिया है तथा शरकोज्या = त्रि, तथा ज्या और चाप का अभेदत्व जनित दोष भी है ही इसलिये यह आनयन ठीक नहीं है, इससे आचार्योक्त पद्य उपपन्न होता है, इसी से "वेदघ्नशङ्कुविहृतात्" इत्यादि सिद्धान्तशेखर में श्रीपत्युक्त पद्य उपपन्न होता है जो कि आचार्योक्त के अनुरूप ही है, (१) इससे "त्रिभोनलग्नार्कविशेषशिञ्जिनी" इत्यादि सिद्धान्तशिरोमणिस्थ भास्करोक्त पद्य उपपन्न होता है, पूर्वोक्त स्पष्टलम्बनघटी =

$\frac{\text{ज्याग्रं}}{\frac{\text{त्रि}^२}{४\text{विशं}}} = \frac{\text{ज्याग्रं}}{\frac{\left(\frac{\text{त्रि}}{२}\right)^२}{\text{विशं}}} = \frac{\text{ज्याग्रं}}{\frac{\text{एकराशिज्या}^२}{\text{विशं}}} = \frac{\text{ज्याग्रं}}{\frac{\text{एकराशिज्या}^२}{\text{दृग्गातज्या}}} = \frac{\text{ज्याग्रं}}{\text{छेद}}$ इससे "एकज्यावर्गतश्छेदो लब्धं दृग्गतिजीवया" इत्यादि सूर्यसिद्धान्तोक्त स्पष्टलम्बनानयन उपपन्न होता है, लेकिन इन आनयनों में कुछ भी भेद नहीं है इति ॥

अब वास्तवानयन को कहते हैं

$\frac{\text{पलंज्या}.\ \text{पृद्दज्या}}{\text{त्रि}} = \text{दृलंज्या}$, परन्तु पृद्दज्या = ज्या (न + लं)। यहां गर्भीयनतांश =

न, दृग्लम्बन=लं चापयोरिष्टयोः इत्यादि से $\frac{\text{पलंज्या}}{\text{त्रि}} \quad \frac{(\text{दृज्या. लंकोज्या} + \text{शं. लंज्या})}{\text{त्रि}} =$ लंज्या, छेदगम से पलंज्या· दृज्या. लंकोज्या + पलंज्या. शं. लंज्या = त्रि². लंज्या समशोधन से त्रि². लंज्या—पलंज्या. लंज्या. शं = पलंज्या. दृज्या. लंकोज्या = लंज्या (त्रि²—पलंज्या. शं) अतः $\frac{\text{लंज्या}}{\text{लंकोज्या}} = \frac{\text{पलंज्या. दृज्या}}{\text{त्रि}^2 - \text{पलंज्या.श}}$ दोनो पक्षों को बारह से गुणने से

$$\frac{\text{लंज्या. १२}}{\text{लंकोज्या}} = \frac{\text{पलंज्या. दृज्या. १२}}{\text{त्रि}^2 - \text{पलंज्या. शं}}$$

$$= \frac{\dfrac{\text{पलंज्या. दृज्या. १२}}{\text{पलंज्या. शं}}}{\dfrac{\text{त्रि}^2}{\text{शं. पलंज्या}} - १} = \frac{\text{दृछाया}}{\dfrac{\text{त्रि}^2}{\text{शं. पलंज्या}} - १} = \text{दृग्लम्बनतुल्याक्ष-}$$

देशीय पलभा, इससे जो अक्षांश होता है वही दृग्लम्बन होता है, इससे म.म. पण्डित श्री सुधाकर द्विवेदी जी का सूत्र उपपन्न होता है "त्रिज्याकृतिःपरमलम्बनमौर्विकाप्ता" इत्यादि संस्कृतोपपत्तिस्थ सूत्र को देखिये.। इसके वश से वास्तवस्पष्टलम्बनानयन होता है इति ॥४-५॥

इदानीं पुनः स्पष्टलम्बनानयनमाह

कर्णगुणाद् व्यासार्धाद् वसुवेदविभाजितात् फलविभक्ता ।
लम्बननाड्यो भास्करवित्रिभलग्नान्तरज्या वा ॥६॥

सु. *भा.*—व्यासार्धात् कर्णगुणाद्वित्रिभच्छायाकर्णगुणात् तस्माद्वसुवेद—४८ भाजिताद्यत् फलं तेन विभक्ता भास्करवित्रिभलग्नान्तरज्या फलं वा लम्बननाड्यः स्युः ।

अत्रोपपत्तिः । पूर्वविधिना लम्बनाड्यः $\frac{\text{४ ज्या(र}\backsim\text{वि)}}{\text{त्रि}} \cdot \frac{\text{विशं}}{\text{त्रि}} =$

$$\frac{\text{४}\times\text{१२ ज्या (र}\backsim\text{वि)}}{\dfrac{\text{१२ त्रि}}{\text{विशं}} - \text{त्रि}} = \frac{\text{४८ ज्या (र}\backsim\text{वि)}}{\text{विछाक. त्रि.}} = \frac{\text{ज्या (र}\backsim\text{वि)}}{\dfrac{\text{विछाक. त्रि}}{\text{४८}}}$$

अत उपपन्नम् ॥६॥

वि. *भा.*—व्यासार्धात् (त्रिज्यातः) कर्णगुणात् (वित्रिभलग्नच्छायाकर्ण-

गुणात्) वसुवेद ४८ भक्ताद्यत् फलं तेन भास्करवित्रिभलग्नान्तरज्या (वित्रिभलग्नार्कान्तरज्या) भक्ता तदा वा (प्रकारान्तरेण) लम्बननाड्यो भवेयुरिति ॥६॥

अत्रोपपत्तिः

$$\text{अथ पूर्वाऽऽनीत लम्बनघट्यः} = \frac{\text{ज्याअं. विशं. ४}}{\text{त्रि. त्रि}} = \frac{४ \times १२ \times \text{ज्याअं}}{\frac{१२ \times \text{त्रि}}{\text{विशं}} \cdot \text{त्रि}} =$$

$$\frac{४८ \times \text{ज्याअं}}{\text{विछाक. त्रि}} = \frac{\text{ज्याअं}}{\frac{\text{विछाक. त्रि}}{४८}} = \frac{\text{ज्याअं}}{\text{फल}}$$.एतेन आचार्योक्तमुपपन्नं भवति। सिद्धान्तशेखरे "श्रुतिसङ्गुणात् त्रिभगुणाद्विभाजिताद्वसुसागरै ४८ रथ फलेन वा हृता। रविवित्रिभोदयवियोगशिञ्जिनीघटिकादिलम्बनमिहासकृत् भवेत्" इति श्रीपत्युक्तमाचार्योक्तानुरूपमेव, इति दर्शान्तकालेऽसकृत्(वारं-वारं) अविशेषपर्यन्तं साध्यमिति ॥६॥

अब पुनः स्पष्टलम्बनानयन को कहते हैं

हि. भा.—वित्रिभलग्न के छाया कर्ण को त्रिज्या से गुणा कर ४८ अड़तालीश से भाग देने से जो फल हो उससे वित्रिभलग्न और रवि की अन्तरज्या को भाग देने से प्रकारान्तर से लम्बन घटी होती है इति ॥६॥

उपपत्ति

$$\text{पूर्वाऽऽनीतलम्बनघटी} = \frac{\text{ज्याअं} \cdot \text{विशं} \cdot ४}{\text{त्रि} \cdot \text{त्रि}} = \frac{४ \times १२ \times \text{ज्याअं}}{\frac{१२ \times \text{त्रि}}{\text{विशं}} \times \text{त्रि}} = \frac{४८\ \text{ज्याअं}}{\text{विछाक} \cdot \text{त्रि}}$$

$$= \frac{\text{ज्याअं}}{\frac{\text{विछाक} \cdot \text{त्रि}}{४८}} = \frac{\text{ज्याअं}}{\text{फल}}$$ इस से आचार्योक्त उपपन्न होता है, 'सिद्धान्तशेखर में 'श्रुतिसङ्गुणात् त्रिभगुणात्' इत्यादि श्रीपत्युक्त आचार्योक्त के अनुरूप ही है, दर्शान्तकाल में असकृत् (वार-वार) इसका साधन करना इति ॥६॥

इदानीं स्पष्टदर्शान्ते रविचन्द्रपातानां चालनान्याह

रविशशिपातगतिकला लम्बनघटिकागुणा हृताः षष्ट्या ।
यदि लम्बनमृणमूना धनमधिकाः स्वफललिप्ताभिः ॥७॥

सु. भा.—स्पष्टार्थाऽऽर्या ॥७॥

वि. भा.—रविचन्द्रपातानां गतिकला असकृत्कर्मणा स्थिरीकृताभिर्लम्बन-

घटिकाभिर्गुणिताः षष्ट्या भक्ता लब्धकलाभिर्यदि लम्बनमृणं तदा गणितागत-दर्शान्तिकालिका रविचन्द्रपाता ऊनाः (हीनाः) कार्याः, यदि लम्बनं धनं तदा लब्ध कलाभिर्गणितदर्शान्तकालिका रविचन्द्रपाता युक्ताः कार्यास्तदा स्पष्टदर्शान्तिकालिका रविचन्द्रपाता भवन्तीति ॥ ७ ॥

अत्रोपपत्तिः

गणितागतदर्शान्तिकालिकरविचन्द्रपातेभ्यः शरादिकं सर्वमानेतव्यम्। ऋणात्मके लम्बने "षष्टिघटिकाभिः पृथक् पृथक् रविचन्द्र पातगतिकला लभ्यन्ते तदा लम्बनघटिकाभिः किमित्यनुपातेन" लब्धकलाभिर्गणितागतदर्शान्तिकालिका रविचन्द्र पाता हीनाः कार्याः, धनात्मके लम्बने लब्धकलाभिस्ते युक्तास्तदा ते स्पष्ट-दर्शान्तिकालिका भवेयुरेवेति, सिद्धान्त शेखरे "गतिं हतां लम्बननाड़िकाभिर्विभज्य षष्ट्या फललिप्तिकाभिः। रवीन्दुपाताः सहिता धनाख्ये विवर्जिताश्च क्षयलम्बने ते" ऽनेन श्रीपतिनाऽऽचार्योक्तानुरूपमेवोक्तमिति ॥ ७ ॥

अब स्पष्ट दर्शान्तकाल में रवि चन्द्र और पात के चालन को कहते हैं।

हि. भा.—रवि, चन्द्र और पात की गति कला को लम्बन घटी से गुणा कर साठ ६० से भाग देने से जो लब्ध कला हो उसको लम्बन ऋण रहने से गणितागत दर्शान्ति-कालिक रवि, चन्द्र और पात में से हीन करना, और धनात्मक लम्बन में गणितागत रवि, चन्द्र और पात में लब्धकला को जोड़ना तब स्पष्ट दर्शान्तकालिक रवि, चन्द्र और पात होते हैं इति ॥ ७ ॥

उपपत्ति ।

गणितागत दर्शान्त कालिक रवि, चन्द्र और पात से शर आदि सब कुछ लाना चाहिये, ऋणात्मक लम्बन रहने से 'साठ घटी में पृथक् पृथक् रविगतकला, चन्द्रगतिकला और पातगति कला पाते हैं तो लम्बन घटी में क्या इस अनुपात से जो लब्ध कला हो उनको गणितागत दर्शान्तकालिक रवि, चन्द्र और पात में से हीन करना, धनात्मक लम्बन रहने से लब्धकला को उनमें (गणितागत दर्शान्त कालिक रवि, चन्द्र और पात) जोड़ देना तब स्पष्ट दर्शान्तकालिक रवि, चन्द्र और पात होते हैं, सिद्धान्त शेखर में 'गतिं हतां लम्बन-नाड़िकाभि' रित्यादि, संस्कृतोपपत्ति में लिखित पद्य से श्रीपति ने आचार्योक्त के अनुरूप ही कहा हैं इति ॥ ७ ॥

इदानीं वित्रिभनतांशानां नतेर्वादिग्ज्ञानार्थमाह

अक्षज्यायां वित्रिभलग्नात् स्वक्रान्तिरुत्तराऽर्कस्य।
इन्दोर्वा यद्यधिकाऽवनतिः सौम्याऽन्यथा याम्या ॥ ८ ॥

सु. भा.—वित्रिभलग्नाद्या स्वक्रान्तिरर्थाद्वित्रिभक्रान्तिज्योत्तरा सा यद्यक्षज्याया अधिका तदाऽर्कस्य वा चन्द्रस्यावनतिर्वित्रिभनतज्या सौम्या ज्ञेयाऽन्यथा सदा याम्या ज्ञेया।

अत्रोपपत्तिः। 'सौम्येऽपमे वित्रिभजेऽधिकेऽक्षा' दित्यादि भास्करविधिना स्फुटा ॥ ८ ॥

वि. भा.—वित्रिभलग्नात् स्वक्रान्तिः (वित्रिभलग्न क्रान्तिज्या) उत्तरा (उत्तरगोल सम्बन्धिनी) अक्षज्यायाः सकाशात् यद्यधिका स्यात्तदाऽर्कस्ये (रवेः) न्दो (चन्द्रस्य) र्वाऽर्थाद्रवि चन्द्र सम्बन्धिनोर्वित्रिभयोरवनतिः सौम्या (उत्तरदिक्का) अन्यथा याम्या (दक्षिणा) भवेदिति ॥ ८ ॥

अत्रोपपत्तिः

"दृग्ज्यैव या वित्रिभलग्नशङ्कोः स एव दृक्क्षेप इनस्य तावत्। सौम्येऽपमे वित्रिभजेऽधिकेऽक्षात् सौम्योऽन्यथा दक्षिण एव वेद्यः" इति सिद्धान्तशिरोमणौ भास्करोक्त्या स्फुटाऽस्ति, सिद्धान्त शेखरे "उत्तरो यदि हि वित्रिभलग्नात् स्वापमः समधिकः पलमौर्व्याः। स्यात्तदाऽवनतिरुत्तरदिक्का दक्षिणात्वपरथा तपनेन्द्वोः" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव भास्करोक्तमप्याचार्योक्तानुरूपं श्रीपत्युक्तानुरूपं वेति बोध्यं गणितिकैरिति ॥ ८ ॥

अब वित्रिभनतांश के वा नतिके दिक्ज्ञान के लिये कहते हैं।

हि. भा.—वित्रिभलग्न से अपनी (वित्रिभ) क्रान्तिज्या उत्तर गोल सम्बन्धी यदि अक्षज्या से अधिक है तब रवि और चन्द्र सम्बन्धी वित्रिभ की नति उत्तर दिशा की होती है, इससे अन्यथा दक्षिण दिशा की होती है इति ॥ ८ ॥

उपपत्ति।

"दृग्ज्यैव या वित्रिभलग्नशङ्कोः स एव दृक्क्षेप इनस्य तावत्" इत्यादि संस्कृतोपपत्ति में लिखित पद्य से सिद्धान्त शिरोमणि में भास्कराचार्य की उक्ति से स्पष्ट है, सिद्धान्त शेखर में "उत्तरो यदि हि वित्रिभ लग्नात् स्वापमः समधिकः" इत्यादि से आचार्योक्त के अनुरूप ही श्रीपति की उक्ति है, भास्कराचार्योक्त भी आचार्योक्त के अनुरूप या श्रीपत्युक्त के अनुरूप ही समझना चाहिये इति ॥ ८ ॥

इदानीं रविचन्द्रयोर्दृग्गतिसाधनमाह

वित्रिभलग्नादुत्तरदक्षिणविक्षेपहीनसंयुक्तम्।
शंकुधनुरुत्तरायामधिकोनं दक्षिणावनतौ ॥ ९ ॥

तज्ज्येन्दुशंकुराद्यः सवितुर्दृक्क्षेपमण्डले युक्ते ।
अपमण्डलेन भानोश्चन्द्रस्य विमण्डलेन युते ।। १० ।।

सु. भा.—उत्तरायां वित्रिभावनतौ वित्रिभलग्नाद्य उत्तरो वा दक्षिणो विक्षेपस्तेन शंकुधनुर्वित्रिभलग्नशंकुचापं क्रमेण हीनं संयुक्तं च कार्यम् । दक्षिणावनतौ च तदेव शंकुचापमुत्तरेण विक्षेपेणाधिकं दक्षिणेनोनं कार्यम् । एवं संस्कृतं चापं यत् तज्ज्या इन्दोः शंकुरर्थाच्चन्द्रस्य वित्रिभशंकुर्दृग्गतिरित्यर्थः । सवितुः सूर्यस्याद्यः पूर्वसाधितो वित्रिभशंकुरेव दृग्गतिरिति ।

दृक्क्षेपमण्डले वित्रिभलग्नदृङ्मण्डलेन युक्ते भानोर्दृग्गतिर्विमण्डलेन युते चन्द्रस्य दृग्गतिरिति । अत्रैतदुक्तं भवति । दृक्क्षेपमण्डलं यत्र क्रान्तिमण्डले लग्नं तस्य बिन्दोर्वित्रिभस्य शंकुसूर्यस्य दृग्गतिः ।

अत्रोपपत्तिः । क्रान्तिवृत्ते यत्र दृक्क्षेपमण्डलं लग्नं तस्माद्विमण्डलावधि दृक्क्षेपमण्डले चापांशाः स्वल्पान्तराद्वित्रिभलग्नशरसमाः । अत उत्तरायां वित्रिभावनतावुत्तरे वित्रिभशरे द्वयोर्योगेन दृक्क्षेपमण्डले खार्द्धाद्विमण्डलावधि चापांशाश्चन्द्रदृक्क्षेपचापांशाः=विन+विश । एते नवतेश्च्युताश्चन्द्रदृग्गतिचापांशाः=९०—विन—विश=विशंचा—विंशं । एवं दक्षिणे वित्रिभशरे चन्द्रदृक्क्षेप चापांशाः=विन—विश । दृग्गतिः=९०—विन+विश=विशंचा+विश । दक्षिणावनतौ च विपरीत संस्कारः स्फुटः । अत उपपन्नं चन्द्रग्गतिसाधनम् । दृक्क्षेपमण्डलं क्रान्तिवृत्ते लम्बरूपं न विमण्डले । अतश्चन्द्रदृक्क्षेपतो या चन्द्रनतिः सा न कदम्ब प्रोतेऽतस्तत्संस्कारेण न स्फुटा नतिरिति सिद्धान्तविदां स्फुटमेव । भास्करेणापि प्रथममेतन्मतानुसारेण 'दृग्ज्यैव या वित्रिभलग्नशंको' रित्यादिविधिना चन्द्रदृक्क्षेपं प्रसाध्य तद्वशात् स्फुटां नतिं कृत्वा पश्चात् सूर्यग्रहणाधिकारान्ते 'शशिदृक्क्षेपार्थं यद्वित्रिभलग्नेषुणाऽत्रसंस्करणम्' इत्यादिनेदमानयनं खण्डितम् ।। ९-१० ।।

वि. भा.—उत्तरायां वित्रिभावनतौ वित्रिभलग्नात् य उत्तरो वा दक्षिणो विक्षेपः (शरः) तेन शंकुधनुः (वित्रिभलग्नशंकुचापं) क्रमेण हीनं संयुक्तं च कार्यं दक्षिणावनतौ तदेव शंकुचापं अधिकोनं (उत्तरेण विक्षेपेणाधिकं दक्षिणेन हीनं) कार्यं तदा तज्ज्या (संस्कृत चापज्या) इन्दुशंकुः (चन्द्रस्य वित्रिभशंकुर्दृग्गतिरित्यर्थः) सवितुः (सूर्यस्य) आद्यः (पूर्वं साधितो वित्रिभशंकुः) वास्तवो दृग्गतिर्भवति । दृक्क्षेपमण्डले (वित्रिभलग्नदृङ्मण्डले) ऽपममण्डलेन (क्रान्तिवृत्तेन) युक्ते भानोः (सूर्यस्य) दृग्गतिः । विमण्डलेन युते चन्द्रस्य दृग्गतिरिति, अत्रैतदुक्तं भवति, दृक्क्षेपवृत्तं यत्र क्रान्तिवृत्ते लगति तस्य बिन्दोर्वित्रिभलग्नशंकुः सूर्यस्य दृग्गतिः । तदेव दृक्क्षेपवृत्तं चन्द्र विमण्डले यत्र लग्नं तस्य विन्दोः शंकुश्चन्द्रस्य दृग्गतिः इति ।। ९-१० ।।

अत्रोपपत्तिः

दृक्क्षेपवृत्तं क्रान्तिवृत्ते यत्र लग्नं तस्माद्विमण्डलावधि दृक्क्षेपवृत्ते स्वल्पान्तराद्वित्रिभलग्नशरः। तेनोत्तरायां वित्रिभावनतौ-उत्तरे वित्रिभशरे च द्वयोर्योगेन खस्वस्तिकाद्विमण्डलावधि दृक्क्षेपवृत्ते चन्द्रदृक्क्षेप चापांशाः= वित्रिभन+वित्रिभशर, एते नवतेर्विशोध्यास्तदा चन्द्रदृग्गतिचापांशाः=९०− वित्रिभशर,=वित्रिभशंचा-विश, दक्षिणे वित्रिभशरे चन्द्रदृक्क्षेप चापांशाः=वित्रिभनतांश− वित्रिभशर ततः शंकुचापांशाः=९०—वित्रिभन+वित्रिभशर=वित्रिभशंचा+वित्रिभशर, दक्षिणावनतौच विलोमसंस्कारः स्फुटः। एतेन चन्द्रदृग्गतिसाधनमुपपद्यते। दृक्क्षेपवृत्तं क्रान्ति वृत्तोपरिलम्बरूपं, नहि विमण्डलोपरितेन चन्द्रदृक्क्षेपतो या दृग्गतिः सा न कदम्बप्रोतवृत्ते ऽतस्तत्संस्कारेण न स्फुटा नतिरिति। भास्करेणापि पूर्वमेतन्मतानुसारेण "दृग्ज्यैव या वित्रिभलग्नशंको" रित्यादिना चन्द्रदृक्क्षेपं प्रसाध्य तद्वशात्स्फुटनतिं कृत्वा पश्चात् सूर्यग्रहणाधिकारान्ते "शशिदृक्क्षेपार्थं यद्वित्रिभलग्नेषुणाऽत्र संस्करणम्" इत्यादि नाऽस्याऽऽनयनस्य खण्डनं कृतमिति[१]।

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(१) यत्र देशे चतुर्विंशतिरक्षांशास्तत्र यदा रविचन्द्रौ तुलादिगौ भवतस्तदोदयकाले रविरेव लग्नम्। खस्वस्तिके च तत्स्थितौ पूर्वापरवृत्तानुकारकमेव क्रान्तिवृत्तं दृग्वृत्तं च भवति, दृग्वृत्तस्य क्रान्तिवृत्ताकारत्वात्तस्मिन्नेव दृग्वृत्ताकारे क्रान्ति वृत्ते चन्द्रोऽवलम्बितो-भवेत्, तेन तत्र चन्द्रनतिः=०, तथा चन्द्रशरः=०, रविनतिः=० तेन स्पष्टोऽत्र बाणो नति-संस्कृत इत्यादिना स्पष्टशरः=०, तत्र स्पष्टनतिरपि=० वित्रिभलग्नोद्भवशरेण संस्कृता रविनतिश्चन्द्रदृक्क्षेपचापम् = रविनति ± वित्रिभलग्नोद्भवशरः = ० ± वित्रिभलग्नोद्भव-शरः=वित्रिभलग्नोद्भवशर। पर मिदं चन्द्र दृक्क्षेपचापं निरर्थकं यतः स्पष्टनत्यर्थमेव दृक्क्षेपस्य प्रयोजनं भवति परमत्र स्पष्टनतिः=०, तेन दृक्क्षेपतो न किमपि कार्यं चलिष्य-त्यतो भास्करोक्त खण्डनं युक्तियुक्तमिति ॥

ब्रह्मगुप्तोक्त चन्द्रदृक्क्षेपचाप के भास्करकृत खण्डन को कहते हैं।

जिस देश में चौबीस २४ अक्षांश है वहां जब रवि और चन्द्र तुलादि में होते हैं तब उदयकाल में रवि ही लग्न होते हैं, खस्वस्तिक में रहने से पूर्वापर वृत्त के सदृश ही क्रान्ति-वृत्त और दृग्वृत्त होता है, क्रान्ति वृत्ताकार दृग्वृत्त के रहने से उसी दृग्वृत्त में चन्द्रलम्वित होते हैं इसलिये चन्द्रनति=०, चद्रशर=०, तथा रविनति=०, अतः 'स्पष्टोऽत्र वाणो नतिसंस्कृतः' इत्यादि से स्पष्टशर=०, स्पष्टनति भी=०, वित्रिभलग्नोत्पन्नशर संस्कृत रविनति चन्द्र दृक्क्षेप चाप होता है, रविनति ± वित्रिभलग्नोत्पन्नशर=० ± वित्रिभलग्नो-त्पन्नशर=वित्रिभलग्नोत्पन्नशर लेकिन यह चन्द्रदृक्क्षेप चाप निरर्थक है क्योंकि स्पष्टनति ही के लिये दृक्क्षेप चाप का प्रयोजन होता है, लेकिन यहां स्पष्टनति=०, इसलिये दृक्क्षेप से कौन सा काम चलेगा ? भास्करोक्त यह खण्डन ठीक है इति ॥

अत्र 'सौम्य याम्येषुणा रहितयुतमुदीच्या' मिति श्रीपत्युक्तिः 'एक दिशोर्योगो भिन्नदिशोरन्तरमित्युक्त्या'' परिवर्त्तिता भास्करेणेति ॥ ९-१० ॥

अब रवि और चन्द्र के दृग्गति साधन को कहते हैं।

हि. भा.—उत्तर वित्रिभनति रहने पर वित्रिभलग्न से जो उत्तर वा दक्षिण शर है उसको वित्रिभलग्न के शंकुचाप में क्रम से हीन और युत करना, दक्षिण नति में उसी शंकुचाप को उत्तर शरचाप करके जोड़ना और दक्षिण शर चाप करके हीन करना तब जो हो उसकी ज्या चन्द्र का वित्रिभशंकु (दृग्गति) होती है, सूर्य का पूर्वसाधित वित्रिभशंकु ही वास्तव दृग्गति होता है, वित्रिभलग्न दृङ्मण्डल और क्रान्तिवृत्त के सम्पात में सूर्य की दृग्गति होती है, दृक्क्षेपवृत्त और विमण्डल के सम्पात में चन्द्र दृग्गति होती है अर्थात् दृक्क्षेपवृत्त क्रान्तिवृत्त में जहां लगता है उस विन्दु का वित्रिभलग्नशंकु सूर्य की दृग्गति होती है, वही दृक्क्षेपवृत्त चन्द्रविमण्डल में जहां लगता है उस बिन्दु का शंकु चन्द्रदृग्गति है इति ॥ ९-१० ॥

उपपत्ति

दृक्क्षेप वृत्त क्रान्तिवृत्त में जहां लगा है वहां से विमण्डलपर्यन्त दृक्क्षेपवृत्त में स्वल्पान्तर से वित्रिभलग्नशर है। इसलिये वित्रिभ की उत्तर नति और वित्रिभ के उत्तर शर रहने से दोनों का योग करने से खस्वस्तिक से विमण्डल पर्यन्त दृक्क्षेपवृत्त में चन्द्रदृक्क्षेप चापांश = वित्रिभनतांश + वित्रिभशर, इसको नवत्यंश में से घटाने से चन्द्रदृग्गतिचापांश = ९० − वित्रिभन − वित्रिभश = वित्रिभशंचा − वित्रिभश, दक्षिण वित्रिभशर में चन्द्रदृक्क्षेप चापांश = वित्रिभनतांश — वित्रिभश, अतः शंकुचापांश = ९० − वित्रिभन + वित्रिभश = वित्रिभशंचा + वित्रिभशर। दक्षिण नति में विलोम संस्कार करना चाहिये। इससे चन्द्रदृग्गति साधन उपपन्न होता है। दृक्क्षेप वृत्त क्रान्ति वृत्त के ऊपर लम्बरूप है, विमण्डल के ऊपर नहीं; इसलिये चन्द्रदृक्क्षेप से जो दृग्गति होती है वह कदम्ब प्रोत वृत्त में नहीं होता है अतः उसका संस्कार करने से स्फुट नति नहीं होती है, भास्कराचार्य भी पहले इस मत के अनुसार 'दृग्ज्यैव या वित्रिभलग्नशंकोः'' इत्यादि से चन्द्रदृक्क्षेप साधन कर उसके वस से स्पष्टनति कर के पीछे सूर्यग्रहणाधिकारान्त में 'शशिदृक्क्षेपार्थं यद्वित्रिभलग्नेषुणात्र संस्करणम्'' इत्यादि से इस आनयन को खण्डित कर दिया, यहां 'सौम्ययाम्येषुणा रहितयुतमुदीच्याम्' इस श्रीपत्युक्ति को भास्कराचार्य ने 'एकदिशोर्योगो भिन्नदिशोरन्तरम्'' से परिवर्त्तित कर दिया है, इति ॥ ९-१० ॥

इदानीं स्पष्टां नतिमाह।

त्रिज्यावर्गाद्वूनौ स्वशंकुवर्गेण तत्पदे दृग्ज्ये।
रविशशिमध्यगतिगुणे तिथिगुणितव्यासदल भक्ते ॥११॥

तच्छाया गुणिते वा मध्यगती तिथिगुणस्वकर्णहृते ।
फलयोर्दिक् साम्येऽन्तरमवनतिरैक्यं दिगन्यत्वे ॥१२॥

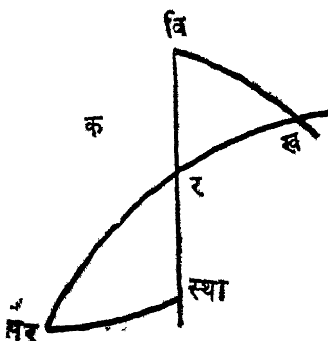
सु० भा०—दृग्ज्ये रविचन्द्रयोर्दृक्क्षेपौ स्वस्वमध्यगतिगुणे तिथिगुणित-व्यासदलेन पञ्चदशगुणितत्रिज्यया भक्ते हृते पृथक् पृथक् रविचन्द्रयोर्नती भवतः वा तयोर्मध्यगती तयोर्दृक्क्षेपसमदृग्ज्ययोर्ये छाये ताभ्यां गुणिते तिथिगुणस्वस्व-च्छायाकर्णहृते तयोर्नती भवतः । शेषं स्पष्टार्थम् ।

अत्रोपपत्तिः । प्रथमानयनस्य 'सदृक्क्षेपघ्ना इन्दोर्निजमध्यभुक्तितिथ्यंशनि-घ्ना' वित्यादि भास्करविधिना स्फुटा ।

प्रथम प्रकारेण नतिः $= \frac{\text{दृक्षे. मग}}{\text{१५ त्रि}} = \frac{\frac{\text{१२ दृक्षे}}{\text{दिश}} \times \text{मग}}{\text{१५} \times \frac{\text{१२ त्रि}}{\text{विश}}} = \frac{\text{विछा. मग}}{\text{विछाक}}$ । अनेन द्वितीयः प्रकारः उपपद्यते । तयोर्नत्योर्दिक्साम्येऽन्तरं दिग्भेदे चैक्यं लंबितरवेर्लम्बि-तचन्द्रस्य दक्षिणोत्तरमवनतिसंज्ञं गोलविदां स्फुटम् ॥११-१२॥

वि. भा.—त्रिज्यावर्गौ स्वशंकुवर्गेण (रविशंकुवर्गेण-चन्द्रशंकुवर्गेण च) ऊनौ (हीनौ) तयोर्मूले दृग्ज्ये (रविचन्द्रयोर्दृक् क्षेपौ) भवतः, ते स्वस्वमध्य-गतिगुणे, तिथि गुणितव्यासदल (पञ्चदशगुणितत्रिज्या) भक्ते तदा रवि-चन्द्रयोर्नती भवेताम् । वा तयोः (रविचन्द्रयोः) मध्यगती, तच्छायागुणिते (तयोर्दृक् क्षेपतुल्यदृग्ज्ययोर्ये छाये ताभ्यां गुणिते) तिथिगुण स्वकर्णहृते (पञ्च-दश गुणित स्वस्वच्छाया कर्ण भक्ते) तदा तयोर्नती भवतः । शेषं स्पष्टमिति ॥ ११-१२ ॥

अत्रोपपत्तिः ।



ख=खस्वस्तिकम् । वि=वित्रिभम् । र = क्रान्तिवृत्ते रविः । लंर=लम्बितरविः । खर=रविनतांशाः । खवि=दृक् क्षेप चापम् । खलं =पृष्ठीयनतांशाः । रलं=दृग्लम्बनम् । लंस्था =रविनतिः । स्थार=रविस्पष्ट लम्बनम् । तदा खरवि, रलंस्था चापीय जात्य त्रिभुजयो-र्ज्याक्षेत्र साजात्यादनुपातेन $\frac{\text{दृक्क्षेप. रदृलंज्या}}{\text{रदृग्ज्या}}$

$=$ रविनतिज्या $=$ रविनतिः स्वल्पान्तरात् परन्तु $\frac{\text{रपलंज्या. रपृदृज्या}}{\text{त्रि}}$ $=$ रदृ-लंज्या, तत उत्थापनात् $\frac{\text{दृक्क्षेप. रपलंज्या. रपृदृज्या}}{\text{त्रि. रदृज्या}}$ $=$ रविनतिः, अत्र स्वल्पान्तरात् रपृदृज्या$=$रदृज्या तथा रपलंज्या$=$रपलं, तदा $\frac{\text{दृक्क्षेप. रपलं}}{\text{त्रि}}$ $=$रविनतिः। एवमेव $\frac{\text{दृक्क्षेप. चपलं}}{\text{त्रि}}$ $=$चंनतिः, परं $\frac{\text{रगक}}{१५}$ $=$ रपलं, तथा $\frac{\text{चंगक}}{१५}$ $=$चंपलं, तत उत्थापनेन $\frac{\text{दृक्क्षेप. रगक}}{\text{त्रि. १५}}$ $=$रनति, तथा $\frac{\text{दृक्क्षेप. चंगक}}{\text{त्रि १५}}$ $=$चंनतिः, एतेन प्रथम प्रकार उपपद्यते। अत्र यद्यपि चन्द्रनतिसाधनार्थं रविनति-साधनवत् क्षेत्रं नोत्पद्यते तथाप्याचार्येण रविनतिसाधनवदेव चन्द्रनतिरपि साधिता।

$$\text{अथ रविनतिः} = \frac{\text{दृक्क्षेप. रगक}}{\text{त्रि. १५}} = \frac{\frac{\text{१२ दृक्क्षे}}{\text{विशं}} \times \text{रगक}}{१५ \times \frac{\text{१२ त्रि}}{\text{विशं}}} = \frac{\text{विछाया. रगक}}{\text{१५. विछाकर्ण.}}$$

$$\text{एवमेव चन्द्रनतिः} = \frac{\text{दृक्षे. चंगक}}{\text{त्रि. १५}} = \frac{\frac{\text{१२ दृक्षे}}{\text{विशं}} \times \text{चंगक}}{१५ \times \frac{\text{१२त्रि}}{\text{विशं}}} = \frac{\text{विछाया. चंगक}}{\text{१५. विछाकर्ण}},$$ अनयो

रविचन्द्रनत्योः संस्कारेण स्फुटा नतिर्भवतीति। सिद्धान्तशेखरे श्रीपतिना "ततो दृग्ज्ये मध्यस्वगति तिथि १५ भागेन गुणिते-त्रिमौर्व्या संभक्ते भवति विवरं यच्च फलयोः। दिशोः साम्ये भेदे युति" रित्यादिना शिद्धान्त शिरोमणौ भास्कराचार्येण चा "दृक्क्षेप इन्दोर्निजमध्यभुक्तितिथ्यंशनिघ्नौ त्रिगुणोद्धृतौ तौ। नती रवीन्द्वोः सम्भिन्न दिक्त्वे तदन्तरैक्य तु नतिः स्फुटाऽत्र" अनेनाऽऽचार्योक्तानुरूपमेवोक्तमिति ॥ ११-१२ ॥

अब स्पष्ट नति को कहते हैं।

हि. भा.— त्रिज्यावर्ग में रविशंकुवर्ग को और चन्द्रशंकु वर्ग को घटा कर मूल लेने से रवि और चन्द्र की दृज्या (रविदृक्क्षेप और चन्द्रदृक्क्षेप) होती है, उन (रविदृक्क्षेप और

चन्द्रदृक्क्षेप) को अपनी अपनी मध्यगति से गुणा कर पन्द्रह गुणित त्रिज्या से भाग देने से रवि और चन्द्र की नति होती है। वा रवि मध्यगति और चन्द्र मध्यगति को रवि और चन्द्र के दृक्क्षेप तुल्य दृग्ज्या की छाया से गुणा कर पन्द्रहगुणित अपने अपने छाया कर्ण से भाग देने से उन दोनों (रवि और चन्द्र) की नति होती है। शेष के अर्थ स्पष्ट है इति ॥ ११-१२ ॥

उपपत्ति ।

यहां संस्कृतोपपत्तिस्थ (क) क्षेत्र को देखिये। ख=खस्वस्तिक, वि=वित्रिभ, र=क्रान्तिवृत्त में रवि, खर=रविनतांश, लंर=लम्बितरवि, खवि=दृक्क्षेपचाप, खलं=पृष्ठीयनतांश, रलं=दृग्लम्बन, लंस्था=रविनति, स्थार=रविस्पष्टलम्बन तब. खरवि, रलंस्था दोनों चापीय जात्य त्रिभुजों के ज्याक्षेत्र सजातीय रहने के कारण अनुपात से. $\frac{\text{रदृक्क्षेप. रदृलंज्या}}{\text{रदृज्या}}$ = रविनतिज्या = रविनति (स्वल्पान्तर से), परन्तु $\frac{\text{रपलंज्या. रपृदृज्या}}{\text{त्रि}}$ = रदृलंज्या, उत्थापन से $\frac{\text{रदृक्षेप. रपलंज्या. रपृदृज्या}}{\text{रदृज्या. त्रि}}$ = रविनति, यहां स्वल्पान्तर से रपृदृज्या = रदृज्या, तथा रपलंज्या = रपलं, तब $\frac{\text{दृक्षेप. रपलं}}{\text{त्रि}}$ = रविनति, इसी तरह $\frac{\text{चंदृक्षे. चंपलं}}{\text{त्रि}}$ = चंनति, लेकिन $\frac{\text{रगक}}{१५}$ = रपलं, $\frac{\text{चंगक}}{१५}$ = चंपलं। अतएव $\frac{\text{रदृक्षे. रगक}}{\text{त्रि. १५}}$ = रविनति, $\frac{\text{चंदृक्षे. चंगक}}{\text{त्रि. १५}}$ = चंनति, इससे प्रथम प्रकार उपपन्न हुआ। यहां यद्यपि चंद्रनति साधनार्थ रविनति साधन के सदृश क्षेत्र नहीं बनता है तथापि आचार्य ने रविनति साधन की तरह ही चंद्रनति साधन भी किया है। रविनति = $\frac{\text{रदृक्षे. रगक}}{\text{त्रि. १५}} = \frac{\frac{\text{१२. रदृक्षे}}{\text{विशं}} \times \text{रगक}}{१५ \times \frac{\text{१२ त्रि}}{\text{विशं}}}$

$= \frac{\text{विछाया. रगक}}{\text{१५. विछाकर्ण}}$, इसीतरह चंद्रनति $= \frac{\text{चंदृक्षे. चंगक}}{\text{त्रि. १५}} = \frac{\frac{\text{१२ चंदृक्षे}}{\text{विशं}} \times \text{चंगक}}{१५ \times \frac{\text{१२ त्रि.}}{\text{विशं}}}$

$= \frac{\text{विछाया. चंगक}}{\text{१५. विछाकर्ण}}$ इन दोनों रविनति और चंद्रनति के संस्कार से स्पष्टनति होती है,

सिद्धांत शेखर में श्रीपति "ततो दृग्ज्ये मध्य स्वगति तिथि १५ भागेन गुणिते" इत्यादि से तथा सिद्धांत शिरोमणि में भास्कराचार्य ने भी "दृक्क्षेप इन्दोर्निजमध्यभुक्तितिथ्यंशनिघ्नौ" इत्यादि से आचार्योक्त के अनुरूप ही कहा है इति ॥ ११-१२ ॥

इदानीं स्फुटशर साधनं स्थित्यर्धसाधनं चाह ।

संयोगान्तरमवनतिशशाङ्कविक्षेपयोः समान्यदिशोः ।
स्फुटविक्षेपः शशिवत् स्थित्यर्धविमर्ददलनाडयः ॥ १३ ॥

सु० भा०—स्पष्टार्थमुपपत्तिश्च 'स्पष्टोऽत्र बाणो नतिसंस्कृतोऽस्मा' दित्यादि-भास्करविधिना स्फुटा ॥१३ ॥

वि. भा.—समान्य दिशोः (एक दिक्कयोर्भिन्नदिक्कयोश्च) अवनतिशशाङ्क-विक्षेपयोः (नतिचन्द्रशरयोः) संयोगान्तरं (योगोऽन्तरं) कार्यं तदा स्फुट विक्षेपः (स्पष्टशरः) भवति, शशिवत् (चन्द्रग्रहणवत्) स्थित्यर्धनाड्योविमर्दार्धनाड्यश्च भवेयुरिति ॥ १३ ॥

अत्रोपपत्तिः ।

अथ लम्बितरव्युपरिगतकदम्बप्रोतवृत्तं यत्र क्रान्तिवृत्ते लगति तस्माल्लम्बितरविं यावद्रविनतिः । चन्द्रोपरिगतकदम्बप्रोतवृत्तं क्रान्तिवृत्ते यत्र लगति तस्माच्चन्द्रं यावच्चन्द्रशरः । एतयोः संस्कारेण लम्बितरव्युपरिगतनति-कोटिव्यासार्धवृत्तचन्द्रोपरिगतकदम्बप्रोतवृत्तयोः सम्पाताच्चन्द्रं यावद् भवेदे-तस्यैव नाम सूर्यग्रहणे स्पष्टशरः । एतस्मात् (स्पष्टशरात्) "छाद्येन युतोनस्य छादकमानस्य तद्दलकृतिभ्या" मित्यादिना स्पष्ट स्थित्यर्ध विमर्दार्धयोर्ज्ञानं सुखेनैव भवेदिति । सिद्धान्तशेखरे "दिशोः साम्ये भेदे युतिरवनतिस्तच्छशिशरौ समाशौ चेद्योगोऽन्तरमपरथा स स्फुटशरः" ऽनेन श्रीपतिना सिद्धान्तशिरोमणौ "स्पष्टोऽत्र-बाणो नति संस्कृतोऽस्मात् प्राग्वत् प्रसाध्ये स्थितिमर्दखण्डे" पद्येनानेन भास्करा-चार्येणाप्याचार्योक्तानुरूपमेवोक्तमिति ॥ १३ ॥

अब स्पष्ट शरानयन को और स्पष्टस्थित्यर्ध और स्पष्टविमर्दार्ध साधन को कहते हैं ।

***हि. भा.*—एक दिशा के चन्द्रशर और नति का योग करने से और भिन्न दिशा के उन दोनों का अन्तर करने से स्पष्टशर होता है, इससे चन्द्रग्रहण की तरह स्थित्यर्ध घटी और विमर्दार्ध घटी होती है इति ॥ १३ ॥**

उपपत्ति ।

लम्बितरव्युपरिगत कदम्बप्रोतवृत्त क्रान्तिवृत्त में जहां लगता है वहां से लम्बित रवि-पर्यन्त रविनति है, चन्द्रोपरिगत कदम्बप्रोतवृत्तक्रान्तिवृत्त में जहां लगता है वहां से चन्द्र पर्यन्त चन्द्रशर है, इन दोनों के संस्कार से लम्बित रव्युपरिगत नतिकोटिव्यासार्धवृत्त और चन्द्रोपरिगत कदम्बप्रोतवृत्त के सम्पात से चन्द्रपर्यन्त सूर्यग्रहणोपयुक्त स्पष्टशर है इससे (स्पष्टशर से) 'छाद्येन युतोनस्य छादक मानस्य तद्दलकृतिभ्याम्'' इत्यादि से स्पष्ट स्थित्यर्ध और स्पष्ट विमर्दार्ध का ज्ञान सुगमता ही से हो जायगा, सिद्धान्त शेखर में 'दिशोः साम्ये भेदे युतिरवनतिस्तच्छशिशरौ समाशौ चेद्योगोऽन्तरमपरथा सस्फुटशरः' इससे श्रीपति तथा सिद्धान्त शिरोमणि में 'स्पष्टोऽत्र बाणो नति संस्कृतोऽस्मात् प्राग्वत् प्रसाध्ये स्थितिमर्दखण्डे' इससे भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा हैं इति ।। १३ ।।

इदानीं स्फुटस्थित्यर्धविमर्दार्धयोरानयनमाह

प्राग्वल्लम्बनमसकृत्तिथ्यन्तात् स्थिति दलेन हीनयुतात् ।
अधिकोनं तन्मध्याद्दृणयोरूनाधिकं धनयोः ।। १४ ।।

यद्यधिकं स्थित्यर्धं तदाऽन्तरेणान्यथोनमृणमेकम् ।
अन्यद्धनं तदैक्येनाधिकमेवं विमर्दार्धे ।। १५ ।।

सु० भा०—तिथ्यन्तात् स्पष्टदर्शान्तात् चन्द्रग्रणवदागतेन स्थितिदलेन हीनयुतात् प्राग्वदसकृद्विधिना लम्बनं कार्यं यावदविशेषः। अत्रैतदुक्तं भवति स्पर्शकालज्ञानाय तिथ्यन्तात् स्थितिदलेनोनात् मोक्षकालज्ञानार्थं च स्थितिदलेन सहितात् तिथ्यन्तादसकृद्विधिना लम्बनं स्थिरं कार्यम् । तल्लम्बनं यदि मध्याद्-दर्शान्तकालिकाल्लम्बनादधिकोनं भवेदर्थात् स्पार्शिकं मध्यकालिकादधिकं मौक्षिकं चोनं भवेत् तथा मध्यस्पर्शकालो भवेन्मध्यमोक्षकालोभवे च द्वे लम्बने ऋ भवतस्तदा तयोर्ऋणयोरन्तरेण पूर्वसाधितं स्थित्यर्धमधिकं कार्यम् । यदि मध्याल्लम्बनात् स्पर्शभवमूनं मोक्षभवमधिकं तथा मध्यस्पर्शभवे मध्यमोक्षभवे च द्वे लम्बने धने भवतस्तदापि तयोर्धनयोरन्तरेण स्थित्यर्धमधिकं कार्यम् । ऋणयोर्ध-नयोश्च यद्यन्यथा भवेत् अर्थादृणयोर्मध्यादूनाधिकं स्पर्शमोक्षभवं धनयोरधिकोनं स्पर्शमोक्षभवं मध्यात् तदा तयोरन्तरेण स्थित्यर्धमूनं कार्यम् । अथ यदि एकं लम्बनमृणमन्यद्धनं भवेत् तदा तयोरैक्येन स्थित्यर्धमधिकं कार्यम् । एवं स्पार्शिकं मौक्षिकं च स्थित्यर्धं भवति । एवं द्वे संमीलनोन्मीलनकालिके विमर्दार्धे च स्फुटे भवतः। अर्थाद्यथा शशिवत् स्थित्यर्धं गृहीत्वा स्फुटस्थित्यर्धं साधितं तथैव स्थित्य-

र्धस्थाने शशिवन्मर्दार्धं गृहीत्वा स्फुटं मर्दार्धद्वयं साध्यमिति ।

अत्रोपपत्तिः । कल्प्यते स्थिरभूतानि स्पर्शमध्यमोक्षकालिकानि लम्बनानि क्रमेण ल$_1$. ल$_2$. ल$_3$. ऋणानि । मध्यमं स्थित्यर्धम्=स्थि । गणितागतदर्शान्तकालः =द, तदा—

स्फुटस्पर्शकालः=द—स्थि—ल$_1$=स्प

स्फुटमध्यकालः=द—ल$_2$ =म

स्फुटमोक्षकालः=द+स्थि—ल$_3$=मो

अतः स्पार्शिकं स्फुटस्थित्यर्धम्=स्पास्फुस्थि=म—स्प=स्थि+ल$_1$—ल$_2$ । मौक्षिकं स्फुट=स्थित्यर्धम्=मौस्फुस्थि=मौ—म=स्थि+ल$_2$—ल$_3$ ।

अतो यदि ल$_1$> ल$_2$ तथा ल$_2$> ल$_3$ तदा ल$_1$—ल$_2$, ल$_3$—ल$_2$ एतद् द्वयं धनम् । यदि तानि लम्बनानि धनानि तदा पूर्वविधिना ल$_1$—ल$_2$, ल$_2$—ल$_3$ अनयोर्माने ल$_2$ —ल$_1$, ल$_3$—ल$_2$ भविष्यतः । अतस्तदा यदि ल$_2$> ल$_1$ तथा ल$_3$> ल$_2$ तदा ल$_2$ —ल$_1$,—ल$_3$—ल$_2$ एतद् द्वयं धनमन्यथा ऋणमिति स्पष्टम् ।

अथ वित्रिभतः प्राक् स्पर्शः पश्चान्मध्यकालस्तदा ल$_1$ ऋणं ल$_2$ धनम् । तदा ल$_1$—ल$_2$ मानं ल$_1$+ल$_2$ इदं धनं भविष्यति । स्पार्शिकलम्बने धने वित्रिभतः पश्चिमस्थे रवौ तयोऽप्यग्रे मध्यकालस्य स्थितेर्मध्यकालिकं लम्बनं सर्वदा धनमेवातस्तत्र धनर्णत्वस्थितिर्न । अथैवं वित्रिभतः प्राग्यदि मध्यकालः पश्चान्मोक्षस्तदा ल$_2$ ऋणं ल$_3$ धनम् । तदा पूर्वविधिना ल$_2$—ल$_3$ अस्य ल$_2$+ल$_3$ एतादृशी स्थितिः सर्वदा धनात्मिका स्यादतो यद्येकमृणमन्यद्धनं तदा सर्वदा तदैक्येनाधिकं स्थित्यर्धं स्फुटं स्थित्यर्धं भवतीति मदीयो विचारः सुधीभिर्भृशं विचिन्तनीयो येनाचार्योक्तं स्पष्टमुपपद्यते । स्फुटस्पर्शमोक्षकालाज्ञानात् प्रथमं ल$_1$, ल$_3$ स्थाने स्थूलं ल$_2$ गृहीतम् । तेन स्प=द—स्थि—ल$_2$=द—ल$_2$—स्थि=स्पष्टदर्शान्त—स्थि । एवं स्थूलमोक्षकालः=स्पष्टदर्शान्त+स्थि । अतः स्पष्टतिथ्यन्तात् स्थितिदलोनाधिकात् प्रथमं लम्बनानयनमुचितं स्थितिदलञ्च स्फुटं स्पर्शमोक्षकालिकशरवशात् तात्कालिकमुचितम् । इह तु मध्यकालिकस्पष्टशरवशात् स्थितिदलं स्थिरं गृहीत्वाऽऽनयनं कृतमत इदं स्थूलं सूक्ष्मार्थमग्रे प्रकारान्तरं वक्ष्यत्याचार्यः ॥१४-१५

वि. भा.—तिथ्यन्तात् (स्पष्टदर्शान्तात्) चन्द्रग्रहणवदागतेन स्थित्यर्धेन हीनयुतात्प्राग्वदसकृत् कर्मणालम्बनं कार्यं यावदविशेषः । अत्रैतदुक्तं भवति । स्पर्शकालज्ञानार्थं स्थित्यर्धेन हीनात् मोक्षकालज्ञानार्थं स्थित्यर्धेन सहितात्तिथ्यन्तादसकृत्कर्मणा लम्बनं स्थिरं कार्यं तल्लम्बनं यदि मध्याद्दर्शान्तकालिकाल्लम्बनादधि-

कोनं भवेदर्थात् स्पार्शिकं मध्यकालिकादधिकं मौक्षिकं चाल्पं भवेत्तथा मध्यस्पर्श-कालोत्पन्ने मध्यमोक्षकालोत्पन्ने च लम्बने ऋणे भवेतां तदा तयोर्ऋणयोरन्तरेण पूर्वसाधितं स्थित्यर्धमधिकं कार्यं यदि मध्यलम्बनात् स्पार्शिकं न्यूनमौक्षिकं चाधिकं तथा मध्यस्पर्शोत्पन्ने मध्यमोक्षोत्पन्ने च द्वे लम्बने धने भवेतां तदाऽपि तयोर्धनयोरन्तरेण स्थित्यर्धकं कार्यम्। ऋणयोर्धनयोश्च यद्यन्यथा भवेदर्थाद्दृण-योर्मध्यादूनाधिकं स्पर्शमोक्षोत्पन्नं धनयोरधिकोनं स्पर्शमोक्षोत्पन्नं मध्यात् तदा तयोरन्तरेण स्थित्यर्धमूनं कार्यम्। अथ यद्येकं लम्बनमृणमन्यद्धनं भवेत्तदा तयो-र्योगेन स्थित्यर्धमधिकं कार्यम्। एवं स्पार्शिकं मौक्षिकं च स्थित्यर्धं भवति। एवं संमीलनोन्मीलनकालिके विमर्दार्धे च स्फुटे भवतः। अर्थाद्यथा चन्द्रवत् स्थित्यर्धं गृहीत्वा स्फुटं स्थित्यर्धं साधितं तथैव स्थित्यर्धस्थाने चन्द्रवत् मर्दार्धं गृहीत्वा स्फुटं विमर्दार्धद्वयं साध्यमिति ॥ १४-१५ ॥

अत्रोपपत्तिः

स्थिरीभूतानि स्पर्शमध्यमोक्षकालिकलम्बनानि क्रमेण ल$_{१}$, ल$_{२}$, ल$_{३}$ ऋणानि, मध्यमं स्थित्यर्धम्=स्थि, गणितागतदर्शान्तिकालः=द, तदा स्फुट-स्पर्शकालः=द−स्थि−ल$_{१}$=स्प, स्फुटमध्यकालः=द−ल$_{२}$=म, स्फुटमोक्ष-कालः=द+स्थि−ल$_{३}$=मो, अतः स्पार्शिकं स्फुटस्थित्यर्धम्=स्पास्फुस्थि=म−स्प=स्थि+ल$_{१}$−ल$_{२}$ मौक्षिकं स्फुटस्थित्यर्धम्=मौस्फुस्थि=मो−म=स्थि+ल$_{२}$−ल$_{३}$ अतो यदि ल$_{१}$>ल$_{२}$ तथा ल$_{२}$>ल$_{३}$ तथैव ल$_{१}$−ल$_{२}$, ल$_{२}$−ल$_{३}$ तद्द्वयं धनम्, यदि तानि लम्बनानि धनानि तदा ल$_{१}$−ल$_{२}$, ल$_{२}$−ल$_{३}$ ऽनयोर्माने ल$_{२}$−ल$_{१}$, ल$_{३}$−ल$_{२}$ भविष्यतः। यदि ल$_{२}$>ल$_{१}$, तथा ल$_{३}$>ल$_{२}$ तदा ल$_{२}$−ल$_{१}$, ल$_{३}$−ल$_{२}$ एतद्द्वयं धनमन्यथा ऋणमिति।

अथ वित्रिभतः पूर्वं स्पर्शः पश्चान्मध्यकालस्तदा ल$_{१}$ ऋणं, ल$_{२}$ धनम्। तदा ल$_{१}$−ल$_{२}$ मानं ल$_{१}$+ल$_{२}$ इदं धनं भविष्यति स्पार्शिकलम्बने धने वित्रिभतः पश्चिमस्थे रवौ ततोऽप्यग्रे मध्यकालस्यस्थितेर्मध्यकालिकं लम्बनं सर्वदा धनमेवातस्तत्र धनर्णत्व-स्थितिर्न। अथैवं वित्रिभतः पूर्वदिशि यदि मध्यकालः पश्चान्मोक्षस्तदा ल$_{२}$ ऋणं ल$_{३}$ धनम्। तदा पूर्व विधिना ल$_{२}$−ल$_{३}$ अस्य ल$_{२}$+ल$_{३}$ एतादृशी स्थितिः सर्वदा धनात्मिका स्यादतो यद्येकमृणमन्यद्धनं तदा सर्वदा तदैक्येनाधिकं स्थित्यर्धं स्फुटं स्थित्यर्धं भवतीति। स्फुटस्पर्शमोक्षकालाज्ञानात् प्रथमं ल$_{१}$, ल$_{३}$ स्थाने स्थूलं ल$_{२}$ गृहीतम्, तेन स्प=द−स्थि−ल$_{२}$=द−ल$_{२}$−स्थि=स्पष्टदर्शान्त−स्थित, एवं स्थूलमोक्षकालः=स्पष्ट दर्शान्त+स्थि, अतः स्पष्ट तिथ्यन्तात् स्थित्यर्धोनाधिकात् प्रथमं लम्बनानयनमुचितं। स्थित्यर्धं च स्फुटं स्पर्शमोक्षकालिक शरवशात् तात्का-

लिकमुचितम्। परन्त्वत्र मध्यकालिक स्पष्टशरवशात् स्थित्यर्धं स्थिरं गृहीत्वाऽऽनयनं कृतमतः स्थूलं सूक्ष्मार्थमग्रे प्रकारान्तरं कथयत्याचार्य इति। सिद्धान्तशेखरे "तिथ्यन्तात् स्थिति खण्ड हीनसहितात् प्रागवत्ततोलम्बनं कुर्यात् प्रग्रहमोक्षयोः स्थिति-दलं युक्तं विधायासकृत्। तन्मध्यग्रहणोत्थ लम्बनभुवा विश्लेषणानेहसा मर्दार्धेन युतात्तिथेरपि तथा सम्मीलनोन्मीलने। अधिकमृणयोराद्यं मध्यात्तथा ऽन्त्यमिहाल्पकं भवति धनयोश्चाद्यं हीनं यदाऽधिकमंतिमम्। नमनविवरेणैवं कुर्याद्विहीनमतोऽन्यथा स्थितिदलस्वस्थे भेदे तदैक्ययुतं पुनः" ऽनेन श्रीपतिना, "स्थित्यर्धोनाधिकात् प्राग्वत् तिथ्यन्ताल्लम्बनं पुनः। ग्रासमोक्षोद्भवं साध्यं तन्मध्यहरिजान्तरम्॥ प्राक्कपालेऽधिकं मध्याद् भवेत् प्रग्रहणं यदि। मौक्षिकं लम्वनं होनं पश्चार्धेतु विपर्ययः॥ तदा मोक्ष स्थितिदले देयं प्रग्रहणे तथा। हरिजान्तरकं शोध्यं यत्रैतत् स्याद्विपर्ययः॥ एतदुक्तं कपालैक्ये तद् भेदे लम्बनैकता। स्वे स्वे स्थितिदले योज्या विमर्दार्धेऽपि चोक्तवत्" इति सूर्य सिद्धान्तोक्तेराचार्योक्तेश्च सर्वथा सदृशमेवोक्तमिति॥ १४-१५

अथ स्फुट स्थित्यर्ध और स्फुटविमर्दार्ध के साधन को कहते हैं।

हि. भा.—चन्द्रग्रहणवत् आये हुये स्थित्यर्ध करके हीन और युत तिथ्यन्त (स्पष्ट-दर्शान्त) से पूर्ववत् असकृत् विधि से लम्बन साधन करना जब तक अविशेष हो, यहां यह कहा जाता है कि स्पर्श काल ज्ञान के लिये स्थित्यर्ध रहित तिथ्यन्त से तथा मोक्ष काल ज्ञान के लिये स्थित्यर्ध सहित तिथ्यन्त से असकृत् विधि से लम्बन को स्थिर करना, यदि वह लम्बन मध्यदर्शान्त कालिक लम्बन से अधिक और ऊन (अल्प) हो अर्थात् स्पार्शिक लम्बन मध्य-कालिक लम्बन से अधिक और मौक्षिक लम्बन अल्प हो तथा मध्यकालिक लम्बन और स्पर्श-कालिक लम्बन दोनों ऋण हो तब उन दोनों ऋणों के अन्तर को पूर्व साधित स्थित्यर्ध में जोड़ देना चाहिये, यदि मध्यलम्बन से स्पार्शिक लम्बन न्यून हो और मौक्षिक लम्बन अधिक हो तथा मध्यकालिक और स्पर्शकालिक लम्बन तथा मध्यकालिक और मोक्ष कालिक लम्बन धन हो तो भी उन दोनों धनों के अन्तर को स्थित्यर्ध में जोड़ना चाहिये। यदि एक लम्बन ऋण रहे और दूसरा लम्बन धन रहे तव दोनों के योग को स्थित्यर्ध में जोड़ना चाहिये। इस तरह स्पार्शिक और मौक्षिक स्थित्यर्ध स्फुट होता है, एवं संमीलन कालिक विमर्दार्ध और उन्मीलन कालिक विमर्दार्ध स्फुट होता है अर्थात् जैसे चन्द्रवत् स्थित्यर्ध को लेकर स्फुट स्थित्यर्ध साधित होता है उसी तरह स्थित्यर्ध स्थान में चन्द्रवत् विमर्दार्ध को ग्रहण करके स्फुट विमर्दार्ध साधन करना इति॥ १४-१५॥

उपपत्ति।

स्थिरी भूत स्पर्श कालिक, मध्यकालिक और मोक्ष कालिक लम्बन क्रम से $ल_1$, $ल_2$, $ल_3$, ऋण है, मध्यम स्थित्यर्ध $=$ स्थि, गणितागत दर्शान्त काल $=$ द, तब स्फुट स्पर्शकाल $=$ द $-$ स्थि $-$ $ल_1$ $=$ स्प, स्फुट मध्यकाल $=$ द $-$ $ल_2$ $=$ म, स्फुट मोक्ष काल $=$ द $+$ स्थि $-$ $ल_3$

=मो, अतः स्पार्शिक स्फुट स्थित्यर्ध=स्यास्फुस्थि=म—स्प=स्थि+$ल_1$—$ल_2$ मौक्षिक स्फुट स्थित्यर्ध=मौस्फुस्थि=मो—म=स्थि+$ल_2$—$ल_3$, इसलिये यदि $ल_1$>$ल_2$ तथा $ल_2$>$ल_3$ तब $ल_1$—$ल_2$, $ल_2$—$ल_3$ यह दोनों धन होते हैं, यदि वे लम्बन धन हैं तब $ल_1$—$ल_2$, $ल_2$—$ल_3$ इन दोनों के मान $ल_2$—$ल_1$, $ल_1$—$ल_2$ होगें। यदि $ल_2$>$ल_1$ तथा $ल_3$>$ल_2$ तब $ल_2$—$ल_1$, $ल_3$—$ल_2$ तब ये दोनों धन होंगें अन्यथा ऋण होगें। वित्रिभ से पूर्व स्पर्श और पश्चात् मध्यकाल रहने से $ल_1$ यह ऋण, $ल_2$ यह धन होगा, तब $ल_1$—$ल_2$ मान $ल_1$+$ल_2$ यह धन होगा, स्पार्शिक लम्बन के धन रहने से वित्रिभ से पश्चिम रवि के रहने से उससे भी आगे मध्यकाल स्थिति के कारण मध्य कालिक लम्बन सर्वदा धन ही होता है इसलिये वहां धनत्व स्थिति और ऋणत्व स्थिति नहीं होती है। इसी तरह वित्रिभ से पूर्व दिशा में यदि मध्यकाल है और पश्चात् मोक्षकाल तब $ल_2$ ऋण होता है और $ल_3$ धन होता है। तब पूर्व विधि से $ल_2$—$ल_3$, इसकी $ल_2$+$ल_3$ ऐसी स्थिति सदा धनात्मक होती है, इसलिये यदि एक ऋण हो और अन्य धन हो तब सदा उन दोनों के योग को स्थित्यर्ध में जोड़ने से स्फुट स्थित्यर्ध होता है, स्फुट स्पर्शकाल और स्फुट मोक्ष काल के अज्ञात रहने के कारण पहले $ल_1$, $ल_3$ के स्थान में स्थूल $ल_2$ ग्रहण किया गया, तब स्प=द—स्थि—$ल_2$=द—$ल_2$—स्थि=स्पष्ट—दर्शान्त—स्थि, एवं स्थूल मोक्षकाल=स्पष्टदर्शान्त+स्थि, इसलिये स्थित्यर्ध कर के हीन, युत स्पष्ट तिथ्यन्त से पहले लम्बनानयन उचित है, और तात्कालिक स्फुट स्थित्यर्ध स्पर्शकालिक और मोक्ष कालिक शरवश से उचित है लेकिन यहां मध्यकालिक स्पष्टशरवश से स्थिर स्थित्यर्ध ग्रहण कर आनयन किया गया है इसलिये यह स्थूल है सूक्ष्मार्थ के वास्ते आगे आचार्य प्रकारान्तर को कहते हैं इति, सिद्धान्त शेखर में "तिथ्यन्तात् स्थितिखण्ड हीन-सहितात्" इत्यादि संस्कृतोपपत्ति में लिखित पद्यों से श्रीपति तथा "स्थित्यर्धोनाधिकात् प्राग्वत्" इत्यादि से सूर्य सिद्धान्तकार ने आचार्योक्त के सदृश ही कहा हैं इति ॥ १४-१५ ॥

अथ प्रकारान्तरेण स्फुटस्थित्यर्धविमर्दार्धसाधनमाह।

स्फुटतिथ्यन्ताल्लम्बनमसकृत् स्थित्यर्धहीनयुक्ताद्वा।
तत्स्फुटविक्षेपकृतस्थित्यर्धोनयुततिथ्यन्तात् ॥ १६ ॥

तत्स्पष्टतिथिच्छेदान्तरे स्फुटे दिनदले विहीनयुतात्।
स्वविमर्दार्धेनासकृदेवं स्पष्टे विमर्दार्धे ॥ १७ ॥

सु० भा०—प्रथमं स्थित्यर्धोनयुतात् स्फुटतिथ्यन्तात् स्पष्टदर्शान्ताल्लम्बनमानेयम्। पुनस्तत्स्फुटविक्षेपकृतस्थित्यर्धोनयुततिथ्यन्ताल्लम्बनमानेयमेवमसकृत्। अत्रैतदुक्तं भवति। यथा स्पर्शकालज्ञानाय प्रथमं मध्यकालिकस्पष्टशर-

वशात् स्थित्यर्धं साध्यं तदूनात् स्फुटतिथ्यन्ताल्लम्बनं युतिश्च साध्या। तात्कालिकसपातचन्द्रवशात् शरः साध्यः। नतिशरसंस्कारेण स्पष्टविक्षेपः साध्यस्तस्माच्छशिग्रहणवत् स्थित्यर्धं साध्यं तदूनात् तिथ्यन्ताद् गुणितागतात् पुनर्लम्बनं, नतिः स्पष्टशरः स्फुटस्थित्यर्ध च सर्वमानेयं यावदविशेषः। अविशेषे यल्लम्बनं तत् तात्कालिकस्फुट विक्षेपजनितस्थित्यर्धोनगणितागतदर्शान्ते यथागतं धनं वा ऋणं संस्कार्यम्। एवं स्फुटः स्पर्शकालः। एवं स्थित्यर्धयुक्तात् तिथ्यन्तात् स्फुटमोक्षकालो भवति। तत्स्फुटतिथिच्छेदान्तरे स्फुटे स्थितिदले भवतः। अर्थात् तत्स्फुटस्पर्शकालस्य वा स्फुटमोक्षकालस्य स्पष्टतिथिच्छेदस्य स्पष्टदर्शान्तकालस्य चान्तरे स्पर्शमौक्षिके स्पष्टे स्थितिखण्डे भवेताम्। एवं यथा स्थित्यर्धेन स्पष्टे स्थितिखण्डे साधिते तथैवासकृत्कर्मणा स्वविमर्दार्धेन स्पष्टे विमर्दार्धे साध्ये। अर्थात् पूर्ववदसकृद्विधिना स्फुटौ संमीलनोन्मीलनकालौ प्रसाध्य तन्मध्यकालान्तरयोः समाने स्पष्टे विमर्दखण्डे ज्ञेये। 'तिथ्यन्ताद्गणितागतात् स्थितिदलेनोनाधिकाल्लम्बन' मित्यादिभास्करोक्तमेतदनुरूपम्। इहाचार्येण प्रथमं मध्यकाललम्बनमेव स्थूलात् स्पर्शे मोक्षे च कल्पितमित्यनेनासकृत्कर्मणि न काचिद्धानिरिति ज्योतिर्विदां प्रसिद्धमिति।

अत्रोपपत्तिः। गर्भक्षितिजात् कियतीष्टघटिकासु पृष्ठाभिप्रायेण स्पर्शकालो भवतीति किलापेक्षितम्। कल्प्यते यदा पृष्ठाभिप्रायेण स्पर्शोऽभूत् तदा वि= रविकेन्द्रम्=रविस्थानम्। वि₁=चन्द्रबिम्बकेन्द्रम्। च=चन्द्रस्थानम्। चच′र= क्रान्तिवृत्तखण्डम्। ख=खस्विस्तकम्। खवि, वि′₁=चन्द्रदृङ्मण्डलम्। ख वि वि′= रविदृङ्मण्डलम्। वि′₁=लम्बितचन्द्रबिम्बकेन्द्रम्। वि′=लम्बित रविबिम्बकेन्द्रम्। वि′₁ च′=चन्द्रस्य स्फुटशरः। वि′र′=रविनतिसमो रवेः स्पष्टशरः।

वि′स=क्रान्तिवृत्त समानान्तरवृत्तम्। वि′₁स=स्फुटस्पर्शकाले स्पष्टशरः।

वि′ क′₁=मानैक्यार्धम्। एतानि चापानि लघुत्वात् सरलरेखाकाराण्याचार्यैः कल्पितानि। अतो वि′ वि′₁ सजात्ये वि′ वि′₁ वि′₁ सवर्गान्तरपदसमाः स्फुटस्थित्यर्धकलाः=वि′ स=र′ च′=स्फुस्थिक। चच′=चन्द्रलम्बन कलाः =चलंक। वि=र′ रविलम्बन कलाः=रलंक। अनयो रविचन्द्रलम्बनयोरन्तरकलाः =(ल₁ क) षष्टिगुणा रविचन्द्रगत्यन्तरकलाहृता आचार्यसाधिताः स्पर्शे लम्बननाड्यः =ल, तथा स्फुटस्थित्यर्धकलाः=(स्फुस्थिक) षष्टिगुणा गत्यन्तर हृता आचार्योक्तं स्फुटं स्थित्यर्धं घटिकात्मकम्=स्फुस्थि। अथैतस्मिन् स्पर्शकाले गर्भाभिप्रायेण

रविचन्द्रान्तरकला: = चवि=चर−वि र′=च′ र′ +च च′—विर′=स्फुस्थिक +चलक—रलक=स्फुस्थिक +ल१ क। एतद्घटिका:=स्फुस्थि+ल१ । गणितागतदर्शान्ते गर्भाभिप्रायेण रविचन्द्रान्तराभाव: स्पर्शकाले च तत: प्रागानीतान्तरं तयो: स्फुस्थि+ल१ एतावतीषु घटिकासु। अतो गणितागतदर्शान्तकाला दागता इष्टघटिका विशोध्य स्फुटस्पर्शकाल: ।

=द−स्फुस्थि—ल१ । स्फुटस्पर्शकाले स्पष्टस्थितिदललम्बनयोरज्ञानादसकृत्कर्मोचितमेव । एवं मोक्षसंमीलनोन्मीलनेष्वपि क्षेत्र संस्थया स्फुटा वासना। अनया मत्क्षेत्रयुक्त्या भास्करोक्तं च सर्वं स्फुटमुपपद्यते शेष वासना स्फुटा ॥ १६-१७ ॥

वि. भा.—स्थित्यर्धहीनयुक्तात् स्फुटतिथ्यन्तात् (स्पष्टदर्शान्तात्) लम्बनमानेयम् । पुनस्तत्स्फुटविक्षेपकृतस्थित्यर्धोनयुततिथ्यन्ताल्लम्बनं साध्यमेवमसकृत् । अत्रैतदुक्तं भवति यथा स्पर्शकालज्ञानाय प्रथमं मध्यकालिकस्पष्टशरवशात् स्थित्यर्धं साध्यं तदूनात् स्फुटतिथ्यन्तात् लम्बनं नतिश्च साध्या । तात्कालिकसपातचन्द्रवशाच्छर: साध्य:, नतिशरसंस्कारेण स्पष्टविक्षेप: साध्य: । तस्माच्चन्द्रग्रहणवत् स्थित्यर्धं साध्यं तदूनात् तिथ्यन्तात्पुनर्लम्बनं नति: स्पष्टशर: स्फुटस्थित्यर्धं च सर्वमानेयं यावदविशेष:, अविशेषे यल्लम्बनं तत्तात्कालिकस्फुट विक्षेपजनितस्थित्यर्धोनगणितागतदर्शान्ते यथागतं धनं वा ऋणं संस्कार्यम्। तदा स्फुट: स्पर्शकाल: । एवं स्थित्यर्धयुक्तात्तिथ्यन्तात् स्फुटमोक्ष कालो भवति, तत् स्फुटतिथिच्छेदान्तरे स्फुटे स्थित्यर्धे भवत: । अर्थात् तस्फुटस्पर्शकालस्य वा स्फुट मोक्ष कालस्य स्पष्टतिथिच्छेदस्या (स्पष्टदर्शान्त कालस्य च) न्तरे स्पर्शमौक्षिके स्पष्टे स्थित्यर्धे भवेताम् । एवं यथा स्थित्यर्धेन स्पष्टे स्थित्यर्धे साधिते तथैवासकृत्कर्मणा स्वविमर्दार्धेन स्पष्टे विमर्दार्धे साध्ये । अर्थात् पूर्ववदसकृ द्विधिना स्फुटौ संमीलनोन्मीलनकालौ प्रसाध्य तन्मध्यकालान्तरयो: समाने स्पष्टे विमर्दार्धे ज्ञेये, अत्राचार्येण प्रथमं मध्यकाललम्बनमेव स्थूलात् स्पर्शे मोक्षे च कल्पितं तेनासकृत्कर्मणि न काचिद्धानिरिति ॥ १६-१७ ॥

अत्रोपपत्ति: ।

तत्र तावत्पूर्वकपाले विचार्यते ।

गर्भीय दर्शा तात्पूर्वं पृष्ठीय दर्शान्तत्वात्स्वत एव गर्भीय दर्शान्तात्पूर्वमेव पृष्ठीय स्पर्शकालो भवेत् । पृष्ठाभिप्रायिकस्पर्शकाले गर्भाभिप्रायिकरविचन्द्रान्तर-

कलाः पृष्ठाभिप्रायिकस्थित्यर्धकला लम्बनान्तरकलयोर्योगतुल्या भवन्ति, कथमिति चेत् स्पर्शकाले सूर्यस्थानाच्चन्द्रस्थानं पश्चिमदिश्येव भवति, गर्भाभिप्रायिकरविस्थानात् पृष्ठाभिप्रायिकरविस्थानं प्राक् दिशि स्यात् । तथैव चन्द्रस्यापि, पृष्ठाभिप्रायिकरविकेन्द्रगतकदम्बप्रोतवृत्तचन्द्रकेन्द्रगतकदम्बप्रोतवृत्तयोरन्तरकलाः क्रान्तिवृत्ते स्थित्यर्धकलाः । अतः स्थित्यर्धकलासु चन्द्रलम्बनकलायुक्ता कार्या तदा गर्भाभिप्रायिकचन्द्रस्थानात् पृष्ठाभिप्रायिकरविस्थानं यावद् क्रान्तिवृत्ते कलाः= स्थि½कला+चलं, अत्र रविलम्बनकला हीना कार्या तदा गर्भाभिप्रायिकरविचन्द्रान्तरकलाः=स्थि½ कला+चलं—रलं, यदा रविलम्बनकलाभ्यः स्थित्यर्धकला अल्पास्तदा रविलम्बनकलासु स्थित्यर्धकला हीनाः कार्यास्तदा पृष्ठाभिप्रायिकचन्द्रस्थानात् गर्भाभिप्रायिकरविस्थानं यावद् भवेत् तत्स्वरूपम्=रलक—स्थि½ क, एताः कलाश्चन्द्रलम्बनकलायां हीना कार्यास्तदा गर्भाभिप्रायेण रविचन्द्रान्तरकलाः =चलंक—(रलंक—स्थि½क)=चलंक—रलंक+स्थि½क=स्थि½क+लम्बनान्तर, अथ घटचात्मककरणार्थमनुपातः

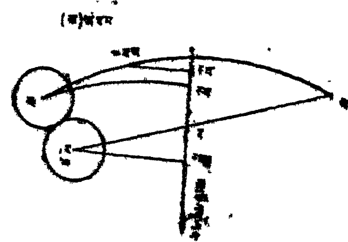
$$\frac{\text{६० × गर्भीयरविचन्द्रान्तरकला}}{\text{रविचन्द्रगत्यन्तरक}}=\frac{\text{६० × (स्थि½ क+लम्बनान्तरक)}}{\text{रविचन्द्रगत्यन्तरक}}=$$

$$\frac{\text{६० × स्थि½ क}}{\text{रविचंगत्यन्तरक}}+\frac{\text{६० × लम्बनान्तरक}}{\text{रविचंगत्यन्तरक}}$$

=स्थि½ घटी+लम्बनान्तरघटी, एतावतीभिर्घटीभिर्गर्भीयदर्शान्तात्पूर्वं पृष्ठाभिप्रायेण स्पर्शकालो भवेदिति सिद्धः । गर्भीयदर्शान्तघटयामेतच्छोधनेन पृष्ठाभिप्रायेण स्पर्शकालघटिका भवेयुः ।

गर्भीयदर्शान्तघ—(स्थि½घ+लम्बनान्तरघ)=गर्भीयदर्शान्तघ—स्थि½घ—लम्बनान्तरघ.

अतः सिद्धं यत् पूर्वकपाले पृष्ठाभिप्रायेण स्पर्शकाले गर्भीयदर्शान्तघटयां पृष्ठाभिप्रायेण स्थित्यर्धघटिकास्तथा लम्बनान्तरघटिकाश्च हीना कार्यास्तदा पृष्ठाभिप्रायेण स्पर्शकालघटिका भवन्तीति । अत्र स्थि½ क=पृष्ठीय स्थि½ कलाः सर्वत्र बोध्याः । स्थि½ घ=पृष्ठीय स्थि½ घ बोध्या ।



ख=खस्वस्तिकम् । र=गर्भीयरविः ।

र=लम्बितरविः=पृष्ठीयरविः ।

स्था=लम्बितरविस्थानम् ।

गचं=गर्भीयचन्द्रः । चं=लम्बितचन्द्रः =पृचं

स्था= गर्भीयचन्द्रस्थानम् । स्था₁=लम्बि[illegible]स्थानम् ।

पश्चिमकपाले विचार्यते

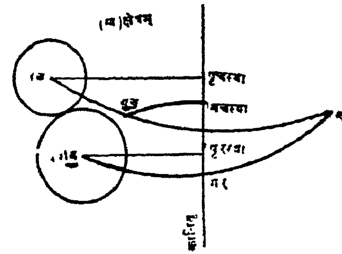
गर्भीयदर्शान्तादग्रे पृष्ठीयदर्शान्तः स्यात् पृष्ठीयदर्शान्तात्पूर्वं पृष्ठाभिप्रायेण स्पर्शकालोऽतः पृष्ठीयदर्शान्तात्पूर्वं पृष्ठाभिप्रायेण स्पर्शकालगर्भीयदर्शान्तयोः सद्भावात् सम्भवोऽस्ति यत् गर्भीयदर्शान्तात्पूर्वं पृष्ठाभिप्रायेण स्पर्शकालो भवेत्। तथा कदाचिदग्रतोऽपि। यदा पृष्ठीयदर्शान्तकाले गर्भाभिप्रायिकरविस्थानात् पृष्ठाभिप्रायिकरविस्थानं पश्चिमादिशि भवेत्तदा गर्भीयदर्शान्तात्पूर्वमेव पृष्ठाभिप्रायिकस्पर्शकालः स्यात्। यतो गर्भीयदर्शान्तात्पूर्वं गर्भाभिप्रायेण रविस्थानात्पश्चिमदिश्येव गर्भाभिप्रायेण चन्द्रस्थानं भवेत्। अथ यदा स्पर्शकाले गर्भाभिप्रायेण रविस्थानात् गर्भाभिप्रायिकचन्द्रस्थानं पूर्वदिशि भवेत्तदा गर्भीयदर्शान्तादग्रे पृष्ठाभिप्रायिकस्पर्शकालो भवेद्यतो गर्भीयदर्शान्तादग्रे पूर्वदिश्येव गर्भाभिप्रायिकरविचन्द्रयोः स्थानं स्यादिति। ननु स्पर्शकाले गर्भाभिप्रायेण रविस्थानात् गर्भाभिप्रायेण चन्द्रस्थानं प्राक् पश्चादिति कथं ज्ञायते। यदि लम्बनघटीयुतो गर्भीयदर्शान्तः पृष्ठीयदर्शान्तो भवेत्ताभ्यः घटिकाभ्यो यदि पृष्ठाभिप्रायेण स्थित्यर्धघटिकाऽल्पा तदा पश्चिमदिशि गर्भाभिप्रायेण रविस्थानाच्चन्द्रस्थानमित्यन्यथा प्राग्दिशीति। अथ कदा गर्भीयदर्शान्तात् प्राक् पृष्ठाभिप्रायेण स्पर्शकाल इत्युच्यते। पृष्ठीयस्थित्यर्धकलासु. चन्द्रलम्बनकला हीनाः कार्यास्तदा गर्भाभिप्रायेण चन्द्रस्थानात्पृष्ठाभिप्रायेण रविस्थानं यावत् क्रान्तिवृत्ते कलाः=स्थि$\frac{1}{2}$ क—चंलंक अत्र रविलम्बनकला युता तदा-पृष्ठाभिप्रायेण रविचन्द्रान्तरकलाः=स्थि$\frac{1}{2}$क—चंलंक+रलक, अथ चन्द्रलम्बनकलाभ्यो रविलम्बनकलानामल्पत्वात् द्वयोरन्तरमृणात्मकमेत्र तदा गर्भीय-रविचन्द्रान्तरकलाः=पृस्थि$\frac{1}{2}$क—लम्बनान्तरकला, ततोऽनुपातेन

$$\frac{\text{६० × (पृस्थि}\frac{1}{2}\text{क − लम्बनान्तरक)}}{\text{गत्यन्तरक}} = \text{स्थि}\frac{1}{2}\text{घ — लम्बनान्तरघ},$$

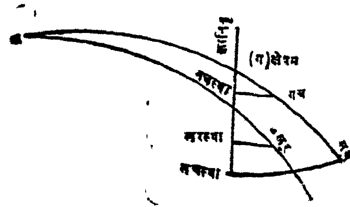
गर्भीयदर्शान्तात्पूर्वं पृष्ठाभिप्रायेण स्पर्शकालकलनया गर्भीयदर्शान्ते (स्थि$\frac{1}{2}$घ—लअंघ) हीना कार्यास्तदा पृष्ठाभिप्रायेण स्पर्शकालः=गदर्शान्तघ—पृस्थि$\frac{1}{2}$घ+लंअंघ अतः सिद्धं यत् पश्चिमकपालेऽपि यदा गर्भीयदर्शान्तात्पूर्वमेव पृष्ठाभिप्रायेण स्पर्शकालस्तदा दर्शान्ते स्थित्यर्धघटीहीनैव कार्या लम्बनान्तरं युतं कार्यमिति। यदा गर्भीयदर्शान्तादग्रे पृष्ठाभिप्रायेण स्पर्शकालस्तदोच्यते। चन्द्रलम्बनकलासु स्थित्यर्धकला हीनास्तदा पृष्ठाभिप्रायेण रविस्थानाद् गर्भाभिप्रायेण चन्द्रस्थानावधिक्रान्तिवृत्ते कलाः=चंलंक—स्थि$\frac{1}{2}$क अत्र रविलम्बनकला हीनाः कार्यास्तदा गर्भाभिप्रायेण रविचन्द्रान्तरकलाः=चंलंक—स्थि$\frac{1}{2}$क—रलंक=लम्बनान्तरक—स्थि$\frac{1}{2}$क

ततोऽनुपातेन $$\frac{\text{६० (लम्बनान्तरक − स्थि}\frac{1}{2}\text{क)}}{\text{गत्यन्तरक}} = \text{लम्बनान्तरघ — स्थि}\frac{1}{2}\text{घ},$$ गर्भीय-

दर्शान्तादग्रे पृष्ठीयस्पर्शकालकल्पनयैताः घटिका (लम्बनान्तरघ—स्थि३घ) गर्भीयदर्शान्ते युतास्तदा पृष्ठाभिप्रायेण स्पर्शकालः=दघ—स्थि३घ + लम्बनान्तरघ, अतः सिद्धं स्फुटतिथ्यन्तात् स्थित्यर्धहीनयुक्तादित्यत्र स्थित्यर्धघटी सर्वदा गर्भीयदर्शान्ते हीनैव कार्या प्राक् पश्चिमकपाले, लम्बनान्तरमृणं धनं च कार्यमिति ।



पश्चिमकपाले गर्भीयदर्शान्तापूर्वं यदा पृष्ठाभिप्रायेण स्पर्शकालस्तदा क्षेत्रम्



सिद्धान्तशेखरे "स्थित्यर्धोनयुतात् परिस्फुटतिथेः स्याल्लम्बनं पूर्ववत् मन्मध्यग्रहवेच मध्यतिथो ततस्तु तिथौ । स्थित्यर्धेन परिस्फुटेषु जनितेनोनाधिकाद्वाऽसकृत् ततिथ्यन्तरनाडिकाः स्थितिदले स्तः स्पर्शमुक्त्योः स्फुटे" ऽनेन श्रीपतिनाऽऽचार्योक्तानुरूपमेवोक्तं परमस्य श्लोकस्य द्वितीयचरणं भ्रष्टं पाठसम्वलितमस्ति, सिद्धान्तशिरोमणौ "तिथ्यन्ताद् गणितागतात् स्थितिदलेनोनाधिकाल्लम्बनं तत्कालोत्थनतीषु संस्कृतभवस्थित्यर्धहीनाधिके । दर्शान्ते गणितागते धनमृणं वा तद्विधायासकृज् ज्ञेयौ प्रग्रहमोक्षसंज्ञसमयावेवं क्रमात् प्रस्फुटौ" इति भास्करोक्तं सर्वथैवाचार्योक्तानुरूपमिति ।।१६-१७।।

अब प्रकारान्तर से स्थित्यर्धसाधन को कहते हैं

हि. भा.—पहले स्थित्यर्ध करके हीन और युत स्फुटतिथ्यन्त (स्पष्टदर्शान्त) से लम्बन लाना चाहिये, फिर उसे स्पष्टशर जनित स्थित्यर्ध करके हीन और युत तिथ्यन्त से लम्बन लाना इस तरह असकृत् करना, यहाँ यह कहा जाता है कि स्पर्शकालज्ञान के लिये पहले मध्यकालिक स्पष्टशरवश से स्थित्यर्ध साधन करना, उसको स्पष्ट तिथ्यन्त में घटाकर जो हो उससे लम्बन और नति साधन करना, तात्कालिक सपात चन्द्र से शरसाधन करना, नति और शर के संस्कार से स्पष्ट शर साधन करना, उससे चन्द्रग्रहण की तरह स्थित्यर्ध साधन करना, तिथ्यन्त में उसको घटाने से जो हो उससे पुनः लम्बन नति, स्पष्टशर और स्फुट स्थित्यर्ध सब कुछ लाना जब तक अविशेष (विशेषता से रहित) हो तब तक इसी तरह करना, अविशेष होने पर जो लम्बन हो उसको तात्कालिक स्पष्टशर जनित स्थित्यर्ध करके हीन गणितागतदर्शान्त में धन वा ऋण करना, तब स्फुट स्पर्श-

[illegible] होता है, इस तरह स्थित्यर्ध युक्त तिथ्यन्त से स्फुट मोक्षकाल होता है, उस स्फुट स्पर्शकाल वा स्फुट मोक्षकाल का तथा स्पष्ट दर्शान्त काल का अन्तर स्पार्शिक और मौक्षिक स्पष्ट स्थित्यर्ध होते हैं, एवं जैसे स्थित्यर्ध से स्पष्ट स्थित्यर्ध साधन किये गये हैं उसी तरह असकृत् कर्म से अपने विमर्दार्ध से स्पष्ट विमर्दार्ध साधन करना चाहिये, अर्थात् पूर्ववत् असकृत् कर्म से स्फुट संमीलन काल और स्फुट उन्मीलन काल का साधन कर उनके और मध्यकाल के अन्तर के बराबर स्पष्ट विमर्दार्धद्वय समझना चाहिये। यहां आचार्य ने पहले मध्यकाल लम्बन ही को स्थूल से स्पर्शकाल में और मोक्षकाल में स्वीकार किया है उससे असकृत् कर्म में कोई हानि नहीं हैं ॥१६-१७॥

उपपत्ति

पहले पूर्वकपाल में विचार करते हैं। गर्भीय दर्शान्त से पूर्व पृष्ठीय दर्शान्त के होने के कारण स्वतः गर्भीय दर्शान्त से पहले पृष्ठीय स्पर्शकाल होता है, पृष्ठाभिप्रायिक स्पर्शकाल में पृष्ठाभिप्रायिक स्थित्यर्ध कला और लम्बनान्तर कला के योग तुल्य गर्भाभिप्रायिक रविचन्द्रान्तर कला होती है, क्योंकि स्पर्शकाल में सूर्यस्थान से चन्द्रस्थान पश्चिम दिशा ही में होता है, गर्भाभिप्रायिक रविस्थान से पृष्ठाभिप्रायिक रविस्थान पूर्व दिशा में होता है, चन्द्र का भी उसी तरह होता है, पृष्ठाभिप्रायिक रविकेन्द्रगतकदम्बप्रोतवृत्त और चन्द्र केन्द्रगत कदम्बप्रोतवृत्त की अन्तर कला क्रान्तिवृत्त में स्थित्यर्धकला है, अतः स्थित्यर्ध कला में चन्द्रलम्बन कला को जोड़ने से गर्भाभिप्रायिक चन्द्रस्थान से पृष्ठाभिप्रायिक रविस्थान पर्यन्त क्रान्तिवृत्तीयकला = स्थि½क + चलंक, इसमें रविलम्बनकला को हीन करने से गर्भाभिप्रायिक रविचन्द्रान्तरकला = स्थि½क + चलंक — रलंक, जब रविलम्बन कला से स्थित्यर्धकला अल्प होगी तब रविलम्बन कला में स्थित्यर्ध कला को हीन करने से पृष्ठाभिप्रायिक चन्द्रस्थान से गर्भाभिप्रायिक रविस्थान पर्यन्त होता है उसका स्वरूप = रलंक — स्थि½क, इसको चन्द्रलम्बन कला में हीन करने से गर्भाभिप्रायिक रविचन्द्रान्तरकला = चलंक — (रलंक — स्थि½क) = चलंक — रलंक + स्थि½क = स्थि½क + लम्बनान्तरक इसको घट्यात्मक करने के लिये अनुपात करते हैं

$$\frac{\text{६० × गर्भीयरविचन्द्रान्तरक}}{\text{रविचन्द्रगत्यन्तरक}} = \frac{\text{६० (स्थि½क + लम्बनान्तरक)}}{\text{रविचन्द्रगत्यन्तरक}} = \frac{\text{६० स्थि½क}}{\text{रविचंगत्यन्तर}}$$

$$\frac{\text{लम्बनान्तरक}}{\text{...}} = \text{स्थि½घ + लम्बनान्तरघ}$$, इतनी घटी करके गर्भीय दर्शान्त से पूर्व

है यह सिद्ध हुआ। इसको गर्भीय दर्शान्त में घटाने से
ती है।

(½घ + लम्बनान्तरघ) = गर्भीयदघ — स्थि½घ — लम्बनान्तरघ
में पृष्ठाभिप्रायिक स्पर्शकाल में गर्भीय दर्शान्त घटी में

पृष्ठाभिप्रायिक स्थित्यर्ध घटी को तथा लम्बनान्तर घटी को घटाने से पृष्ठाभिप्रायि स्पर्शकाल घटी होती है। यहां स्थि$\frac{1}{2}$ क=पृष्ठीयस्थि$\frac{1}{2}$ कला सब जगह समझनी चाहिये। तथा स्थि$\frac{1}{2}$घ=पृस्थि$\frac{1}{2}$घ समझनी चाहिये।

यहाँ संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये। ख=खस्वस्तिक, र=गर्भीय-रवि, र=लम्बितरवि=पूरवि स्था=लम्बितरविस्थान, गचं=गर्भीयचन्द्र, चं=लम्बित-चन्द्र=पूचं, स्था=गर्भीयचन्द्रस्थान, स्था$_{1}$,=लम्बितचन्द्रस्थान।

अब पश्चिमकपाल में विचार करते हैं

गर्भीयदर्शान्त से आगे पृष्ठीय दर्शान्त है, पृष्ठीय दर्शान्त से पूर्व पृष्ठाभिप्रायिक स्पर्शकाल है इसलिये पृष्ठीयदर्शान्त से पूर्व पृष्ठाभिप्रायिक स्पर्शकाल और गर्भीयामान्त के होने से सम्भव है कि गर्भीय दर्शान्त से पूर्व पृष्ठाभिप्रायिक स्पर्शकाल हो और कदाचित् आगे भी, जब पृष्ठीय दर्शान्तकाल में गर्भाभिप्रायिक रविस्थान से पृष्ठाभिप्रायिक रविस्थान पश्चिम दिशा में होता है तब गर्भीय दर्शान्त से पहले ही पृष्ठाभिप्रायिक स्पर्शकाल होता है, क्योंकि गर्भीय दर्शान्त से पहले गर्भाभिप्रायिक रविस्थान से पश्चिम दिशा ही में गर्भाभि-प्रायिक चन्द्रस्थान है, जब स्पर्शकाल में गर्भाभिप्राय से रविस्थान से गर्भाभिप्रायिक चन्द्रस्थान पूर्वदिशा में होता है तब गर्भीयदर्शान्त से आगे पृष्ठाभिप्रायिक स्पर्शकाल होता है क्योंकि गर्भीयदर्शान्त से आगे पूर्वदिशा ही में गर्भाभिप्रायिक रविस्थान और चन्द्रस्थान है।

स्पर्शकाल में गर्भाभिप्रायिक रविस्थान से गर्भाभिप्रायिक चन्द्र स्थान पूर्वदिशा में और पश्चिमदिशा में होता है, यह कैसे मालूम होता है, इस के लिए विचार करते हैं। यदि गर्भीयदर्शान्त में लम्बन घटी जोड़ने से पृष्ठीय दर्शान्त होता है उन घटियों से यदि पृष्ठा-भिप्रायिक स्थित्यर्ध घटी अल्प हो तब पश्चिम दिशा में गर्भाभिप्रायिक रविस्थान से चन्द्र-स्थान होता है अन्यथा पूर्व दिशा में। कब गर्भीय दर्शान्त से पहले पृष्ठाभिप्रायिक स्पर्श-काल होता है इसके लिए विचार करते हैं। पृष्ठीय स्थित्यर्धकला में चन्द्र लम्बन कला को घटाने से गर्भाभिप्राय से चन्द्रस्थान से पृष्ठाभिप्राय से रविस्थान पर्यन्त क्रान्ति-वृत्त में कला होती है,=स्थि$\frac{1}{2}$क- चंलंक, इस में रविलम्बनकला को जोड़ने से पृष्ठाभिप्रायिक रविचन्द्रान्तरकला = स्थि$\frac{1}{2}$ क−चंलंक +रलंक, चन्द्रलम्बन-कला से रविलम्बनकला के अल्प होने के कारण दोनों का अन्तर ऋणात्मक ही है तब गर्भीय रविचन्द्रान्तरकला=पृस्थि$\frac{1}{2}$ क—लम्बनान्तरक तब अनुपात से $\frac{६० (\text{पृस्थि}\frac{1}{2}\text{ क—लम्बनान्तरक})}{\text{गत्यन्तरक}}$=स्थि$\frac{1}{2}$ घ—लम्बनान्तरघ, गर्भीय दर्शान्त से पूर्वपृष्ठा-भिप्राय से स्पर्शकाल कल्पना से गर्भीयदर्शान्त में स्थि$\frac{1}{2}$घ—लम्बनान्तरघ हीन करने से पृष्ठाभिप्राय से स्पर्शकाल=गदर्शान्तघ—पृस्थि$\frac{1}{2}$घ+लंअंघ इससे सिद्ध हुआ कि पश्चिम कपाल में भी जब गर्भीय दर्शान्त से पहले ही पृष्ठाभिप्राय से स्पर्शकाल होता है तब दर्शान्त में स्थित्यर्ध घटी को हीन ही करना और लम्बनान्तर को युत करना। जब गर्भीय दर्शान्त के

आगे पृष्ठाभिप्राय से स्पर्शकाल होता है तब विचार करते हैं। चन्द्रलम्बनकला में स्थित्यर्ध कला को हीन करने से पृष्ठाभिप्राय से रवि स्थान से गर्भाभिप्राय से चन्द्रस्थानावधि क्रान्तिवृत्त में कला=चंलंक—स्थि ३/२ क इस में रविलम्बनकला को हीन करने से गर्भाभिप्राय से रविचन्द्रान्तरकला=चंलंक—स्थि ३/२ क—रलंक=लम्बनान्तरक—स्थि ३/२ क तब अनुपात से

$$\frac{६०(\text{लम्बनान्तरक}—\text{स्थि}\,\frac{३}{२}\text{क})}{\text{गत्यन्तरक}}=\frac{६०\ \text{लम्बनान्तरक}}{\text{गत्यन्तरक}}—\frac{६०\ \text{स्थि}\,\frac{३}{२}\text{क}}{\text{गत्यन्तरक}}=$$

लम्बनान्तरघ—स्थि ३/२ घ गर्भीयदर्शान्त से आगे पृष्ठीय स्पर्शकाल कल्पना से इन घटियों (लम्बनान्तरघ—स्थि ३/२ घ) को गर्भीयदर्शान्त में जोड़ने से पृष्ठाभिप्राय से स्पर्शकाल=दघ —स्थि ३/२ घ+लम्बनान्तरघ, इस से सिद्ध हुआ कि "स्फुटतिथ्यन्तात् स्थित्यर्धहीन-युक्तात्' यहां स्थित्यर्ध घटी सर्वदा गर्भीय दर्शान्त में हीन ही करनी चाहिये पूर्वकपाल में और पश्चिम कपाल में, लम्बनान्तर को ऋण और धन करना इति। यहां संस्कृतोपपत्ति में लिखित (ख) क्षेत्र को देखिये।

पश्चिम कपाल में गर्भीय दर्शान्त से पहले जब पृष्ठाभिप्राय से स्पर्शकाल होता है तब संस्कृतोपपत्ति में लिखित (ग) क्षेत्र को देखिये। सिद्धान्तशेखर में 'स्थित्यर्धोनयुतात् परिस्फुटतिथेः" इत्यादि से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है। सिद्धान्तशिरोमणि में "तिथ्यन्ताद् गणितागतात् स्थितिदलेनोनाधिकात्" इत्यादि से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है इति-॥१६-१७॥

इदानीमिष्टग्रासे ग्रासात्कालानयने च चन्द्रग्रहणाद्यो विशेषस्तमाह

शशिवद्बाहुः स्फुटविक्षेपकृतस्थितिदलेन सङ्गुणितः।
स्पष्टस्थित्यर्धहृतो भवति भुजः पूर्ववच्छेषम्. ॥१८॥

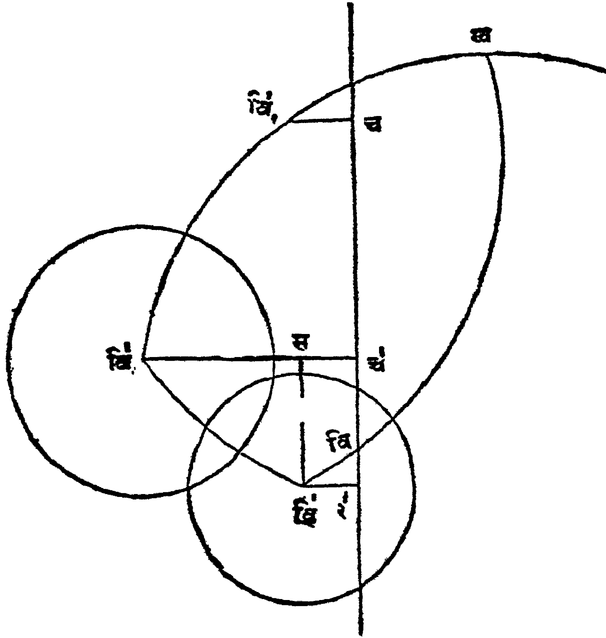
ग्रासात्कालः शशिवत् स्पष्टस्थितिदलगुणोऽसकृद् भक्तः।
स्फुटविक्षेपकृतस्थितिदलेन शोध्यः स्थितिदलात् स्यात् ॥१९॥

सु. भा.—ग्रासात् शशिवत् कालः 'शेषमूलं कृतं तिथिव' दित्यनेन चन्द्रग्रहण-विधिना यः कालः स ज्ञेयः। शेषव्याख्या 'शेष शशाङ्कग्रहणोक्तमत्र' त्यादि भास्करविधिना स्फुटा। (सू्प्र. श्लो० १८-१९)

कल्प्यते वित्रिभतः प्राक् स्पष्टस्पर्शकालादनन्तरमिष्टकाले इ, समे इष्ट-ग्रासोऽपेक्षितः। तत् क्षेत्रसंस्था चेयम्। अत्रापि स्पष्टस्थित्यर्धोपपत्तिलिखित-क्षेत्रसङ्केतानि बोध्यानि।

अत्र विं, स=इष्टकाले स्पष्टशरः। वि स=इष्टकाले भुजकला यज्ज्ञान-

मत्रापक्षितमस्ति। ततः क्षेत्रयुक्त्या। भुजकला $\overset{।}{\text{वि}}$ स $=$ च $\overset{।}{\text{चं}}$ $=$ चवि $+$ $\overset{।}{\text{वि}}$र $-$ घ $\overset{।}{\text{चं}}$ $=$ च वि $-$ इलं $\therefore$ च वि $=$ भुक $\pm$ इलं। अत्र



च$\overset{।}{\text{चं}}$ $-$ $\overset{।}{\text{वि}}$र $=$ इष्टकालिकलम्बनकला। चवि $=$ इष्टकाले गर्भाभिप्रायेण रविचन्द्रान्तरांशाः। ततः पूर्ववद्गर्भक्षितिजादिष्टग्रासे इष्टकालः $=$ द $-$ भुघ $-$ इलंघ।

पूर्वसाधितस्पष्टस्पर्शकालः $=$ द $-$ स्फुस्थि $-$ लं$_{१}$

स्पर्शादनन्तरमिष्टग्रासे इष्टकालः

$=$ (द $-$ भुघ $-$ इलंघ) $-$ (द $-$ स्फुस्थि $-$ लं$_{१}$)

$=$ स्फुस्थि $+$ लं$_{१}$ $-$ इलंघ $-$ भुघ $=$ इ

$\therefore$ भुघ $=$ स्फुस्थि $+$ लं$_{१}$ $-$ इलंघ $-$ इ ... ... (१)

अथ पूर्वसाधितः

स्पष्टदर्शान्तकालः $=$ द $-$ लं$_{२}$

स्पष्टस्पर्शकालः $=$ द $-$ स्फुस्थि $-$ लं$_{१}$

द्वयोरन्तरेण स्पार्शिकं स्पष्टस्थितिदलम्

=स्फुस्थि+लं$_1$—लं$_2$=स्पस्थि। अथ यदि स्पष्टस्थितिदलेन लं$_1$—ल$_2$ इदं लम्बनान्तरं तदा स्पर्शादनन्तरं इमितेन कालेन किमित्यनुपातेन यदि वास्तवमान—(लं$_1$—इलंघ) मस्येदं $\frac{\text{इ (लं}_1\text{—लं}_2\text{)}}{\text{स्पस्थि}}$ कल्प्यते तदाऽस्या (१) स्मिन्नुत्थापनेन

$$\text{भुघ}=\text{स्फुस्थि}—\text{इ}+\frac{\text{इ (लं}_1\text{—लं}_2\text{)}}{\text{स्पस्थि}}$$

$$=\frac{\text{स्फुस्थि—स्पस्थि—इ}\left\{\text{स्पस्थि}-(\text{लं}_1\text{—लं}_2)\right\}}{\text{स्पस्थि}}$$

$$=\frac{\text{स्फुस्थि. स्पस्थि—इ. स्फुस्थि}}{\text{स्पस्थि}}=\frac{\text{स्फुस्थि (स्पस्थि—इ)}}{\text{स्पस्थि}}$$

भुजघटिका गत्यन्तरकलागुणा षष्टिभक्ता जाता भुजकला:

$$=\text{भुक}=\frac{\text{स्फुस्थि}}{\text{स्पस्थि}}\cdot\frac{\text{गअं (स्पस्थि—इ)}}{\text{स्पस्थि ६०}}=\frac{\text{स्फुस्थि}\times\text{चन्द्रग्रहणवत् भुज}}{\text{स्पस्थि}}$$

अनेन भुजकलानयनमुपपद्यते। एवमतो व्यस्तविधिना भुजघटीतो वीष्ट-स्पष्टस्थितिदलमानम् = स्पस्थि—इ=$\frac{\text{भुघ. स्पस्थि}}{\text{स्फुस्थि}}$ । इष्टग्रासकालिकस्पष्ट-शराज्ञानान्मध्यकालिकस्पष्टशरतः कर्म कृतमतोऽसकृत्कर्मयुक्तमेव यतस्तात्कालिक-शराज्ञानात् स्फुटस्थितिदलादिकस्याज्ञानमिति । एवं स्पष्टस्थितिदलानुपाततो यदि लं$_1$—इलंघ अस्य मानमानीयते तदा भुजादिसाधनं सूक्ष्ममाचार्योक्तम्। अनुपातस्य नियतैकरूपत्वात् तादृशानुपातेन लम्बनान्तरं न सूक्ष्ममायात्यत आचार्योक्तं स्थूलमानयनम्। तदेव भास्करस्यापि स्थूलमानयनमतो मदीयं सूत्रम्।

चेत् स्पष्टस्थितिखण्डकेन जनितं तत्कालमध्येऽन्तरं स्पष्टं लम्बनयोरिदं भवति किं तदीष्टकालेन चेत्। सूक्ष्मं स्यादनुपातजातमनिशं दोरादिकं कोविद श्रीमद्भास्करसत्प्रकारविलसत् सत् स्यात् तदाऽर्कग्रहे। इदं युक्तमेवेति सिद्धान्त-विद्भिर्भृशं विचिन्त्यनीयम् । एवं मौक्तिकेऽष्टेऽपि क्षेत्रसंस्थया स्फुटा वासना ॥१८ १९॥

वि. भा.—शशिवत् (चन्द्रग्रहणविधिनैव इष्टकालोद्भवो) यो बाहुः (भुजः) स स्फुटविक्षेपकृतस्थितिदलेन (तात्कालिकस्फुटशरजनितेन स्थित्यर्धेन) सङ्गुणितः स्पष्टस्थित्यर्धेन (स्पर्शमध्यकालयोरन्तरेण) हृतः (भक्तः) तदा भुजः

(सूर्यग्रहणे स्फुटो भुजः) भवेत् । ग्रासात् (इष्टग्रासात्) सकाशात्—शशिवत् (चन्द्रग्रहणोक्तवत्) भुजः स्पष्टस्थितिदलेन (स्पष्टस्थित्यर्धेन) गुणितः, स्फुटविक्षेपकृतस्थितिदलेन (तात्कालिकस्फुटशरजनितस्थित्यर्धेन) भक्त एवमसकृत्करणेन यो भवति स स्थित्यर्धाच्छोध्यस्तदा कालः (कालसिद्धिः) स्यादिति॥१८-१९॥

अत्रोपपत्तिः

गर=गर्भीयरविः । चं=गर्भीयचन्द्रः।

स्था=लम्बितरविस्थानम् ।

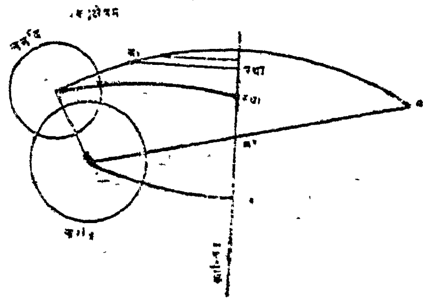
स्था, =लम्बितचन्द्रस्थानम् ।

स्था=गर्भीयचन्द्रस्थानम् ।

स्था स्था, =चन्द्रस्पष्टलम्बनम् ।

गस्था=रविस्पष्टलम्बनम् ।

गस्था=गर्भीयरविचन्द्रान्तरम् ।



स्था स्था, =लम्बितरविचन्द्रान्तरम् ।

गर्भीयदर्शान्तादग्रे यदा पृष्ठाभिप्रायेण स्पर्शकालस्तदा क्षेत्रदर्शनम् ।

गर्भीयरविचन्द्रान्तर + रलं — चंलं = लम्बितचन्द्रस्थानाल्लम्बितरविस्थानंयावत्=गर्भीयरविचन्द्रान्तर—लम्बनान्तर=कोटिः । अतो गर्भीयरविचन्द्रान्तर=लम्बनान्तर+कोटि, अथ वित्रिभतः प्राक्कपाले स्पर्शकालानन्तरमिष्टग्रासे इष्टकालः= गर्भीयदर्शान्त— रविचन्द्रान्तरघ=गर्भीयदर्शान्त— कोटिघ—लम्बनान्तरघ स्फुटतिथ्यन्ताल्लम्बनमसकृदित्यादिना स्पर्शकालः=

गर्भीयदर्शान्तघटी — स्फुटस्थित्यर्धघ—स्पार्शिकलम्बनान्तरघ=गर्भीयदघ—स्फुटस्थित्यर्धघ—लं, अत्र स्पार्शिकलम्बनान्तरघटी=ल,, अनयोरन्तरम् स्पर्शकालानन्तरमिष्टकालः=इ=(गर्भीयदघटी—कोटिघ—लम्बनान्तरघ) — (गर्भीयद—स्फुटस्थि३ घ—ल,) अत्र लम्बनान्तरम=इलंघ ततो गर्भीयदर्शान्तघ—कोटिघ—इलंघ—गर्भीयदघ+स्फुटस्थि३ घ+ल,

=स्फुस्थि३ घ—कोघ—इलंघ+लं,=इ, अतः स्फुस्थि३ घ—इलंघ—इ+लं,=कोटिघ

अथ स्पष्टदर्शान्तघ=गर्भीयदर्शान्तघ—लं, अत्र लं,= रविचन्द्रयोः स्पष्टलम्बनान्तरम्.

तथा स्फुटतिथ्यन्ताल्लम्बनमसकृदित्यादिना स्पर्शकालः = गर्भीयदघ— स्फुस्थि$\frac{1}{2}$घ—लं$_1$

अनयोरन्तरम् स्पार्शिकस्थित्यर्धम् = स्पस्थि$\frac{1}{2}$ = गर्भीयदघ—लं$_2$—(गदघ— स्फुस्थि$\frac{1}{2}$घ—लं$_1$) = गर्भीयदघ— लं$_2$—गर्भीयदघ + स्फुस्थि$\frac{1}{2}$घ + लं$_1$ = स्फुस्थि$\frac{1}{2}$ + लं$_1$—लं$_2$ = स्पार्शिकस्थि$\frac{1}{2}$ घ ततो $\frac{(लं_1 - लं_2)\ इ}{स्पस्थि\frac{1}{2}घ}$ ऽनुपातेन यत्फलं तद्यदि लं$_1$ —इलंघ कल्प्यते तदा

$$कोटिघटीप्रमाणम् = कोघ = स्फुस्थि\tfrac{1}{2}\ घ + \frac{(लं_1 - लं_2)\ इ}{स्पस्थि\frac{1}{2}घ} - इ$$

$$= \frac{स्फुस्थि\frac{1}{2}घ \times स्पस्थि\frac{1}{2}घ + (लं_1 - लं_2)\ इ - स्पस्थि\frac{1}{2}घ.\ इ}{स्पस्थि\frac{1}{2}घ}$$

$$= \frac{स्फुस्थि\frac{1}{2}घ \times स्पस्थि\frac{1}{2}घ + इ\ \{(लं_1 - लं_2) - स्पस्थि\frac{1}{2}घ\}}{स्पस्थि\frac{1}{2}घ}$$

$$= \frac{स्फुस्थि\frac{1}{2}घ \times स्पस्थि\frac{1}{2}घ - इ \times स्फुस्थि\frac{1}{2}घ}{स्पस्थि\frac{1}{2}घ}$$

$$= \frac{स्फुस्थि\frac{1}{2}घ\ \ (स्फुस्थि\frac{1}{2}घ - इ}{स्पस्थि\frac{1}{2}घ} = कोटिघ$$

ततः $\frac{गत्यन्तरक \times कोटिघ}{६०}$ = कोटिक, अत उत्थापनेन $\frac{स्फुस्थि\frac{1}{2}घ\ (स्पस्थि\frac{1}{2}घ - इ)}{स्पस्थि\frac{1}{2}घ}$ $\times \frac{गत्यन्तरक}{६०} = \frac{स्फुस्थि\frac{1}{2}घ}{स्पस्थि\frac{1}{2}घ}$ (स्पस्थि$\frac{1}{2}$घ—इ) $\times \frac{गत्यन्तरक}{६०} = \frac{स्फुटस्थि\frac{1}{2}घ}{स्पस्थि\frac{1}{2}घ}$

× इष्टोनस्थित्यर्धकला = $\frac{स्फुटस्थि\frac{1}{2}घ}{स्पस्थि\frac{1}{2}घ}$ × चन्द्रग्रहणवत्कोटिः = कोटिकला (१)

= $\frac{स्फुटस्थि\frac{1}{2}घ}{स्पस्थि\frac{1}{2}घ}$ × चन्द्रग्रहणवद्भुजः = भुजकला यदि कोटिघटी = भुजघटी,

अथ $\frac{स्फुस्थि\frac{1}{2}घ}{स्पस्थि\frac{1}{2}घ}$ × इष्टोनस्थित्यर्धकला = भुजकला, ∴ इष्टोनस्पष्टस्थि$\frac{1}{2}$क =

$\frac{भुकला \times स्पष्टस्थि\frac{1}{2}घ}{स्फुस्थि\frac{1}{2}घ}$ इदं फलं स्पष्टस्थित्यर्धे शोध्यं तदेष्टकालो भवेत् ।

परमिदमानयनं न समीचीनं यतस्तात्कालिकशराज्ञानान्मध्यग्रहणकालिक-

शरवशादेव स्थित्यर्धादिसाधनं कृतमतोऽसकृत्कर्म कार्यमेतेनाऽऽचार्योक्तमुपपद्यते। सिद्धान्तशेखरे "बाहुश्चन्द्रग्रहणविधिनेष्टकालोद्भवो यः क्षेपस्पष्टस्थिति-दलहतो भाजितः प्रस्फुटेन। स्थित्यर्धेन स्फुट इह भवेदुक्तवत् कालसिद्धिश्चेष्ट-ग्रासाद् गुणकहरयोर्व्यत्ययेनासकृत् स्यात्" ऽनेन श्रीपतिना सिद्धान्तशिरोमणौ शेषं शशाङ्कग्रहणोक्तमत्र स्फुटेषुजेनस्थितिखण्डकेन। हतोऽथ तेनैव हृतः स्फुटेन बाहुः स्फुटः स्याद् ग्रहणे ऽत्र भानोः" ग्रासाच्च कालानयने फलं यत् स्फुटेन निघ्नं स्थितिखण्डकेन। स्फुटेषुजेनासकृदुद्धृतं तत् स्थित्यर्धशुद्धं भवतीष्टकालः पद्येनानेन भास्कराचार्येणाप्याचार्योक्तानुरूपमेवोक्तम्। (१) अनेनच "भानोर्ग्रहे कोटिलिप्ता मध्यस्थित्यर्धसङ्गुणा। स्फुटस्थित्यर्धसंभक्ता स्फुटाः कोटिकलाः स्मृताः" सूर्य-सिद्धान्तोक्तमिदमप्युपपन्नमिति ॥१८-१९॥

अब इष्टग्रास में और ग्रास से कालानयन में चन्द्रग्रहण से जो विशेष बातें हैं उनको कहते हैं

हि. भा.—चन्द्रग्रहण विधि से इष्टकालोत्पन्न जो भुज हो उसको तात्कालिक स्फुट शरजनित स्थित्यर्ध से गुणाकर स्पष्ट स्थित्यर्ध (स्पर्शकाल और मध्यकाल के अन्तर) से भाग देने से सूर्यग्रहण में भुज होता है, इष्टग्रास से चन्द्रग्रहणोक्तवत् भुज को स्पष्ट स्थित्यर्ध से गुणाकर तात्कालिक स्फुटशर जनित स्थित्यर्ध से भाग देना। इस तरह असकृत् करने से जो होता हो उसको स्थित्यर्ध में घटाने से कालसिद्धि होती है इति ॥ १८-१९ ॥

उपपत्ति

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये। गर्भीयदर्शान्त से आगे जब पृष्ठाभिप्राय से स्पर्शकाल है उस कालिक यह क्षेत्र है। गर=गर्भीयरवि, चं=गर्भीयचन्द्र, स्था=लम्बितरविस्थान, स्था$_1$=लम्बितचन्द्रस्थान, स्था=गर्भीय चंस्थान स्थास्था$_1$= चन्द्रस्पष्टलम्बन, गस्था=रविस्पष्टलम्बन, गस्था=गर्भीयरविचन्द्रान्तर, स्थास्था$_1$= लम्बितरविचन्द्रान्तर गर्भीयरविचन्द्रान्तर+रलं—चंलं=लम्बितचन्द्रस्थान से लम्बित रविस्थानपर्यन्त, =गर्भीयरविचन्द्रान्तर—लम्बनान्तर=कोटि

इसलिये गर्भीयरविचन्द्रान्तर=लम्बनान्तर+कोटि, वित्रिभ से पूर्व कपाल में स्पर्शकाल के बाद इष्टग्रास में इष्टकाल=गर्भीयदर्शान्त—रविचन्द्रान्तरघ=गर्भीयदर्शान्त—कोटिघ—लम्बनान्तरघ

'स्फुटतिथ्यन्ताल्लम्बनमसकृत्' इत्यादि से स्पर्शकाल=

गर्भीयदघ—स्फुटस्थि$\frac{1}{2}$घ—स्पार्शिकलम्बनान्तरघ=गर्भीयदघ—स्फुटस्थि$\frac{1}{2}$घ—बँ,

यहां स्पार्शिक लम्बनान्तरघ=$लं_1$, इन दोनों का अन्तर करने से स्पर्शकाल के बाद इष्टकाल=इ=

(गर्भीयदघ—कोटिघ—लम्बनान्तरघ)—(गर्भीयदघ—स्फुस्थि$\frac{1}{2}$घ—$लं_1$)

यहां लम्बनान्तरघ=इलंघ, तब गर्भीयदघ—कोटिघ—इलंघ—गर्भीयदघ+स्फुस्थि$\frac{1}{2}$घ +$लं_1$=

स्फुस्थि$\frac{1}{2}$घ—कोघ—इलंघ+$लं_1$=इ, अतः स्फुस्थि$\frac{1}{2}$घ—इलंघ—इ+$लं_1$=कोटिघ

स्पष्टदर्शान्तघ=गर्भीयदघ—$लं_2$, यहां $लं_2$=रवि और चन्द्र का स्पष्टलम्बनान्तर, तथा 'स्फुटतिथ्यन्ताल्लम्बनमसकृत्' इत्यादि से स्पर्शकाल=गर्भीयदघ—स्फुस्थि$\frac{1}{2}$घ—$लं_1$ दोनों का अन्तर करने से

स्पार्शिकस्थित्यर्घ=स्पस्थि$\frac{1}{2}$—गर्भीयदघ—$लं_2$—(गदघ—स्फुस्थि$\frac{1}{2}$घ—$लं_1$)

=गर्भीयदघ - $लं_2$—गर्भीयदघ+स्फुस्थि$\frac{1}{2}$घ+$लं_1$=स्फुस्थि$\frac{1}{2}$+$लं_1$—$लं_2$= स्पार्शिकस्थि$\frac{1}{2}$घ

तब $\frac{(लं_1-लं_2)इ}{स्पस्थि\frac{1}{2}घ}$ इस अनुपात से जो फल होता है वह यदि $लं_1$—इलंघ माना जाय तब

कोटिघटी=कोघ=स्फुस्थि$\frac{1}{2}$घ+ $\frac{(लं_1-लं_2)इ}{स्पस्थि\frac{1}{2}घ}$—इ=

$$=\frac{स्फुस्थि\frac{1}{2}घ\times स्पस्थि\frac{1}{2}घ+(लं_1-लं_2)\ इ-स्पस्थि\frac{1}{2}घ\cdot इ}{स्पस्थि\frac{1}{2}घ}$$

$$=\frac{स्फुस्थि\frac{1}{2}घ\times स्पस्थि\frac{1}{2}घ+इ\ \{(लं_1-लं_2)-स्पस्थि\frac{1}{2}घ\}}{स्पस्थि\frac{1}{2}घ}$$

$$=\frac{स्फुस्थि\frac{1}{2}घ\times स्पस्थि\frac{1}{2}घ-इ\times स्फुस्थि\frac{1}{2}घ}{स्पस्थि\frac{1}{2}घ}=\frac{स्फुस्थि\frac{1}{2}घ\ (स्पस्थि\frac{1}{2}घ-इ)}{स्पस्थि\frac{1}{2}घ}$$

=कोटिघ, $\therefore \frac{गत्यन्तरक\times कोटिघ}{६०}$=कोटिक, उत्थापन करने से

$$\frac{स्फुस्थि\frac{1}{2}घ\ (स्पस्थि\frac{1}{2}घ-इ)}{स्पस्थि\frac{1}{2}घ}\times\frac{गत्यन्तरक\cdot कोटिघ}{६०}$$

$$=\frac{स्फुस्थि\frac{1}{2}घ}{स्पस्थि\frac{1}{2}घ}\times इष्टनस्थि\frac{1}{2}कला=\frac{स्फुस्थि\frac{1}{2}घ}{स्पस्थि\frac{1}{2}घ}\times चन्द्रग्रहणवत्कोटि=कोटिकला \quad (१)$$

$$= \frac{\text{स्फुस्थि}\frac{1}{2}\text{घ}}{\text{स्पस्थि}\frac{1}{2}\text{घ}} \times \text{चन्द्रग्रहणवद्भुज} = \text{भुजकला}$$

यदि कोटिघटी = भुजघटी

$$\frac{\text{स्फुस्थि}\frac{1}{2}\text{घ}}{\text{स्पस्थि}\frac{1}{2}\text{घ}} \times \text{इष्टोनस्थित्यर्धकला} = \text{भुजकला} \quad \therefore \text{इष्टोनस्पस्थि}\frac{1}{2}\text{क}$$

$$= \frac{\text{भुजकला} \times \text{स्पस्थि}\frac{1}{2}\text{घ}}{\text{स्फुस्थि}\frac{1}{2}\text{घ}}$$ इस फल को स्पष्टस्थित्यर्ध में घटाने से इष्टकाल होता है, लेकिन यह आनयन ठीक नहीं है, क्योंकि तात्कालिकशर विदित नहीं रहने के कारण मध्यग्रहण कालिकशरवश से ही स्थित्यर्धादि का साधन किया गया है इसलिये असकृत् कर्म करना चाहिये, इससे आचार्योक्त उपपन्न हुआ। सिद्धान्तशेखर में "बाहुश्चन्द्रग्रहणविधिनैवेष्टकालोद्भवो यः" इत्यादि संस्कृत पद्य में लिखित श्लोक से श्रीपति ने, तथा सिद्धान्तशिरोमणि में "शेषं शशाङ्कग्रहणोक्तमत्र स्फटेषुजेन" इत्यादि संस्कृतोपपत्ति में लिखित पद्यों से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा (१) इससे "भानोर्ग्रहे कोटिलिप्ता मध्यस्थित्यर्धसङ्गुणा" इत्यादि सूर्यसिद्धान्तोक्त भी उपपन्न हुआ इति ॥१८-१९॥

इदानीमादेश्यानादेश्ययोर्ग्रहणयोर्नियममाह

वलनादिशशिवदन्यद् ग्रहणं तैक्ष्ण्याद्रवेरनादेश्यम् ।
द्वादशभागादूनं स्वच्छत्वात् षोडशादिन्दोः ॥२०॥

सु. भा.—षोडशात् षोडशभागात् । शेषं स्पष्टार्थम् । चन्द्रग्रहणाधिकारे 'इन्दोर्भागः षोडशः खण्डितोऽपि' इत्यादि भास्करोक्तमेतदनुरूपमेव (चं.ग्र. श्लो० ३७) ॥२०॥

वि. भा.—अन्यत् वलनादि शशिवत् (चन्द्रग्रहणोक्तवत्) ज्ञेयम् । रवेः (सूर्यस्य) तैक्ष्ण्यात् (तेजस्तैक्ष्ण्यात् असह्यत्वात्) द्वादशभागादूनं (द्वादशांशान्न्यूनं) ग्रहणमनादेश्यम् (ग्रस्तस्यापि द्वादशांशस्यादृश्यत्वात्) इन्दोः (चन्द्रस्य) स्वच्छत्वात् (किरणानामतिशुभ्रतावशेन) षोडशात् (षोडशभागान्न्यूनं) ग्रहणमनादेश्यमिति सिद्धान्तशेखरे "तेजस्तैक्ष्ण्यात्तीक्ष्णगोर्मण्डलस्य ग्रस्तोऽप्यंशो द्वादशांशोन दृश्यः । तद्वद्भागः षोडशः शीतरश्मेः स्वच्छांशुत्वाल्लक्ष्यते नाधिकोऽतः" श्रीपतिनैवमुक्तम् । अमुमेव श्रीपतिप्रकारं भास्कराचार्यो यत्किञ्चित्परिवर्त्तितमेवमाह "इन्दोर्भागः षोडशः खण्डितोऽपितेजः पुञ्जच्छन्नभावान्न लक्ष्यः । तैजस्तैक्ष्ण्यात् तीक्ष्णगोर्द्वादशांशो नादेश्योऽतोऽल्पो ग्रहो बुद्धिमद्भिः" सूर्यसिद्धान्ते च

"स्वच्छत्वात् द्वादशांशोऽपि ग्रस्तश्चन्द्रस्य दृश्यते । लिप्तात्रयमपि ग्रस्तं

तीक्ष्णत्वान्न विवस्वतः" वमुक्तम् परमत्रोपलब्धिरेव वासना नान्यत्कारणं वक्तुं शक्यत इति ।।२०।।

अब आदेश्य (कहने योग्य) और अनादेश्य (नहीं कहने योग्य) ग्रहण के नियम को कहते हैं

हि. भा.—अन्य वलन आदि चन्द्रग्रहणोक्तवत् समझना चाहिये। रवि के तेज की तीक्ष्णता के कारण द्वादशांश से न्यून ग्रहण को नहीं कहना चाहिये क्योंकि द्वादशांश ग्रस्त रहने पर भी देखने में नहीं आता है, चन्द्रमा की स्वच्छता के कारण सोलह अंश से न्यून ग्रहण को नहीं कहना चाहिये (लोगों में), "सिद्धान्तशेखर में "तेजस्तैक्ष्ण्यात्तीक्ष्ण-गोर्मण्डलस्य" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने इस तरह कहा है, इसी श्रीपति प्रकार को कुछ परिवर्तित कर भास्कराचार्य इस तरह कहते हैं "इन्दोर्भागः षोडशः खण्डितोऽपि" इत्यादि संस्कृतोपपत्ति में लिखित श्लोकोक्त के अनुसार सूर्यसिद्धान्त में "स्वच्छत्वात् द्वादशांशोऽपि" इत्यादि के अनुसार कहा गया है, लेकिन इन में केवल उपलब्धि को ही उपपत्ति कह सकते हैं, दूसरा कारण कुछ भी नहीं कहा जा सकता है इति।।२०।।

इदानीं स्वप्रशंसामाह

न स्फुटमार्यभटादिष्वर्कग्रहणं यतस्ततः स्पष्टम् ।
शङ्कुज्यया कृतं लघु लघुतरमेवं रवेर्ग्रहणम् ॥२१॥

सु. भा.—शङ्कुज्यया वित्रिभशङ्कुना मया लघु कृतमित्याचार्याशयः। एवमग्रे वक्ष्यमाणप्रकारेण रवेर्ग्रहणं रविग्रहणसाधनं लघुतरं च भवति। शेषं स्फुटार्थम् ।।२१।।

वि. भा.—यतः (यस्मात्कारणात्) आर्यभटादिषु (आर्यभटश्रीषेणचन्द्रजाद्येषु ग्रन्थेषु) अर्कग्रहणं (सूर्यग्रहणं) स्फुटं नास्ति ततः (तस्मात् कारणात्) शङ्कुज्यया (वित्रिभशङ्कुना) मया स्पष्टं लघुकृतम् । एवमग्रे वक्ष्यमाणप्रकारेण रवेर्ग्रहणं (सूर्यग्रहणसाधनं) लघुतरं च भवतीति ।।२१।।

अब अपनी प्रशंसा को कहते हैं

हि. भा.—जिस कारण से आर्यभट, श्रीषेण प्रभृति आचार्यों के ग्रन्थों में सूर्यग्रहण साधन स्फुट नहीं है, उस कारण से वित्रिभ शङ्कु से मैंने स्पष्ट और लघु किया, एवं आगे कथित प्रकार से सूर्यग्रहण साधन लघुतर (अतिशयलघु) होता है इति।।२१।।

इदानीं लघुकर्मणा लम्बननत्योः साधनमाह

लग्नात् त्रिराशिहीनादपक्रमाक्षांशयुति विशेषोनात् ।
भत्रितयाज्ज्याछेदस्त्रिज्यार्धकृतेः फलेन हृता ॥२२॥
वित्रिभलग्नार्कान्तरजीवा घटिकादिलम्बनं वा स्यात् ।
वित्रिभलग्नापक्रमविक्षेपाक्षांश युतिवियुतेः ॥२३॥
जीवा शशाङ्कभास्कर मध्यम भुक्त्यन्तरेण सङ्गुणिता ।
पञ्चदशभिर्गुणितया विभाजिता त्रिज्ययाऽवनतिः ॥२४॥

सु. भा.—त्रिराशिहीनाल्लग्नाद्वित्रिभात् क्रान्त्यंशा ये तेषामक्षांशानां चैक-दिशां युतिर्विभिन्नदिशां विशेषः स्वल्पाक्षे देशे वित्रिभस्य याम्योत्तरवृत्तासन्ने स्थितत्वाद्वित्रिभनतांशा भवन्ति । तदूनाद्भत्रितयाद्राशित्रयाज्ज्या वित्रिभशङ्कुस्त्रिज्यार्धकृतेश्छेदो भवति । छेदात् त्रिज्यार्धकृतेर्यत् फलं तेन वित्रिभलग्नार्कान्तरज्या हृता लब्धं घटिकादि वा लम्बनं भवेत् । वित्रिभलग्नापमांशानां वित्रिभशरांशानामक्षांशानां चैव दिशां युतेर्विभिन्नदिशां वियुतेर्जीवा चन्द्रदृक्क्षेपः । सा रविचन्द्रमध्यगत्यन्तरेण सङ्गुणिता पञ्चदशभिर्गुणितया त्रिज्यया विभाजिताऽवनतिः स्यात् ।

अत्रोपपत्तिः । याम्योत्तरवृत्त एव सुखार्थं त्रित्रिभं प्रकल्प्य दिनार्धवत् तन्नतांशा उन्नतांशाश्च साधिताः । उन्नतांशजीवा वित्रिभशङ्कुः प्रसिद्धस्ततः पूर्वविधिना लम्बनघटिकाः $= \frac{४ \text{ ज्या } (र \smile वि)}{त्रि} \cdot \frac{विशं}{त्रि} = \frac{\text{ज्या } (र \smile वि)}{\frac{त्रि^२}{४ \text{ विशं}}}$

अनेन लम्बनानयनमुपपद्यते ।

अथ पूर्वसाधितवित्रिभनतांशेषु वित्रिभशरं संस्कृत्य विमण्डलावधि चन्द्रदृक्क्षेपचापांशाः साधिताः सुखार्थं तत्समा रविदृक्क्षेपचापांशाः स्थूला अङ्गीकृताः । अतस्तयोर्दृक्क्षेपौ समौ जातौ । ततो 'रविशशिमध्यगतिगुणे' इत्यादिविधिना पृथक्-पृथक् नती प्रसाध्य तयोरन्तरं कृतमिति सुगमा वासना ॥२२-२४॥

वि. भा.—त्रिराशिहीनात् लग्नात् (राशित्रयरहितात् लग्नात् वित्रिभात्) येऽपक्रमांशाः (क्रान्त्यंशाः) तेषामक्षांशानामेकदिशां युतिः (योगः) भिन्नदिशां विशेषः (अन्तरं) स्वल्पाक्षेदेशे वित्रिभस्य याम्योत्तरवृत्तासन्ने स्थितत्वाद्वित्रिभनतांशा भवन्ति, तदूनात् (वित्रिभनतांशरहितात्) भत्रितयात् (राशित्रयात्) ज्या वित्रिभशङ्कुर्भवति । स च त्रिज्यार्धकृतेः (त्रिज्यार्धवर्गस्य) छेदः (हरः) भवति ।

छेदात् त्रिज्यार्धकृतेर्यत्फलं तेन वित्रिभलग्नार्कान्तरज्या हृता (भक्ता) लब्धं घटिकादि वा लम्बनं भवेत् । वित्रिभलग्नक्रान्त्यंशानां वित्रिभशरांशानामक्षांशानां चैकदिशां युतेर्विभिन्नदिशां वियुतेर्जीवा (ज्या) चन्द्रदृक्क्षेपः । सा (जीवा) रविचन्द्रमध्यगत्यन्तरेण सङ्गुणिता पञ्चदशभिर्गुणितया त्रिज्यया विभाजिता तदाऽवनतिः (स्पष्टनतिः) स्यादिति ॥२२-२३-२४॥

अत्रोपपत्तिः

याम्योत्तरवृत्त एव स्वल्पान्तरात् वित्रिभं मत्वा दिनार्धवत् तन्नतांशा उन्नतांशाश्च साध्याः । उन्नतांशज्या वित्रिभशङ्कुः ततः पूर्वोक्त्या लम्बनघटिकाः,

$$=\frac{४\,\text{ज्या}\,(\text{र}\sim\text{वि})}{\text{त्रि}}\times\frac{\text{विशं}}{\text{त्रि.}}=\frac{\text{ज्या}\,(\text{र}\sim\text{वि})}{\dfrac{\text{त्रि}^{२}}{४\,\text{विशं}}}=\frac{\text{ज्या}\,(\text{र}\sim\text{वि})}{\dfrac{\left(\frac{\text{त्रि}}{२}\right)^{२}}{\text{विशं}}}=\frac{\text{ज्या}(\text{र}\sim\text{वि})}{\text{फल.}}$$

एतेन लम्बनानयनमुपपद्यते ।

पूर्वसाधितवित्रिभनतांशेषु वित्रिभशरं संस्कृत्य विमण्डलपर्यन्तं चन्द्रदृक्क्षेपचापांशा साधिताः स्वल्पान्तरात्तत्तुल्या रविदृक्क्षेप चापांशाः स्वीकृताः, अतस्तयोर्दृक्क्षेपौ समौ जातौ, ततो "रविशशिमध्यगतिगुणे" इत्यादिना पृथक्-पृथक् नती प्रसाध्य तयोरन्तरमवनतिसंज्ञकमिति । अत्र वि=वित्रिभम् । ज्या (र—वि) =वित्रिभार्कान्तरज्या सिद्धान्तशेखरे "विपदोदयापमपलैकतान्तरात् त्रिगृहच्युतात् क्रमगुणेन भाजिता । त्रिभशिञ्जिनीदलकृतिः फलोद्धृता रविवित्रिभोदयवियोगशिञ्जिनी । अथवाऽपि लम्बनमृणं स्वमुक्तवत् विपदोदयापमपलैकतान्तरम् । त्रिगृहोनलग्नजशरेण मिश्रितं स्वदिगन्यथा तु वियुतं ततो गुणः । खनगैर्हृतो भवति वाऽवनतिरिति" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव केवलं 'खनगैर्हृतो भवति वाऽवनति' रित्याचार्योक्तादधिकं कथ्यते ।

'रविशशिमध्यगतिगुणे' इत्यादिना रविनतिः $=\dfrac{\text{रदृक्षे}\times\text{रमग}}{१५\cdot\text{त्रि}}$, चन्द्रदृक्क्षेपः

$=\dfrac{\text{चंदृक्षे}\times\text{चंमग}}{१५\cdot\text{त्रि}}$ अनयोरन्तरम् $\dfrac{\text{चंदृक्षेपो वा रविदृक्षे}\times\text{गत्यन्तर}}{१५\cdot\text{त्रि.}}=$

$\dfrac{\text{दृक्षे}\,(७६०।३५-५९।८)}{३४१५\times१५}=\dfrac{\text{दृक्षे}\times(७३१।२७)}{५१२२५}=\dfrac{\text{दृक्षे}}{७०}$ स्वल्पान्तरात् ।

"दृक्क्षेपात् सप्ततिहृतात् भवेद्वाऽवनतिः फलम्" इत्यनेन सूर्यसिद्धान्तेऽपि

प्रकारान्तरेणेदं नत्यानयनमुक्तम् । अत्र रविचन्द्रनती समे स्वीकृते आचार्येणेति ॥ २२-२३-२४॥

अब लघु कर्म से लम्बन और नति के साधन को कहते हैं

हि. भा.— राशित्रय रहित लग्न (वित्रिभ लग्न) से जो क्रान्त्यंश हो उसका और अक्षांश का एक दिशा में योग और भिन्न दिशा में अन्तर करने से स्वल्पाक्षांश देश में याम्योत्तर वृत्त के आसन्न में वित्रिभ के रहने से वित्रिभ नतांश होता है, इस को तीन राशि में घटाने से जो होता है उसकी ज्या वित्रिभशङ्कु है । त्रिज्यार्ध (त्रिज्या का आधा) वर्ग का वह (वित्रिभशङ्कु) छेद (हर) होता है, त्रिज्यार्ध वर्ग में छेद (हर) से भाग देने से जो फल होता है उससे वित्रिभलग्न और रवि की अन्तरज्या को भाग देने से लब्ध वा (प्रकारान्तर से) घटिकादिक लम्बन होता है ।. वित्रिभलग्न की क्रान्ति, वित्रिभ के शरांश और अव के एक दिशा में रहने से योग और भिन्न दिशा में रहने से अन्तर करने पर जो शेष रहता है उसकी ज्या चन्द्रदृक्क्षेप होता. है । उस (ज्या) को रवि और चन्द्र के मध्य गत्यन्तर से गुणा कर पन्द्रह गुणित त्रिज्या से भाग देने से अवनति (स्पष्टनति) होती है इति॥२२-२३-२४॥

उपपत्ति

स्वल्पान्तर से याम्योत्तरवृत्त ही में वित्रिभ का मान कर दिनार्धकाल की तरह वित्रिभनतांश और उन्नतांश साधन करना.। उन्नतांशज्या = वित्रिभशङ्कु.। तब "त्रिज्याकृतेश्चतुर्गुणशङ्कुहृतायाः" इत्यादि से लम्बनघटी $= \frac{४ ज्या (र \sim वि)}{त्रि} \times \frac{विशं}{त्रि}$

$= \frac{ज्या (र \sim वि)}{\frac{त्रि^2}{४ विशं}} = \frac{ज्या (र \sim वि)}{\frac{\left(\frac{त्रि}{२}\right)^2}{विशं}} = \frac{ज्या (र \sim वि)}{फल}$ इससे स्पष्ट लम्बनानयन उपपन्न होता है. ।

पूर्वसाधित वित्रिभनतांश में वित्रिभशर को संस्कार करने से विमण्डल पर्यन्त चन्द्रदृक्क्षेप चापांश होता है, स्वल्पान्तर से इसके समान ही रवि के दृक्क्षेप चापांश भी स्वीकार कर लिये गये । इसलिये दोनों (रवि और चन्द्र) का दृक्क्षेप बराबर हुआ ।

तब "रविचन्द्रमध्यगतिगुणे" इत्यादि से रवि और चन्द्र के पृथक्-पृथक् नतिसाधन कर दोनों का अन्तर अवनति (स्पष्टनति) होती है । यहां वि = वित्रिभ, ज्या (र ∼ वि) =

त्रिभार्कान्तरज्या, सिद्धान्तशेखर में "त्रिपदादयापमपलैकतान्तरात्" इत्यादि संस्कृतोपपत्ति में लिखित पद्यों से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है, केवल 'खनगैर्हृतो भवति वाऽवनतिः, यह आचार्योक्त से भिन्न कहते हैं। 'रविशशिमध्यगतिगुणे' इत्यादि से रविनति

$= \frac{\text{दृक्षेप}\cdot\text{रमग}}{१५.\text{त्रि}}$,चन्द्रनति $= \frac{\text{दृक्षेप}.\text{चंमग}}{१५ \text{ त्रि}}$ दोनों का अन्तर करने से $\frac{\text{दृक्षेप}.\text{गत्यन्तर}}{१५.\text{त्रि}} =$

$\frac{\text{दृक्षेप}.(७९०।३५-५९।८)}{३४१५\times १५} = \frac{\text{दृक्षेप}(७३१।२७)}{५१२२५} = \frac{\text{दृक्षेप}}{७०}$ = स्पष्टनति, स्वल्पान्तर से, इस से 'खनगैर्हृतो भवति वाऽवनतिः' यह श्रीपत्युक्त प्रकार तथा 'दृक्क्षेपात् सप्ततिहृतात् भवेद्वाऽवनतिः फलम्, यह सूर्यसिद्धान्तोक्त स्पष्टनत्यानयनप्रकार उपपन्न होता है, इति॥२२-२३-२४॥

इदानीं विशेषमाह

पूर्ववदन्यत् स्पष्टं ब्रह्मोक्तस्पष्टसूर्यशशिपातैः ।
नार्यभटादिभिरुक्तं यतोऽस्फुटास्ते ततोऽस्पष्टम् ।।२५।।

सु. भा.—अन्यदवशिष्टं स्थित्यर्धादिसाधनं पूर्ववत्। एवं ब्रह्मोक्तस्पष्टसूर्यशशिपातैर्ग्रहणं स्पष्टं दृग्योग्यं भवति। यत आर्यभटादिभिर्ये स्पष्टसूर्यशशिपाता उक्तास्तेऽस्फुटा न दृष्टियोग्यास्ततस्तदुक्तं रविशशिपातैर्ग्रहणमस्पष्टं न दृष्टियोग्यमित्यर्थः ॥२५॥

वि. भा.—अन्यदवशिष्टं (स्थित्यर्धादिकं) पूर्ववत् (चन्द्रग्रहणोक्तसाधनविधिवत्) भवति, ब्रह्मोक्तस्पष्टसूर्यशशिपातैः (मत्कथितस्पष्टरविचन्द्रपातैः) ग्रहणं स्पष्टं (दृग्योग्यं) भवति, आर्यभटादिभिराचार्यैर्यदुक्तं ततो न (दृग्योग्यं न भवति) यतस्ते (आर्यभटादिकथितस्पष्टसूर्यशशिपाताः) ऽस्फुटास्ततस्तदुक्तं ग्रहणमस्पष्टं (न दृष्टियोग्यमिति)। सिद्धान्तशेखरे ग्रहणाध्यायोपसंहारे 'न स्फुटं भवति पञ्चजीवया लम्बनं न हि यतस्ततः कृतम्। युक्तमुक्तमिति जिष्णुसूनुना तन्मयाऽपि कथितं परिस्फुटम्' ऽनया श्रीपत्युक्त्या सूर्यग्रहणाध्यायः श्रीपतिना ब्रह्मगुप्तोक्तानुरूप एवोक्त इति सूच्यते। "दृग्गणितैक्यं न भवति यस्मात् पञ्चज्यया रविग्रहणे। तस्माद्यथा तदैक्यं प्रवक्ष्यामि तिथ्यन्ते" इत्याचार्योक्तव्याख्यायां चतुर्वेदाचार्यः—

"पञ्चज्यया पञ्चज्याविधानेन रविग्रहणं यदाचार्यैरुपनिबद्धं तद्यथा। उदयज्या, शङ्कुज्या, मध्यज्या, दृग्गतिज्या, दृक्क्षेपज्या च। एताभिरार्यभटादिभिस्तथा पौलिशतन्त्रे पञ्चज्याश्चन्द्रमसः स्वदिनगतशेषचरदलक्रान्त्यादिभिः

कल्पिताः। एवं तत्र दशज्याविधानेन रविग्रहणं यदुपनिबद्धं तादृशममान्ते भवति। ये च तत्र दोषास्तानाचार्य एव वक्ष्यति तन्त्रपरीक्षाध्याये वयमपि तत्रैव व्याख्यास्यामः।' तन्त्र परीक्षाध्याये च

"पञ्चज्यया यतोऽर्कग्रहणं श्रीषेणविष्णुचन्द्रकृतम्।
आर्यभटोक्तान्यनयोरर्कग्रहदूषणानि ततः॥
एवं विचार्यमाणे पञ्चज्यालम्बनं महास्थूलम्।
स्थूलाऽवनतिश्च तथा दशज्यया लम्बनावनती॥

इत्यादिनोक्तं विचार्य 'न स्फुटं भवति पञ्चजीवयेति' श्रीपतिनोक्तम्। सूर्यसिद्धान्ते, शिष्यधीवृद्धिदे लल्लाचार्येण च पूर्वोक्तपञ्चजीवयैव रविग्रहणानयनमुक्तं तत् सदोषं ज्ञात्वा श्रीपतिनाऽऽचार्य (ब्रह्मगुप्त) कथितमार्ग एवावलम्बित इति॥२५॥

अब विशेष कहते हैं

हि. भा.— अन्य जो शेष (स्थित्यर्धादि साधन) रह गया है वह पूर्ववत् (चन्द्रग्रहणोक्त साधन की तरह) होता है, ब्रह्म (आचार्य) कथित स्पष्ट रवि, स्पष्टचन्द्र और स्पष्ट पात से ग्रहण स्पष्ट (दृष्टियोग्य) होता है, आर्यभटादि आचार्यों से जो कथित है उससे दृष्टियोग्य नहीं होता है, क्योंकि वे (आर्यभटादिकथित स्पष्टरवि, स्पष्टचन्द्र और स्पष्ट पात) अस्फुट हैं इसलिये तत्कथित ग्रहण अस्पष्ट (दृष्टिगोचर नहीं) है इति सिद्धान्तशेखर में "न स्फुटं भवति पञ्चजीवया" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से, सूचित होता है कि श्रीपति ने सूर्यग्रहणाध्याय में आचार्योक्त के अनुरूप ही कहा है। "दृग्गणितैक्यं न भवति" इत्यादि संस्कृतोपपत्ति में लिखित आचार्योक्त पद्य की व्याख्या चतुर्वेदाचार्य इस तरह कहते हैं। पञ्चज्याविधान से सूर्यग्रहण जो आचार्य से कथित है वह यह है 'उदयज्या, मध्यज्या, शङ्कुज्या, दृग्गतिज्या, दृक्क्षेपज्या इन से आर्यभटादि आचार्य द्वारा तथा पौलिशतन्त्र में चन्द्रमा की पञ्चज्या स्वदिनगत-शेष, चरखण्ड, क्रान्ति आदियों से कल्पित है। इस तरह उस में दशज्या विधान से रविग्रहण साधन जो कहा गया है वह अमान्त में होता है, उसमें जो दोष है उनको तन्त्रपरीक्षा अध्याय में आचार्य कहेंगे मैं भी वहीं व्याख्या करूंगा। तन्त्रपरीक्षा अध्याय में "पञ्चज्यया यतोऽर्कग्रहणं" इत्यादि संस्कृतोपपत्ति में लिखित श्लोकोक्त को विचार कर 'न स्फुटं भवति पञ्चजीवया" यह श्रीपति ने कहा है। सूर्यसिद्धान्त में, शिष्यधीवृद्धद में लल्लाचार्य ने पूर्वोक्त पञ्चज्या ही से सूर्यग्रहण साधन कहा है, उसको दोषावह समझकर श्रीपति ने आचार्य (ब्रह्मगुप्त) कथित मार्ग ही का अवलम्बन किया है॥२५॥

इदानीं ग्रहणे वर्णमाह

अङ्गुलमात्रे विरते रक्तः शशिमण्डले भवेद्वर्णः ।
भानोस्तु पुनः कृष्णो वर्णः सर्वत्र निर्दिष्टः ॥२६॥

सु. भा.—शशिमण्डले चन्द्रबिम्बेऽङ्गुलमात्रे विरते विरामतां गते भानोर्वर्णो रक्तो भवेत् । अर्थाद्रविग्रहणे चन्द्रबिम्बस्य छादकत्वादङ्गुलमात्रेऽपि विरते यत्र ग्रासाभावोऽर्थाद्यद्रविबिम्बमवशिष्टं तद्रक्तमेव भवति । अवशिष्टमङ्गुलमात्रं वा यथेच्छं ततोऽप्यल्पं भवेत् । अन्यत्र सर्वत्र तु पुनः कृष्णवर्णो गणकैर्निर्दिष्टः कथितः अर्थाद् ग्रस्तं रविबिम्बमङ्गुलाल्पं वा यथेच्छं ततोऽप्यधिकं सर्वदा कृष्णमेव भवतीत्यर्थः ॥२६॥

वि. भा.—शशिमण्डले (चन्द्रबिम्बे) ऽङ्गुलमात्रे विरामतां प्राप्ते भानोः (सूर्यस्य) वर्णो रक्तो भवति, अर्थात् सूर्यग्रहणे चन्द्रबिम्बस्य छादकत्वादङ्गुलमात्रेऽपि विरते यत्र ग्रासाभावोऽर्थात्सूर्यबिम्बमवशिष्टं तद्रक्तमेव भवति । अवशिष्टमङ्गुलमात्रं वा यथेच्छं ततोऽप्यल्पं भवेत् । अन्यत्र सर्वत्र पुनः कृष्णो वर्णो गणकैः कथितः । अर्थाद् ग्रस्तं रविबिम्बमङ्गुलाल्पं वा यथेच्छं ततोऽप्यधिकं सर्वदा कृष्णमेव भवतीति ।

अब ग्रहण में वर्ण को कहते हैं

हि. भा.— एक अङ्गुल मात्र में सूर्यग्रहण में सूर्य बिम्ब में चन्द्र बिम्ब विरामता को प्राप्त करे अर्थात् स्थिर हो तब सूर्य का वर्ण रक्त (लाल) होता है, अन्यत्र सब जगह कृष्ण वर्ण होता है अर्थात् ग्रस्त (चन्द्र बिम्ब से ढका हुआ रवि बिम्ब) रवि बिम्ब एक अङ्गुल से अल्प वा अधिक हो तो सदा उनका (सूर्य का) वर्ण कृष्ण ही होता है इति॥२६॥

इदानीं सूर्यग्रहणाधिकारोपसंहारमाह

इष्टग्रासविमर्दस्थित्यर्धावनतिलम्बनाद्येषु ।
आर्याषड्विंशत्याऽर्कग्रहणं पञ्चमोऽध्यायः ॥२७॥

सु. भा.—स्पष्टार्थम् ॥२७॥

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते । हृदि तं विनिधाय नूतनोऽयं रचितः सूर्ययुतौ सुधाकरेण ।

इति श्रीकृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्तनूतनतिलके सूर्यग्रहणाधिकारः पञ्चमः ॥५॥

वि. भा.—इष्टग्रास-विमर्दार्ध-स्थित्यर्ध-स्पष्टनतिस्पष्टलम्बनाद्येषु विषयेषु-...

षड्विंशतिप्रमिताऽऽर्याश्लोकेन सूर्यग्रहणनामकः पञ्चमोऽध्यायः समाप्त इति ।।२७।।

इति ब्रह्मगुप्तविरचिते ब्राह्मस्फुटसिद्धान्ते सूर्यग्रहणाधिकारः पञ्चमः ।।५।।

अब सूर्यग्रहणाधिकार के उपसंहार को कहते हैं

हि. भा.—इष्टग्रास-विमर्दार्ध-स्थित्यर्ध-स्पष्टनति स्पष्टलम्बनादियों में छब्बीश आर्या छन्द के श्लोकों से सूर्यग्रहण नामक पांचवा अध्याय समाप्त हुआ। इति।।२७।।

इति ब्रह्मगुप्तविरचित ब्राह्मस्फुटसिद्धान्त सूर्यग्रहणाधिकार समाप्त हुआ ।।५।।



ब्राह्मस्फुटसिद्धान्तः

७

उदयास्ताधिकारः

ब्राह्मस्फुटसिद्धान्तः

उदयास्ताधिकारः

अथोदयास्ताधिकारः प्रारभ्यते । तत्रादौ तदारम्भप्रयोजनमाह

ग्रहभास्करान्तरैः प्राक् पश्चादर्कग्रहान्तरैर्यस्मात् ।
स्वांशैर्दृश्यादृश्यास्तस्माद्वक्ष्ये तदानयनम् ॥१॥

सु. भा.—प्राक् पूर्वक्षितिजे ग्रहभास्करान्तरैः स्वांशैः स्वकालांशैः पश्चात् पश्चिमक्षितिजेऽर्कग्रहान्तरैः स्वकालांशैर्यतो यथासंख्यं ग्रहा दृश्यादृश्या भवन्ति । तस्मात् तदानयनं ग्रहार्कान्तरानयनं वक्ष्येहमिति । अर्थात् प्राक्क्षितिजे यस्मिन् दिने ग्रहोदयादनन्तरं कालांशघटीभी रवेरुदयस्तस्मिन् दिने ग्रहो रात्रिशेषे दृश्यो भवति । एवं यस्मिन् दिने पश्चिमक्षितिजे रव्यस्तानन्तरं कालांशघटीभिर्ग्रहस्यास्तमयस्तस्मिन् दिने सायंकाले ग्रहस्यादृश्यत्वम् । अत उदयास्तज्ञानं ग्रहार्कान्तरघटिकाधीनं तदानयनायायमध्यायोऽवश्यमारम्भणीय इति ॥१।

वि. भा.—यस्मात् कारणात् प्राक् (पूर्वक्षितिजे) ग्रहभास्करान्तरैः (ग्रहसूर्यान्तरैः) स्वांशैः (स्वकालांशैः) पश्चात् (पश्चिमक्षितिजे) अर्कग्रहान्तरैः स्वकालांशैर्यथासंख्यं ग्रहा दृश्यादृश्या भवन्ति, एतदुक्तं भवति पूर्वक्षितिजे यस्मिन् दिने ग्रहोदयानन्तरं कालांशघटीभी रवेरुदयस्तस्मिन् दिने ग्रहो रात्रिशेषे दृश्यो भवति, एवं यस्मिन् दिने पश्चिमक्षितिजे सूर्यास्तानन्तरं कालांशघटीभिर्ग्रहस्यास्तमयस्तस्मिन् दिने सायंकाले ग्रहोऽदृश्यो भवति, तस्मात् कारणादुदयास्तज्ञानस्य ग्रहरव्यन्तरघटिकाधीनत्वात्तदानयनं (ग्रहरव्यन्तरसाधनं) वक्ष्येऽहमिति सिद्धान्तशेखरे श्रीपतिना "प्राक् खेचरार्कविवरप्रभवैर्यतोऽशैः पश्चात् सहस्रकिरणद्युचरान्तरस्थैः । तिग्मांशुसन्निधिवशात् स्फुरदृश्यदृश्यास्तस्माद् ब्रवीम्यथ तदानयनं स्फुटार्थम्" ऽऽचार्योक्तानुरूपमेवोक्तमिति ॥१॥

अब उदयास्ताधिकार प्रारम्भ किया जाता है, पहले आरम्भ करने के प्रयोजन को कहते हैं

हि. भा.—जिस कारण से पूर्वक्षितिज में ग्रह और रवि का अन्तर रूप स्वकालांश करके ग्रह दृश्य होते हैं, पश्चिम क्षितिज में रवि और ग्रह का अन्तररूप स्वकालांश करके

ग्रह अदृश्य हैं, अर्थात् पूर्वक्षितिज में जिस ग्रहोदय के बाद कालांश घटीतुल्यकाल में रवि का उदय होता है उस दिन ग्रह रात्रिशेष में दृश्य होते हैं । इसी तरह जिस दिन पश्चिम क्षितिज में सूर्यास्त के बाद कालांशघटीमित काल में ग्रह अस्त होते हैं उस दिन सायंकाल में ग्रह अदृश्य होते हैं, उस कारण से उदय और अस्त का ज्ञान ग्रहार्कान्तरघटी के अधीन होने के कारण उसके आनयन (ग्रह और रवि के अन्तर) को मैं कहता हूँ इति ॥१॥

इदानीं सूर्यसान्निध्यवशेन ग्रहाणां दृश्यादृश्यत्वमाह

प्रागूनभुक्तिरूनो दृश्योऽदृश्योऽन्यथा रवितः ।
दृश्योऽधिकगतिरधिकोऽदृश्यः पश्चाद् ग्रहोऽल्पगतिः ॥२॥

सु. भा.—रवित ऊनो रवेरूनभुक्तिर्ग्रहो प्राक् प्राच्यां दिशि रात्रिशेषे रवितः कालांशान्तरितो दृश्यो भवति । अन्यथा रवेरधिकगतिर्ग्रहो रवित ऊनः प्राच्यां दिशि रात्रिशेषे रवितः कालांशान्तरितोऽदृश्यो भवति । एवमधिकगतिर्ग्रहो रवितोऽधिकः कालांशान्तरितः पश्चात् पश्चिमायां दिशि दृश्यो भवति। अल्पगतिश्च रवितोऽधिकः कालांशान्तरितस्तत्रैवादृश्यो भवति ।

अत्रोपपत्तिः । 'रवेरूनभुक्तिर्ग्रहः प्रागुदेतीत्यादिभास्करविधिना स्फुटा (ग्र. ग. उ. अ. ४) ॥

वि. भा.—रवित ऊनः (अल्पः) ऊनभुक्ति (स्वल्पगति) ग्रहः प्राक् (पूर्वस्यां) दिशि दृश्यो भवति, अन्यथा (रवेरधिकगतिग्रहो न्यूनश्च) प्राक् दिश्यदृश्यो भवति । एवं रवितोऽधिकगतिरधिकश्च ग्रहः पश्चात् (पश्चिमायां दिशि) दृश्यो भवति अल्पगतिश्च ग्रहो रवितोऽधिकः पश्चाददृश्यो भवतीति ॥२॥

अत्रोपपत्तिः

रवितोऽल्पगतिका ग्रहा सूर्यसान्निध्यवशेनादृश्यबिम्बका यदा सूर्येण याम्यं प्राप्तास्तदा स परमास्तकालः । ततोऽनन्तरं रविः शीघ्रगतित्वादग्रतो गच्छन् पूर्वक्षितिजे ग्रहोदयानन्तरमुत्तरोत्तरवृद्ध्या समागच्छति, ग्रहाणामेतेषां प्रथमदर्शनरूप उदयो रात्रिशेषे भवेदिति पूर्वस्यां दिश्युदयः । ततोऽन्तरवृद्ध्यैषां पश्चाद् भागे रवौ समागते एषां पश्चिमदिशि दर्शनं तत्रैव निश्चितकालांशतुल्येऽन्तरेऽवशिष्टेऽदर्शनमिति पश्चिमायामस्तत्वम् । रवितोऽधिकगतीनां ग्रहाणां परमास्तसमयादग्रतो गमनात् सूर्यास्तानन्तरं दर्शनसम्भवात् पश्चिमोदयः । परावर्त्य रवितः पश्चाद्भागे समायातेषु रात्रिशेषे तेषां दर्शनात् तत्रैव कालांशतुल्येऽन्तरेऽस्तसम्भावनातः पूर्वास्तगामित्वम् । वक्रगयोर्बुधशुक्रयो रवेरल्पगतित्वात्तयोः पूर्व-

दिश्युदयः । पश्चादस्तमयश्च भवेत् । तेन ऋजुबुधशुक्रौ पश्चिमायामुद्गम्य तत्रैव वक्रगत्याऽस्तमयं यातः । रवेरग्रतः पृष्ठतो वा मन्दफलशीघ्रफलयोगाधिकगमनाभावादुदयास्तमयसमययोरभ्यन्तरे वक्रगतित्वाच्च रवितोऽल्पगतित्वं रवितोऽधिकगतित्वं चानयोर्भवतः । तेन पूर्वापरयोरुभयोरपि दिशोरुदयास्तौ भवेतामिति । सिद्धान्तशेखरे "ऊनो ह्यूनगतिः सहस्रकिरणाद् दृश्यो भवेत् प्राग्ग्रहः पश्चादभ्यधिकस्तथाऽधिकगतिः स्यात् प्रागदृश्यः पुनः । स्वल्पोऽनल्पगतिस्तथोनगतिकः पश्चाददृश्योऽधिकः कालांशैरधिकोनकस्तु कथितैरिति" ऽनेन श्रीपतिना ऽऽचार्योक्तानुरूपमेवोक्तं सिद्धान्तशिरोमणौ "रवेरूनभुक्तिर्ग्रहः प्रागुदेतीत्यादिना" भास्करेणाप्येवमेव कथ्यत इति ॥२॥

अब सूर्यसान्निध्यवश से ग्रहों के दृश्यत्व और अदृश्यत्व को कहते हैं

हि. भा.—रवि से अल्प और अल्पगतिग्रह पूर्वदिशा में दृश्य होते हैं । अन्यथा (रवि से अधिक गतिग्रह और न्यून) पूर्वदिशा में अदृश्य होते हैं । एवं रवि से अधिक गतिग्रह और अधिक पश्चिम दिशा में दृश्य होते हैं । अल्पगतिग्रह और रवि से अधिक पश्चिम दिशा में अदृश्य होते हैं इति ॥२॥

उपपत्ति

रवि से अल्पगतिकग्रह सूर्यसान्निध्य (समीपता) वश से जिनके बिम्ब अदृश्य हैं वे जब सूर्य के साथ तुल्यता को प्राप्त होते हैं तब परमास्तकाल होता है। उसके बाद रवि शीघ्रगति होने के कारण आगे जाते हुए पूर्व क्षितिज में ग्रहोदय के बाद धीरे-धीरे आता है । इन ग्रहों का प्रथमदर्शन रूप उदय रात्रिशेष में होता है अतः पूर्वदिशा में उदय होता है, बाद में अन्तर वृद्धि से इन ग्रहों के पश्चाद् भाग में रवि के आने से पश्चिम दिशा में इन ग्रहों का दर्शन होता है, वहीं पर निश्चित कालांश तुल्य अन्तर में अदर्शन (नहीं देखना) होता है, अतः पश्चिम दिशा में अस्तत्व होता है, रवि से अधिक गति ग्रहों के परमास्त समय से आगे जाने से सूर्यास्त के बाद दर्शन सम्भव से पश्चिम दिशा में उदय होता है, लौटकर रवि से पश्चाद् भाग में आने पर उसके रात्रि शेष में दर्शन से वहीं पर कालांश तुल्य अन्तर में अस्तसम्भावना से पूर्वदिशा में अस्तगामित्व होता है । वक्रगति बुध और शुक्र के रवि से अल्पगतित्व के कारण पूर्वदिशा में उदय होता है, और पश्चिम दिशा में अस्त होता है, इसलिये ऋजु (मार्गी) बुध और शुक्र पश्चिम दिशा में उदित होकर वहीं वक्रगति से अस्तत्व प्राप्त होते हैं। रवि से आगे या पीछे मन्दफल और शीघ्रफल के योग से अधिक चलना नहीं हो सकता है इसलिये उदयकाल और अस्तकाल के अभ्यन्तर में वक्रता से इन दोनों (बुध और शुक्र) का रवि से अल्पगतित्व और अधिक गतित्व होता है, इसलिये पूर्वदिशा में और पश्चिमदिशा में (दोनों में) इन दोनों का उदय और अस्त होता है । सिद्धान्तशेखर में "ऊनो ह्यूनगतिः सहस्रकिरणाद् दृश्यो भवेद् प्राग्ग्रहः" इत्यादि

संस्कृतोपपत्ति में लिखित पद्यों से श्रीपति आचार्योक्तानुरूप ही कहते हैं। सिद्धान्त-शिरोमणि में "रवेरूनभुक्तिर्ग्रहः प्रागुदेति" इत्यादि से भास्कराचार्य ने भी इन्हीं बातों को कहा है इति ॥२॥

इदानीं ग्रहबिम्बोदयास्तलग्नानयनार्थमायनदृक्कर्मानयनमाह

विक्षेपसत्रिराशिक्रान्तिवधो व्यासदलहृतो लिप्ताः ।
शोध्यास्तयोः समदिशोर्यद्यन्यदिशोस्तयोः क्षेप्याः ॥३॥

सु. भा.—सत्रिराशिक्रान्तिः सत्रिभग्रहक्रान्तिज्या द्युज्यावृत्ते आयनवलनमाचार्यमते स्थूलां द्युज्यां त्रिज्यामितां प्रकल्प्य तदेवायनं वलनम् । तयोर्विक्षेपायनवलनयोः शेषं स्पष्टार्थम् ।

अत्रोपपत्तिः । 'आयनं वलनमस्फुटेषुणा सङ्गुणं द्युगुणभाजितं हृतम्' इत्यादि भास्करविधिना द्युज्यां त्रिज्यासमां राश्युदयासून् राशिकलामितान् १८०० प्रकल्प्य स्फुटा ज्ञेया । वस्तुतो बिंबीयद्युज्ययाऽऽयनदृक्कर्म सूक्ष्मं भवति, भास्करेणापि स्थानीयद्युज्यां गृहीत्वा स्थूलमेवेदमानीतमिति सिद्धान्तविदां स्फुटम् ॥३॥

वि. भा.—विक्षेपसत्रिराशिक्रान्तिवधः (शरसत्रिभग्रहक्रान्तिघातः) व्यासदलहृतः (त्रिज्यया भक्तः) फलतो या लिप्ताः (कलाः) ताः समदिशोः (एकदिक्कयोः) तयोः (शरसत्रिराशिक्रान्त्योः) ग्रहे शोध्याः, अन्यदिशोस्तयोः (भिन्नदिक्कयोः शरसत्रिराशिक्रान्त्योः) ग्रहे क्षेप्याः (योज्याः) इति प्रथमं दृक्कर्म आयनाख्यमस्तीति. ॥३॥

अत्रोपपत्तिः

ग्रहबिम्बकेन्द्रोपरिगतं कदम्बप्रोतवृत्तं क्रान्तिवृत्ते यत्र लगति तदेव ग्रहस्थानम् । स्थानोपरि बिम्बोपरि च गतं ध्रुवप्रोतवृत्तं कार्यं, स्थानीयाहोरात्रवृत्तं बिम्बीयाहोरात्रवृत्तं च कार्यं तदा स्थानोपरिगतध्रुवप्रोतवृत्तकदम्बप्रोतवृत्तयोरन्तरे बिम्बीयाहोरात्रवृत्तीयं चापमायनदृक्कर्म वा स्थानबिम्बयोरुपरिगतध्रुवप्रोतवृत्तयोरन्तर्गतं नाड़ीवृत्तीयचापम् ग्रहबिम्बकेन्द्राद् ग्रहस्थानं यावद् ग्रहमध्यमशरः । स्थानगतकदम्बप्रोतवृत्तध्रुवप्रोतवृत्तयोरुत्पन्नकोणः स्थानीयमायनवलनमिदं (द्युज्याग्रीयमायनवलनं) सत्रिभग्रहक्रान्तिसमं भवति । ततो ग्रहमध्यमशर एको भुजः । बिम्बकेन्द्रात्स्थानगतध्रुवप्रोतवृत्तोपरिलम्बचापं द्वितीयो भुजः । स्थानगतध्रुवप्रोतवृत्ते तृतीयो भुजः । त्रिभुजेऽस्मिन् कोणानुपातः क्रियते यदि त्रिज्यया मध्यमशरज्या लभ्यते तदाऽऽयनवलनज्यया

किमित्यनुपातेन समागच्छति लम्बचापज्या $\frac{\text{मशज्या. आयनवज्या}}{\text{त्रि}}$ यावती लम्बज्या तावत्येव बिम्बीयाहोरात्रवृत्तीयायनदृक्कर्मासुज्याऽतः

$\frac{\text{मशज्या. आयनवज्या}}{\text{त्रि}}$ = आयनदृक्कर्मासुज्या, ज्याचापयोरभेदत्वस्वीकार

$\frac{\text{मशर. आयनवलन}}{\text{त्रि}}$ = आयनदृक्कर्मासव: । आचार्येण स्वल्पान्तरत्वात् त्रि = स्थानीयद्यु स्वीकृतम् एतद्वशेनाऽयनदृक्कर्मकलानयन $\frac{\text{'१८०० × आयनदृक्कर्मासु'}}{\text{ग्रहाक्रान्तराशेर्निरक्षोदयासु}}$ मेतेन सुगममेव । इदमानयनं बिम्बीयद्युज्यावशेन समीचीनं भवितुमर्हति, परं बिम्बीयद्युज्याया अज्ञानात्स्थानीयद्युज्यावशेनैवानयनमभिहितं तत्रापि त्रिज्याद्युज्ययो: समत्वस्वीकरणजनितदोषस्तु वर्त्तत एव । सिद्धान्तशिरोमणौ "आयनं वलनमस्फुटेषुणा सङ्गुणं द्युगुणभाजितं हृतम् । पूर्णपूर्णधृति १८०० भिर्ग्रहाश्रितव्यक्षभोदयहृदायना: कला:" भास्कराचार्येणापि त्रिज्यासमामेव द्युज्यां मत्वाऽऽयनदृक्कर्मानयनमभिहितम् । सिद्धान्तशेखरे "विक्षेपसत्रिभखगोत्क्रमजाऽऽमज्या-घाते गृहत्रयगुणेन हृते कलास्ता: । शोध्यास्तयो: समदिशो: खचरेषु देया भिन्नाशयो र्भवति दृग्विधिरेष पूर्व:' श्लोकेनानेन श्रीपतिना लल्लाचार्योक्तसत्रिभग्रहोत्क्रमज्यासाधितक्रान्तिज्यातुल्याऽयनवलनज्यात आयनदृक्कर्मानयनं कृतं, श्रीपतिर्बहुधाऽऽचार्यमतानुसरणं कुर्वन्नपि कुत्रचित् कुत्रचित् स्थले लल्लोक्तमपि आचार्यमतविरुद्धं स्वीचकार, सत्रिभग्रहक्रांतिज्या द्युज्याप्रीयाऽयनवलनज्या समा भवति, न हि सत्रिभग्रहोत्क्रमज्यासाधितक्रान्तिज्याऽऽयनवलनतुल्या भवत्यतो लल्लाचार्योक्तं श्रीपत्युक्तं चायनदृक्कर्मसाधनं न युक्तम् । सूर्यसिद्धान्ते 'सत्रिभग्रहजक्रान्तिभागघ्ना क्षेपलिप्तिका इत्यादि" ऽयनदृक्कर्मानयनं लल्लाचार्यश्रीपतिसाधिताऽऽयनदृक्कर्माभ्यां किञ्चित् सूक्ष्मं परं केषामप्यानयनं वास्तवं नास्तीति विज्ञैर्बोध्यमिति ॥३॥

अब ग्रहबिम्बोदयास्तलग्नसाधन के लिये आयनदृक्कर्म साधन को कहते हैं

हि. भा.—शर और सत्रिभ ग्रह क्रान्ति के घात को त्रिज्या से भाग देने से जो फल हो उसकी कला को शर और सत्रिभ ग्रह क्रान्ति के एक दिशा रहने से ग्रह में घटा देना भिन्न दिशा रहने से ग्रह में जोड़ना चाहिये इति ॥३॥

उपपत्ति

ग्रहबिम्बकेन्द्रोपरिगतकदम्बप्रोतवृत्त क्रान्तिवृत्त में जहां लगता है वह ग्रहस्थान

है, स्थान से बिम्बकेन्द्र तक ग्रह का मध्यमशर है स्थानोपरिगत तथा बिम्बोपरिगत ध्रुव-प्रोतवृत्त करना, स्थानीयाहोरात्रवृत्त और बिम्बीयाहोरात्रवृत्त कर देना, तब स्थानोपरिगत ध्रुवप्रोतवृत्त और स्थानोपरिगत कदम्बप्रोतवृत्त के अन्तर्गत बिम्बीयाहोरात्रवृत्तीय चाप आयन दृक्कर्मासु है अथवा स्थानोपरिगत ध्रुवप्रोतवृत्त तथा बिम्बोपरिगत ध्रुवप्रोतवृत्त के अन्तर्गत नाड़ीवृत्तीय चाप आयन दृक्कर्मासु है, स्थानगत कदम्बप्रोतवृत्त और ध्रुवप्रोतवृत्त से उत्पन्न कोण स्थानीय आयनवलन है, द्युज्याग्रीय आयनवलन सत्रिभग्रह की क्रान्ति के बराबर होता है, तब ग्रह का मध्यमशर एकभुज, बिम्बकेन्द्र से स्थानगत ध्रुवप्रोतवृत्त के ऊपर लम्बवृत्तीय चाप द्वितीय भुज, स्थानगत ध्रुवप्रोतवृत्त में तृतीय भुज, इन तीनों भुजों से उत्पन्न चापीयजात्यत्रिभुज में कोणानुपात करते हैं यदि त्रिज्या में मध्यमशरज्या पाते हैं तो आयन वलनज्या में क्या इससे लम्बवृत्तीय चापज्या आती है, $\frac{\text{मशरज्या.आयनवज्या}}{\text{त्रि}}$ = लंवृचापज्या परन्तु लम्बवृत्तीय चाप-ज्या और बिम्बीयाहोरात्रवृत्तीयायनदृक्कर्मासुज्या बराबर है इसलिये $\frac{\text{मशरज्या.आयनवज्या}}{\text{त्रि}}$ = आयनदृक्कर्मासुज्या, = $\frac{\text{मशरज्या.सत्रिभग्रक्रांज्या}}{\text{त्रि.}}$ ज्या और चाप का अभेदत्व स्वीकार करने से $\frac{\text{मशर.सत्रिभग्रक्रान्ति}}{\text{त्रि}}$ आयनदृक्कर्मासु, यहां आचार्य ने स्वल्पान्तर से त्रि = स्थानीय द्युज्या स्वीकार किया है। इसके वश से आयन दृक्कर्मकलानयन करते हैं $\frac{१८०० \times \text{आयनदृक्कर्मासु}}{\text{ग्रहाक्रान्त राशि के निरक्षोदयासु}}$ = आयनदृक्कर्मकला बिम्बीय द्युज्या वश से आयन दृक्कर्मानयन समीचीन हो सकता है, लेकिन बिम्बीय द्युज्या विदित नहीं है, स्थानीय द्युज्या वश ही से आचार्य ने आनयन किया है तथा द्युज्या को त्रिज्या के बराबर मान लिया है इसलिये यह आनयन ठीक नहीं है। सिद्धान्त-शिरोमणि में "आयनं वलनमस्फुटेषुणा सङ्गुणं" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से आयन दृक्कर्मानयन किया है, लेकिन भास्कराचार्य ने भी त्रिज्या तुल्य ही द्युज्या स्वीकार की है, सिद्धान्तशेखर में 'विक्षेपसत्रिभखगोत्क्रमजाऽपमज्या' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने लल्लाचार्योक्त सत्रिभग्रह की उत्क्रमज्या से साधित क्रान्तिज्या तुल्य आयनवलज्या से आयनदृक्कर्मानयन किया है। श्रीपति ने बहुत स्थानों में आचार्य (ब्रह्मगुप्त) मत का अनुसरण करते हुये भी किसी-किसी स्थल में आचार्यमत के विरुद्ध लल्लोक्त को भी स्वीकार किया है, सत्रिभग्रह क्रान्तिज्या और द्युज्याग्रीयायनवलज्या बराबर होती हैं। सत्रिभग्रहोत्क्रमज्या साधित क्रान्तिज्या, आयनवलनज्या के तुल्य नहीं होती है। इसलिये लल्लाचार्योक्त और श्रीपत्युक्त आयन दृक्कर्मानयन ठीक नहीं है, सूर्यसिद्धान्त में "सत्रिभग्रहजक्रान्तिभागघ्ना क्षेपलिप्तिका" इत्यादि से आयन दृक्कर्मानयन, लल्लाचार्य और श्रीपति से साधित आयन दृक्कर्मों से किञ्चित् सूक्ष्म है, लेकिन किसी भी आचार्य का दृक्कर्मानयन ठीक नहीं है इति॥३॥

इदानीमाक्षदृक्कर्मानयनमाह

विषुवच्छायागुणिताद्विक्षेपाद् द्वादशोद्धृतात् सौम्यात् ।
फलमृणं धनं धनमृणं याम्यादुदयास्तमयलग्ने ॥४॥

सु. भा.—सौम्यात् शरात् फलमुदयलग्नसाधने फलं कलात्मकमृणमस्तलग्न-साधने च धनं याम्याद्विक्षेपाच्च फलं क्रमेण धनमृणं ज्ञेयं पूर्वसाधितायनदृक्कर्म-संस्कृतग्रहे तदोदयास्तलग्ने भवतः ।

अत्रोपपत्तिः । क्षितिजे स्थूलादक्षज्यासममक्षवलनं कदम्बाभिमुखं गणिता-गतशरं च स्वल्पांतराद् ध्रुवाभिमुखं स्पष्टशरं च प्रकल्प्य 'लम्बज्यययाऽक्षजं चेत् स्याद्वलनं किं स्फुटेषुणा' इत्यादिभास्करविधिना त्रिज्यासमां द्युज्या राश्युदयासून्

खखाष्टेन्दुसमान् प्रकल्प्याक्षजदृक्कर्मकला$=\frac{\text{ज्या अ· श}}{\text{ज्याल}}=\frac{\text{वि· श}}{१२}$ । 'अथ तैः शरे तु याम्योत्तरे क्रमविलोमविधानलग्न' मित्यादिभास्करोक्तेन उत्तरे शरेऽक्षजदृ-क्कर्मकलाभिरूनो दक्षिणे शरे युतः कृतायनफलः खेट उदयाख्यलग्नं भवति । अस्तलग्नसाधने तु सौम्ये शरेऽक्षजदृक्कर्मकलासहितो याम्ये रहितः सषड्भः कृता-यनफलः खेटो ग्रहे पश्चिमक्षितिजेऽस्तंगते प्राक्क्षितिजे यल्लग्नं तदस्तलग्नं भास्करमते । इहाचार्येण तस्मात् षड्राशिं विशोध्य पश्चिमक्षितिजे ग्रहेऽस्तंगते यदस्तलग्नं तदेव ग्रहास्तलग्नं कल्पितमिति ॥४॥

वि. भा.—विषुवच्छाया (पलभा) गुणितात् विक्षेपात् (मध्यमशरात्) द्वादशभक्ताद्यत्फलं कलात्मकं सौम्याच्छरात् तदुदयलग्नसाधने ऋणमस्तलग्न साधने च धनं याम्याच्छरात् फलं क्रमेण पूर्वसाधिताऽयनदृक्कर्म संस्कृतग्रहे धनमृणं कार्यं तदोदयास्तलग्ने भवेतामिति ॥४॥

अत्रोपपत्तिः

यदा ग्रहस्थानं क्षितिजे भवेत्तदा बिम्बं क्षितिजादध ऊर्ध्वं वा भवेत् । स्थानो-परिगतं ध्रुवप्रोतवृत्तं बिम्बकेन्द्रोपरिगतं ध्रुवप्रोतवृत्तं च कार्यं बिम्बकेन्द्रापर्यहोरात्र-वृत्तं (बिम्बीयाहोरात्रवृत्तं) कार्यं तदा तयोः स्थानबिम्बकेन्द्रगतध्रुवप्रोतवृत्त-योरन्तर्गतं बिम्बीयाहोरात्रवृत्तीयचापमाक्षदृक्कर्मसंज्ञकं भवति । अथ स्थाना-द्बिम्बीयाहोरात्रवृत्तं यावत्स्थानगतध्रुवप्रोतवृत्ते स्पष्टशर एको भुजः । बिम्बीया-होरात्रवृत्तक्षितिजवृत्तयोः सम्पातात्स्थानं यावत् क्षितिजवृत्ते द्वितीयो भुजः। बिम्बी-याहोरात्रवृत्तक्षितिजवृत्तयोः सम्पातात्स्थानगतध्रुवप्रोतवृत्तोपरिलम्बवृत्तं तृतीयो भुजः । एतत्त्रिभुजं सरलजात्यं स्वीकृतमाचार्येण अत्र स्थानलग्नकोणोऽक्षांश

समोऽक्षजवलनांशः (क्षितिजेऽक्षज्यया तुल्यमक्षजं वलनमित्युक्तेः) एकः कोणः समकोणोऽतोऽवशिष्टः कोणो लम्बांशस्तदाऽनुपातः क्रियते, यदि लम्बज्यया स्पष्टशरज्या लभ्यते तदाऽक्षज्यया किमित्यनेन लम्बवृत्तीयचापज्याबिम्बीयाहोरात्रवृत्तीयचापज्या वा समागच्छति तत्स्वरूपम् $= \frac{\text{स्पशज्या} \cdot \text{अक्षज्या}}{\text{लज्या}}$ (१) परन्तु

$\frac{\text{अक्षज्या}}{\text{ज्या}} = \frac{\text{पभा}}{१२}$, $\therefore$ $\frac{\text{स्पशज्या.पभा}}{१९\cdot}$ = लम्बवृत्तापज्या = बिम्बीयाहोरात्रवृत्तापज्या

अत्र स्वल्पान्तरात् स्पष्टशर = मध्यशर, तथाऽऽगतफलस्य चापकरणेन च

$\frac{\text{शर.पभा}}{१२}$ = बिम्बीयाहोरात्रवृत्तचापपरमित्यक्षजदृक्कर्मतुल्यं नास्त्यत आचार्योक्तमिदमानयनं महत्स्थूलम् । (१) अत्रत्य स्वरूपे क्षितिजे ग्रहस्थानस्य स्थितत्वात् अक्षज्या = आक्षवलनज्या, स्वल्पान्तरात् स्पशज्या = स्पशर, तदा—

$\frac{\text{स्पश. आक्षवलन}}{\text{लंज्या}}$ = आक्षदृक्कर्म, परं $\frac{\text{अज्या}}{\text{लंज्या}} = \frac{\text{पभा}}{१२}$ $\therefore$ $\frac{\text{स्पशर. पभा}}{१२}$ = आक्षदृक्कर्म

एतेन 'स्पष्टेषुरक्षवलेन हतो विभक्तो लम्बज्यया रविहृतोऽक्षभया हतो वेति" सिद्धान्तशिरोमणौ भास्करोक्तमुपपद्यते । सिद्धान्तशेखरे "क्षुण्णे क्षेपेऽक्षज्यया लम्बभक्तेऽक्षच्छायाघ्ने भानुभक्तेऽथवाऽत्रेति" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव; "सूर्यसिद्धान्तेऽपि "विषुवच्छाययाभ्यस्ताद्विक्षेपादित्यादिना" तदानयनं कृतमस्ति, परं केषामपि तदानयनं समीचीनं नास्तीति तदुपपत्तिदर्शनेनाऽक्षजदृक्कर्मगोलिकस्वरूपदर्शनेन च स्फुटमिति । अथ तैः शरे तु याम्योत्तरे क्रमविलोमविधानलग्नमित्यादि भास्करोक्तेन—उत्तरे शरेऽक्षजदृक्कर्मकलाभिरूनो दक्षिणे शरे युतः कृतायनफलः खेट उदयलग्नं भवति । अस्तलग्नसाधने तु सौम्ये शरेऽक्षजदृक्कर्मकलासहितो याम्ये रहितः सषड्भः कृतायनफलः खेटो ग्रहे पश्चिमक्षितिजेऽस्तंगते प्राक्क्षितिजे यल्लग्नं तदस्तलग्नं भास्करमते । अत्राचार्येण तस्मात् षड्राशि विशोध्य पश्चिमक्षितिजे ग्रहेऽस्तंगते यदस्तलग्नं तदेव ग्रहास्तलग्नं कल्पितमिति ॥४॥

अब अक्षज दृक्कर्मानयन को कहते हैं

हि. भा.—शर को पलभा से गुणा कर द्वादश (१२) से भाग देने से जो फल होता है उससे जो कलात्मक फल होता है उत्तर शर में उदयलग्न साधन में उस फल को (१) ऋण करना तथा अस्तलग्न साधन में धन करना, दक्षिण शर रहने से उस फल को क्रम से पूर्वसाधित आयन दृक्कर्म संस्कृत ग्रह में धन और ऋण करने से उदयलग्न और अस्त लग्न होता है । (१) पूर्व साधित आयन दृक्कर्म संस्कृतग्रह में इति ॥४॥

उपपत्ति

जब ग्रहस्थान क्षितिज में रहता है तब ग्रहविम्व केन्द्र क्षितिज से नीचा या ऊपर रहता है, स्थानोपरिगतध्रुवप्रोतवृत्त तथा बिम्बकेन्द्रोपरिगतध्रुवप्रोतवृत्त करने से दोनों के अन्तर्गत बिम्बीयाहोरात्र वृत्तीय चाप आक्षदृक्कर्म संज्ञक है। स्थान से बिम्बीयाहोरात्र-वृत्तपर्यन्त स्थानगत ध्रुवप्रोतवृत्त में स्पष्टशर एक भुज, बिम्बीयाहोरात्रवृत्त और क्षितिज-वृत्त के सम्पात से स्थान पर्यन्त क्षितिज वृत्त में द्वितीय भुज। बिम्बीयाहोरात्रवृत्त और क्षितिज वृत्त के सम्पात से स्थानगत ध्रुवप्रोतवृत्त के ऊपर लम्बवृत्त में तृतीय भुज, इस त्रिभुज को आचार्य ने सरल जात्य मान लिया है, उक्त त्रिभुज में स्थान लग्न कोण अक्षांश या तत्तुल्य आक्षवलन है, 'क्षितिजेऽक्षज्यया तुल्यमक्षजं वलनं' इस उक्ति से एक कोण समकोण है अत: अवशिष्ट तृतीय कोण लम्बांश के बराबर हुआ। अब अनुपात करते हैं यदि लम्बज्या में स्पष्ट शरज्या पाते हैं तो अक्षज्या में क्या इससे लम्बवृत्तीय चापज्या वा बिम्बीयाहोरात्र-वृत्तीय चापज्या आती है $\frac{\text{स्पशज्या. अक्षज्या (क)}}{\text{लंज्या}}$ परन्तु $\frac{\text{अज्या}}{\text{लंज्या}}=\frac{\text{पभा}}{१२}$ अत: $\frac{\text{स्पशज्या. पभा}}{१२}$ $=$लम्बवृचापज्या$=$बिम्बीयाहोरात्रवृचापज्या, यहां स्वल्पान्तर से स्पशरज्या$=$स्पशर$=$मशर तथा पूर्वागत फल के चाप करने से $\frac{\text{शर. पभा}}{१२}$ बिम्बीयाहोरात्र वृचा, लेकिन यह आक्ष-दृक्कर्म के बराबर नहीं है। इसलिए आचार्योक्त यह आनयन अत्यन्त स्थूल है। (क) इस स्वरूप में क्षितिज में ग्रहस्थान स्थित रहने से अक्षज्या$=$आक्षवलनज्या$=$आक्षवलन स्वल्पा-न्तर से $\frac{\text{स्पशर. आक्षवलन}}{\text{लंज्या}}=\frac{\text{स्पशर. पभा}}{१२}=$आक्षदृक्कर्म, इससे 'स्पष्टेषुरक्षवलनेन हतो विभक्त:" इत्यादि सिद्धांत शिरोमणिस्थ भास्करोक्त उपपन्न होता है। सिद्धांत शेखर में "क्षुण्णो क्षेपेऽक्षज्यया लम्बभक्ते" इत्यादि से श्रीपति ने आचार्योक्तानुरूप ही कहा है। सूर्य सिद्धांत में भी "विषुवच्छाययाभ्यस्ताद्विक्षेपात्" इत्यादि से आक्ष दृक्कर्मानयन किया गया है लेकिन किसी का आनयन ठीक नहीं है यह उपपत्ति देखने से तथा अक्षज दृक्कर्म का प्रदेश देखने से स्फुट है, 'अथ तै: शरे तु याम्योत्तरे क्रमविलोमविधानलग्नं' इत्यादि भास्करोक्ति से उत्तरशर में अयनदृक्कर्मसंस्कृत ग्रह में अक्षज दृक्कर्म कला को घटाने से दक्षिण शर रहने से अक्षजदृक्कर्म कला को आयन दृक्कर्म संस्कृत ग्रह में जोड़ने से उदयलग्न होता है, अस्तलग्न साधन में उत्तरशर रहने से छ: राशि सहित आयन दृक्कर्म संस्कृत ग्रह में अक्षजदृक्कर्म कला को जोड़ने से तथा दक्षिणशर रहने से घटाने से पश्चिम क्षितिज में ग्रह के अस्तंगत रहने से पूर्वक्षितिज में जो लग्न होता हैं वह भास्कराचार्य संमत अस्तलग्न होता है, यहां आचार्य ने उस में से छ: राशि को घटाकर पश्चिम क्षितिज में ग्रह के अस्तंगत रहने से जो अस्तलग्न होता है उसी को ग्रहास्त लग्न स्वीकार किया है इति ॥ ४ ॥

इदानीं ग्रहार्कान्तरघट्यानयनमाह ।

प्रागूनमाद्यमधिकं पश्चाल्लग्नाद्ग्रहोदयोऽस्तमयः ।
षड्भयुतमन्यदुदयैर्घटिकाः कृत्वोनमधिकसमम् ॥५॥

सु० भा०—प्राक्क्षितिजे आद्यमुदयलग्नं लग्नाद्वा सूर्याद्वूनं तदा ग्रहोदयो भवति। पश्चात् क्षितिजे लग्नाद्वा सूर्यात् षड्भयुतं षड्राशिसहितमन्यदस्तलग्नमधिकं तदा ग्रहास्तमयो भवति । अत्रोनमधिकसमं कृत्वाऽर्थादूनस्य भोग्योऽधिकभुक्तयुक्तो मध्योदयाढ्य इत्यादिभास्करविधिना उदयैः स्वदेशोदयैर्लग्नग्रहान्तरे रवेनासन्नभावेन ग्रहोदयज्ञानाय रविग्रहोदयलग्नान्तरेऽस्तज्ञानाय सषड्भार्कास्तलग्नान्तरे घटिकाः साध्या इत्याचार्याभिप्रायः ।

अत्रोपपत्तिः । 'प्राग्दृग्ग्रहः स्यादुदयाख्यलग्नमि' त्यादिभास्करविधिना स्फुटा ॥ ५ ॥

वि. भा.—प्राक् (पूर्व क्षितिजे) आद्यं (उदयलग्नं) लग्नाद्वा सूर्याद्वूनं तदा ग्रहोदयो भवति, पश्चात् (पश्चिम क्षितिजे) लग्नाद्वा सूर्यात् षड्भयुतं (राशिषट्क सहितं) अन्यत् (अस्तलग्नं) अधिकं तदा ग्रहास्तमयो भवति । अत्रोनमधिकसमं कृत्वाऽर्थादूनस्य भोग्योऽधिकभुक्तयुक्तो मध्योदयाढ्य इत्यादि भास्करोक्त्योदयैः (स्वदेशोदयैः) लग्नग्रहान्तरे वा रविसान्निध्यवशेन ग्रहोदयज्ञानार्थं रविग्रहोदयलग्नान्तरेऽस्त ज्ञानार्थं सषड्भार्कास्त लग्नान्तरे घटिकाः साध्या इत्याचार्याभिप्राय इति ॥ ५ ॥

अत्रोपपत्तिः ।

'प्राग् दृग्ग्रहः स्यादुदयाख्यलग्न' मित्यादि भास्करकथितप्रकारेण स्फुटेति ॥ ५ ॥

अब ग्रह और रवि की अन्तरघटी के साधन करते हैं ।

हि. भा.—पूर्वक्षितिज में लग्न से वा सूर्य से उदय लग्न अल्प हो तो ग्रहोदय होता है, तथा पश्चिम क्षितिज में लग्न से वा सूर्य से सषड्भ (छः राशियुत) अस्त लग्न अधिक हो तब ग्रहास्त होता है, यहां 'ऊनस्य भोग्योधिकभुक्तयुक्तो मध्योदयाढ्यः' इत्यादि भास्कर कथित प्रकार से स्वदेशोदय से लग्न और ग्रह के अन्तर में वा रवि के सान्निध्य (समीपता) वश से ग्रहोदय ज्ञान के लिये रवि और ग्रहोदयलग्न के अन्तर में अस्त ज्ञान के लिये सषड्भ (छः राशि युत) रवि और अस्तलग्न के अन्तरघट्यानयन करना चाहिये यह आचार्य का अभिप्राय है इति ॥ ५ ॥

उपपत्ति ।

'प्राग् दृग्ग्रहः स्यादुदयाख्य लग्नं' इत्यादि भास्कर कथित विधि से स्पष्ट है ।। ५ ।।

इदानीं ग्रहाणां कालांशानाह ।

द्वादशभिः शीतांशुः सितजीवज्ञशनिभूमिजा नवभिः ।
द्वयुत्तरवृद्धैरन्तरघटिका षड्गुणितकालांशैः ॥ ६ ॥

सु० *भा०*—शीतांशुर्द्वादशभिः कालांशैः। शुक्रगुरुबुधशनिभौमा द्वयुत्तरवृद्धैर्नवभिः कालांशैर्दृश्यादृश्या भवंति । अर्थात् शुक्रस्य नव ९ । गुरोः ९+२=११ । बुधस्य ११+२=१३ । शनेः १३+२=१५ । भौमस्य १५×२=१७ । पूर्वं या ग्रहार्कान्तरघटिकाः साधितास्ताः षड्गुणिताः कालांशा इष्टा भवंति तैरिष्टैः कालांशैरित्यग्रे संबंधः ।

अत्रोपपत्तिः । कालांशसाधने आगमप्रमाणम् । वस्तुतोग्रहाणां नीचोच्चवशाद्रविग्रहांतरसूत्रवैलक्षण्याच्च वेधेनापि गोलयुक्त्या स्थिराः कालांशा असम्भवा एवेति कमलाकरमतं तत्त्वविवेके तथ्यमेवेति ज्योतिर्विद्भिश्चिन्त्यम् । 'दस्रेन्दवः शैलभुवश्च शक्रा' इत्यादि भास्करविधिना चन्द्रादीनां कालांशाः ।

चं. १२ । भौ. १७ । बु. १४ । गु. ११ । शु० १० । श० १५ । आचार्योक्ताः चं. १२ । भौ० १७ । बु० १३ । गु० ११ । शु० ९ । श० १५ । द्वयोर्मतयोर्बुधशुक्रकालांशयोरेकैकमन्तरम् ।। ६ ।।

वि. भा.—शीतांशुः (चन्द्रः) रवित इत्यध्याहार्यम्-द्वादशभिरंशैरदृश्यो दृश्यश्च जायते, सितजीवज्ञशनिभूमिजाः (शुक्रगुरुबुध शनिमङ्गलाः) द्वयुत्तरवृद्धैर्नवभिः, अन्तरघटिका षड्गुणितकालांशैरर्थादुदयलग्नरव्योरन्तरे वाऽस्तलग्नरव्योरन्तरे घटिकाः साध्यास्ताः षड्गुणाः कालांशा भवेयुरेभिस्ते दृश्या अदृश्याश्च भवन्ति । यथा शुक्रस्य नव ९, गुरोः=९+२=११, बुधस्य=११+२=१३, शनेः=१३+२=१५, मङ्गलस्य=१५+२=१७, इति ।। ६ ।।

अत्रोपपत्तिः

रवितो यावदन्तरेण ग्रहाणामुदयोऽस्तमयश्च भवति तेऽन्तरांशाः (कालांशाः) प्राचीनैरसकृद्वेधेन ज्ञात्वा पठिताः परं वस्तुतो ग्रहाणां नीचोच्चवशाद्रविग्रहान्तरसूत्रवैलक्ष्यण्याच्च वेधेनापि कालांशाः स्थिरा न भवितुमर्हन्त्येतद्विषये सिद्धांततत्त्वविवेके कमलाकरेण युक्तियुक्तं प्रतिपादितमस्ति, अथ "दस्रेन्दवः शैलभुवश्चेत्यादि" भास्करकथितविधिना चन्द्रादि ग्रहाणां

कालांशा: = चन्द्रस्य = १२, कुजस्य = १७, बुधस्य = १४, गुरो: = ११, शुक्रस्य = १०, शने: = १५, तथाऽऽचार्योक्ता: चन्द्रस्य = १२, कुजस्य = १७, बुधस्य = १३, गुरो: = ११, शुक्रस्य = ९, शने: = १५ एतयोर्मतयोर्बुधशुक्रकालांशयोरेकैकमन्तरमस्ति। सिद्धांतशेखरे श्रीपतिना "शुक्रार्यज्ञद्युमणिजकुजा द्वयुत्तरै: कालभागैर्गोभिश्चन्द्रो रविभिरिनतो जायतेऽदृश्यदृश्य:। गम्यो न्यूनादसुचय इतश्चाधिकादन्तरस्थैर्युक्त: प्राणै: स खरसहृत: कालभागा भवन्ति" ऽनेनाऽऽचार्योक्तानुरूपा एव कालांशा उक्ता इति ॥ ६ ॥

अब ग्रहों के कालांशों को कहते है।

हि. भा.—चन्द्रमा रवि से बारह अंश (कालांश) पर दृश्य और अदृश्य होते हैं, शुक्र, गुरु, बुध, शनि, और मङ्गल, ये ग्रह नौ ९ में दो दो की वृद्धि से अर्थात् शुक्र ९, गुरु ९ + २ = ११, बुध ११ + २ = १३, शनि १३ + २ = १५, मङ्गल १५ + २ = १७ इतने कालांश में दृश्य और अदृश्य होते हैं। इति ॥ ६ ॥

उपपत्ति।

रवि से जितने अन्तर में ग्रहों का उदय अस्त होता है वह अन्तर कालांश कहलाता है, प्राचीनाचार्यों ने बार बार वेधद्वारा कालांश को समझकर पठित किया है, लेकिन यथार्थत: रवि और ग्रह के अन्तर सूत्र (विम्बान्तर सूत्र) की विलक्षणता के कारण वेध से भी कालांश स्थिर नहीं हो सकता है इस विषय में सिद्धान्ततत्त्वविवेक में कमलाकर ने युक्ति युक्त बातें कही है, "दस्रेन्दव: शैलभुवश्चशक्रा" इत्यादि भास्कर विधि से चन्द्रादि ग्रहों के कालांश ये हैं—चन्द्र के = १२, मङ्गल के = १७, बुध के = १४, वृहस्पति के = ११, शुक्र के = १०, शनि के = १५, तथा आचार्य कथित विधि से चन्द्र के = १२, मङ्गल के = १७, बुध के = १३, बृहस्पति के = ११, शुक्र के = ९, शनि के = १५। दोनों मतों से बुध और शुक्र के कालांशों में एक एक का अन्तर है, सिद्धान्त शेखर में श्रीपति ने "शुक्रार्यज्ञद्युमणिज कुजा" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से आचार्योक्त के अनुरूप ही कालांश कहा है इति ॥ ६ ॥

इदानीमुदयास्तयोर्गतैष्यदिनानयनमाह।

दृश्यादृश्यैर्युतिवद्ग्रहार्क-भुक्तयन्तरैक्य-लब्ध-दिनै: ।
ऊनाधिक लिप्ताभ्यां प्राग्वत् तात्कालिकैरसकृत् ॥ ७ ॥

सु० भा०—पूर्वसाधितैरिष्टकालांशैर्दृश्यादृश्यै: पठितकालांशैश्च ऊनाधिकलिप्ताभ्यां ग्रहार्कभुक्तयन्तरैक्यलब्धदिनैस्तात्कालिकैरिष्टकालांशै: प्राग्वदसकृद्विधिना युतिवद्ग्रहयुतिवदुदयास्तयोर्गतैष्यदिनसाधनं कार्यमित्यर्थ:। अत्रैतदुक्तं भवति

पठितेष्टकालांशान्तरकला ग्रहार्कगत्यन्तरभक्ता ग्रहे वक्रिणि तु ग्रहार्कगतियोगभक्ता लब्धा पठितकालांशेभ्य इष्टाधिके उदये गता इष्टाल्पे एष्या दिवसा ज्ञेयाः। एवमस्तविचारे पठितकालांशेभ्य इष्टाल्पे गता इष्टाधिके चैष्या दिवसा ज्ञेयाः। लब्धदिनैस्तात्कालिकाभ्यां दृग्ग्रहार्काभ्यां पुनस्तात्कालिका इष्टकालांशाः साध्यास्तैः प्राग्वत् पुनर्गतैष्या दिवसा एवमसकृद्यावदविशेषः।

अत्रोपपत्तिः। 'उक्तेभ्य ऊनाभ्यधिका यदीष्टाः खेटोदयो गम्यगतस्तदा स्यादि' त्यादिभास्करविधिना स्फुटा। इहाचार्येण च स्थूलाराश्युदयासवः खाभ्राष्टभूकलामिता अङ्गीकृता इति ॥ ७ ॥

वि. भा.—पूर्वसाधितैरिष्टकालांशैर्दृश्यादृश्यैः (पठितकालांशैश्च) ऊनाधिकलिप्ताभ्यां ग्रहार्कभुक्त्यन्तरैक्यलब्धदिनैस्तात्कालिकैः (इष्टकालांशैः) प्राग्वदसकृद्विधिना युतिवत् (ग्रहयुतिवत्) उदयास्तयोर्गतैष्यदिनसाधनं कार्यमिति। अत्रैतदुक्तं भवति। पठितेष्टकालांशान्तरकला ग्रहरविगत्यन्तरभक्ता वक्रिणि ग्रहे तु ग्रहरविगतियोगभक्ता लब्धाः पठितकालांशेभ्य इष्टाधिके उदये गता इष्टाल्पे एष्या दिवसा ज्ञेयाः। अस्त विचारे पठितकालांशेभ्य इष्टाल्पे गता इष्टाधिके चैष्या दिवसा ज्ञेयाः। लब्धदिनैस्तात्कालिकाभ्यां दृग्ग्रहार्काभ्यां पुनस्तात्कालिका इष्टकालांशाः साध्यास्तैः पूर्ववत् पुनर्गतैष्या दिवसा एवमसकृद्यावदविशेष इति ॥७॥

अत्रोपपत्तिः।

ग्रहोदयो गत एष्यो वेति विचार्यमाणे पठितकालांशेष्टकालांशयोरन्तरं कार्यं ततोऽनुपातो यदि ग्रहरविगत्यन्तरकलायामेकं दिनं लभ्यते तदा कालांशान्तरकलायां किमित्यनेन समागतदिनैः पठितकालांशेभ्य इष्टकालांशस्याधिकत्वे उदयो गतोऽन्यथा भावी भवति, अस्तविचारे तु पूर्ववदनुपातेन यानि दिनान्यागच्छेयुस्तैः पठितकालांशेभ्य इष्टकालांशस्याल्पत्वेऽस्तो गतोऽन्यथा भावी भवतीति। सिद्धान्तशेखरे श्रीपतिनो "उक्तोनाधिककालभागविवरं राशेः कलाभिः १८०० हृतं भक्तं प्राचि निजोदयेन वरुणाशायां तदस्तेन च। षष्टिघ्नं ग्रहसूर्यभुक्ति विवरेणाप्तं ग्रहे वक्रिते भुक्त्यैक्येन दिनानि तैरथ मुहुः साध्योग्रहास्तोदयः॥" उदयास्तयोर्दिनानयनं कथितम्। सिद्धांत शिरोमणौ—

उक्तेभ्य ऊनाभ्यधिका यदीष्टाः खेटोदयो गम्यगतस्तदा स्यात्।
अतोऽन्यथा वास्तमयोऽवगम्यः प्रोक्तेष्टकालांश वियोग लिप्ताः॥
खाभ्राष्टभूघ्ना द्युचरोदयाप्ताः खेटार्कभुक्त्यन्तरभाजिताश्च।
वक्रे तु भुक्त्यैकहृता अवाप्तास्तदन्तराले दिवसा गतैष्याः॥

"तात्कालिकाभ्यां रविदृग्ग्रहाभ्यां मुहुः कृतास्ते स्फुटतां प्रयान्ति" इति भास्करोक्तं श्रीपत्युक्तयनुरूपमेवेति, तथोदयास्तदिनादेर्गतैष्यता प्रतिपादनं सिद्धान्तशेखरे "कथितसमयांशेभ्योऽभीष्टा भवन्ति यदाधिका विगत उदयो भावी चास्तस्तथाऽपरथाऽल्पकैः। उदयति सितो वक्रं यातश्चतुर्भिरिहांशकैः समयजनितैरेवं केचिद् वदन्त्यपरे त्रिभिः" चैवमस्ति, वक्री शुक्रश्चतुर्भिः कालांशैरुदयतीति केचिद्वदन्ति, अपरे त्रिभिः कालांशैर्वक्री शुक्र उदयतीति वदन्ति, परमिति केषां केषां मतमिति न ज्ञायते, सूर्यसिद्धान्त-ल्लसिद्धान्तादिषु कालांशा आचार्योक्त सदृशाः श्रीपत्युक्तसदृशा वोक्तास्तदा केचित्, अपरे इत्युक्त्या केषां बोधो भवतीति ग्रन्थान्तर दर्शनेन स्फुटं भविष्यतीति ॥ ७ ॥

अब उदय और अस्त के गतैष्य दिनानयन को कहते हैं।

हि. भा.—पठित कालांश और इष्ट कालांश के अन्तर कला को ग्रह और रवि के गत्यन्तर से भाग देना, ग्रह के वक्री रहने से ग्रह और रवि के गतियोग से भाग देना, लब्धदिन पठित कालांश से इष्टकालांश अधिक रहे तो उदय में गतदिन और पठित कालांश से इष्टकालांश अल्प रहे तो एष्यदिन समझना चाहिये। अस्तविचार में पठित कालांश से इष्टकालांश अल्प रहने से गतदिन और पठित कालांश से इष्टकालांश अधिक रहने से एष्यदिन समझना चाहिये। लब्ध दिनों से तात्कालिक दृग्ग्रह और रवि से पुनः तात्कालिक इष्ट कालांश साधन करना, इन (इष्ट कालांश) से पुनः पूर्ववत् गतैष्य दिनानयन करना, इस तरह असकृत्कर्म करते रहना जबतक कि बिलकुल ठीक न हो जाय इति ॥ ७ ॥

उपपत्ति।

ग्रह का उदय पहले हो गया है या पीछे होगा इस के लिये पठित कालांश और इष्टकालांश का अन्तर करके अनुपात करते हैं यदि ग्रह और रवि की गत्यन्तर कला में एक दिन पाते हैं तो कालांशान्तर कला में क्या इस से जो दिन प्रमाण आता है उतने दिन करके पठित कालांश से इष्ट कालांश के अधिक रहने पर उदयगत होता है अन्यथा भावी होता है, अस्त विचार के लिये पूर्ववत् अनुपात से जो दिन प्रमाण आवें उतने दिनों में पठित कालांश से इष्टकालांश के अल्प रहने पर अस्त गत होता है, अन्यथा एष्य (भावी) होता है। सिद्धान्त शेखर में श्रीपति "उक्तोनाधिककालभागविवरं राशेः कलाभि १८०० र्हतं" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से उदय और अस्त के दिनानयन कहे हैं। सिद्धान्त शिरोमणि में "उक्तेभ्य ऊनाभ्यधिका यदीष्टाः खेटोदयो गम्यगतस्तदा स्यात्" इत्यादि से भास्कराचार्य ने श्रीपत्युक्त के अनुरूप ही कहा है, उदय दिन तथा अस्तदिन की गतैष्यता का प्रतिपादन सिद्धान्त शेखर में "कथितसमयांशेभ्योऽभीष्टा भवन्ति यदाधिका" इत्यादि इस तरह किया गया है, वक्री शुक्र चार कालांश में उदित होते हैं यह किसी आचार्य का मत है, अपर (दूसरे) आचार्य कहते हैं कि वक्री शुक्र तीन कालांश में उदित होते हैं। लेकिन ये मत किन

आचार्यों का है मालूम नहीं होता है, सूर्यसिद्धान्त-लल्लसिद्धान्त आदि ग्रन्थों में पठित कालांश आचार्योक्त या श्रीपत्युक्त कालांश सदृश ही है, तब पूर्वोक्त मतों के लिये ग्रन्थान्तरों को देख कर निर्णय करना चाहिये कि ये मत किन आचार्यों के है इति ।। ७ ।।

इदानीं ग्रहाणां नित्योदयास्तसाधनं चन्द्रोदये च विशेषमाह ।

प्रतिदिनमुदयास्तमयावसकृत् तात्कालिकग्रहविलग्नैः ।
सूर्यास्तमयौदयिकौ शीतांशोः पूर्णिमास्यन्तः ॥ ८ ॥

सु० भा०—तात्कालिकग्रहविलग्नैरसकृत् प्रतिदिनसुदयास्तमयौ साध्यौ अर्थाद्यस्मिन्काले ग्रहोदितघटीज्ञानमपेक्षितं तदा तात्कालिकं लग्नं ग्रहोदयलग्नं च कृत्वा पूर्ववत् तयोरन्तरे घटिकाः प्रसाध्य ताभिर्ग्रहं प्रचाल्य तस्य पुनरुदयलग्नं प्रसाध्य तात्कालिकात् स्थिरलग्नात् पुनरिष्टघटिकाः साध्याः। एवमसकृत्। एवमस्तकालज्ञानार्थमस्तलग्नात् सषड्भात् कर्म कर्त्तव्यम्। एवं पूर्णिमास्यन्तः प्रथमचन्द्रदर्शनदिनात् पूर्णिमापर्यन्तमभीष्टदिने शीतांशोश्चन्द्रस्य सूर्यास्तमयौदयिकौ सूर्यास्ताद्वा सूर्योदयादस्तमयौदयिकौ कालौ साध्यौ अर्थात् सूर्यास्तात् प्राक् पश्चाद्वा कतिघटिकाभिश्चन्द्रोदयोऽस्तो वा सूर्योदयात् प्राक् पश्चात् कतिघटिकाभिश्चन्द्रोदयोऽस्तो वेति सर्वं प्रसाध्यमित्यर्थः।

अत्रोपपत्तिः। ग्रहार्कान्तरकालानयनेन स्फुटा ।। ८ ।।

वि. भा.—तात्कालिकग्रहविलग्नैः प्रतिदिनसमकृत् उदयास्तमयौ साध्यौ, अर्थाद्यस्मिन् काले ग्रहोदितघटीज्ञानमभीष्टं तदा तात्कालिकलग्नं ग्रहोदयलग्नं च विधाय तयोरन्तर्गतघटिकाः प्रसाध्य ताभिर्ग्रहचालनं कृत्वा तस्य पुनरुदयलग्नं प्रसाध्य तात्कालिकात् स्थिरलग्नात् पुनरिष्टघट्यः साध्या एवमसकृत्। एवमस्तकालं ज्ञातुमस्तलग्नात् सषड्भास्तलग्नात्कर्म कर्त्तव्यम्। एवं पूर्णिमास्यन्तः प्रथमचन्द्रदर्शनदिनात् पूर्णिमापर्यन्तमभीष्टदिने शीतांशोः (चन्द्रस्य) सूर्यास्तमयौदयिकौ (सूर्यास्ताद्वा सूर्योदयादस्तमयौदयिकौ कालौ साध्यौ) अर्थात् सूर्यास्तात्पूर्वं पश्चाद्वा कियन्मिताभिर्घटीभिश्चन्द्रोदयोऽस्तोवा सूर्योदयात् पूर्वं पश्चाद्वा कियन्मिताभिर्घटीभिश्चन्द्रोदयोऽस्तो वेति सर्वं संसाध्यमिति ॥ ८ ॥

अत्रोपपत्तिः।

यदि सषड्भरवितश्चन्द्रोऽल्पोभवेत्तदा प्राक् दिने उदयति, तदधिकश्चेत्तदा सूर्यास्तानन्तरमुदयति तत्र कालज्ञानं "ऊनस्य भोग्योऽधिक भुक्त युक्तो मध्योदयाढ्य" इतिवद् भवति, सिद्धान्तशेखरे श्रीपतिना "उदयति सममस्तं गच्छता

प्राक् तदूनस्तदनु तदधिकश्चेदुक्तवत् तत्र कालः" ऽनेनाऽऽचार्योक्तानुरूपमेवोक्त मिति ॥ ८ ॥

अब ग्रहों के नित्योदयास्त साधन को तथा चन्द्रोदय के लिये विशेष कहते हैं।

हि. भा. – तात्कालिक ग्रह और लग्न से असकृत् कर्म द्वारा प्रतिदिन उदय और अस्त साधन करना अर्थात् जिस समय ग्रहोदित घटी ज्ञान करना हो उस समय के लग्न (तात्कालिक लग्न) तथा ग्रहोदय लग्न साधन कर दोनों के अन्तर्गत घटी साधन कर उन (साधित घटी) से ग्रह को चलाकर उसके फिर उदयलग्न साधन कर तात्कालिक स्थिर लग्न से पुनः इष्टघटी साधन करना, इसतरह असकृत् (वारंवार) करना, एवं अस्तकाल ज्ञान के लिये अस्तलग्न (सषड्भास्त लग्न) से कर्म करना चाहिये। इस तरह प्रथम चन्द्र दर्शन दिन से पूर्णिमा पर्यन्त इष्ट दिन में चन्द्र के सूर्यास्त से वा सूर्योदय से अस्तमय काल और औदयिक काल साधन करना अर्थात् सूर्यास्त पहले वा पीछे कितनी इष्ट घटी में चन्द्रोदय वा चन्द्रास्त होता है वा सूर्योदय से पहले या पीछे कितनी घटी में चन्द्रोदय वा चन्द्रास्त होता है ये सब साधन करना चाहिये इति ॥ ८ ॥

उपपत्ति।

यदि सषड्भ (छः राशि से सहित) रवि से चन्द्र अल्प हो तब सूर्यास्त से पहले चन्द्र उदित होते हैं। यदि सषड्भ रवि से चन्द्र अधिक हो तब सूर्यास्त के बाद चन्द्र उदित होते हैं वहां कालज्ञान "ऊनस्य भोग्योऽधिकभुक्तयुक्तो मध्योदयाढ्यः" इसी के अनुसार होता है, सिद्धान्त शेखर में श्रीपति ने भी "उदयति सममस्तं गच्छता प्राक् तदूनः" इत्यादि से आचार्योक्तानुरूप ही कहा है इति ॥ ८ ॥

इदानीं सूर्यासन्न भावेन चन्द्रोदयास्तज्ञानमाह।

उदयास्तमयाविन्दोः कालांशैरर्कसंमितैः कार्यौ।
हीनत्वं त्वधिकत्वं तदन्तरे योगकालः स्यात् ॥९॥

सु० भा०—अर्कसंमितैः कालांशैरर्थाद् द्वादशकालांशैरिन्दोश्चन्द्रस्योदयास्तमयौ साध्यौ। अत्रपठितकालांशेभ्य इष्टकालांशानां यदि हीनत्वं वाऽधिकत्वं भवेत् तदा तदन्तरे तयोः पठितेष्टकालांशयोरन्तरे योगकालो योगवद्ग्रहयोगवत् कालः स्यादिति सप्तमश्लोकेन स्फुटोऽर्थ इति ॥ ९ ॥

वि. भा.—इन्दोः (चन्द्रस्य) अर्कसंमितैरर्थात् द्वादशतुल्यैः कालांशैरुदयास्तमयौ साध्यौ। पठितकालांशेभ्य इष्टकालांशस्य यदि हीनत्वं (अल्पत्वं)

वाऽधिकत्वं भवेत्तदा तदन्तरे (पठितेष्ट कालांशयोरन्तरे) योगकालः (ग्रह योगवत् कालः) स्यादिति ॥ ९ ॥

अत्रोपपत्तिः ।

दृश्यादृश्यैर्युतिवद् ग्रहार्कभुक्तचन्तरैक्यलब्धदिनैरित्यादिना चन्द्रपठित कालांशस्येष्टकालांशस्य चान्तरे याः घटिकास्ततो गतैष्यकालज्ञानं सुगममिति ॥ ९ ॥

अब सूर्यासन्न भाव से चन्द्र के उदयास्तज्ञान को कहते हैं ।

हि. भा.—चन्द्र के बारह कालांश से उदय और अस्तमय साधन करना, पठित कालांश इष्ट कालांश की अल्पता में या अधिकता में दोनों के (पठित कालांश और इष्टकालांश) के अन्तर में ग्रहयोग की तरह काल होता है इति ॥ ९ ॥

उपपत्ति ।

'दृश्यादृश्यैर्युतिवत्' इत्यादि सप्तम श्लोक से चन्द्र के पठित कालांश और इष्ट कालांश के अन्तर में जो घटी है उससे गत काल और एष्य काल ज्ञान सुगम ही है इति ॥ ९ ॥

इदानीं बुधगुर्वोरुदयास्तयोर्विशेषमाह ।

उदयास्तविधौ रविवद्बुधशीघ्रादाप्तफलयुतो नो ज्ञः ।
तैक्ष्ण्याद्गुरुर्विहीनस्तत्समलिप्तेन भागेन ॥ १० ॥

सु० *भा०*—बुधशीघ्राद्बुधशीघ्रोच्चाद्रविवद्यदाप्तं प्राप्तं फलं मन्दफलं भवेत् तेन यथागतेन बुधो युतो वोनः कार्यः । एतादृशोबुध उदयास्तसाधने ग्राह्यः । अत्रैतदुक्तं भवति । बुधशीघ्रं मध्यरविं प्रकल्प्य तस्मान्मन्दफलमानीय तेन संस्कृतो बुध उदयास्तविधौग्राह्यः । एतेन बुधकालांशेषु वैलक्षण्यं सूचितम् । एवं गुरुस्तत्समलिप्तेन मध्यमगुरुसमं मध्यमरविं प्रकल्प्य यन्मंन्दफलं भागात्मकं तत्समकलाभिरूनो भागेनैकेन च विहीन उदयास्तविधौ ग्राह्यः । कस्मात् । तैक्ष्ण्यात् । अर्थाद्गुरुबिंबं विपुलमत एवं कालांशवैलक्षण्यं भवति

अत्रोपलब्धिरेव वासना ॥ १० ॥

वि. भा.—बुधशीघ्रात् (बुधशीघ्रोच्चात्) रविवद्यदाप्तं (प्राप्तं) फलं (मन्दफलं) भवेत्तेन ज्ञः (बुधः) युतोनः कार्यस्तदैतादृशो बुध उदयास्तसाधनोपयुक्तः । अत्रैतदुक्तं भवति, बुधशीघ्रोच्चं मध्यमरविं मत्वा ततो मन्दफलमानीय तत्संस्कृतो बुध उदयास्तोपयुक्त एतावता बुधकालांशे वैलक्षण्यं सूच्यते । एवं गुरुस्तत्सम-

लिप्तेन (मध्यमगुरुसमं मध्यमरविं मत्वांऽशात्मकं मन्दफलं साध्यं तत्सम-कलाभिः) हीनो भागेनैकेन च विहीन उदयास्तोपयुक्तत्वार्थं ग्राह्यः। कथमेवं भवति तैक्ष्ण्यात् (गुरुबिम्बं विपुलमस्त्यतएव कालांशवैलक्षण्यं भवति) इति ॥ १० ॥

अत्रोपपत्तिः ।

अत्रोपलब्धिरेव वासना नान्यत्कारणं वक्तुं शक्यत आचार्यकथनमेव प्रमाणमिति ॥ १० ॥

अब बुध और गुरु के उदयास्त के बिषय में विशेष कहते हैं ।

हि॰ भा.—बुध के शीघ्रोच्च से रवि की तरह प्राप्त जो मन्द फल हो उससे बुध को युत और हीन करना, तब यह बुध उदय और अस्त साधन के लिये उपयुक्त होता है । अर्थात् बुध शीघ्रोच्च को मध्यम रवि मानकर उससे मन्दफल लाकर बुध में उसको संस्कार करने से उदयास्तोपयुक्त बुध होते हैं इससे बुध के कालांश में विलक्षणता सूचित होती है, उस तरह मध्य गुरु के समान मध्यम रवि मानकर अंशात्मक मन्द फल साधन करना । तत्तुल्य कला को गुरु में हीन तथा एकांश को हीन करना तब इस तरह के गुरु उदय और अस्त के लिये उपयुक्त होते हैं । ऐसा क्यों होता है ? गुरु का बिम्ब बड़ा है इसलिये कालांश में विलक्षणता होती है इति ॥ १० ॥

उपपत्ति ।

इस में उपलब्धि ही उपपत्ति है आचार्य कथन ही प्रमाण है दूसरा कारण नहीं कह सकते हैं इति ॥ १० ॥

इदानीं शुक्रकालांशेषु विशेषमाह ।

मानाल्पत्वात् पश्चादुदयोऽस्तमयः सितस्य दशभिः प्राक् ।
पश्चान्मानमहत्वादस्तमयोऽष्टाभिरुदयः प्राक् ॥ ११ ॥

सु॰ भा॰—सितस्य पश्चात् पश्चिमायां दिशि दशभिः कालांशैरुदयः। प्रागस्तमयश्च दशभिरेव भवति मानाल्पत्वात् । यतस्तदा शुक्लो मार्गो भवति । ऋजुगतेरुच्चासनत्वाद्बिंबं लघु भवति तस्मात् कालांशा अधिकाः पठिताः । एवं तस्य पश्चादस्तमयः प्रागुदयश्च नीचासन्नत्वाद्वक्रत्वाच्च बिंबमानं विपुलं भवति तस्मा-न्मानमहत्त्वादष्टभिरेव न्यूनैः कालांशैर्भवति । भास्करेणाप्याचार्योक्तामीदृशीं वैलक्षण्यक्रियामवलम्ब्य तारतम्ये न 'ज्ञशुक्रयोर्वक्रगयोर्द्विहीनाः' इत्युक्तम् ।

अत्रोपपत्तिरुपलब्धिरेव ॥ ११ ॥

वि. भा.—सितस्य (शुक्रस्य) पश्चात् (पश्चिमायां दिशि) दशभिः कालांशैरुदयः, प्राक् (पूर्वदिशि) दशभिरेव कालांशैरस्तमयश्च भवति। पूर्वोक्तेभ्यो भिन्नैरंशैः कथं कथ्यत इत्याह। मानाल्पत्वात्कारणात्। यतस्तदा शुक्रो मार्गी भवति मार्गगतेरुच्चासन्नत्वाद् बिम्बं लघु भवति तस्मात् कालांशा अधिकाः पठिताः। तस्य पश्चिमायामस्तमयः पूर्वस्यामुदयश्च नीचासन्नत्वाद् वक्रत्वाच्च बिम्बमानं विपुलं भवति, तस्मान्मानमहत्वादष्टाभिरेव न्यूनैः कालांशैर्भवतीति ॥ ११ ॥

अत्रोपपत्तिः।

सिद्धान्त शेखरे श्रीपतिना "मानाल्पत्वाद्दशभिरुदयं याति शुक्रः प्रतीच्यामंशैरस्तं दिशि सुरपतेः पीनभावात्तु मूर्त्तेः पश्चादस्तं व्रजति वसुभिः प्रागुदेतीत्यनेन" सिद्धान्त शिरोमणौ भास्कराचार्येणाप्याचार्योक्तां वैलक्षण्यक्रियामवगत्य 'ज्ञशुक्रयोर्वक्रगयोर्द्विहीनाः' इत्युक्तम्। अत्र प्राचीनानामुपलब्धिरेवोपपत्तिरिति ॥ ११ ॥

अब शुक्र कालांश में विशेष कहते हैं।

हि. भा.—शुक्र पश्चिम दिशा में दश कालांश में उदित होते हैं और पूर्व दिशा में दश ही कालांश में अस्त होते हैं। पूर्व कथित कालांश से यहां भिन्न कालांश क्यों कहते हैं इसके लिये आचार्य कहते हैं कि बिम्ब की अल्पता के कारण ऐसा होता है क्यों कि वहां शुक्रमार्गी होते हैं। उच्च के आसन्न में मार्गगति गृह का बिम्ब छोटा होता है इसलिये कालांश अधिक पठित किया गया है। उन (शुक्र) की पश्चिम दिशा में अस्तमय और पूर्वदिशा में उदय भी (नीचासन्न में वक्रता से बिम्बमान बड़ा होता है) इसलिये बिम्ब के बड़ा होने के कारण आठ ही कालांश में होता है इति ॥ ११ ॥

उपपत्ति।

सिद्धान्त शेखर में श्रीपति "मानाल्पत्वाद्दशभिरुदयं" इत्यादि श्लोक से तथा सिद्धान्त शिरोमणि में भास्कराचार्य ने भी आचार्योक्त क्रिया की विलक्षणता को समझ कर 'ज्ञशुक्रयोर्वक्रगयोर्द्विहीना' कहा है। इन में प्राचीनों की उपलब्धि ही उपपत्ति है, दूसरा कारण कुछ भी नहीं कह सकते हैं इति ॥ ११ ॥

इदानीमार्यभटदूषणं स्वप्रशंसां चाह॥

आर्यभटः क्षेत्रांशैर्दृश्यादृश्यान् यदुक्तवांस्तदसत्।
दृग्गणित विसंवादाद् दृग्गणितैक्यं स्वकालांशैः ॥१२॥

सु० भा०—आर्यभटः कालांशान् विहाय क्षेत्रांशैः क्रान्तिवृत्तीयग्रहार्कान्तरांशैरेव ग्रहाणां दृश्यादृश्ययोराचार्योक्तादन्यत् साधनं यदुक्तवान् तद्दृग्गणितविसंवादात् दृग्गणितयोर्विरोधादसत्। स्वकालांशैराचार्योक्तकालांशैश्च दृग्गणितैक्यं भवत्यत आचार्योक्तं साधनमेव समीचीनमिति ॥ १२ ॥

तथा चाचार्यर्यभटः ।

चन्द्रोऽशैर्द्वादशभिरविक्षिप्तोऽर्कान्तरस्थितैर्दृश्यः ।
नवभिर्भृगुर्भृगोस्तैर्द्व्यधिकैर्यथा श्लक्ष्णाः ।।
(गोलपा. श्लो० ४)

वि. भा.—आर्यभटः क्षेत्रांशैः (क्रान्तिवृत्तीय ग्रहरव्यन्तरांशैरेव) ग्रहाणां दृश्यादृश्यान् (कालांशान्) विहायदृश्या दृश्ययोराचार्योक्तादन्यत्साधनं यत् उक्तवान्, तद्दृग्गणित विसंवादात् (दृग्गणितयोर्विरोधात्) असत् (शोभनं नास्ति) स्वकालांशैः (आचार्योक्तकालांशैः) दृग्गणितैक्यं भवत्यत आचार्योक्तसाधनमेव युक्तियुक्तमिति ।। १२ ।।

हि. भा.—आर्य भट, दृश्यादृश्य (कालांश) को छोड़कर ग्रहों के उदय और अस्त के साधन आचार्योक्त से भिन्न जो कहते हैं सो ठीक नहीं है क्यों कि उनके साधन से दृग्गणित (वेधागत और गणितागत उदय और अस्त) में विरोध होता है, आचार्योक्त कालांशों से दृग्गणितैक्य होता है इसलिये आचार्यो (ब्रह्मगुप्त) क्त साधन ही युक्तियुक्त है इति ।। १२ ।।

इदानीमध्यायोपसंहारमाह ।

दृग्लग्नदृष्टिभागग्रहोदयास्तमयनाडिकाद्येषु ।
उदयास्तमयाध्यायः षष्ठो द्वादशभिरार्याभिः ।।१३।।

सु० भा०—दृग्लग्नमुदयलग्नमस्तलग्नं च । दृष्टिभागाः कालांशाः शेषं स्पष्टार्थम् ।। १३ ।।

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णजोक्ते ।
हृदि तं विनिधाय नूतनोऽयं रचितोऽस्तौदयिके सुधाकरेण ।।

इति श्री कृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्तनूतनतिलके उदयास्ताधिकारः षष्ठः ।। ६ ।।

वि. भा.—दृग्लग्नं (उदयलग्नमस्तलग्नं च) दृष्टिभागाः (कालांशाः) ग्रहाणामुदयास्तघट्यादिषु द्वादशभिरार्याभिः (द्वादशसंख्यकैरार्याछन्दोभिः) अयं षष्ठः उदयास्तमयाध्यायोऽस्तीति ।। १३ ।।

इति ब्रह्मगुप्त विरचिते ब्राह्मस्फुट सिद्धान्ते उदयास्ताधिकारः षष्ठः ।। ६ ।।

हि. भा.—दृग्लग्न (उदयलग्न और अस्तलग्न) दृष्टिभाग (कालांश) और ग्रहों के उदय और अस्त घट्यादियों में बारह आर्या छन्द श्लोकों से यह छठा उदयास्तमयाध्याय है इति ।। १३ ।।

इति ब्रह्मगुप्तविरचित ब्राह्मस्फुट सिद्धान्त में छठा उदयास्ताधिकार समाप्त हुआ ।। ६ ।।

ब्राह्मस्फुटसिद्धान्तः

७

चन्द्रशृङ्गोन्नत्यधिकारः

ब्राह्मस्फुटसिद्धान्तः

७

चन्द्रशृङ्गोन्नत्यधिकारः

अथ चन्द्रशृङ्गोन्नत्यधिकारः प्रारभ्यते ।

तत्रादौ रवेरुपरिचन्द्रोऽस्तीति पुराण मत खण्डनमाह ।

सितवृद्धिहानिवीर्यादि शशाङ्काज्जायते कथं गणितात् ।
उपरि रवेरिन्दुश्चेदर्वागर्धं सदा शुक्लम् ॥ १ ॥

सु० भा०—चेद्यदि रवेरुपरि इन्दुस्तदा गणिताद्गणितागतात् शशाङ्काच्चन्द्रात् सितवृद्धिहानिवीर्यादि कथं जायते । अर्थाद्गणितविधिना चन्द्रस्य शुक्लोपचयापचयमानं कृष्णाङ्गुलमानं च कथं जायते यतस्तादृशस्थितौ भौमगुरुशनिवत् सदा अर्वागर्धं पूर्वार्धं नृदृश्यं खण्डं शुल्कं स्यात् परन्तु दृष्ट्या सदा शुल्कं नोपलक्ष्यतेऽतो रवेरुपरि नेन्दुरिति स्फुटम् । तथा रवेरधश्चन्द्रं प्रकल्प्य गणितविधिनाऽऽनीतं शुक्लादिदृष्टियोग्यं भवति तेन रवेरधश्चन्द्र इति स्फुटम् ॥ १ ॥

वि. भा.—चन्द्रस्य सितवृद्धिहानी (स्वच्छतोपचयापचयौ) शापाद् भवत इति पुराणमतमस्ति, यद्येवं तदा गणिताच्छशाङ्कात् (गणितागतचन्द्रात्) सितवृद्धिहानिवीर्यादिज्ञानं कथं जायते, अर्थाद् गणितविधिना चन्द्रस्य शुक्लोपचयापचयादिमानं नावगम्यं स्यात् । चेत् (यदि) रवेरुपरि, इन्दुः (चन्द्रः) तदाऽर्वागर्धं (अधस्तनमर्धंनृदृश्यं खण्डं) सदा शुक्लं स्यात्, परन्तु दृष्ट्या सर्वदा शुक्लं नोपलक्ष्यतेऽतोरवेरुपरि चन्द्रो नास्ति, यदि च रवेरधश्चन्द्रं स्वीकृत्य गणितविधिना शुक्लादिमानमानीयते तदा तत्सर्वथा दृष्टियोग्यं भवत्यतो रवितश्चन्द्रोऽध एवातश्चन्द्रशुक्लस्योपचयापचयस्य गणितावगम्यत्वात् सर्वदैव चन्द्रबिम्बपूर्वार्धस्य शुक्लत्वाभावाच्च पुराणोक्तमतद्वयं (शापाच्चन्द्रस्य सितवृद्धिहान्यादि भवति तथा रवित उपरिचन्द्रोऽस्तीति) न युक्तिसङ्गतमिति सिद्धान्तितम् । सिद्धान्तशेखरे श्रीपतिनै "शापाद्यदीन्दोः सितवृद्धिहानी कथं तु जाते गणितावगम्ये । ऊर्ध्वं यदीन्दू रवितस्तदार्धमर्वाक्तनं हन्त सदैव शुक्लम्" वमुक्तमिति ॥ १ ॥

अब चन्द्र शृङ्गोन्नति अधिकार प्रारम्भ किया जाता है, 'उसमें पहले रवि से ऊपर चन्द्र है' इस पुराणमत के खण्डन को कहते हैं—

हि. भा.—चन्द्र की स्वच्छता का उपचय (वृद्धि) और अपचय (ह्रानि) शाप से होता है यह पुराण में कहा गया है, आचार्य इसका खराण्डन करते हैं। यदि शाप से चन्द्र

शुक्ल का उपचय-अपचय आदि होता है तब गणितागत चन्द्र से शुक्ल के उपचय अपचय आदि) का ज्ञान क्यों होता है अर्थात् गणित विधि से उन का ज्ञान नहीं होना चाहिये, और यदि रवि से चन्द्र ऊपर है तब चन्द्र के नीचे का आधाभाग (मनुष्य के लिए दृश्य भाग) सदा शुक्ल होना चाहिये, परन्तु दृष्टि से वह सदा शुक्ल देखने में नहीं आता है इसलिये रवि से चन्द्र ऊपर नहीं है, यदि रवि से चन्द्र को नीचा मानकर गणित से शुक्लादि लाते हैं तो वे सर्वथा दृष्टि योग्य होते हैं अतः रवि से चन्द्र नीचा ही है, यह सिद्ध होता है, पुराणोक्त दोनों मत (शाप से चन्द्र शुक्ल की वृद्धि और हानि होना तथा रवि से चन्द्र ऊपर है) ठीक नहीं है यह ऊपर प्रदर्शित युक्तियों से सिद्ध हुआ। सिद्धान्त शेखर में श्रीपति "शापाद्यदीन्दोः सितवृद्धि हानी' इत्यादि से इन्हीं बातों को कहते हैं इति ॥ १ ॥

इदानीं चन्द्र बिम्बे सितवृद्धिहान्योः कारणमाह।

रविदृष्टं सितमर्धं कृष्णमदृष्टं यथाऽऽतपस्थस्य।
कुम्भस्य तथासन्नं रवेरधः स्थस्य चन्द्रस्य ॥ २ ॥

सु. भा.—तदासन्नं तादृगेव। अन्यत् स्पष्टम् ॥ २ ॥

वि. भा.—यथाऽऽतपस्थस्य (रौद्र स्थितस्य) कुम्भस्य (घटस्य) रविदृष्टं (रविणा दृष्टियोग्यमर्थाद्रव्यभिमुखं) अर्धं सितं (स्वच्छं) भवति, अदृष्टं (दृष्टियोग्यानर्हमर्थाद्रवितो विरुद्धदिशं) अर्धं कृष्णं (असितं) भवति तथासन्नं (तादृशमेव) रवेरधः स्थस्य चन्द्रस्यार्थाद्रव्यभिमुखं चन्द्र बिम्बार्धं सितं तद्विरुद्धदिशि चन्द्र बिम्बार्धं कृष्णं (असितं) भवतीति। सिद्धान्तशेखरे श्रीपतिना "धाम्ना धामनिधेरयं जलमयो धत्ते सुधादीधिति; सद्यः कृत्तमृणालकन्दविशदच्छायां विवस्वद्दिशि। हर्म्ये घर्मघृणेः करैर्घट इवान्यस्मिन् विभागे पुनर्बाला कुन्तलकालता कलयति स्वस्यास्तनोश्छायया" अनेनैवमुक्तम् तथोक्तार्थमेवा "पाथोमये शीतकरेऽर्क रश्मयो विमूर्छिता घ्नन्ति तमस्विनीतमः। निकेतनाभ्यन्तरगं तमः स्वयं यथा त एवामल दर्पणाश्रिताः" नेन विशदयति, परमियं "सलिलमये शशिनि रवेर्दीधितयो मूर्च्छितास्तमो नैशम्। क्षपयन्ति दर्पणोदरनिहिता इव मन्दिरस्यान्तः॥" वराहमिहिरोक्तेरस्या एव पुनरुक्तिः। सिद्धान्तशिरोमणौ भास्कराचार्येण—

"तरणिकिरणसङ्गादेषपीयूषपिण्डो दिनकर दिशि चन्द्रश्चन्द्रिकाभिश्चकास्ति।
तदितरदिशि बाला कुन्तलश्यामलश्रीर्घट इव निजमूर्त्तिच्छाययैवातपस्थः॥"
छन्दोऽन्तरेण श्रीपतेः काव्यकला कौशलमेवोक्तमिति विज्ञैश्चिन्त्यमिति ॥ २ ॥

अब चन्द्र बिम्ब में सितवृद्धि और सित हानि के कारण को कहते हैं।

हि. भा.—जैसे धूप में स्थित घड़े का रवि की तरफ का आधा भाग सित (स्वच्छ) होता है और रवि से भिन्नदिशा का आधा भाग कृष्ण (असित) होता है।

वैसा ही रवि से अधः (नीचा) स्थितचन्द्र का होता है अर्थात् रवि की तरफ का चन्द्रबिम्ब का आधा भाग सित (उज्ज्वलीभूत) होता है और रवि से भिन्न तरफ का चन्द्रबिम्बार्ध असित (अनुज्ज्वल) होता है। सिद्धान्तशेखर में श्रीपति ने "धाम्ना धामनिधेरयं जलमयो धत्ते सुधादीधितिः" इत्यादि से इसी तरह कहा है । इसी अर्थ को "पाथोमये शीतकरेऽर्करश्मयो विमूर्च्छिता" इत्यादि संस्कृत भाष्य में लिखित श्लोक से विशद (स्फुट) करते हैं परन्तु यह श्रीपति की उक्ति "सलिलमये शशिनि रवेर्दीधितयो" इत्यादि संस्कृत भाष्य में लिखित वराहमिहिरोक्ति की पुनरुक्ति मात्र है। सिद्धान्तशिरोमणि में भास्कराचार्य ने "तरणिकिरणसङ्गादेषपीयूषपिण्डो दिनकरदिशि" इत्यादि संस्कृत भाष्य में लिखित श्लोक से श्रीपति की काव्यकला चातुरी को कहा है इति ॥२॥

इदानीं गणितेन शृङ्गोन्नतिज्ञानं कथं भवतीत्यत्र हेतुमाह

सितमुन्नतं यतोऽर्कः सितासितं शुक्लपक्षान्ते ।
अर्वागर्धं पश्चाद् गणिताच्छृङ्गोन्नतिस्तस्मात् ॥३॥

सु. भा.—यतो यद्दिशि अर्कस्तत्रैव सितं शुक्लमुन्नतं वृद्धिगतं भवति। शुक्लपक्षान्ते पूर्णिमान्ते च अर्वागर्धं पूर्वार्धं रविसंमुखस्थं सितं पश्चादर्धं नृदृश्यखण्डं चासितमुपलक्ष्यते । तस्माद्रविचन्द्रांतरवशतो गणितात् शृंगोन्नतिः साध्या भवतीति ॥३॥

वि. भा—यतः (यद्दिशि) अर्कः (रविः) तद्दिश्येव सितं (शुक्लं) उन्नतं (वृद्धिगतं) भवति, शुक्लपक्षान्ते (पूर्णान्ते) अर्वागर्धं (पूर्वार्धं) सूर्याभिमुखं सितं, पश्चादर्धं (नृदृश्यखण्डं) चासितमुपलक्ष्यते तस्मात् कारणात् रविचन्द्रान्तरवशेन गणिताच्चन्द्रशृङ्गोन्नतिः साधिता भवति । सिद्धान्तशेखरे श्रीपतिनाप्य "यस्यां सहस्रकिरणो दिशि तत्र नूनमालोक्यते शशधरस्य सितोन्नतत्वम्। पक्षान्तयोरपि सितासितता यतोऽस्य शृङ्गोन्नतिः खलु ततो गणितावगम्या" नेनाऽऽचार्योक्तानुरूपमेवोक्तमिति ॥३॥

अब गणित से चन्द्र शृङ्गोन्नति का ज्ञान कैसे होता है उसके कारण को कहते हैं

हि. भा.—चन्द्र से जिस दिशा में रवि रहता है उसी तरफ सित (शुक्ल) उन्नत (वृद्धिगत) होता है, पूर्णान्त में सूर्याभिमुख चन्द्रबिम्ब का पूर्वार्ध शुक्ल होता है और परार्ध असित (कृष्ण) देखने में आता है, उस कारण से रवि और चन्द्र के अन्तर वश से गणित द्वारा चन्द्रशृङ्गोन्नति साधित होती है । सिद्धान्तशेखर में श्रीपति ने भी "यस्यां सहस्रकिरणो दिशि तत्र नूनमालोक्यते" इत्यादि संस्कृत भाष्य में लिखित श्लोक से आचार्योक्त के अनुरूप ही कहा है इति ॥३॥

इदानीं शृङ्गोन्नत्यर्थमितिकर्त्तव्यतामाह

रविचन्द्रपातलग्नैः स्वक्रान्त्युदयात् स्वलग्नगतशेषाः ।
घटिकाः खचरार्धास्तात् स्वेष्टौ रविशीतगू कृत्वा ॥४॥

सु० भा०—खचरार्धास्ताद्रव्यस्तात् स्वलग्नगतशेषाः शशिन उदयलग्नस्य गताः शेषा वा घटिकाः साध्याः । कैः । रविचन्द्रपातलग्नैस्तथा स्वक्रान्त्युदयाच्च । अत्रैतदुक्तं भवति । रव्यस्तकाले रविश्चन्द्रः पातो लग्नम् । एतानि कृत्वा तैः स्वक्रान्त्या चन्द्रक्रान्त्या उदयाच्चन्द्रोदयलग्नाच्चोदयलग्नस्य गता वा शेषा घटिका ऊनस्य भोग्योऽधिकभुक्तयुक्तो मध्योदयाढ्य इत्यनेन विधिना साध्याः । सूर्यास्तानन्तरं यावतीभिर्घटिकाभिश्चन्द्रास्तस्ता गता घटिकाः । सूर्यास्तात् प्राग् यावतीभिर्घटिकाभिश्चन्द्रास्तस्ता एष्या घटिकाः । एवं प्राक् क्षितिजे रव्युदयाद् गता एष्या वा चन्द्रोदयघटिकाः साध्या इत्यर्थादवगम्यते । यस्मिन् दिने सूर्यास्तादनन्तरं कालांशघटिकातोऽधिकाभिश्चन्द्रास्तः । रव्युदयात् प्राक् कालांशघटिकातोऽधिकाभिश्चन्द्रोदयस्तस्मिन्नेव चन्द्रदर्शनं सति दर्शने शृङ्गोन्नतिः साध्या । सितशृङ्गोन्नतिश्च बिम्बार्धाल्पे चन्द्रसितेऽत एव भास्करेण मासान्तपादे प्रथमे च शृंगोन्नतिः साधिता । द्वितीयतृतीयपादयोश्च बिम्बार्धाल्पं कृष्णं भवति। अतस्तत्र कृष्णशृङ्गोन्नतिर्भवति । इत्याचार्येण शृंगोन्नतिद्वयं साध्यते । तदर्थं पादचर्चा न कृता । भास्करेण न हि स्पष्टा कृष्णशृङ्गोन्नतिर्नरैरुपलक्ष्यत इति मनसि संप्रधार्य सितशृंगोन्नतिरेव साधिता । उक्तं च 'द्वितीयतृतीययोरपि चरणयोर्ब्रह्मगुप्तादिभिः कृष्णशृंगोन्नतिरानीता सा मम न संमता । न हि नरैः कृष्णशृंगोन्नतिः स्पष्टोपलक्ष्यते' । स्वेष्टौ स्वेष्टकालिकौ रविशीतगू रविचन्द्रौ कृत्वा विक्षेपक्रान्त्यंशाः साध्या इत्यध्याहार्यम् ॥४॥

वि. भा.—खचरार्धास्तात् (रव्यस्तात्) स्वलग्नगतशेषाः शशिन उदयलग्नस्य गताः शेषाः वा घटिका रविचन्द्रपातलग्नैस्तथा स्वक्रान्त्युदयाच्च साध्याः। अत्रैतदुक्तं भवति, सूर्यास्तकाले रविश्चन्द्रः चन्द्रपातो लग्नं च कृत्वा तैः चन्द्रक्रान्त्या उदयात् (चन्द्रोदयलग्नात्) उदयलग्नस्य गता वा शेषा घटिका 'ऊनस्य भोग्योऽधिकभुक्तयुक्तो मध्योदयाढ्य' इत्यनेन साध्याः । सूर्यास्तानन्तरं यावतीभिर्घटीभिश्चन्द्रास्तस्ता गतघटिकाः । तथा सूर्यास्तात्पूर्वं यावतीभिर्घटीभिश्चन्द्रास्तस्ता एष्या घटिकाः । एवं पूर्वक्षितिजे सूर्योदयाद् गता एष्याश्च चन्द्रोदयघट्यो विधेयाः। यस्मिन् दिने सूर्यास्तात्परं कालांशघटीतोऽधिकाभिर्घटीभिश्चन्द्रास्तः, सूर्योदयात् पूर्वं कालांशघटीतोऽधिकाभिश्चन्द्रोदयस्तस्मिन्नेव चन्द्रदर्शने शृङ्गोन्नतिः साध्या । सितशृङ्गोन्नतिश्च बिम्बार्धाल्पे चन्द्रसिते भवत्यत एव मासान्तपादे प्रथमे भास्करेण शृङ्गोन्नतिसाधनं कृतम् । द्वितीयतृतीयपादयोर्बिम्बार्धाल्पं कृष्णं भवति, तेन तत्र कृष्णशृङ्गोन्नतिर्भवति, आचार्येण

पादचर्चा न क्रियतेऽतः सूच्यते यदनेन सितशृङ्गोन्नमनं कृष्णशृङ्गोन्नमनं चेति शृङ्गोन्नतिद्वयं साध्यते । कृष्णशृङ्गोन्नतिः स्फुटा मनुष्यैर्नोपलक्ष्यत इति विचार्य शुक्लशृङ्गोन्नतिरेव साधिता, 'द्वितीयतृतीययोरपि चरणयोर्ब्रह्मगुप्तादिभिः कृष्णशृङ्गोन्नतिरानीता सा मम न संमता । न हि नरैः कृष्णशृङ्गोन्नतिः स्पष्टोपलक्ष्यते' इत्युक्तं च । स्वेष्टौ रविशीतगू (स्वेष्टकालिकौ रविचन्द्रौ) कृत्वा शरक्रान्त्यंशाः साध्या इत्यध्याहार्यम्. । सिद्धान्तशेखरे "सूर्यशीतकरपातविलग्नैरस्तकालजनितैः सितरश्मेः । स्वापमभ्रमचरादिविलग्नातीतशेषघटिकाश्च विधेयाः" श्रीपतेरयं प्रकार आचार्योक्तानुरूप एवेति. ।।४।।

अब शृङ्गोन्नतिकाल में सूर्यास्त से चन्द्रास्तपर्यन्त गतघटी और शेषघटी के साधन को कहते हैं

हि. भा.—सूर्यास्तकाल में रवि, चन्द्र, चन्द्रपात और लग्न से चन्द्रक्रान्ति से और चन्द्र के उदयलग्न से उदयलग्न की गतघटी और शेषघटी 'ऊनस्य भोग्योऽधिकभुक्तयुक्तो मध्योदयाढ्य' इस विधि से साधन करना, सूर्यास्त के बाद जितनी घटी में चन्द्रास्त होता है वह गतघटी है, तथा सूर्यास्त से पहले जितनी घटी में चन्द्रास्त होता है वह एष्य घटी है, एवं पूर्वक्षितिज में सूर्योदय से गत और एष्य चन्द्रोदय घटी साधन करना। जिस दिन में सूर्यास्त के बाद कालांश घटी से अधिक घटी में चन्द्रास्त होता है तथा सूर्योदय से पहले कालांश घटी से अधिक घटी में चन्द्रोदय होता है उसी दिन चन्द्र दर्शन होने से शृङ्गोन्नति साधन करना । चन्द्रबिम्बार्धाल्प शुक्ल में शुक्लशृङ्गोन्नति होती है। इसलिये भास्कराचार्य ने 'मासान्तपादे प्रथमेऽथवेन्दोः' इससे प्रथम चरण और चतुर्थ चरण में शृङ्गोन्नति साधन किया है, द्वितीय चरण (पाद) और तृतीय चरण में चन्द्रबिम्बार्धाल्प कृष्ण होता है इसलिये वहां कृष्ण शृङ्गोन्नति होती है। यहां आचार्य पाद की चर्चा नहीं करते हैं इससे सूचित होता है कि आचार्य दोनों शृङ्गोन्नतियों (सितशृङ्गोन्नति और कृष्ण शृङ्गोन्नति) का साधन करते हैं। मनुष्यों को कृष्ण शृङ्गोन्नति स्फुट लक्षित नहीं होती है यह सोचकर शुक्ल शृङ्गोन्नति का साधन किया है। 'द्वितीय और तृतीय चरण में ब्रह्मगुप्त आदि आचार्यों ने कृष्ण शृङ्गोन्नति की है वह मेरे मत के विरुद्ध है। मनुष्य कृष्ण शृङ्गोन्नति को स्पष्ट नहीं देखते हैं, यह भास्करोक्ति है। सिद्धान्तशेखर में 'सूर्यशीतकरपातविलग्नैः' इत्यादि संस्कृत भाष्य में लिखित श्रीपति का प्रकार आचार्योक्त के अनुरूप ही है इति ।।४।।

इदानीं चन्द्रस्य स्पष्टक्रान्तिज्यासाधनमाह

विक्षेपशश्यपक्रमधनुषोर्योगान्तरं समान्यदिशोः ।
तज्ज्येन्द्वपक्रमज्या स्वाहोरात्रार्धतो रविवत् ।।५।।

सु. भा.—समान्यदिशोः विक्षेपशश्यपक्रमधनुषोः शशिशरापक्रमचापयोर्योगा-

न्तरं यत् तज्ज्या इन्द्वपक्रमज्या शशिनः स्पष्टापमज्या रविवत् स्वाहोरात्रार्धतश्चन्द्रस्य बिम्बीयाहोरात्रवृत्ताद्भवति ।

अत्रोपपत्तिः । गणितागतः कदम्बप्रोतीयश्चन्द्रशर एव ध्रुवाभिमुख आचार्यैः प्रकल्पितः । ततः स्थानीयक्रान्तिशरयोः संस्कारेण बिम्बाहोरात्रवृत्तपर्यन्तं चन्द्रस्पष्टक्रान्तिरानीता । अत्र 'ब्रह्मगुप्तादिभिः स्वल्पान्तरत्वान्न कृतः स्फुटः' इत्यादि भास्करवचनं प्रसिद्धमिति ॥५॥

वि. भा.—समान्यदिशोः (तुल्यदिक्कयोर्भिन्नदिक्कयोश्च) विक्षेपशश्यपक्रमधनुषोः (चन्द्रशरक्रान्तिचापयोः) योगोऽन्तरं यद् भवति तज्ज्या इन्द्वपक्रमज्या (चन्द्रस्य स्पष्टक्रान्तिज्या) रविवत् स्वाहोरात्रार्धतः (चन्द्रस्य बिम्बीयाहोरात्रवृत्तात्) भवतीति ॥५॥

अत्रोपपत्तिः

चन्द्रबिम्बकेन्द्रोपरिगतं कदम्बप्रोतवृत्तं क्रान्तिवृत्ते यत्र लगति तदेव चन्द्रस्थानम् । चन्द्रस्थानोपरिगतं ध्रुवप्रोतवृत्तं नाडीवृत्ते यत्र लगति तस्माच्चन्द्रस्थानं यावच्चन्द्रमध्यमक्रान्तिः । तथा चन्द्रबिम्बकेन्द्रोपर्यहोरात्रवृत्तं (बिम्बीयाहोरात्रवृत्तं) चन्द्रस्थानोपरि चाहोरात्रवृत्तं (स्थानीयाहोरात्रवृत्तं) कार्यम् । चन्द्रबिम्बकेन्द्रोपरिगतं ध्रुवप्रोतवृत्तं स्थानीयाहोरात्रवृत्ते यत्र लगति तस्माच्चन्द्रबिम्बकेन्द्रं यावत् वा स्थानोपरिगतं ध्रुवप्रोतवृत्तं बिम्बीयाहोरात्रवृत्ते यत्र लगति तस्मात् स्थानं यावत् स्पष्टशरः, चन्द्रबिम्बकेन्द्राच्चन्द्रस्थानं यावत्कदम्बप्रोतवृत्ते मध्यमशरः। चन्द्रस्थानान्नाडीवृत्तावधिस्थानगतध्रुवप्रोतवृत्ते चन्द्रमध्यक्रान्तिः । चन्द्रस्थानाद्बिम्बीयाहोरात्रवृत्तपर्यन्तं स्थानगतध्रुवप्रोतवृत्त एव स्पष्टशरः । अनयोरेकदिक्कयोर्योगे भिन्नदिक्कयोश्चान्तरे कृते नाडीवृत्तस्थानगतध्रुवप्रोतवृत्तयोः सम्पातात् स्थानगतध्रुवप्रोतवृत्तबिम्बीयाहोरात्रवृत्तयोः सम्पातं यावत्स्पष्टा क्रान्तिर्भवेत् परमत्राचार्येण चन्द्रस्पष्टशरमध्यमशरयोरभेदत्वं स्वीकृत्य चन्द्रस्पष्टा क्रान्तिरानीताऽतो न समीचीना तेनैव हेतुना भास्कराचार्येण "ब्रह्मगुप्तादिभिः स्वल्पान्तरत्वान्न कृतः स्फुटः" ऽनेन ब्रह्मगुप्तादिमतं न समीचीनमिति प्रतिपादितम् । सिद्धान्तशेखरे "शीतांश्वपक्रमधनुः शरयोः समासस्तुल्याशयोर्विवरमन्यदिशोस्ततो ज्या । सा शीतगोः स्फुटमपक्रमशिञ्जिनी स्याद् द्युज्या कुजा चरदलादितया ऽर्कवच्च" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव । सूर्यसिद्धान्तेऽपि "विक्षेपापक्रमैकत्वे क्रान्तिर्विक्षेपसंयुता। दिग्भेदे वियुता स्पष्टा भास्करस्य यथागता" भगवता सूर्येणानेन ब्रह्मगुप्तादिकथितप्रकारसदृश एव प्रकारोऽभिहितोऽस्ति, भास्कराचार्येण "त्रिज्यावर्गादयनवलनज्याकृतिं प्रोह्य मूलमित्यादिना" स्पष्टशरानयनं कृत्वा ततः "स्पष्टा क्रान्तिः स्फुटशरयुत इत्यादिना" स्पष्टक्रान्त्यानयनं स्पष्टशरमध्यमक्रान्त्योः संस्कारात्कृतं तत्समीचीनमेवेति विज्ञैर्विभावनीयमिति ।

अब चन्द्र की स्पष्ट क्रान्तिज्या का साधन करते हैं

हि. भा.—एक दिशा की चन्द्रक्रान्ति और चन्द्रशर का योग करने से तथा भिन्न दिशा की चन्द्रक्रान्ति और चन्द्रशर का अन्तर करने से जो होता है उस की ज्या चन्द्र की स्पष्टक्रान्तिज्या रवि की तरह बिम्बीयाहोरात्रवृत्त से होती है इति ।।५।।

उपपत्ति

चन्द्रबिम्बकेन्द्रोपरिगत कदम्बप्रोतवृत्त क्रान्तिवृत्त में जहां लगता है वह चन्द्रस्थान है, स्थान से चन्द्रबिम्बकेन्द्रपर्यन्त चन्द्र का मध्यम शर है, चन्द्रस्थानोपरिगत ध्रुवप्रोतवृत्त नाड़ीवृत्त में जहां लगता है वहां से चन्द्रस्थानपर्यन्त चन्द्र की मध्यम क्रान्ति है, चन्द्रबिम्ब के ऊपर अहोरात्र वृत्त करने से वह चन्द्र का बिम्बीयाहोरात्रवृत्त होता है, तथा चन्द्रस्थान गत अहोरात्रवृत्त करने से चन्द्र का स्थानीय अहोरात्रवृत्त होता है, चन्द्रबिम्बकेन्द्रोपरिगत ध्रुवप्रोतवृत्त स्थानीय अहोरात्रवृत्त में जहां लगता है वहां से चन्द्रबिम्बकेन्द्रपर्यन्त अथवा चन्द्रस्थानोपरिगत ध्रुवप्रोतवृत्त बिम्बीयाहोरात्रवृत्त में जहां लगता है वहां से चन्द्रस्थान पर्यन्त चन्द्र का स्पष्ट शर है, यहां एकदिशा के चन्द्र स्पष्टशर और चन्द्रमध्यम क्रान्ति का योग करने से तथा भिन्न दिशा के उन दोनों का अन्तर करने से स्थानगत ध्रुवप्रोतवृत्त और नाड़ीवृत्त के सम्पात से स्थानगत ध्रुवप्रोतवृत्त और बिम्बीयाहोरात्रवृत्त के सम्पात पर्यन्त चन्द्र की स्पष्टा क्रान्ति होती है, लेकिन यहां आचार्य चन्द्र के स्पष्ट शर और मध्यमशर में अभेदत्व स्वीकार कर चन्द्र की स्पष्टा क्रान्ति लाये हैं इसलिये यह ठीक नहीं है, इसी कारण से भास्कराचार्य ने "ब्रह्मगुप्तादिभिः स्वल्पान्तरत्वान्न कृतः स्फुटः" इस पद्य से ब्रह्मगुप्तादि मत का खण्डन किया है । सिद्धान्तशेखर में "शीतांशवपक्रमधनुःशरयोः समासस्तुल्याशयोः" इत्यादि से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है, सूर्यसिद्धान्त में भी "विक्षेपापक्रमैकत्वे क्रान्तिर्विक्षपसंयुता" इत्यादि से भगवान् सूर्य ने ब्रह्मगुप्तादि कथित प्रकार के समान ही कहा है, भास्कराचार्य ने सिद्धान्तशिरोमणि में "त्रिज्यावर्गादयनवलनज्याकृतिं प्रोह्य मूलं" इत्यादि से स्पष्टशर का आनयन कर के "स्पष्टा क्रान्तिः स्फुटशरयुतः" इत्यादि से चन्द्र स्पष्टशर और चन्द्रमध्यम क्रान्ति के संस्कार से चन्द्र की स्पष्ट क्रान्ति का साधन किया है जो बिलकुल ठीक हैं इसको विज्ञ लोग विचार कर समझें इति ।।५।।

इदानीं रविचन्द्रयोर्भुजसाधनमाह

स्वक्रान्तिज्ये त्रिज्यागुणे हृते लम्बकेन रविशशिनोः ।
अग्रे पृथक् स्वशङ्कुतलतुल्ययुतिरन्यदिग्वियुतिः ।।६।।

सु. भा.—लम्बकेन लम्बज्यया हृते तदा रविशशिनोरग्रे भवतः । अग्रा पृथक् स्वशङ्कुतलतुल्ययुतिरन्यदिग्वियुतिः कार्या । एवं रविचन्द्रयोर्भुजौ भवतः ।

अर्थात् स्वाग्रास्वशङ्कुतलयोः समदिशोर्योगो विभिन्नदिशोरन्तरं संस्कारदिक्को भुजः स्यादिति ।

अत्रोपपत्तिः। क्रान्तिज्यातोऽग्रानयनस्य शङ्कुतलाग्रासंस्कारेण भुजानयनस्यापि सुगमा ॥६॥

वि.भा.—रविशशिनोः (रविचन्द्रयोः) स्वक्रान्तिज्ये त्रिज्यागुणिते लम्बकेन (लम्बज्यया) हृते (भक्ते) तदा तयोरग्रे भवेताम् । अग्रा पृथक् स्वशङ्कुतलतुल्ययुतिरन्यदिग्वियुतिः कार्या अर्थात् स्वाग्रास्वशङ्कुतलयोः समदिशोर्योगो विभिन्नदिशोरन्तरं कार्यं तदा संस्कारदिक्कौ रविचन्द्रयोर्भुजौ भवत इति ॥६॥

अत्रोपपत्तिः

$$\text{अथाऽक्षक्षेत्रानुपातेन}\frac{\text{त्रि. रक्रांज्या}}{\text{लंज्या}}=\text{रवेरग्रा ।}\frac{\text{त्रि· चंक्रांज्या}}{\text{लंज्या}}=\text{चन्द्रस्याग्रा}$$

ततोऽग्राशङ्कुतलयोः संस्कारेण रविचन्द्रयोर्भुजौ भवेताम्। सिद्धान्तशेखरे "स्वक्रान्तिभ्यामुक्तवच्चन्द्रभान्वोरग्रे शङ्कुः पूर्ववत् तत्तलं च । तुल्यांशत्वेऽग्रातलाभ्यां समासस्तद्विश्लेषश्चान्यथा तद्भुजौ तौ" ऽनेन श्लोकेन श्रीपतिनाऽऽप्याचार्योक्तानुरूपमेवोक्तमिति ॥६॥

अब रवि और चन्द्र के भुजानयन को कहते हैं

हि. भा.—रवि और चन्द्र की अपनी क्रान्तिज्या को त्रिज्या से गुणा कर लम्बज्या से भाग देने से उन दोनों की अग्रा होती है। अपनी अग्रा और शङ्कुतल के एक दिशा में योग करने से तथा भिन्न दिशा में अन्तर करने से रवि और चन्द्र का भुज होता है इति ॥६॥

उपपत्ति

$$\text{अक्षक्षेत्रानुपात से}\ \frac{\text{त्रि. रविक्रांज्या}}{\text{लंज्या}}=\text{रवि की अग्रा।}\ \frac{\text{त्रि. चन्द्रक्रांज्या}}{\text{लंज्या}}=\text{चन्द्र की}$$

अग्रा। अपनी-अपनी अग्रा और शङ्कुतल के संस्कार करने से रवि और चन्द्र का भुज होता है। सिद्धान्तशेखर में "स्वक्रान्तिभ्यामुक्तवच्चंद्रभान्वोः" इत्यादि से श्रीपति ने भी आचार्योक्तानुरूप ही कहा है इति ॥६॥

इदानीं शृङ्गोन्नत्युपयुक्तस्पष्टभुजस्य कोटिकर्णयोश्च साधनमाह

पृथगन्तरसंयोगौ भुजो यतोऽर्कात् शशी समान्यदिशोः ।
दृग्ज्यावर्गात् स्वात् स्वात् पृथक् स्ववर्गं विशोध्य पदे ॥७॥

वियुतसहिते रवीन्द्वोरेकान्यकपालसंस्थयोराद्यः ।
रविशशिदृक्शङ्क्वन्तरमन्योऽदृग्दृश्यशङ्क्वैक्यम् ॥८॥

आद्यान्ययवर्गयोर्युतिमूलं पूर्वापरा भुजात् कोटिः ।
भुजकोटिकृतियुतिपदं तिर्यक् कर्णोऽस्य चन्द्रोऽग्रे ॥९॥

सु. भा.—तयोः पृथक्स्थयोर्भुजयोः समान्यदिशोरन्तरसंयोगौ क्रमशो भुजः स्पष्टो भुजो भवेत् । अर्काद्यतो यद्दिशि शशी सैव भुजस्य दिग्ज्ञेया । स्वात् स्वाद् दृग्ज्यावर्गात् पृथक्स्थापितस्य स्वस्वभुजस्य वर्गं विशोध्य पदे ग्राह्ये । एवं पूर्वापर-रेखायां रविशशिनोः कोटी भवतः । एकान्यकपालसंस्थयो रवीन्द्वोस्तयो कोटयो-र्वियुतसहिते ये भवतः स आद्यो ज्ञेयः । रविचन्द्रयोरेककपालस्थयोः कोटयोरन्तरं विभिन्नकपालस्थयोश्च योग आद्यो भवतीत्यर्थः । रविशशिदृक्शङ्क्वन्तरमन्यो भवति । अर्थाद्यदि रविचन्द्रौ द्वौ क्षितिजादुपरि तदा तयोर्दृक्शङ्कू एकजातीयौ भवतोऽतस्तयोरन्तरमन्यसंज्ञं भवति । यदि एकः क्षितिजादुपरि अन्यः क्षितिजाद-धस्तदाऽधःस्थस्यादृक्शङ्कुरूर्ध्वस्थस्य दृक्शङ्कुः । अतोऽनयोरैक्यं तदान्यो भवति । आद्यान्ययोर्वर्गयुतिमूलं भुजात् पूर्वसाधितात् कोटिः पूर्वापरा भवति । भुज-कोटिकृतियुतिपदं तिर्यक् कर्णः स्यात् । अस्य कर्णस्याग्रे चन्द्रश्चन्द्रबिंबकेन्द्र-मिति ॥

अत्रोपपत्तिः । अत्रैकस्मिन् गोले रविचन्द्रौ प्रकल्प्य बिम्बान्तरसूत्ररूपः कर्णः साध्यते । रविकेन्द्राच्चन्द्रशङ्कूपरि यो लम्बस्तन्मूलाच्चन्द्रबिम्बकेन्द्रपर्यन्तमन्यसंज्ञम्। लम्बमूलात् पूर्वापररेखायाः समानान्तरा कृता या रेखा तस्या उपरि रविकेन्द्रात् कृतो यो द्वितीयो लम्बस्तन्मूलात् प्रथमलम्बमूलपर्यन्तमेव क्षेत्रयुक्त्याऽऽद्यसंज्ञा। तयो-राद्यान्ययोर्वर्गयुतेः पदं द्वितीयलम्बमूलाच्चन्द्रबिम्बकेन्द्रपर्यन्तं रेखा द्वितीयलम्बो-परि रेखागणितैकादशाध्याययुक्त्या लम्बरूपा भवति । द्वितीयलम्बश्च पूर्वसाधि-तस्पष्टभुजसमः । तयोर्वर्गयोगपदमेकगोलीयरविचन्द्रयो बिम्बान्तरसूत्रं कर्णो भवति । एवमत्र भुजकोटिकर्णा यस्मिन् धरातले तत् क्षितिजधरातले समप्रोत-धरातलवन्न लम्बरूपमतो द्रष्टुः संमुखेनेदं क्षेत्रमादर्शवत् । अतएवास्य क्षेत्रस्य भास्करेण स्वशृंगोन्नतौ खंडनं कृतम् । रवीन्द्वोरन्तरार्धज्या द्विगुणाऽयमेव कर्णो भवति । भुजकर्णवर्गान्तरपदं चेयमेव कोटिरिति शृङ्गोन्नत्युत्तराधिकारे आचार्येण ।

'व्यर्केन्द्वर्धभुजज्या द्विगुणाऽर्केन्द्वन्तरं भवति कर्णः । तद्वर्गान्तरपदमिदमिन्दुभुजाग्रान्तरं कोटिः' ॥

इत्यनेन प्रकारान्तरं दर्शितम् । अत एव भास्करः । 'तत् क्षेत्रं ब्रह्मगुप्तेन रवीन्द्वोरन्तरार्धज्यां द्विगुणां कर्णं प्रकल्प्य तद्भुजवर्गान्तरपदं कोटिरिति यत् त्र्यस्रं प्रकल्पितं तत् तिरश्चीनं जातम् । न हि द्रष्टुर्दृष्टिसंमुखमादर्शवत्' । भास्कर-ब्रह्मगुप्तयोः प्रकारेण शृङ्गोन्नतिर्न समीचीनेति कमलाकरेण तत्त्वविवेके स्पष्टं प्रतिपादितं । वास्तवा कथं शृङ्गोन्नतिर्भवत्येतदर्थं मद्विरचितं वास्तवचन्द्रशृङ्गोन्नतिसाधनं विलोक्यम् ॥७-८-९॥

वि. भा.—पृथक्स्थितयो रविचन्द्रभुजयोः समान्यदिशोः (एकभिन्नदिक्कयोः) अन्तरसंयोगौ कार्यौ तदा भुजः (स्पष्टभुजः) भवेत् अर्कात् (रवितः) सकाशात् यतो (यद्दिशि) शशी (चन्द्रः) सा स्पष्टभुजस्य दिग्भवति । स्वात् स्वात् दृग्ज्यावर्गात् पृथक् स्ववर्गं (भुजवर्गं) विशोध्य पदे (मूले) ग्राह्ये तदा रविचन्द्रयोः कोटी भवतः । एकान्यकपालसंस्थयो रवीन्द्वोः कोटयोर्वियुतसहिते ये भवतः स आद्यसंज्ञकोऽर्यादिककपालस्थयोः रविचन्द्रयोः कोटयोरन्तरं भिन्नकपालस्थयोश्च योग आद्यसंज्ञको भवति । रविशशिदृक्शङ्क्वन्तरमर्थाद्यदि रविचन्द्रौ क्षितिजादुपरि भवेतां तदा तयोर्दृक्शङ्क्वोरन्तरमन्यसंज्ञकं भवति, यद्येकः क्षितिजादुपरि, अन्यः क्षितिजादधस्तदाऽधःस्थस्याहृक्शङ्कुरूर्ध्वस्थस्य दृक्शङ्कुस्तेनानयोरैक्यमन्यसंज्ञकं भवति । आद्यान्ययोर्वर्गयुतिमूलं भुजात् (पूर्वसाधितात्)पूर्वापरा कोटिर्भवति । भुजकोटिकृतियुतिपदं तिर्यक् कर्णः स्यात् । अस्य कर्णस्याग्रे चन्द्रः (चन्द्रबिम्बकेन्द्रं) भवेदिति ॥७-८-९॥

अत्रोपपत्तिः

अत्रैकस्मिन् गोले रविचन्द्रौ प्रकल्प्य तयोर्बिम्बान्तरसूत्ररूपकर्णमान साध्यते । रविकेन्द्राच्चन्द्रशङ्कूपरि यो लम्बस्तन्मूलाद्रविकेन्द्रपर्यन्तमन्यसंज्ञकम् । लम्बमूलात् पूर्वापररेखायाः समानान्तरा रेखा कार्या तदुपरि रविकेन्द्राद्यो द्वितीयो लम्बस्तन्मूलात् पूर्वलम्ब (प्रथमलम्ब) मूलपर्यन्तमाद्यसंज्ञकम् । तयोराद्यान्ययोर्वर्गयोगमूलं द्वितीयलम्बमूलाच्चन्द्रबिम्बकेन्द्रपर्यन्तं रेखा द्वितीयलम्बोपरि लम्बरूपा (११ अध्याययुक्त्या) भवति । द्वितीयलम्बः पूर्वोक्तस्पष्टभुजसमः । तयोर्वर्गयोगमूलमेकगोलीयरविचन्द्रयोर्बिम्बान्तरसूत्रं कर्णो भवति । भुजकोटिकर्णा यस्मिन् धरातले सन्ति तत् क्षितिजधरातलोपरि समप्रोतवृत्तधरातलवन्न लम्बरूपमतो द्रष्टुः संमुखे नेदं क्षेत्रमादर्शवत् । अत एवाऽस्य क्षेत्रस्य सिद्धान्तशिरोमणौ भास्करेण खण्डनं कृतम् रविचन्द्रयोरन्तरार्धज्या द्विगुणाऽयमेव कर्णो भवति । भुजकर्णयोर्वर्गान्तरमूलं कोटिरिति शृङ्गोन्नत्युत्तराधिकारे आचार्येण "व्यर्केन्द्वर्धभुजज्या द्विगुणाऽर्केन्द्वन्तरं भवति कर्णः । तद्वर्गान्तरपदमिदमिन्दुभुजा-

ग्रान्तरं कोटिः" इति प्रकारान्तरं कथितम् तस्मात् कारणाद् भास्करः 'तत् क्षेत्रं ब्रह्मगुप्तेन रवीन्द्वोरन्तरार्धज्यां द्विगुणां कर्णं प्रकल्प्य तद्भुजवर्गान्तरपदं कोटिरिति यत् त्र्यस्त्रं प्रकल्पितं तत् तिरश्चीनं जातम् । नहि द्रष्टुर्दृष्टिसंमुखमादर्शवत्' सिद्धान्तशेखरे श्रीपतिनाप्ये "समान्यककुभोस्तयोर्विवरयोगतः स्याद् भुजो दिगस्य च यतो रवेर्भवति शीतगुः स स्फुटः । स्वदृष्टिगुणवर्गतः स्वभुजवर्गहीनात् पदे समेतरकपालयोर्वियुतसंयुते ह्यादिमः ॥ दृश्यशङ्कुविवरं शशीनयोः स्यात् परो युतिरदृश्यदृश्ययोः । मूलमाद्यपरवर्गयोगजं विद्धि कोटिमिह पूर्वपश्चिमाम् ॥ बाहुकोटिकृतियोगतः पदं स्याच्छ्रुतिस्तदुभयाग्रसङ्गिनी । आदिमान्त्यपदयोः स्थिते शशिन्यर्कवर्जिततनावयं विधिः ॥" भिराचार्योक्तानुरूपमेव सर्वमुक्तम् । ब्रह्मगुप्तभास्करादीनां शृङ्गोन्नतिसाधनं न समीचीनमिति "सिद्धान्ततत्त्वविवेके' कमलाकरेण बहुप्रतिपादितम् । शृङ्गोन्नतिविचारः शुक्लाङ्गुलाधीनः परं शुक्लाङ्गुलसाधनं कमलाकरस्यापि समीचीनं नास्त्यतस्तस्यच्छृङ्गोन्नतिसाधनमपि न वास्तवमतो वास्तवार्थं म.म. पण्डितश्रीसुधाकरद्विवेदिनिर्मितं 'वास्तवचन्द्रशृङ्गोन्नतिसाधनम्' पुस्तकं द्रष्टव्यमिति ॥७-८-९॥

अब शृङ्गोन्नति के लिये उपयुक्त स्पष्टभुज कोटि कर्णों के साधन को कहते हैं

हि. भा.— पृथक् स्थित रविभुज और चन्द्रभुज का एक दिशा में अन्तर और भिन्न दिशा में योग करने से स्पष्टभुज होता है । रवि से जिस दिशा में चन्द्र रहता है वह स्पष्ट भुज की दिशा है, अपनी-अपनी दृग्ज्या के वर्ग में अपने भुजवर्ग को घटाकर मूल लेने से रवि और चन्द्र की कोटि होती हैं । एक कपाल स्थित रवि और चन्द्र की कोटियों का अन्तर करने से तथा भिन्न कपालस्थित रवि और चन्द्र की कोटियों का योग करने से आद्य संज्ञक होता है । यदि रवि और चन्द्र में एक क्षितिज से ऊपर हो तो दोनों का दृक् शङ्कु का अन्तर अन्य संज्ञक होता है । यदि एक क्षितिज से ऊपर और दूसरा क्षितिज से नीचे हो तो अधः स्थित का अदृश्य शङ्कु, ऊर्ध्व स्थित का दृक् शङ्कु होता है इसलिये इन दोनों के योग से अन्य संज्ञक होता है । आद्य और अन्य का वर्गयोग मूल पूर्वसाधित भुज से पूर्वापर कोटि होती है । भुज और कोटि का वर्गयोग मूल तिर्यक् कर्ण होता है । इस कर्ण के अग्र में चन्द्र बिम्ब केन्द्र होता है इति ॥७-८-९॥

उपपत्ति

यहां एक गोल में रवि और चन्द्र को मान कर उन दोनों के बिम्बान्तर सूत्र रूप कर्ण का साधन करते हैं । रवि केन्द्र से चन्द्र शङ्कु के ऊपर लम्ब करने से लम्बमूल से रवि-केन्द्रपर्यन्त अन्यसंज्ञक है । लम्बमूल से पूर्वापर रेखा की समानान्तर रेखा करना उस के ऊपर रविकेन्द्र से जो द्वितीय लम्ब होता है उसके मूल से प्रथम लम्ब (पूर्वलम्ब) के मूल-पर्यन्त आद्य संज्ञक है। आद्य और अन्य का वर्गयोगमूल द्वितीय लम्बमूल से चन्द्रबिम्ब केन्द्रपर्यन्त रेखा द्वितीयलम्ब के ऊपर लम्बरूप (रे ११ अध्याय युक्ति से) होती है । और

द्वितीय लम्ब पूर्वोक्त स्पष्टभुज के तुल्य है। दोनों का वर्गयोग मूल एक गोलीय रवि और चन्द्र का बिम्बान्तर सूत्र कर्ण होता है। भुज, कोटि और कर्ण ये जिस धरातल में हैं वह धरातल क्षितिज धरातल के ऊपर समप्रोत धरातल की तरह लम्बरूप नहीं है इसलिये दर्शक के सामने यह क्षेत्र आदर्श (दर्पण) की तरह नहीं होता है इसलिये सिद्धान्तशिरोमणि में भास्कराचार्य ने इस क्षेत्र का खण्डन किया है। रवि और चन्द्र की अन्तरार्धज्या द्विगुणित कर्ण होता है। भुज और कर्ण का वर्गान्तर मूल कोटि होती है, यह शृङ्गोन्नति के उत्तराधिकार में आचार्य ने "व्यर्केन्द्वर्धभुजज्या द्विगुणा" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से प्रकारान्तर दिखलाया है। इसी कारण से भास्कराचार्य ने 'तत् क्षेत्रं ब्रह्मगुप्तेन रवीन्द्वोरन्तरार्धज्यां द्विगुणां कर्णं प्रकल्प्य.. ... न हि द्रष्टुर्दृष्टिसंमुखमादर्शवत्" संस्कृतोपपत्ति में लिखित भाष्य कहा है, सिद्धान्तशेखर में श्रीपति ने भी 'समान्यककुभोस्तयोरित्यादि' संस्कृतोपपत्ति में लिखित श्लोकों से आचार्योक्त के अनुरूप ही सब कुछ कहा है। ब्रह्मगुप्त-श्रीपति-सूर्यसिद्धान्तकार भास्कराचार्य प्रभृति आचार्यों का शृङ्गोन्नति साधन ठीक नहीं है। सिद्धान्ततत्त्वविवेक में इसके सम्बन्ध में कमलाकर ने बहुत कहा हैं। शृङ्गोन्नति का विचार सिताङ्गुल के अधीन है लेकिन सिताङ्गुलानयन कमलाकरोक्त भी ठीक नहीं है इसलिये कमलाकरोक्त शृङ्गोन्नति साधन भी ठीक नहीं है, वास्तवानयन के लिये म.म. पण्डित श्री सुधाकर द्विवेदि निर्मित 'वास्तवचन्द्रशृङ्गोन्नतिसाधनम्' नामक पुस्तक देखनी चाहिये इति।।७-८-९।।

अथ विशेषमाह

एवं तावद्यावत् पदयोराद्यन्तयोः शशिनि चार्कात्।
रविरर्धचक्रयुक्तः कल्प्यो द्वित्रिपदयोरर्कः ।।१०।।

सु. भा.—एवमर्कात् प्रथमचतुर्थपदयोः शशिनि चन्द्रे सति क्रिया कार्या। अर्थादेवं मासान्तपादे वा प्रथमे भुजकोटिकर्णादिकं भवति। द्वित्रिपदयो रविरर्धचक्रयुक्तः षड्राशिसहितः स चार्कः कल्पः। अर्थात् सषड्भमर्कं रविं प्रकल्प्य भुजकोटिकर्णादिकमानेयम्। एवं भुजकोटिकर्णैः कृष्णश्रृंगोन्नतिरुत्पद्यत इत्यर्थत एवावगम्यते ।।१०।।

वि. भा.—एवमर्कात् (रवितः) यावदाद्यन्तयोः पदयोः (प्रथमचतुर्थपदयोः) शशिनि (चन्द्रे) सति तावदेव भुजकोटिकर्णादिकं भवति, द्वितीयतृतीयपदयो रविरर्धचक्रयुक्तः (षड्राशिसहितः) अर्कः कल्प्योऽर्थात् सषड्भं रविमर्कं प्रकल्प्य भुजकोटिकर्णादिकमानेयम्। एवमानीतैर्भुजकोटिकर्णैः कृष्णशृङ्गोन्नतिरुत्पद्यत इत्युपपत्त्या सिध्यतीति ।।१०।।

अत्रोपपत्तिः

'शेषयोस्तु पदयोः सषड्गृहं भास्करं दिनकरं प्रकल्पयेदिति' सिद्धान्तशेखरे

श्रीपत्युक्तं 'रविरर्धचक्रयुक्तः कल्प्यो द्वित्रिपदयोरर्कः' ब्रह्मगुप्तोक्तानुरूपमेव, "द्वितीयतृतीययोरपि चरणयोर्ब्रह्मगुप्तादिभिः कृष्णशृङ्गोन्नतिरानीता सा मम न संमता। न हि नरैः कृष्णशृङ्गोन्नतिः स्पष्टोपलक्ष्यते, प्रसिद्धा तु शुक्लशृङ्गोन्नतिः" इत्यादिना भास्करेण कृष्णशृङ्गोन्नतिसाधनस्य निराकरणं कृतमिति सुधीभिर्विभावनीयम् ॥१०॥

अब विशेष कहते हैं

इस तरह रवि से जब तक प्रथम पद और चतुर्थ पद में चन्द्र रहे तब ही भुज, कोटि और कर्ण आदि होता है। द्वितीय और तृतीय पद में रवि में छः राशि जोड़कर जो हो उसको रवि कल्पना करना अर्थात् छः राशि युक्त रवि को अर्क (रवि) मानकर भुज, कोटि और कर्ण आदि लाना चाहिये। इस तरह लाये हुए भुज, कोटि और कर्ण से कृष्णशृङ्गोन्नति उत्पन्न होती है, यह उपपत्ति से जानी जाती है इति ॥१०॥

उपपत्ति

"शेषयोश्च पदयोः सषड्गृहं" इत्यादि संस्कृतोपपत्ति में लिखित श्रीपतिप्रकार 'रविरर्धचक्रयुक्तः कल्प्यो द्वित्रिपदयोरर्कः' इस आचार्योक्त के अनुरूप ही है। "द्वितीयतृतीययोरपि चरणयोर्ब्रह्मगुप्तादिभिः यहां से प्रसिद्धा तु शुक्लशृङ्गोन्नतिः" यहां तक संस्कृतोपपत्ति में लिखित गद्यों से भास्कराचार्य ने कृष्णशृङ्गोन्नति साधन का खण्डन किया है। इसको पण्डित लोग विचारें ॥१०॥

इदानीं सिताङ्गुलसाधनमाह

व्यर्केन्दुदलभुजांशाः शशिमानगुणाः सितं नवतिभक्ताः।
द्विगुणांशोत्क्रमजीवा तावद्यावन्नवतिरंशाः ॥११॥

नवतेरधिकांशानां क्रमज्यया संयुतोत्क्रमा त्रिज्या।
चन्द्रप्रमाणगुणिता द्विगुणव्यासार्धभक्ताऽन्यत् ॥१२॥

प्रथमं शुक्लं रात्रौ दिवसेऽन्यत् सन्ध्ययोस्तदैक्यार्धम्।
कर्णो ज्या रविदिग् भवति तस्य सितं श्रवणगत्या च ॥१३॥

सु॰ भा॰—व्यर्केन्दुदलभुजांशाः शशिबिम्बमानगुणा नवतिभक्ताः फलं सितं सिताङ्गुलानि। अयं प्रथमः प्रकारः। अथ द्वितीयप्रकारः। यावद्रविचन्द्रयोरन्तरांशा नवतिरंशा स्युस्तावत् पूर्वसाधिता व्यर्केन्दुदलभुजांशा द्विगुणाः कार्यास्तत्र येंऽशास्तेषामुत्क्रमज्या कार्या यद्यन्तरांशा नवतेरधिकास्तदाधिकांशानां या क्रमज्या तया त्रिज्या संयुता। एवमुत्क्रमाऽर्थादुत्क्रमज्या साध्या। एवं योत्क्रमज्या सा चन्द्रप्रमाणेन चन्द्रबिम्बमानेन गुणिता द्विगुणव्यासार्धेन द्विगुणत्रिज्यया भक्ताऽन्यत्

सितं सिताङ्गुलानि भवन्ति । यदि रात्रौ शृङ्गोन्नतिः साध्यते तदा प्रथमप्रकारागतं शुक्लं सिताङ्गुलं ग्राह्यम् । दिवसे चेत् तदान्यत् द्वितीयप्रकारागतं शुक्लं ग्राह्यम् । सन्ध्ययोः सूर्योदये सूर्यास्ते च तयोः प्रथमद्वितीयप्रकारागतयोः सितयोरैक्यार्धसमं शुक्लं ग्राह्यम् । रविचन्द्रान्तरांशानां ज्या पूर्णज्यैव रविदिक् कर्णो भवेत् । अथ द्रविकर्णगत्यैव शौक्ल्यं दीयते ।

अत्रोपपत्तिः । यदि नवत्यन्तरेण चन्द्रबिम्बार्धसमं शुक्लं तदाऽभीष्टरविचन्द्रान्तरेण किं जातं सिताङ्गुलमानम् $=\frac{\text{अं. विमा}}{९०\times२}=\frac{\text{अंदल. विमा}}{९०}$ । द्वितीयं सितमन्तरांशोत्क्रमज्यययाऽनुपातेन साधितं लल्लोक्तवत् । द्विसि $=\frac{\text{उज्या. विमा}}{\text{त्रि}\times२}$।

रात्रौ सुदृशा चन्द्रोज्ज्वलभागो विपुलो विलोक्यते । दिने रवितेजसा दृष्टिदोषादल्पः सितभागो लक्ष्यते । सन्ध्ययोश्चैवं दर्शने सितवैषम्यमुपलक्ष्यत इति तारतम्येनाधिकमल्पं तद्योगार्धसमं च सितं कल्पितमाचार्येण । वास्तवसितं तूत्क्रमज्यातोऽप्यल्पं तदर्थं मदीयं वास्तवचन्द्रशृंगोन्नतिसाधनं विलोक्यं ॥११-१२-१३॥

वि. भा.—व्यर्केन्दुदलभुजांशाः (रविरहितचन्द्रस्यार्धभुजांशाः) शशिमान-(चन्द्रबिम्ब) गुणाः, नवत्या भक्तास्तदा सितं (शुक्लप्रमाणं) भवति रात्रावित्यध्याहार्यम् । रविचन्द्रयोरन्तरांशा यावन्नवतिरंशाः स्युस्तावत् पूर्वोक्तव्यर्केन्दुदले भुजांशा द्विगुणाः कर्त्तव्यास्तत्र यावन्तोंऽशास्तेषामुत्क्रमज्या विधेया, यद्यन्तरांशाः नवतेरधिकास्तदाऽधिकांशानां या क्रमज्या तद्युता त्रिज्या कार्या, एवं करणेन योत्क्रमज्या भवेत्सा चन्द्रप्रमाणेन (चन्द्रबिम्बमानेन) गुणिता, द्विगुणव्यासार्धेन (द्विगुणितत्रिज्यया) भक्ता तदाऽन्यत् सितं (सितमानं) भवति, रात्रौ शृङ्गोन्नतिसाधने प्रथमं "व्यर्केन्दुदलभुजांशा" इत्यादि प्रथमप्रकारसाधितं शुक्लं (शुक्लं) ग्रहीतव्यम् । दिवसे शृङ्गोन्नतिसाधनेऽन्यत् (चन्द्रप्रमाणगुणितेत्यादि द्वितीयप्रकारसाधितं) शुक्लं ग्राह्यम् । सन्ध्ययोः (सूर्योदये सूर्यास्ते च) तदैक्यार्धं (प्रथमद्वितीयप्रकारसाधितयोः शुक्लयोर्योगार्धतुल्यं) शुक्लं ग्राह्यम् । रविचन्द्रान्तरांशानां ज्या (पूर्णज्या) रविदिक् कर्णो भवति, तस्य (चन्द्रस्य) सितं श्रवणगत्या (रविकर्णगत्या) भवतीति ॥११-१२-१३॥

अत्रोपपत्तिः

अथ पूर्णान्ते रविचन्द्रयोरन्तरांशाः=१८०°, तत्र सम्पूर्णं चन्द्रबिम्बं शुक्लं भवत्यतोऽनुपातेना "यदि साशीतिशतांश १८० तुल्येन रविचन्द्रान्तरांशेन सम्पूर्ण-

चन्द्रबिम्बतुल्यं शुक्लं लभ्यते तदेष्टरविचन्द्रान्तरांशेन किम्' नेन समागच्छति

$$\text{शुक्लाङ्गुलमानम्} = \frac{\text{रविचन्द्रान्तरांश} \times \text{चन्द्रबिम्ब}}{१८०} = \frac{\dfrac{\text{रविचन्द्रान्तरांश} \times \text{चन्द्रबिम्ब}}{२}}{\dfrac{१८०}{२}}$$

$$= \frac{\text{सूर्योनचन्द्रांशार्ध} \times \text{चन्द्रबिम्ब}}{९०}$$ रात्रौ शृङ्गोन्नतिसाधने प्रकारेणानेन शुक्लानयनं कार्यम् । दिने शुक्लानयनार्थमधोलिखितविधिर्बोध्यः ।

यदा रविचन्द्रयोरन्तरम्=०, तदा शुक्लाङ्गुलम्=०, यदा च रविचन्द्रयोरन्तरम्=१८०° तदा चन्द्रबिम्बतुल्यं शुक्लं भवति, तथा यदा रविचन्द्रयोरन्तरम्=९०°, तदा चन्द्रबिम्बार्धतुल्यं शुक्लं भवतीति भास्करतः सर्वैः प्राचीनाचार्यैः स्वीकृतम् । अथ रविचन्द्रयोरन्तरांशोत्क्रमज्यया शुक्लवृद्धेः प्रत्यक्षतो दर्शनादनुपातेना 'यदि त्रिज्यातुल्यया रविचन्द्रान्तरांशोत्क्रमज्यया चन्द्रबिम्बार्धतुल्यं शुक्लं लभ्यतेऽथवा द्विगुणितत्रिज्यातुल्यया द्विगुणभुजांशोत्क्रमज्यया चन्द्रबिम्बतुल्यं शुक्लं लभ्यते तदेष्टया द्विगुणितभुजांशोत्क्रमज्यया किम्'नेन समागतं शुक्लमानं दिनोपयोगि भवति, उत्क्रमज्ययाऽनुपातो लल्लोक्तमार्गमनुसृत्याऽऽचार्येण कृतः, दिने रविकिरणप्रभावाद् दृष्टिदोषादल्पः सितभागो दृग्गोचरीभूतो भवति, सन्ध्ययोर्दर्शने सितवैषम्यं प्राप्यत इति तारतम्यात्तद्योगार्धसमं शुक्लं स्वीकृतमाचार्येणेति, सिद्धान्तदर्पणे "व्यर्कशीतकिरणार्धभुजांशानिन्दुबिम्बगुणितान् गगनाङ्कैः ९० । भाजयेत् खलु कलादिफलं यत् तत्सितं निजगदुः क्षणदायाम्" ऽनेन रात्र्युपयोगिशुक्लमानं तदा "द्विघ्नबाहुलवजोत्क्रमजीवा चन्द्रमाननिहताऽथ विभक्ता । त्रिज्यया द्विगुणया फलमन्हि स्यात् सितं शशधरस्य कलाद्यम्" ऽनेन दिनोपयोगिशुक्लमानं, "द्विगुणभुजलवाश्चेत् खाङ्कभागाधिकाः स्युः समधिक लवजीवा जायते या क्रमेण । त्रिभवनभवमौर्व्या संयुतां तां विधाय प्रगिगदितविधानात् वासरे शुक्लसिद्धिः" अनेन दिवा शुक्लानयनप्रकारे विशेषं "रात्रिवासरसितैक्यदलं यत् सन्ध्ययोस्तदुभयोरपि शुक्लम्" अनेन पुनर्विशेषं श्रीपतिराचार्योक्तानुरूपमेव कथितवानिति ॥११-१२-१३॥

अब सिताङ्गुल साधन को कहते हैं

हि. भा.—रविचन्द्रान्तरांशार्ध को चन्द्रबिम्ब से गुणा कर नब्बे से भाग देने से रात्रि में शुक्ल प्रमाण होता है, यह प्रथम प्रकार है, जब तक रवि और चन्द्र का अन्तरांश नब्बे हो तब तक रविचन्द्रान्तरार्ध भुजांश को द्विगुणित करना तब जो अंश हो उसकी

उत्क्रमज्या करनी चाहिये। यदि अन्तरांश नब्बे से अधिक हो तो अधिक चापांश की जो क्रमज्या हो उसको त्रिज्या में जोड़ना तब जो उत्क्रमज्या हो उसको चन्द्रबिम्ब से गुणाकर द्विगुणित त्रिज्या से भाग देने से दूसरा सित मान होता है, यह द्वितीय प्रकार है, रात्रि में शृङ्गोन्नति साधन करना हो तो प्रथम प्रकारागत सितमान ग्रहण करना चाहिये। यदि दिन में शृङ्गोन्नति साधन करना हो तो द्वितीय प्रकारागत सितमान ग्रहण करना चाहिये। रवि और चन्द्र के अन्तरांश की पूर्णज्या रविदिशा का कर्ण होता है, चन्द्र के सित को रवि कर्णगति से देते हैं इति ॥११-१२-१३॥

उपपत्ति

पूर्णान्तकाल में रवि और चन्द्र का अन्तरांश $=१८०^\circ$ वहां सम्पूर्ण चन्द्रबिम्ब शुक्ल होता है। इसलिये "यदि एक सौ अस्सी रविचन्द्रान्तरांश में सम्पूर्ण चन्द्रबिम्बतुल्य शुक्ल पाते हैं तो इष्ट रवि और चन्द्र के अन्तरांश में क्या" इस अनुपात से शुक्ल प्रमाण

$$=\frac{\text{रविचन्द्रान्तरांश}\times\text{चन्द्रबिम्ब}}{१८०}=\frac{\frac{\text{रविचन्द्रान्तरांश}}{२}}{\frac{१८०}{२}}\times\text{चंबि}$$

$$=\frac{\text{सूर्योनचन्द्रांशार्ध}\times\text{चंबि}}{९०}$$ इस प्रकार से रात्रि में शृङ्गोन्नति साधन में शुक्लानयन करना चाहिये। दिन में शुक्लानयन के लिये अधोलिखित विधि समझनी चाहिये। जब रवि चन्द्रान्तरांश$=०$, तदा शुक्लमान$=०$, जब रविचन्द्रान्तरांश$=१८०^\circ$ तब चन्द्रबिम्बतुल्य शुक्लमान होता है, जब रविचन्द्रान्तरांश$=९०$ तब चन्द्रबिम्बार्धतुल्य शुक्लमान होता है, इन बातों को भास्कराचार्य से प्राचीन सब आचार्यों ने स्वीकार किया है। रवि और चन्द्र के अन्तरांश की उत्क्रमज्या से प्रत्यक्ष शुक्ल वृद्धि देखने से 'यदि त्रिज्या-तुल्यरविचन्द्रान्तरांशोत्क्रमज्या में चन्द्रबिम्ब तुल्य शुक्ल पाते हैं अथवा द्विगुणित त्रिज्या तुल्य द्विगुणित भुजांशोत्क्रमज्या में चन्द्रबिम्ब तुल्य शुक्ल पाते हैं तो इष्ट द्विगुण भुजांशो-त्क्रमज्जा में क्या' इससे जो शुक्ल मान आता है वह दिनोपयोगी होता है, लल्लोक्त मार्ग का अनुसरण करके आचार्य ने उत्क्रमज्या से अनुपात किया है। दिन में रवि के तेज से दृष्टि दोष से अल्प सितभाग लक्षित होता है, दोनों सन्ध्याओं में सित में वैषम्य उपलब्ध होता है इसलिए तारतम्य से उन दोनों (प्रथम प्रकारागत तथा द्वितीय प्रकारागत) सित प्रमाणों का योगार्ध के बराबर शुक्लमान आचार्य ने स्वीकार किया है। सिद्धान्तदर्पण में "व्यर्कशीत-किरणार्धभुजांशान्" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से रात्रि में उपयोगी शुक्ल-मान तथा "द्विघ्नबाहुलवजोत्क्रमजीवा" इत्यादि संस्कृत उपपत्ति में लिखित श्लोक से इससे दिनोपयोगी शुक्लमान, "द्विगुणभुजलवाश्चेत् खाङ्कभागाधिकाः स्युः" इत्यादि संस्कृत

उपपत्ति में लिखित श्लोक से दिन में शुक्लानयन में विशेष "रात्रिवासरसितैक्यदलं" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से पुनर्विशेष श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ।।११-१२-१३।।

इदानीं परिलेखसूत्रसाधनमाह

शशिमानवर्गपादो मानार्धसितान्तरार्धभक्तयुतः ।
परिलेखसूत्रमस्मात् शुक्लेऽर्धाल्पे च परिलेखः ।।१४।।

सु. भा.— शशिमानवर्गस्य चतुर्थांशो मानार्धस्य सिताङ्गुलस्य च यदन्तरं तस्यार्धेन भक्तः फलं तदर्धेन युतं परिलेखसूत्रं स्यात् । अस्मात् परिलेखसूत्रा-दर्धाल्पे शुक्ले परिलेखो भवति ।

अत्रोपपत्तिः । मानार्धसितान्तरमेव 'व्यर्केन्दुकोटयंशशरेङ्गुं भागो हारो भवति स एव कोटिकर्णान्तरम् । शशिमानार्धं च भुजः । ततो 'भुजाद्वर्गगतात् कोटिकर्णा-न्तराप्त' मित्यादिभास्करविधिना

$$\text{कर्णमानमेव परिलेखसूत्रम्} = \frac{\text{हा}}{२} + \frac{\frac{\text{विंमा}^२}{\text{हा}}}{\frac{४}{\frac{\text{हा}}{२}}}$$ । अस्मात् परिलेखश्च भास्करविधिना स्फुटः ।।१४।।

इदानीं चन्द्रादिदर्शनार्थं प्रकारमाह

त्रिप्रश्नोक्त्या शङ्कोः पूर्वापरतो निधाय दिङ्मध्ये ।
छायाग्रं छायाग्राच्छङ्क्वग्रगतोर्ध्वसूत्रवशात् ।।१५।।
कृत्वा वंशद्वितयं दृष्टया तत् प्रथममुन्नतरमन्यत् ।
प्रथमाग्रस्थितदृष्टया द्वितीयवंशाग्रगं चन्द्रम् ।।१६।।
ग्रहणं ग्रहयोगं वा विस्मयकरणाय दर्शयेद् गणकः ।
लोकस्य नरपतेर्वा दुष्करमन्यैर्हि गणितविद्भिः ।।१७।।

सु. भा.—त्रिप्रश्नाधिकारविधिनाऽभीष्टे काले ग्रहशङ्कोर्मानं विज्ञाय यथा दिङ्मध्ये तस्य शङ्कोश्छायाग्रं पतति तथा पूर्वापररेखातो दक्षिणे वोत्तरे तं शङ्कुं निधाय स्थिरः कार्यः । शङ्कुसमो वंश एकः । अथ छायाग्रादर्थाद् दिङ्मध्याच्छ-ङ्क्वग्रगतोर्ध्वसूत्रवशादग्रेवंशद्वितयं द्वितीयं वंशं कृत्वा तं च स्थिरं कुर्यात् । तत् प्रथमं वंशमानं दृष्ट्या समं कार्यम् । अन्यद् द्वितीयवंशमानं प्रथमादुन्नतरं कुर्यात् । अत्रैतदुक्तं भवति । दिङ्मध्याच्छङ्क्वग्रगामिकर्णसूत्रं स्वगत्या प्रसार्यान्यस्मिन् वंशे बध्नीयात् । तं द्वितीयं वंशं च स्थिरं कुर्यात् । अथ कर्णसूत्रे प्रथमशङ्क्वग्रगत-दृष्ट्या द्वितीय वंशाग्रमं चन्द्रं ग्रहणं ग्रहयोगं वाऽभीष्टं गणको,लोकस्य जनस्य वा

नरपते राज्ञो विस्मयकरणाय दर्शयेत् । इदं दर्शनमन्यैरार्यभटादिभिर्गणित-विद्भिर्दुष्करमसाध्यमिति ।

अत्रोपपत्तिः छायाक्षेत्रसंस्थयैव स्फुटा किं ग्रन्थगौरवेण ॥१५-१६-१७॥

वि. भा.—त्रिप्रश्नोक्त्या (त्रिप्रश्नाधिकारकथितनियमेन) शङ्कोः (अभीष्ट-ग्रहशङ्कोः) मानं ज्ञात्वा दिङ्मध्ये तस्य शङ्कोश्छायाग्रं यथा पतेत्तथा पूर्वापरतो (पूर्वापररेखातः) दक्षिणे उत्तरे वा तं शङ्कुं स्थापयित्वा स्थिरः कार्यः । शङ्कुसम एको वंशः । छायाग्रात् (दिङ्मध्यात्) शङ्क्वग्रगतोर्ध्वसूत्रवशादग्रे वंशद्वितयं (द्वितीयवंशं) कृत्वा स्थिरं कुर्यात् तत् प्रथमं वशमानं दृष्ट्वा समं कार्यम् । अन्यत् (द्वितीयवंशमानं) तदपेक्षयोच्चतरं कार्यम् । दिङ्मध्यात् प्रथमवंशाग्रगतं कर्णसूत्रं वर्धनेन द्वितीयवंशे यत्र लगति तत्र दृढं बध्नीयात्, तदा प्रथमवंशा (शङ्कु) ग्रगत-दृष्ट्वा द्वितीयवंशाग्रगं चन्द्रं ग्रहणं वा ग्रहयुतिं लोकस्य (जनस्य) नरपते (राज्ञः) वा विस्मयकरणाय गणको दर्शयेत् । अन्यैः (आर्यभटादिभिः) गणितविद्भिः (गणितज्ञैः) इदं दर्शनं दुष्करं (असाध्यं) इति ॥१५-१६-१७॥

अत्रोपपत्तिः

छायाक्षेत्रं हृदि निधाय विज्ञानभाष्यदर्शनेन स्पष्टैवास्तीति विज्ञैर्भृशं विभावनीया ।।१५-१६-१७।।

अब चन्द्र-ग्रहण-ग्रहयुति आदि देखने के प्रकार को कहते हैं

हि. भा. — त्रिप्रश्नाधिकार में कथित विधि से इष्टकाल में ग्रहशङ्कु का मान जान कर दिङ्मध्य (दिशाओं के मध्य याने केन्द्र) में उस शङ्कु का छायाग्र जैसे पतित हो वैसे पूर्वापर रेखा से उत्तर या दक्षिण में उस शङ्कु को रख कर स्थिर करना । शङ्कु के बराबर प्रथम वंश मानना । छायाग्र (दिङ्मध्य) से शङ्क्वग्रगत ऊर्ध्वसूत्रवश से आगे दूसरे वंश को स्थापन कर स्थिर करना चाहिये । उस प्रथम वंश मान को दृष्टि से समान करना । उसकी अपेक्षा द्वितीय वंशमान को उच्चतर (अतिशय उच्च) करना चाहिये । दिङ्मध्य से प्रथम वंशाग्रगत कर्णसूत्र को बढ़ाने से द्वितीय वंश में जहां लगे वहां खूब मजबूती से बांध देना चाहिये. तब प्रथम वंशा (शङ्कु) ग्रगत दृष्टि से द्वितीय वंशाग्रगत चन्द्र को, ग्रहण को वा ग्रहयोग को गणक (ज्यौतिषिक) लोगों को वा राजा को आश्चर्य चकित करने के लिये दिखावे; आर्यभट आदि गणितज्ञों से यह दिखाना असाध्य है इति. ।।१५-१६-१७।।

उपपत्ति

छाया क्षेत्र को हृदय में रखकर हिन्दी भाष्य देखने से स्पष्ट ही है । इसको विज्ञ लोग विचारें इति ।।१५-१६-१७

इदानीमध्यायोपसंहारमाह

इति बाहुकोटिकर्णस्फुटसितपरिलेखसूत्रकर्णेषु ।
आर्याष्टादश चन्द्रशृङ्गोन्नतिसप्तमोऽध्यायः ।।१८।।

सु. भा.— परिलेखसूत्रमेव कर्णं इति परिलेखसूत्रकर्णः । शेषं स्पष्टार्थम् ।।१८।।

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते ।
हृदि तं विनिधाय नूतनोऽयं रचितः शृंगविधौ सुधाकरेण ।।

इति श्री कृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्तनूतन-तिलके शृङ्गोन्नत्यधिकारः सप्तमः ।।७।।

वि. भा.—एवं भुजकोटिकर्णस्फुटसिताङ्गुलपरिलेखसूत्रकर्णेषु, अष्टादश-भिरार्याभिश्चन्द्रशृङ्गोन्नतिनामकः सप्तमोऽध्यायोऽस्तीति ।।१८।।

इति श्री ब्रह्मगुप्तविरचिते ब्राह्मस्फुटसिद्धान्ते चन्द्रशृङ्गोन्नत्यधिकारः सप्तमः ।।७।।

अब अध्याय के उपसंहार को कहते हैं ।

हि. भा.— इस तरह भुज, कोटि, कर्ण, स्फुट सिताङ्गुल, परिलेखसूत्र (कर्ण) में अठारह आर्याश्लोकों से- चन्द्रशृङ्गोन्नति नामक सप्तम अध्याय है ।

श्री ब्रह्मगुप्त विरचित ब्राह्मस्फुट सिद्धान्त में चन्द्रशृङ्गोन्नति नाम का सप्तम अध्याय सम्पूर्ण ।।

ब्राह्मस्फटसिद्धान्तः

७

चन्द्रच्छायाधिकारः

ब्राह्मस्फुटसिद्धान्तः

चन्द्रच्छायाधिकारः

अथ चन्द्रच्छायाधिकारः प्रारभ्यते । तत्रादौ तदारम्भप्रयोजनमाह ।

प्राक्चन्द्रलग्नयोरस्तलग्नशशिनो यतोऽन्तरं पश्चात् ।
प्रतिदिनमिन्दुच्छाया यतस्तदानयनमभिधास्ये ।।१।।

सु. भा.—प्राक् क्षितिजे यतश्चन्द्रलग्नयोरन्तरं पश्चात् क्षितिजेऽस्तलग्नशशिनोरन्तरं च प्रतिदिनं यत् तेनैवेन्दुच्छाया ज्ञायते तथा यत इन्दुच्छायातस्तदन्तरं च ज्ञायतेऽतस्तदानयनं छायानयनमभिधास्ये कथयिष्ये इति ।।१।।

वि. भा.—प्राक् (पूर्वक्षितिजे) चन्द्रलग्नयोरन्तरं, पश्चात् (पश्चिमक्षितिजे) अस्तलग्नशशिनो (सप्तमलग्नचन्द्रयोः) रन्तरं च प्रतिदिनं यत्तेनैव यतः (यस्मात्कारणात्) इन्दुच्छाया (चन्द्रच्छाया) ज्ञायते, तथेन्दुच्छायातस्तदन्तरं च ज्ञायतेऽतस्तदानयन (छायानयनं) मभिधास्ये (कथयिष्ये) इति, सिद्धान्तशेखरे "प्राग्यतस्तुहिनरश्मिलग्नयोरस्तलग्नशशिनोश्च पश्चिमे । अन्तरात् प्रतिदिनं शशिप्रभा "तत्प्रसाधनमतोऽधुनोच्यते" ऽनेन श्रीपतिनाप्याचार्योक्तानुरूपमेवोक्तमिति ।।१।।

अब चन्द्रच्छायाधिकार प्रारम्भ किया जाता है, पहले उसके आरम्भ-प्रयोजन को कहते हैं

हि. भा.—पूर्व क्षितिज में चन्द्र और लग्न का अन्तर, पश्चिम क्षितिज में सप्तमलग्न और चन्द्र का अन्तर प्रत्येक दिन में जो होता है उसी से क्योंकि चन्द्रच्छाया समझी जाती है (अर्थात् चन्द्रच्छाया का ज्ञान होता है) तथा चन्द्रच्छाया से उस अन्तर का ज्ञान होता है इसीलिये छायानयन को कहता हूं । सिद्धान्तशेखर में "प्राग्यतस्तुहिनरश्मिलग्नयोः इत्यादि सं० वि० भा० में लिखित श्लोक से" श्रीपति भी आचार्योक्त के अनुरूप ही कहते हैं ।।१।।

इदानीं कर्त्तव्यतामाह

प्रग्रहणकालिकैरिष्टकालिकैरर्कलग्नशशिपातैः ।
कृत्वोदयास्तलग्ने स्वचरप्राणान् प्रसाध्यस्य ।।२।।

सु. भा.—यदि प्रग्रहणे चन्द्रग्रहणस्पर्शकाले छायाज्ञानमभीष्टं तदा प्रग्रहण-

कालिकैरन्यथेष्टकालिकैः सूर्यलग्नशशिपातैः शशाङ्कस्योदयास्तलग्ने स्वचरप्राणान् चन्द्रचरासूंश्च कृत्वा अनष्टाः स्थाप्या इति ॥२॥

वि. भा.—यदि प्रग्रहणकाले (चन्द्रग्रहणस्पर्शसमये) छायाज्ञानमभीष्टं तदा तत्कालिकैरन्यथेष्टकालिकैः अर्कलग्नशशिपातैः (रविलग्नचन्द्रपातैः) शशाङ्कस्यो (चन्द्रस्य) दयास्तलग्ने स्वचरप्राणान् (चन्द्रचरासूंश्च) कृत्वा स्थाप्या इति ॥२॥

अब कर्त्तव्यता को कहते हैं

हि. भा.—यदि चन्द्रग्रहण स्पर्शकाल में छाया साधन अभीष्ट हो तो स्पर्शकालिक रवि, लग्न, और चन्द्रपात से, अन्यथा इष्टकालिक रवि, लग्न, और चन्द्रपात से चन्द्र के उदयलग्न और अस्त (सप्तम) लग्न साधन कर तथा चन्द्र के चरासु को भी साधन कर रखना इति ॥२॥

इदानीं चन्द्रस्य दृश्यादृश्यत्वमादिशति

यद्यधिकमुदयलग्नादूनं षड्गृहयुतास्तमयलग्नात् ।
लग्नं तदा शशाङ्को दृश्यः सति दर्शने छाया ॥३॥

सु. भा.—लग्नं तात्कालिकं प्राक्क्षितिजे क्रान्तिवृत्तस्य लग्नप्रदेशः । तद्यदि चन्द्रोदयलग्नादधिकं षड्गृहयुतास्तमयलग्नाच्चोनं तदा चन्द्रो दृश्यो भवति । दर्शने सति छाया साध्या ।

अत्रोपपत्तिः । उदयलग्नसमे लग्ने चन्द्रः प्राक्क्षितिजे उदेति । आचार्येणोदयास्ताधिकारे पश्चिमक्षितिजस्थे ग्रहबिम्बे पश्चिमक्षितिजलग्नस्यापमण्डलप्रदेशस्यास्तलग्नसंज्ञा कृताऽतस्तदासषड्भास्तलग्नं प्राक्क्षितिजे लग्नं भवति तस्मादिष्टलग्ने न्यूने उदयलग्नाच्चाधिके बिम्बं क्षितिजादुपरि वर्त्तत इति गोलयुक्त्या स्फुटम् । अतश्चन्द्रदर्शने सति तच्छायासाधनमुचितमिति । 'निशीष्टलग्नादुदयास्तलग्ने न्यूनाधिके यस्य खगः स दृश्यः' इति भास्करोक्तमेतदनुरूपमेव ॥३॥

वि. भा.—यदि लग्नं तात्कालिकं पूर्वक्षितिजक्रान्तिवृत्तसम्पातरूपं चन्द्रोदयलग्नादधिकं षड्गृहयुतास्तमयलग्नादूनं तदा शशाङ्को (चन्द्रः) दृश्यो भवति चन्द्रदर्शने सति तदीया छाया साध्येति ॥३॥

अत्रोपपत्तिः

उदयलग्नतुल्ये लग्ने पूर्वक्षितिजे चन्द्रस्योदयः । पश्चिमक्षितिजस्थे ग्रहबिम्बे पश्चिमक्षितिजक्रान्तिवृत्तयोः सम्पातबिन्दोरस्तलग्नसंज्ञोदयास्ताधिकारे आचार्येण कृतोऽतस्तदा सषड्भास्तलग्नं पूर्वक्षितिजे लग्नं भवेत् । तस्मादिष्टलग्ने न्यूने उदयलग्नाच्चाधिके बिम्बं क्षितिजादुपरि भवेत्तेन तदा चन्द्रदर्शनं भवेदेव। चन्द्रदर्शने सति तदीया छाया साध्या सिद्धान्तशेखरे श्रीपति "ऊनको यदि विलग्नतो भवेत् शुभ्रभानुरधिकोऽस्तलग्नतः । दृश्यते विहितदृग्विधिद्वयस्तत्प्रभा खलु- विलोकने सति" रेवं कथितवान् । सिद्धान्तशिरोमणौ भास्कराचार्येण "निशीष्ट लग्नादुदयास्तलग्ने न्यूनाधिके यस्य खगः स दृश्यः" नेनाचार्योक्तानुरूपमेवोक्तमिति ॥३॥

अब चन्द्र के दृश्यादृश्यत्व को कहते हैं

हि.भा.—यदि पूर्व क्षितिज और क्रान्तिवृत्त का सम्पात रूप तात्कालिक लग्न चन्द्रोदय लग्न से अधिक हो तथा छः राशि युक्त अस्त लग्न से न्यून हो तो चन्द्र दृश्य होते हैं, चन्द्रदर्शन होने से उनका छाया-साधन करना चाहिए इति ॥३॥

उपपत्ति

उदय लग्न के तुल्य लग्न के रहने से पूर्व क्षितिज में चन्द्र उदित होते हैं। पश्चिम क्षितिज में ग्रह बिम्ब के रहने से पश्चिम क्षितिज और क्रान्तिवृत्त के सम्पात-बिन्दु को आचार्य ने उदयास्ताधिकार में अस्तलग्न संज्ञक कहा है इसलिये तब छः राशियुत अस्तलग्न पूर्व क्षितिज में लग्न होता है। उस से इष्ट लग्न न्यून हो तथा उदय लग्न से अधिक हो तो बिम्ब क्षितिज से ऊपर होता है इसलिये तब चन्द्र दर्शन भी होता ही है, चन्द्र दर्शन होने से उसकी छाया का साधन करना समुचित है, सिद्धान्तशेखर में "ऊनको यदि बिलग्नतो भवेद-त्यादि सं. उपपत्ति में लिखित श्लोक से" श्रीपति ऐसे कहते हैं, सिद्धान्तशिरोमणि में भास्कराचार्य "निशीष्ट लग्नोदयास्तलग्ने" इत्यादि से आचार्योक्तानुरूप ही कहते हैं इति ॥३॥

इदानीं चन्द्रोन्नतकालसाधनमाह

लग्नसममुदयलग्नं षड्गृहयुक्तास्तमयलग्नसमम् ।
पूर्वापरयोः कृत्वा गतशेषाः स्वोदयैर्घटिकाः ॥४॥

सु. भा.—पूर्वापरयोः क्षितिजयोः क्रमेणोदयलग्नं लग्नसमं लग्नं च षड्गृहयुक्तास्तमयलग्नसमं कृत्वाऽर्थात् प्राक् क्षितिजे उदयलग्नभोग्यकालो लग्नभुक्तकालो

मध्योदयाश्चैषां स्वदेश्युदयैर्योगं कृत्वा पश्चिमक्षितिजे च लग्नभोग्यकालः सषड्भास्तलग्नभुक्तकालो मध्योदयाश्चैषां योगं कृत्वा चन्द्रस्य गतशेषा घटिकाः साध्याः ।

अत्रोपपत्तिः । लग्नात् कालसाधनविधिना स्फुटा ॥४॥

वि. भा.—पूर्वापरयोः (पूर्वक्षितिजपश्चिमक्षितिजयोः) क्रमेण लग्नतुल्यमुदयलग्नं, षड्गृहयुक्तास्तमयलग्नसमम् (षड्राशियुतास्तलग्नतुल्यं) लग्नं कृत्वाऽर्थात्पूर्वक्षितिजे उदयलग्नभोग्यकालो लग्नस्यभुक्तकालो मध्योदयाश्चैषां स्वदेश्युदयैर्युतिं कृत्वा पश्चिमक्षितिजे च लग्नस्य भोग्यकालः षड्गृहयुतास्तलग्नभुक्तकालो मध्यादयाश्चैषां युतिं कृत्वा चन्द्रस्य गतघटिकाः शेषघटिकाश्च साधनीया इति ॥४॥

अत्रोपपत्तिः

अत्रोपपत्तिस्तु लग्नतः कालानयनप्रकारेण स्फुटेति; सिद्धान्तशेखरे श्रीपति "प्राचिलग्न उदयेन्दुना समे सर्त्तुभास्तशशिना च पश्चिमे । संविधाय गतशेषनाड़िकाः" रेवं कथितवानिति ॥४॥

अब चन्द्र के उन्नत कालानयन को कहते हैं ।

हि. भा. पूर्वक्षितिज में लग्न के तुल्य उदय लग्न को करके तथा छः राशियुत अस्तलग्न के तुल्य लग्न को करके अर्थात् पूर्वक्षितिज में उदयलग्न के भोग्यकाल लग्न के भुक्तकाल और दोनों (उदयलग्न और लग्न) के मध्योदय इन सबों का योग कर तथा पश्चिम क्षितिज मे लग्न के भोग्यकाल छ राशियुत अस्तलग्न के भुक्तकाल तथा मध्योदय इन सबों का योग कर चन्द्र की गत घटी और शेष घटी साधन करना इति ॥४॥

उपपत्ति

लग्न से इष्ट कालानयन प्रकार से स्पष्ट है 'सिद्धान्तशेखर में श्रीपति ने 'प्राचि उदयेन्दुना समे इत्यादि'' से ऐसा कहा है इति ॥४॥

इदानीं चन्द्रशङ्क्वानयनमाह

गतघटिकाः शेषा वा स्वदिनार्धसमा यदेन्दुरस्त्यर्धे ।
गतशेषनाड़िकाभिर्नताभिरथवाऽर्कवच्छङ्कुः ॥५॥

सु. भा.—पूर्वसाधिता गतघटिका वा शेषघटिका यदा स्वदिनार्धसमाश्चन्द्रदिनार्धसमास्तदेन्दुरुर्ध्वे याम्योत्तरवृत्तेऽस्तीति ज्ञेयम् । अथ गत शेषनाडिकाभिस्त्रिप्रश्नोक्त्या चन्द्रचरं विधायार्कवच्चन्द्रशङ्कुः साध्यः । अथवा चन्द्रचराच्चन्द्रदिनार्धं

प्रसाध्य गतशेषनाडिकाभिश्चन्द्रनतघटिकाः कृत्वा ततो नताभिरर्कवच्चन्द्रशङ्कुः साध्य इति ।

अत्रोपपत्तिः । शङ्कुसाधने त्रिप्रश्नोक्तैव ॥५॥

वि. भा.—पूर्वानीता गतघटिकाः शेषघटिका वा यदा स्वदिनार्धसमा- (चन्द्रदिनार्धतुल्याः) स्तदेन्दु (चन्द्रः) रर्धे (याम्योत्तरवृत्तेऽस्तीति) गतशेष नाड़िकाभिस्त्रिप्रश्नोक्त्या चन्द्रचरं विज्ञाय रविवच्चन्द्रशङ्कुः साध्यः । अथवा नताभिः चन्द्रचरवशेन चन्द्रदिनार्धं कृत्वा गतशेषनाड़िकाभिश्चन्द्रनतघटिकाः कृत्वा ततो नताभिरर्कवच्चन्द्रशङ्कुः साध्य इति ॥५॥

अत्रोपपत्तिः

चन्द्रशङ्कुसाधनं त्रिप्रश्नोक्तविधिनैव कार्यं सिद्धान्तशेखरे श्रीपतिना "निजदिनदलतुल्या नाड़िका यातयेया यदि तुहिनमरीचेः स्युस्तदाऽसौ खमध्ये । सवितुरिव नताभिर्वोन्नताभिर्घटीभिः स्फुटतरनिजशङ्कोः" ऽप्यनेनाचार्योक्तानुरूपमेवोक्तमिति ॥५॥

अब चन्द्रशङ्कु के आनयन को कहते हैं ।

हि. भा.—यदि पूर्व साधित गत घटी वा शेषघटी चन्द्रदिनार्ध के बराबर हो तो चन्द्र याम्योत्तर वृत्त में है यह समझना चाहिये। गत घटी या शेष घटी से त्रिप्रश्नोक्त विधि से चन्द्र के चर जान कर रवि की तरह चन्द्रशङ्कु साधन करना, अथवा चन्द्रचरवश से चन्द्र के दिनार्ध जान कर गतघटी और शेष घटी से चन्द्र की नत घटी साधन कर रवि की तरह चन्द्रशङ्कु साधन करना चाहिये इति ॥५॥

उपपत्ति

त्रिप्रश्नोक्त विधि से चन्द्रशङ्कु साधन करना चाहिये । सिद्धान्तशेखर में श्रीपति ने भी "निजदिनदलतुल्या नाड़िका" इत्यादि से आचार्योक्त के अनुरूप ही कहा है इति. ॥५॥

इदानीं रविचन्द्रयोः स्फुटशङ्क्वानयनमाह

शङ्कुधनुषोऽधिकस्य स्फुटप्रमाणार्धलिप्तिकाभिर्ज्या ।
रविशशिमध्यगतिकला तिथ्यंशेनोनिता छेदः ॥६॥

सु. भा.—स्फुटप्रमाणार्धलिप्तिकाभिरधिकस्य शङ्कुधनुषो ज्या साध्या सा रविशशिमध्यगतिकलातिथ्यंशेनोनिता छेदो हरः स्यात् । द्वादशभिर्गुणिताया

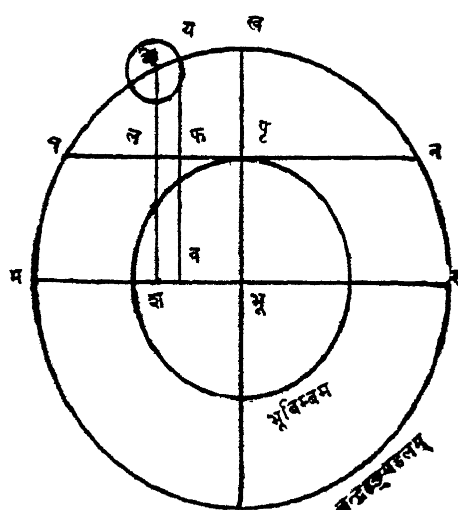
दृग्ज्याया इत्यग्रिमेण सहान्वयः । अत्रैतदुक्तं भवति । रविस्फुटशङ्कुसाधनार्थं तद्गणितागतशङ्कोश्चापं कार्यं । तत्र रविबिंबकलार्धं प्रक्षिप्य ज्या कार्या । सा ज्या च रविमध्यगतिपञ्चदशांशेनोनिता स्फुटशङ्कुः स्यात् । स एव छेदः । चन्द्रस्फुटशङ्कुसाधने च चन्द्रस्य बिंबकलार्धं चन्द्रगणितागतशङ्कुचापे प्रक्षिप्य या ज्या सा चन्द्रगतिपञ्चदशांशेनोना ।

अत्रोपपत्तिः । रविचन्द्रयोरुपरि ये दृङ्मण्डले तत्र केन्द्राद् गर्भक्षितिजावधि गणितागताः शङ्कुचापकलाः । दृङ्मण्डलं च बिम्बोर्ध्वप्रदेशे खार्धासन्ने यत्र लग्नं तस्मात् केन्द्रावधि स्फुटबिम्बार्धकलाः तदधिकागर्भशङ्कुचापकला गर्भक्षितिजादूर्ध्वबिम्बप्रदेशस्योन्नतांशास्तज्ज्या च तत्प्रदेशस्य गर्भीयः शङ्कुस्तत्र स्वगतिपञ्चदशांशसमाः कुच्छत्रकला विशोध्य पृष्ठशङ्कुरानीत आचार्येण । ऊर्ध्वप्रदेशस्य पृष्ठशङ्कुर्मुनीश्वरेणापि स्वसिद्धान्तसार्वभौमे साधितस्तत्खण्डनं च कमलाकरेण तत्त्वविवेके छायाधिकारे सम्यक् कृतम् । पृष्ठशङ्कोरनुपातेन भास्करादीनां मतेन विजातीयक्षेत्रत्वान्न स्फुटा छायाऽऽगच्छति इत्यस्यापि मीमांसा कमलाकरस्यैव तत्र समीचीना । यदि ग्रहणादिना बिम्बस्य सर्वप्रदेश ऊर्ध्वप्रदेशातिरिक्तश्छन्नो भवेत् । तदैवोर्ध्वप्रदेशाच्छङ्कोश्छाया स्फुटोपलक्ष्यते । अन्यथा बिम्बकेन्द्रादागता शङ्क्वग्रोपरि किरणरेखा या तदवरोधवशेनैव शङ्कुच्छाया स्पष्टोपलक्ष्यत इति सिद्धान्तविदामतिरोहितमेवेति ॥६॥

वि. भा.—रविचन्द्रयोः स्फुटप्रमाणार्धलिप्तिकाभिः (स्फुटबिम्बमानार्धकलाभिः) अधिकस्य (युक्तस्य) शङ्कुधनुषः (शङ्कुचापस्य) या ज्या सा रविशशिमध्यगतिकलातिथ्यंशेन (रविचन्द्रयोर्मध्यगतिकला पञ्चदशांशेन) ऊनिता (रहिता) तदा छेदो भवेत् । अत्रैतदुक्तं भवति, रविचन्द्रयोः स्फुटशङ्कुसाधनार्थं तद् गणितागतशङ्क्वोश्चापे कार्ये तत्र तयोर्बिम्बकलार्धे योज्ये तयोर्ज्यके भवतस्ते तन्मध्यगतिकला पञ्चदशांशेन हीने तदा तयोः स्फुटशङ्कू (छेदसंज्ञके) भवेतामिति ॥६॥

अत्रोपपत्तिः

भू=भूकेन्द्रम् । ख=खस्वस्तिकम् । पृ=भूपृष्ठस्थानम् । मभूर=गर्भक्षितिज धरातलम् । चपृन=पृष्ठक्षितिजधरातलम् । के=चन्द्रबिम्बकेन्द्रम् । केय=चन्द्रबिम्बमानार्धम् । भूपृ=लश=कुछत्रकला । केश=गणितागतचन्द्रशङ्कुः । केल=चन्द्रस्य स्फुटशङ्कुः । केम=चन्द्रबिम्बकेन्द्राद्गर्भ क्षितिजावधि गणितागतचन्द्रशङ्कुचापकलाः । य=चन्द्रबिम्बोर्ध्व प्रदेशः ।



केम + केय = बिम्बकेन्द्राद्गर्भक्षितिजावधिशङ्कुचाप + स्फुटबिम्बमानार्धक = बिम्बोर्ध्वप्रदेशस्योन्नतांशाः । एतज्ज्या तत्प्रदेशस्य (य बिन्दोः) गर्भीयशङ्कुः = यव, चन्द्रमध्यगतिपञ्चदशांशसमाः कुच्छन्न कलाः = वफ, अतः यव − वफ = यफ = य बिम्बोर्ध्व प्रदेशीयशङ्कुः— कुछन्नकला = पृष्ठीयशङ्कुः = स्फुट शङ्कु = छेदः = हर संज्ञकः । एवमेव रवेरपि स्फुटशङ्कुसाधनम् । बिम्बोर्ध्व प्रदेशस्य पृष्ठशङ्कुः सार्वभौमे मुनीश्वरेण साधितस्तत्खण्डनं कमलाकरेण सिद्धान्ततत्त्व विवेके युक्ति युक्तं कृतम् । बिम्बकेन्द्रीयपृष्ठशङ्कुवशेन भास्करादिभिश्छायानयनं कृतं तदपि समीचीनं नेति कमलाकरेण सम्यक् प्रतिपादितम् । यदि हि ग्रहणादिनोर्ध्व प्रदेशातिरिक्तः सर्वप्रदेशश्छन्नो भवेत्तदैव बिम्बोर्ध्वप्रदेशाच्छङ्कोश्छाया स्फुटोपलक्ष्यतेऽन्यथा शङ्क्वग्रगामिनी बिम्बकेन्द्रात्समागता किरणरेखा या तदवरोधेन शङ्कुच्छाया स्फुटोपलक्ष्यते, सिद्धान्तशेखरे "मानखण्डसहितान्नृकार्मुकात् शिञ्जिनी भवति हि क्रमेण या । मध्यभुक्तितिथिभागजीवया वर्जिता स्फुटतरो नरो भवेत्" ऽनेनश्रीपतिनाऽऽचार्योक्तानुरूपमेवोक्तमिति ॥६॥

अब रवि और चन्द्र के स्फुटशङ्कु-साधन को कहते हैं ।

हि. भा.—रवि और चन्द्र के गणितागत शङ्कु के चाप में अपने-अपने स्फुट बिम्बमानार्धकला को जोड़ने से जो हो उनकी ज्या में से अपनी मध्यगति कला के पञ्चदशांश को घटा देने से छेद (हर संज्ञक) होता है अर्थात् रवि और चन्द्र के स्फुटशङ्कु साधनार्थ उनके गणितागत शङ्कु के चाप करना, उनमें अपने बिम्बफलार्ध को जोड़ने से जो हो उनकी ज्या में से अपनी मध्यगति कला के पन्द्रहवें अंश (कुच्छन्न कला) को हीन करने पर दोनों (रवि और चन्द्र) का स्फुटशङ्कु (छेद संज्ञक) होता है इति ॥६॥

उपपत्ति

संस्कृतोपपत्ति में लिखित क्षेत्र को देखिये । भू = भूकेन्द्र । ख = खस्वस्तिक,

पृ=भूपृष्ठस्थान, मभूर=गर्भक्षितिज धरातल, चपृन=पृष्ठ क्षितिज धरातल, के=बिम्बकेन्द्र, केय=बिम्बमानार्ध, भूपृ=लश=कुछन्नकला, केश=गणितागतशङ्कुः। केल=स्फुट-शङ्कुः। केम=बिम्बकेन्द्र से गर्भ क्षितिजावधि गणितागत शङ्कु का चाप। य=बिम्बोर्ध्व-प्रदेश, केम+केय=बिम्बकेन्द्र से गर्भक्षितिजावधिशङ्कुचाप+स्फुटबिम्बमानार्ध-कला=बिम्बोर्ध्व प्रदेश का उन्नतांशचाप, इसकी ज्या बिम्बोर्ध्व प्रदेश बिन्दु का गर्भीय-शङ्कु है=यव, मध्यगतिपञ्चदशांश=कुछन्नकला=वफ, अतः यव—वफ=यफ=य बिम्बोर्ध्वप्रदेशीय शङ्कु—कुच्छन्नक=पृष्ठीयशङ्कु=स्फुटशङ्कु=छेद=हरसंज्ञक, यहां बिम्ब से चन्द्र बिम्ब और सूर्यबिम्ब समझना चाहिए, सिद्धान्त सार्वभौम में मुनीश्वर ने बिम्बोर्ध्वप्रदेश बिन्दु का पृष्ठ शङ्कु साधन किया है उसका खण्डन सिद्धान्त तत्त्व विवेक में कमलाकर ने युक्तियुक्त किया है, यदि ऊर्ध्व प्रदेशातिरिक्त सर्व प्रदेश ग्रहण आदि से आच्छादित हो तब ही बिम्बोर्ध्व प्रदेशीय शङ्कु की छाया स्फुट लक्षित होती है अन्यथा बिम्बकेन्द्र से शङ्क्वग्रगत जो किरण रेखा होती है उसके अवरोध से शङ्कुच्छाया स्फुट लक्षित होती है, सिद्धान्तशेखर में "मानखण्डसहितान्नृकामुंकात् इत्यादि से" श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ।।६।।

इदानीं चन्द्रस्य स्फुटच्छायासाधनप्रकारमाह

द्वादशभिर्गुणिताया दृग्ज्याया इष्टमङ्गुलाप्तं यत् ।
तत् अग्रहणे छाया स्फुटा विधोरन्यथाऽऽसन्ना ।।७।।

सु. भा.—द्वादशभिर्गुणिताया दृग्ज्यायाश्छेदहृतेन यदिष्टमङ्गुलाप्तं तत् अग्रहणे ग्रहणकाले विधोश्चन्द्रस्य स्फुटा छाया स्यादन्यथाऽऽसन्ना स्वल्पान्तरा। अर्थाद्यदा चन्द्रसर्वग्रहणे उन्मीलनप्रदेश एव विधोर्दृङ्मण्डलीय ऊर्ध्वप्रदेशस्तदैवानेन साधनेन स्फुटा छायाऽन्यथा तु स्थूलेत्याचार्योक्तं समीचीनमेवेति ।

अत्रोपपत्तिः । 'स्वभुक्तितिथ्यंशविवर्जितोना महान् लघु' रित्यादि भास्करोक्तेन स्फुटा तत्र या स्थूलता सा कमलाकरेण सम्यगुपपादितेति तत्त्वविवेके तच्छायाधिकारो द्रष्टव्यः ।।७।।

वि. भा.—द्वादशभिर्गुणिताया दृग्ज्यायाः पूर्वानीतच्छेदेन हृताया यदिष्टमङ्गुलं प्राप्तं तत् ग्रहणकाले विधोः (चन्द्रस्य) स्फुटा छाया भवत्यन्यथाऽऽसन्ना (स्वल्पान्तरा)। अर्थाद्यदा चन्द्र सर्वग्रहणे उन्मीलनप्रदेश एव चन्द्रस्य दृङ्मण्डलीय उर्ध्वप्रदेशस्तदेव प्रकारेणानेन स्फुटा छाया भवितुमर्हत्यन्यथा स्थूलेत्याचार्यकथनं युक्तियुक्तमिति ।।७।।

अत्रोपपत्तिः ।

मध्यमशङ्कूद्भवां दृग्ज्यां द्वादशभिर्गुणयित्वा पूर्वानीतेन चन्द्रस्फुटशङ्कुना विभजेत्तदाऽङ्गुलादिकं फलं चन्द्रग्रहणकाले तदीया सूक्ष्मा छाया भवति, अन्यथा मध्यमशङ्कुनैव छायासाधनेन स्थूलेति, सिध्दान्तशिरोमणौ भास्कराचार्येण "स्वभुक्ति तिथ्यंश विवर्जितोना महान् लघुः खाग्निकृतांशहीनः । स्पष्टो भवेदस्फुट जातदृग्ज्यासंताड़िताकैः स्फुटशङ्कुभक्ता ।। प्रभा भवे" दित्यादिना भास्कराचार्येण छाया साधनं स्फुटी कृतं तत्रत्यं स्थौल्यं च सिद्धान्ततत्त्वविवेके कमलाकरेण स्फुटं प्रतिपादितम् । सिद्धान्तशेखरे "अस्पष्टशङ्कुजनितां खलुदृष्टिजीवामभ्यस्य युग्मशशिभिर्विभजेन्नरेण । स्पष्टीकृतेन फलमङ्गुल पूर्वकं यत् सेन्दोः स्फुटा भवति भा निकटा ऽन्यथा तु "ऽनेन श्रीपतिना ऽऽचार्योक्तानुरुपमेवोक्तम् । परं छायानयनं कस्यापि प्राचीनाचार्यस्य समीचीनं नास्तीति बुद्धिमद्भिर्ज्ञेयमिति ।।७।।

अब चन्द्र की स्फुटच्छाया के साधन-प्रकार को कहते हैं ।

हि.भा.—दृग्ज्या को बारह से गुणा कर पूर्वसाधित छेद (स्फुटशङ्कु.) से भाग देने से जो अङ्गुलादिक फल होता है वह ग्रहण काल में चन्द्र की स्फुटच्छाया होती है, अन्यथा आसन्न (स्वल्पान्तर, स्थूल) होती है अर्थात् जब चन्द्र के सर्व ग्रहण में उन्मीलन प्रदेश ही चन्द्र दृङ्मण्डलीय ऊर्ध्व प्रदेश हो तब ही इस प्रकार से स्फुटच्छाया होती है अन्यथा स्थूल होती है यह आचार्य का कथन युक्ति युक्त है इति ।।७।।

उपपत्ति

सिद्धान्तशिरोमणि में 'स्वभुक्तितिथ्यंश विवर्जितोना' इत्यादि सं. उपपत्ति में लिखित श्लोक से भास्कराचार्य ने जो छायानयन किया हैं उसी से यह आचार्योक्त स्पष्ट है, भास्करोक्त छाया साधन में जो स्थूलता है वह सिद्धान्त तत्त्व विवेक में कमलाकर से सम्यक् प्रतिपादित है, सिद्धान्त शेखर में 'अस्पष्ट शङ्कुजनितां खलु दृष्टिजीवां इत्यादि से" श्रीपति आचार्योक्तानुरुप ही कहते हैं, लेकिन किसी भी प्राचीनाचार्य का छायानयन ठीक नहीं हैं इसको विज्ञलोग विचार कर समझें इति ।।७।।

इदानीं मध्यच्छायासाधनप्रकारमाह

स्पष्टापक्रमभागैर्मध्यच्छाया ऽर्कवच्छशाङ्कस्य ।
शशिवद्भौमादीनामृक्षाणां तु स्वककुब्वशात् ।।८।।

सु. भा.—अर्कवच्छशाङ्कस्य मध्यछायामध्याह्नच्छाया ऽर्थाद्याम्योत्तरवृत्तस्थे चन्द्रे तस्य स्पष्टापक्रमभागैः साध्या । अर्थाद्यथा क्रान्त्यक्षांशसंस्कारेण खेर्मध्यनतांशा

उन्नतांशाश्च साधितास्ततः शङ्क्वनुपातेन मध्यच्छाया त्रिप्रश्नाधिकारे साधिता तथैव चन्द्रस्पष्टापक्रमभागैर्याम्योत्तरवृत्तस्थे चन्द्रे तन्मध्यच्छाया साध्या शशिवद् भौमादीनां नक्षत्राणां च स्वककुब्वशात् स्पष्टापक्रमदिग्वशात् स्पष्टापक्रमांशैश्छाया साध्येत्यर्थः ॥८॥

वि. भा.—शशाङ्कस्या (चन्द्रस्य) ऽर्कवत् (रविमध्यच्छाया साधन सदृशैव) स्पष्टापक्रमभागैः(स्फुटक्रान्त्यंशैः)छाया साध्या ऽर्थाद्यथा त्रिप्रश्नाधिकारे मध्यान्हकाले (याम्योत्तरवृत्तस्थे रवौ)क्रान्त्यक्षांश संस्कारेण रवेर्नतांशा उन्नतांशाश्च साधितास्ततो-ऽनुपातेन मध्यच्छाया साधिता तथैव याम्योत्तरवृत्तस्थिते चन्द्रे तत्स्पष्टक्रान्त्यंशैर्मध्य-च्छाया साधनीया, भौमादीनां ग्रहाणां शशिवत् (चन्द्रच्छायानयनवत्) छायासाध्या, ऋक्षाणां (नक्षत्राणां) स्वककुब्वशात् (स्पष्टक्रान्तिदिग्वशात्) स्पष्टक्रान्त्यंशै-श्छायासाध्येति ॥८॥

अत्रोपपत्तिः।

चन्द्र भौमादीनां सर्वेषां ग्रहाणां नक्षत्राणां च छाया साधनार्थं सर्वथैवैक युक्तित्वात्सुगमेति-सिद्धान्तशेखरे "स्वक्रान्तिभागैः शशिनो दिनार्धच्छायाश्रुतीभास्कर वत् प्रसाध्ये । भौमादिकानां च नभश्चराणां शशांङ्कवत् स्वध्रुवकाच्च भानाम्" श्रीपतिरेवं कथितवान् ॥८॥

अब मध्यच्छाया के साधन-प्रकार को कहते हैं।

हि. भा.—रवि के मध्यच्छायानयन के सदृश ही चन्द्र के स्फुटक्रान्त्यंश से मध्यच्छाया-साधन करना अर्थात् जैसे त्रिप्रश्नाधिकार में मध्यान्ह काल में (याम्योत्तर वृत्त में रवि के रहने से) क्रान्त्यंश और अक्षांश के संस्कार से रवि का नतांश और उन्नतांश साधन किया गया है और उससे शङ्क्वनुपातद्वारा मध्यच्छाया का साधन किया गया है उसी तरह याम्योत्तर वृत्त में चन्द्र के रहने से उनके स्पष्ट क्रान्त्यंश से मध्यच्छाया का साधन करना चाहिये । चन्द्रच्छायानयन के सदृश ही मङ्गलादि ग्रहों के छाया साधन करना, नक्षत्रों के स्पष्ट क्रान्ति दिशावश से स्पष्ट क्रान्त्यंश से छाया साधन करना चाहिये. इति ॥८॥

उपपत्ति

चन्द्र और भौमादि सब ग्रहों के तथा नक्षत्रों के छाया साधन सर्वथा एक ही युक्ति से होने के कारण सुगम ही हैं, सिद्धान्त शेखर में "स्वक्रान्ति भागैः शशिनो दिना-र्धच्छाया श्रुती इत्यादि से" श्रीपति इस तरह कहते हैं इति ॥८॥

इदानीमध्यायोपसंहारमाह ।

इह नोद्दिष्टं यत् तदुग्लवि बहुगत शेषनाडिकाद्येषु ।
आर्याभिर्नवभिरयं चन्द्रच्छायाऽष्टमोऽध्यायः ॥९॥

सु. भा.—इह चन्द्रच्छायाधिकारे यद्बहुनोद्दिष्टं तदुग्लवि चन्द्रेऽर्थाच्चन्द्रच्छायोत्तराधिकारे वक्ष्ये—इति । गतशेषनाडिकाद्येषु नवभिरार्याभिश्चन्द्रच्छायाऽयमष्टमोऽध्यायो गत इति ।

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते ।
हृदि तं विनिधाय नूतनोऽयं रचितो भेन्दुविधौ सुधाकरेण ॥

इति श्री कृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्तनूतनतिलके चन्द्रच्छायाधिकारोऽष्टमः ॥९॥

वि. भा.—इह (चन्द्रच्छायाधिकारे) यद्बहु न कथितं तदुग्लवि (चन्द्रेऽर्थाच्चन्द्रच्छायोत्तराधिकारे) वक्ष्ये । गतशेषनाड़िकाद्येषु नवभिरार्याभिरयं चन्द्रच्छाया नामकोऽष्टमोऽध्यायः समाप्तिं गत इति ॥९॥

इति श्री ब्रह्मगुप्तविरचिते ब्राह्मस्फुटसिद्धान्ते चन्द्रच्छायानामकोऽष्टमोऽध्यायः ॥८॥

अब इस अध्याय के उपसंहार को कहते हैं

हि. भा.—इस चन्द्रच्छायाधिकार में जो बहुत नहीं कहा गया है वह चन्द्रच्छायात्तराधिकार में कहा जायगा । गत घटी और शेष घटी आदियों में नौ आर्याश्लोकों से यह चन्द्रच्छाया नाम का अष्टम अध्याय समाप्त हुआ इति ॥९॥

श्री ब्रह्मगुप्त विरचित ब्राह्मस्फुट सिद्धान्त में चन्द्रच्छाया नामक
आठवां अध्याय समाप्त ॥८॥

ब्राह्मस्फुटसिद्धान्तः

७

ग्रहयुत्यधिकारः

ब्राह्मस्फुटसिद्धान्तः

७

ग्रहयुत्यधिकारः

तत्रादौ ग्रहाणां मध्यमशरकला मध्यम विम्बकलाश्चाह

शून्येशाः ११० यम तिथयः १५२ षड्गा ७६ षट्त्रीन्दवः १३६ खगुणचन्द्राः १३० ॥
क्रान्तेर्विक्षेपकलाः कुजबुधगुरुशुक्ररविजानाम् ॥१॥

भूगजलिप्ता भक्ताः कुजादि दृश्यांश संमितैर्लब्धाः ।
मध्यमसमानकलाः स्युः कुजवुधगुरुशुक्ररविजानाम् ।२॥

सु. भा.—स्पष्टार्थम् । 'विक्षेपलिप्ताः जिनिजादिकाना' मित्यादि तथा 'व्यङ्घ्रीषवः सचरगा ऋतवः' इत्यादि भास्करोक्तमेतदनुरूपमेव ।

इहाचार्यमतेनोदयास्ताधिकारस्य ६ श्लोकेन पठितान् दृश्यांशान् संगृह्य भौमादीनां मध्यमबिम्बकलाः ।

$$\text{भौ}=\frac{८१}{१७}=४'।४६''॥ \text{बु}=\frac{८१}{१३}=६'।१४''॥ \text{गु}=\frac{८१}{११}=७'।२२''$$

$$\text{शु}=\frac{८१}{९}=९'।०॥ \text{श}=\frac{८१}{१५}=५'।२४''॥$$

एवं भौ=४'।४६''॥ बु=६'।१४''॥ गु=७'।२२''॥ शु=९'।०॥
श=५'।२४''॥ भास्करमतेन भौ=४।४५। बु=६।१५॥
गु=७।२०॥ शु=९।०॥ श।५।२०॥

एता मध्यबिम्बकलाः प्रायः स्वल्पान्तरादाचार्योक्तसमा एव । अथात्र द्वितीयाऽऽर्या पुस्तकेषुनोपलभ्यते । मया वक्ष्यमाणं स्फुटमानकलानयनमाचार्योक्तं मनसि संप्रधार्याचार्यार्थप्रदायिनी द्वितीया नूतना रचिता । मूलपुस्तकेषु त्रुटिरास्त यत आचार्योक्तोपसंहारेऽस्मिन्नध्याये षड्विंशतिरार्या न पूर्यतेऽनया सह च पूर्यते । इति सुधीभिर्भृशं विचिन्त्यम् ॥१-२॥

वि. भा.—शून्येशा यमतिथय इत्यादिकाः कुजबुधगुरुशुक्रशनैश्चराणां क्रान्तेः (क्रान्तिवृत्तस्थ स्थानीय ग्रहविन्दोः) मध्यमाः शरकलाः स्युः । तथा च भूगज (८१) कलाः कुजादिग्रहाणामुदयास्ताधिकारे पठिता ये दृश्यांशाः (कालांशाः)

तैर्भक्तास्तदा लब्धास्तेषां (कुजादिग्रहाणां) मध्यमबिम्बकला भवन्ति, विक्षेप-लिप्ताः क्षितिजादिकानामित्यादि, 'व्यङ्घ्रीषवः सचरणा ऋतवः, इत्यादि च भास्करोक्तमेतदनुरूपमेव,

अत्राचार्यमतेनोदयास्ताधिकारे पठितान् कालांशान् गृहीत्वा कुजादि ग्रहाणां मध्यम बिम्बकलाः

कु $= \frac{८१}{१७} =$ ४' । ४६'', बु $= \frac{८१}{१३} =$ ६' । १४'', गु $= \frac{८१}{११} =$ ७' । २२'',

शु $= \frac{८१}{९} =$ ९' । ०, श $= \frac{८१}{१५} =$ ५' । २४'', एवं निष्पन्ना मध्यम बिम्बकलाः =

कु = ४' । ४६'', बु = ६' । १४'', गु + ७' । २२'', शु = ९' । ०, श = ५' । २४''

भास्करमतेन कु = ४' । ४६'', बु = ६' । १५'', गु = ७' । २०'', शु = ९' । ०, श = ५' । २०''

सिद्धान्तशेखरे "दिगिन्दवो द्वीषु भुवोरसेभाः षड्वन्हि चन्द्राः १३६ खगुणे-न्दवश्च १३०'', इति कुजादिग्रहाणां मध्यमशरकलाः पठिताः सन्ति,

कुजस्य दिगिन्दवः ११० कलाः ।
बुधस्य द्वीषुभुवः १५२ कलाः
गुरोः रसेभाः ८६ कलाः ।

अत्र 'षड्गाः : ७६'' इत्याचार्योक्तिः ।

'रसाश्वाः, ७६ इति भास्करोक्तिश्च, "दिगिन्दवो द्वीषु भुवो रसाश्वाः" इति सिद्धान्तशेखरपाठः सम्भाव्यते ईति ॥१-२॥

ग्रहयुत्यधिकार प्रारम्भ किया जाता है। उसमें पहले ग्रहों की मध्यम शर कला को और मध्यमबिम्बकला को कहते हैं ।

हि. भा.— ११०, १५२, ७६, १३६, १३० ये क्रमशः कुजादि ग्रहों की मध्यम शर कला हैं तथा ८१ कला को उदयास्ताधिकार में पठित कुजादि ग्रहों के दृश्यांश (कालांश) से भाग देने से लब्धि तुल्य कुजादि ग्रहों की मध्यम बिम्बकला होती है 'विक्षेपलिप्ताः क्षितिजा-दिकानाम्, इत्यादि तथा 'व्यङ्घ्रीषवः सचरणा ऋतवः, इत्यादि भास्कराचार्योक्ति आचार्योक्ति के अनुरूप ही है ।

आचार्य मत से उदयास्ताधिकार में पठित कुजादि ग्रहों के दृश्यांश (कालांश) को लेकर कुजादि ग्रहों की मध्यम बिम्बकला अधोलिखित है, कु$=\frac{८१}{१७}$=४′ । ४६″,

बु$=\frac{८१}{१३}$=६′ । १४′, गु$=\frac{८१}{११}$=७′ । २२″, शु$=\frac{८१}{९}$=९′ । ०

श$=\frac{८१}{१५}$=५′ । २४″ इस तरह निष्पन्न मध्यम बिम्बकला=

कु=४′ । ४६″, बु=६′ । १४″, गु=७′ । २२″, शु ९′ । ०, श=५′ । २४.″
भास्कराचार्य के मत से कु=४′ । ४६″, बु=६′ । १५″, गु=७′ । २०″, शु=९′ । ०, श=५′ । २०″

सिद्धान्तशेखर में कुजादि ग्रहों की पठित शरकला ये हैं, कु=११० कला, बु=१५२ कला, गु=८६ कला यहां गुरु की शर कला ८६ आचार्योक्त वा भास्करोक्त गुरु की शर कला ७६ से अन्तरित है ।। इति १-२ ।।

इदानीं ग्रहबिम्बकलास्फुटीकरणमाह

व्यासार्धं संयुक्तं त्रिगुणान्त्यफलज्ययाऽन्त्यकर्णोनम् ।
स्वरहृग्घ्नं स्वदृगंशैर्गुणयाऽन्त्यफलज्यया भक्तम् ।।३।।
स्फुटमानकला भूमिजबुधसुरगुरुशुक्रसूर्यपुत्राणाम् ।
नाथः स्थयोर्न्न सितयोरासन्नत्वाद्रवेरसितम् ।। ४ ।।

सु. भा.—व्यासार्धं त्रिज्यामानं त्रिगुणान्त्यफलज्यया संयुक्तम् । अन्त्यकर्णोन स्थिरीभूतेन शीघ्रकर्णेनोनं सप्तविंशत्या गुणं कालांशैर्गुणयाऽन्त्यफलज्यया भक्तं भूमिजबुधसुरगुरुशुक्रशनीनां स्फुटमानकला भवन्ति । सूर्यादधः स्थयोर्बुधशुक्रयोः शशिवन्नासितं भवति । कस्मात् । रवेरासन्नत्वान्निकटत्वादिति ।

अत्रोपपत्तिः । मध्यमबिम्बमानस्य त्रिभागसममुच्चनीचयोरपचयोपचयमुपलक्ष्यावान्तरे त्रिज्या कर्णान्तरेणापचयोचपचयज्ञानार्थमनुपातः । यद्यन्त्यफलज्यामितेन त्रिज्याशीघ्रकर्णान्तरेण बिम्बमानत्रिभागसमश्चयापचय स्तदा त्रिज्येष्टशीघ्रकर्णान्तरेण किं लब्धं त्रिज्यातोऽधिके शीघ्रकर्णे मध्यमबिम्बाद्विशोध्याल्पे च शीघ्रकर्णे मध्यमबिम्बे प्रक्षिप्य जाताः

$$\text{स्फुटमानकलाः}=\text{मवि}-\frac{\text{मवि}_{०}}{३}\cdot\frac{(\text{शीक}-\text{त्रि})}{\text{अंफज्या}}$$

$$=\frac{\text{मवि}}{३\ \text{अंफज्या}}(३\ \text{अंफज्या}+\text{त्रि}-\text{शीक})$$

वा स्फुटमानकला: $=$ मवि $+\frac{\text{मवि}}{३}\;\frac{(\text{त्रि}-\text{शीक})}{\text{अंफज्या}}$

$$=\frac{\text{मवि}}{\text{३ अंफज्या}}(\text{अंफज्या}\;+\text{त्रि}-\text{शीक})$$

उभयत्र मध्यम बिम्बकलास्थाने $\frac{८१}{\text{हृ अं}}$ इत्युत्थाप्य जाता:

स्फुट बिम्बकला: $=\frac{२७(\text{३ अंफज्या}+\text{त्रि}-\text{शीक})}{\text{अंफज्या}+\text{हृ अं}}$

इत्युपपद्यते स्फुटबिम्बमानकलानयनम् । भास्करोक्तं च तदुपपद्यतेऽनेन, सूक्ष्मदूरदर्शकयन्त्रादिना बुधशुक्रयोरपि शशिवत् सितवृद्धि हानित्वं शृङ्गोन्नतिश्चोपलभ्यते । आचार्य समये तादृश यन्त्राणामभावाद् दृष्ट्या शृङ्गोन्नति: सितासित बिम्बमितिश्च नोपलब्धाऽतोऽनुमानेन रवेरासन्नत्वादित्यादिकल्पना न समीचीनेति सर्वं स्फुटम् ॥ ३-४॥

वि. भा—त्रिगुणितान्त्यफलज्यया संयुक्तं व्यासार्धं (त्रिज्यामानं) अन्त्यकर्णोनो (स्थिरीभूतेन शीघ्रकर्णेन) नं (हीन) स्वरहग्घ्नं (सप्तविंशत्या गुणितं) स्वदृगंशै: (कालांशै:) गुणितयाऽन्त्यफलज्यया भक्तं तदा मङ्गलबुधगुरुशुक्रशनीनां स्फुटमानकला भवेयु: । रवेरध: स्थितयोर्ज्ञसितयो: (बुधशुक्रयो:) तदासन्नत्वात् (रविनिकटस्थितत्वात्) चन्द्रवन्नासितं भवतीति, ॥ ३-४ ॥

अत्रोपपत्ति:

उच्चस्थानस्थे ग्रहविम्बे मध्यमविम्बमानस्य तृतीयांशसमोऽपचयो भवति, नीचस्थानस्थिते ग्रहविम्बे च मध्यम विम्बमानस्य तृतीयांशसम उपचयो भवत्यतोऽवान्तरेऽनुपात:, यदि त्रिज्या शीघ्रकर्णान्तरेणान्त्यफलज्या तुल्येन विम्बमानस्य तृतीयांश तुल्यश्चयापचयो लभ्यते तदा त्रिज्येष्ट शीघ्र कर्णान्तरेण किं फलं त्रिज्यातोऽधिके शीघ्रकर्णे मध्यम विम्बाद्विशोध्यं त्रिज्याल्पे शीघ्रकर्णे च मध्यम विम्बे योज्यं तदा स्फुटा मानकला भवन्ति तत्स्वरूपम् $=$ मवि $-\frac{\text{मवि}(\text{शीक}-\text{त्रि})}{\text{३ अन्त्यफज्या}}$

$$=\frac{\text{मवि}}{\text{३अन्त्यफज्या}}(\text{अन्त्यफज्या}+\text{त्रि}-\text{शीक})=\text{मवि}+\frac{\text{मवि}\;(\text{त्रि-शीक})}{\text{३ अन्त्यफज्या}}=$$

$\frac{\text{मवि}}{\text{३ अन्त्यफज्या}}(\text{३ अन्त्यफज्या}+\text{त्रि}-\text{शीक})$, परन्तु मध्यम विम्बकला

$=\frac{८१}{\text{कालांश}}$ उत्थापनेन स्फुटविम्बकला $=\frac{२७\;(\text{३ अन्त्यफज्या}+\text{त्रि}-\text{शीक})}{\text{अन्त्यफज्या. कालांश}}$

एतेना ऽऽचार्योक्तमुपपन्नम् । अनेनैव भास्करोक्तमपि स्फुटबिम्बमानकलानयनमुपपद्यते, सिद्धान्तशेखरे श्रीपतिना "त्रिगुणयाऽन्त्य फलोद्भवजीवया समधिकां भवनत्रयशिञ्जिनीम् । द्युचरचञ्चलकर्णविवर्जितां त्रिघनसङ्गुणितां च विभाजयेत् ॥ स्वसमयांशहृताऽन्त्यफलज्यया द्युचरमानकलाः सुपरिस्फुटाः । न बुधभार्गवयोरासितो रवेर्ध्रुवमधः स्थितयोर्निकटत्वतः ॥" ऽप्यनेनाऽऽचार्योक्तानुरूपमेवोक्तम् । परमेतदानयनं कस्यापि समीचीनं नास्ति यत उच्चस्थानीयमध्यस्थानीयबिम्बकलज्ययोर्यदन्तरं तदेव मध्यस्थानीयनीचस्थानीयबिम्बकलज्ययोरन्तरमाचार्यैः स्वीकृतं परमेवं न भवतीति प्रदर्श्यते । उच्चस्थानीयबिम्बकलाज्या-

ऽऽचार्यं संमता $= \frac{\text{त्रि-विंज्या}}{\text{उकर्ण}} = \frac{\text{त्रि.विंज्या}}{\text{त्रि+ ,अंफज्या.}}$ मध्यस्थानीय

बिम्बकलाज्या $=$ विंज्या, तथा नीचस्थानीयबिम्बकलाज्या $= \frac{\text{त्रि. विंज्या}}{\text{नीचकर्ण}}$

$$= \frac{\text{त्रि. विंज्या}}{\text{त्रि-अंफज्या.}}$$

तदा ऽऽचार्यस्वीकृत्या मध्यस्थानीय विकलाज्या—उच्चस्थानीय विकज्या $=$ नीविकलाज्या—मध्यस्था विकज्या

$$= \text{विंज्या} - \frac{\text{त्रि. विंज्या.}}{\text{त्रि+अंफज्या}} = \frac{\text{त्रि. विंज्या}}{\text{त्रि-अंफज्या}} - \text{विंज्या}$$

$$= \frac{\text{त्रि. विंज्या+विंज्या.अंफज्या—त्रि.विंज्या}}{\text{त्रि+अंफज्या}}$$

$$= \frac{\text{त्रि. विंज्या—त्रि.विंज्या+अंफज्या.विंज्या}}{\text{त्रि—अंफज्या}}$$

$$= \frac{\text{विंज्या. अंफज्या}}{\text{त्रि+अंफज्या}} = \frac{\text{अंफज्या.विंज्या}}{\text{त्रि-विंज्या}} \therefore \frac{1}{\text{त्रि}\times\text{अंफज्या}} = \frac{1}{\text{त्रि -अंफज्या}}$$ ततः

त्रि—अंफज्या $=$ त्रि+अंफज्या समयोजनेन त्रि+अंफज्या+अंफज्या $=$ त्रि+ अंफज्या $=$ त्रि $\therefore$ २ अंफज्या $=$ त्रि —त्रि $=$ ०द्वाभ्यांभक्तेन अंफज्या $=$ ०, पूर्वकथिनाऽऽचार्यं स्वीकृत्या ऽन्त्यफलज्यामानं शून्य समनागतं तन्न युक्तमत अचार्योक्तस्फुट बिम्बकलानयनं न समीचीनमिति सिद्धान्तितम् । बुधशुक्रयोरपि चन्द्रवदेव बिम्बस्योपचयत्वमपचयत्वं शृङ्गोन्नतिदर्शनंचा ऽऽधुनिक दूरदर्शकयन्त्रबलेनोपलभ्यते दृष्टया तन्नोपलब्धमाचार्येण (आचार्यं समये दूरदर्शक यन्त्राणामभावात) नोऽनुमानेनाऽसन्नत्वाद्रवेरिति कल्पना कृता सा न युक्तिसङ्गतेति विज्ञेयं ॥ ३-४॥

अब ग्रह विम्बकला के स्फुटीकरण को कहते हैं ।

हि.भा.—त्रिज्या में त्रिगुणित अन्त्यफलज्या को जोड़कर अन्त्यकर्ण (स्थिरीभूत शीघ्रकर्ण) को घटा देना फिर सताइस से गुणा कर अपने कालांश से गुणित अन्त्यफलज्या से भाग देने से कुज, बुध, गुरु, शुक्र और शनैश्चर की स्फुट मानकला होती है, रवि से अधः (नीचा) स्थित बुध और शुक्र के रवि के निकट (समीप) में रहने के कारण चन्द्र की तरह असित (कृष्ण) नहीं होता है इति ॥३-४॥

उपपत्ति

उच्च स्थान में ग्रह बिम्ब के रहने से मध्यम बिम्बमान के तृतीयांश तुल्य अपचय होता है, तथा नीच स्थान में ग्रह बिम्ब के रहने से मध्यम बिम्बमान के तृतीयांश तुल्य उपचय होता है, इसलिए इन दोनों (उच्च और नीच) के अन्तर में अनुपात करते हैं । यदि अन्त्यफलज्या तुल्य त्रिज्या और शीघ्र कर्ण के अन्तर में बिम्बमान के तृतीयांशतुल्य उपचय और अपचय पाते हैं तो त्रिज्या और इष्ट शीघ्र कर्ण के अन्तर में क्या इससे जो फल आता है उसको त्रिज्या से अधिक शीघ्र कर्ण रहने से मध्यम बिम्ब में से घटा देना, त्रिज्या से अल्प शीघ्र कर्ण रहने से मध्यम विम्ब में जोड़ देना तब स्फुट मानकला होती हैं । जैसे—

$$\text{मविं} - \frac{\text{मविं}\,(\text{शीक} - \text{त्रि})}{३\ \text{अंफज्या}} = \text{स्फुटमानकला} = \frac{\text{मविं}}{३\ \text{अंफज्या}}(३\ \text{अंफज्या} + \text{त्रि} - \text{शीक})$$

$$= \text{मविं} + \frac{\text{मविं}\,(\text{त्रि} - \text{शीक})}{३\ \text{अफज्या}} = \frac{\text{मविं}}{३\ \text{अंफज्या}}(३\ \text{अंफज्या} + \text{त्रि} - \text{शीक})$$

मध्यम बिम्बकला $= \frac{८१}{\text{कालांश}}$, इससे उत्थापन देने से स्फुट बिम्बकला

$$= \frac{२७\,(३\ \text{अंफज्या} + \text{त्रि} - \text{शीक})}{\text{अंफज्या} \cdot \text{कालांश}}$$

इससे आचार्योक्त उपपन्न हुआ । इसी से भास्कराचार्योक्त स्फुटबिम्बमान कलानयन भी उपपन्न होता है,सिद्धान्त शेखर में श्रीपति "त्रिगुणयाऽन्त्यफलोद्भव जीवया इत्यादि" सं· उपपत्ति में लिखित श्लोकों से आचार्योक्त के अनुरूप ही कहा है । लेकिन यहमानयन ठीक नहीं है, क्योंकि उच्चस्थानीय और मध्यस्थानीय बिम्बकलाज्या के अन्तर के तुल्य ही नीच स्थानीय और मध्य स्थानीय विम्ब कलाज्या के अन्तर आचार्य ने स्वीकार किये हैं जो ठीक नहीं है, जैसे—

आचार्य संमत उच्च स्थानीयबिम्ब कलाज्या $= \frac{\text{त्रि} \cdot \text{विंज्या}}{\text{त्रि} + \text{अफज्या}}\ \frac{\text{त्रि} \cdot \text{विंज्या}}{= \text{उकर्ण}}$,

मध्यस्थानीय विम्बकलाज्या = विंज्या, तथा नीचस्थानीय बिम्ब कलाज्या $= \frac{\text{त्रि} \cdot \text{विंज्या}}{\text{नीकर्ण}}$

$$=\frac{\text{त्रि· विज्या}}{\text{त्रि — अंफज्या}}$$

तब आचार्य स्वीकृति से मध्यस्थानीय विकज्या—उच्चस्थाविकज्या=नीविकज्या—

$$\text{मध्यस्थाविकज्या} = \text{विज्या} - \frac{\text{त्रि विज्या}}{\text{त्रि + अंफज्या}} = \frac{\text{त्रि विज्या}}{\text{त्रि अंफज्या}} - \text{विज्या}$$

$$=\frac{\text{त्रि· विज्या + विज्या· अंफज्या — त्रि विज्या}}{\text{त्रि + अंफज्या}}$$

$$=\frac{\text{त्रि· विज्या — त्रि· विज्या + विज्या·अंफज्या}}{\text{त्रि — अफज्या}}$$

$$=\frac{\text{विज्या· अंफज्या}}{\text{त्रि + अंफज्या}} = \frac{\text{विज्या. अंफज्या}}{\text{त्रि — अंफज्या}} \text{ अपवर्त्तन देने से } \frac{1}{\text{त्रि + अंफज्या}} = \frac{1}{\text{त्रि — अंफज्या}}$$

∴ त्रि—अंफज्या=त्रि+अंफज्या, तुल्य जोड़ने से त्रि+अंफज्या+अंफज्या
=त्रि+२अंफज्या=त्रि

∴ २अंफज्या=त्रि—त्रि=० दो से भाग देने से अंफज्या=०, पूर्वोक्त आचार्यस्वीकृति से अन्त्यफलज्या का मान शून्य आया यह अयुक्त आया इसलिये आचार्योक्त स्फुट बिम्ब कलानयन ठीक नहीं है यह सिद्ध हुआ। बुध और शुक्र के भी चन्द्र ही की तरह शृङ्गोन्नतिदर्शन और सित के उपचयत्व और अपचयत्व आधुनिक सूक्ष्म दूरदर्शक यन्त्रबल से उपलब्ध होता है दृष्टि से उसको आचार्य ने उपलब्ध नहीं किया क्योंकि उस समय(आचार्य के समय) में उस तरह के यन्त्र का अभाव था इसलिए अनुमान से 'आसन्नत्वाद्रवेः' यह कल्पना की गयी जो युक्तियुक्त नहीं है इति ॥३-४॥

अथ युति काल ज्ञानार्थं चालन फल ज्ञानार्थं चाह।

भुक्त्यन्तरेण भक्तं ग्रहान्तरं फलदिनैरधिकभुक्तौ।
प्रागूनगतौ पश्चाद्युतिरधिके वक्रिणोर्व्यस्तम् ॥५॥
एको वक्री भुक्त्योर्युत्योनः प्रागथाधिकः पश्चात्।
ग्रहयोरन्तरलिप्तास्तथैव भक्ताः स्वभुक्तिगुणाः ॥६॥

सु. भा.—ग्रहान्तरं मार्गयोर्ग्रहयोर्भुक्त्यन्तरेण हृतं फलं दिनानि भवन्ति। अधिकभुक्तौ ग्रहेऽल्पभुक्तेरधिके युतिः प्राग्गता वाच्या। ऊनगतौ ग्रहेऽधिकभुक्तेरधिके पश्चादेष्या युतिर्वाच्या। द्वयोर्ग्रहयोर्वक्रिणोर्व्यस्ता युतिरर्थात् पूर्वविधिना गतलक्षणे एष्या। एष्यलक्षणे च गता वाच्या। यद्येको ग्रहो वक्री तदा ग्रहान्तरं

भुक्त्योर्युत्या भक्तं फलं दिनानि ग्राह्याणि। वक्री चेन्मार्गग्रहादूनस्तदा फलदिनै-र्युतिः प्राग्गताऽधिकश्चेत् तदा पश्चादेष्या वाच्या। अथ ग्रहयोश्चालनमाह। ग्रहयोरन्तर लिप्तास्तथैव पूर्वप्रतिपादितस्थित्यनुसारेण गत्योरन्तरेण वा योगेन भक्ताः स्वभुक्तिगुणाश्चालनकला भवन्ति। तत् संस्कारं चाग्रिमश्लोकेन वक्ष्यत्याचार्यः॥

अत्रोपपत्तिः। त्रैराशिकेन 'दिवौकसोरन्तरलिप्तिकौघाद् गत्योर्वियोगेनहृता' दित्यादिभास्करोक्तविधिना स्फुटा। गतैष्या युतिस्तथा चालनफलं च सर्वं सुगममिति॥५-६॥

वि. भा.:—ग्रहान्तरं भुक्त्यन्तरेण (मार्गगतिग्रहयोर्गत्यन्तरेण) भक्तं फलं दिनानि भवन्ति, अधिकभुक्तौ ग्रहे (अधिकगति ग्रहे) ऊनगति (अल्पगति) ग्रहादधिके पूर्वलब्धदिनैर्युतिः प्राक् (गता) बोध्या। ऊनगतौ ग्रहे (अल्पगतिग्रहे) ऽधिकभुक्ते (अधिक गति ग्रहात्) रधिके युतिः पश्चात् (एष्या) बोध्या, वक्रिणोर्ग्रहयोर्व्यस्त-मर्थात्पूर्वोक्त गतलक्षणे एष्या, एष्यलक्षणे च गता बोध्या, यदि ग्रहयोर्मध्ये एको वक्री तदा ग्रहान्तरं भुक्त्योर्युत्या (गतियोगमित्या) भक्तं फलं दिनानि भवन्ति। यदि वक्री ग्रहो मार्गगतिग्रहादून (अल्पः) स्तदा पूर्वलब्धदिनैर्युतिः प्राक् (गता) बोध्या, यद्यधिकस्तदा पश्चात् (एष्या) बोध्या, ग्रहयोरन्तरलिप्ताः (ग्रहयोरन्तर कलाः) तथैव (पूर्वकथित स्थित्यनुसारेण) ग्रहगत्योरन्तरेण योगेन वा भक्ताः स्वभुक्तिगुणा (स्वगतिगुणाः) स्तदा चालन कला भवन्तीति॥५-६॥

अत्रोपपत्तिः

एकं दिशं गच्छतो र्द्वयो र्ग्रहयोर्गत्यन्तरमेव प्रतिदिनमन्तरं भवति। यदा ग्रहयोरेकोऽग्रतः पूर्वस्यां दिशि गच्छत्यन्यः पश्चिमस्यां तदा तयोर्गतियोगः प्रतिदिनमन्तरं भवति। ततोऽनुपातो यद्येतावता ग्रहान्तरेणैकं दिनं लभ्यते तदा ग्रहान्तर कलाभि : किमिति लब्ध दिनैर्युतिर्गता वाच्या, अल्पगति ग्रहेऽधिकगति-ग्रहान्न्यूने वा वक्रे ग्रहे न्यूने तमतिक्रम्य यत इतरग्रहोऽग्रतो गच्छति, वक्रिणोर्द्वयो र्ग्रहयोरितोऽन्यथा भवति, सिद्धान्त शिरोमणौ भास्कराचार्येण "दिवौकसोरन्तर लिप्तिकौघाद् गत्योर्वियोगेन हृतादित्यादिना" ऽऽचार्योक्तानुरूपमेवोक्तं, सिद्धान्त-शेखरे श्रीपतिनापि "भुक्त्यन्तरेण विवरे ग्रहयोर्विभक्ते मार्गस्थयोः कुटिलयोरपि भिन्नगत्योरित्यादिना" तथैवोक्तमिति विज्ञैश्चिन्त्यम्। ५-६

अब युतिकाल तथा चालनफल के ज्ञान के लिए कहते हैं।

हि. भा. ग्रहान्तर कला को मार्गगति ग्रहद्वय के गत्यन्तर से भाग देने से फल दिन होते हैं। अधिक गतिग्रह अल्पगति ग्रह से अधिक रहे तब पूर्वागत दिनों में ग्रहयुति गत

समझनी चाहिये । यदि अल्पगतिग्रह अधिक गतिग्रह से अधिक हो तब पूर्व विधि से समागत दिनों में ग्रहयुति एष्य समझनी चाहिये । दोनों ग्रह वक्री रहें तब विपरीत होता है अर्थात् पूर्वोक्त गत लक्षण को एष्य तथा एष्य लक्षण को गत समझना चाहिये, यदि दोनों ग्रहों में एक ग्रह वक्री हो तब ग्रहान्तर को गतियोग से भाग देने से लब्ध दिन होते हैं । यदि मार्गगति ग्रह से वक्री ग्रह अल्प हो तब पूर्व लब्ध दिनों में युति गत कहनी चाहिये, यदि अधिक हो तो एष्य समझनी चाहिए ग्रहान्तर कला को पूर्वकथित स्थिति के अनुसार ग्रहगति के अन्तर वा योग से भाग देना फल को अपनी गति से गुणने से चालन फल कला होती है इति ॥५-६ ॥

उपपत्ति

एक दिशा में चलने वाले दो ग्रहों का गत्यन्तर ही प्रत्येक दिन में अन्तर होता है, यदि दोनों ग्रहों में एक ग्रह पूर्व दिशा में चले और दूसरा ग्रह पश्चिम दिशा में तब दोनों की गति का योग करने से अन्तरज्ञानहोता हैं । तब अनुपात करते हैं । यदि गत्यन्तर कला में एक दिन पाते हैं ता ग्रहान्तर कला में क्या इससे जो लब्ध दिन हो उतने दिन पहले युति कहनी चाहिये । क्योंकि अल्पगति ग्रह के अधिक गतिग्रह ने न्यून रहने से वा वक्री ग्रह के न्यून रहने से दूसरे ग्रह उसको अतिक्रमण कर आगे चले जाते हैं । दोनों ग्रहों के वक्री रहने से इससे विपरीत होता है, अब चालन फल के लिये अनुपात करते हैं यदि गत्यन्तर कला वा गतियोगकला में एक दिन पाते हैं तो ग्रहान्तर कला में क्या इससे ग्रहान्तर कला सम्बन्धी दिन आते हैं तब पुनः अनुपात करते हैं, एक दिन में यदि ग्रहगतिकला पाते हैं तो ग्रहान्तरकला सम्बन्धी दिनों में क्या इससे ग्रहान्तर कला सम्बधी दिन जनित ग्रहगति आती है इसके संस्कार के लिये आगे के श्लोक में आचार्य व्यवस्था करते हैं ।''सिद्धान्त शिरोमणि'' में भास्कराचार्य ''दिवौकसौरन्तर लिप्तिकौघात्'' इत्यादि से आचार्योक्तानुरूप ही कहते हैं । सिद्धान्त शेखर में 'भुक्त्यन्तरेण विवरे ग्रहयो विंभक्ते इत्यादि से' श्रीपति भी उसी तरह कहते हैं इति ॥ ५-६ ॥

इदानीं चालनफलसंस्कार द्वारा ग्रहयोः समलिप्तीकरणार्थमाह

स्वफलमृणं प्राक् पश्चाद्युतौ धनं वक्रिणि व्यस्तम् ।
समलिप्तौ बुधसित शीघ्रचन्द्रपातेषु च स्वफलम् ॥ ७ ॥

सु. भा.— प्राग्युतौ (गतेयोगे) स्वफलं पूर्वागतमृणं पश्चाद्युतावेष्ययोगे धनं भवति । विक्रिणि ग्रहे च चालनं व्यस्तं देयं गतयोगे धनमेष्ययोगे ऋणमित्यर्थः । एवं ग्रहौ युतौ समलिप्तौ तुल्यौ भवतः । एवं यदि केनापि ग्रहेण सह बुधशुक्रचन्द्रा युतिं कुर्वन्ति तदा बुधशुक्र शीघ्रोच्चयोश्चन्द्रपाते पूर्वागतं स्वचालनफलं देयं ।

अत्रोपपत्तिः। चालनधनर्णस्याति सुगमा बुधशुक्रयोः शरानयनं तच्छीघ्रोच्च-वशाद्भवति। चन्द्रपातस्य च गतिर्दैनन्दिनी वर्त्ततेऽतस्तेषु शरज्ञानाय चाल युतिकालेऽत्यावश्यकम्। अन्येषां पातानां गतिश्च वर्षशतेनापि नोपलक्ष्यतेऽतस्त च्चालनं युतिकाले शून्यमेवे तिसर्वं स्फुटम् ॥ ७॥

वि. भा.— प्राग्युतौ (गते योगे) स्वफलं "ग्रहयोरन्तरलिप्तास्तथैव भक्ताः स्वभुक्तिगुणा इत्यनेनाऽऽनीतं चालनफलं" ऋणं पश्चाद्युतौ (एष्य योगे) चालनफलं धनं भवति, वक्रिणि ग्रहे चालनंफलं व्यस्तं (विपरीतं) देय-मर्थाद्गतयोगे धनमेष्ययोगे च ऋणं तदायुतौ ग्रहौ समलिप्तौ (राश्यंश कलाभिस्तुल्यौ) भवतः। यदि बुधशुक्रचन्द्राः केनापि ग्रहेण सह युतिं कुर्युस्तदा बुधशुक्रशीघ्रोच्चयोश्चन्द्र पाते च स्वफलं (स्वचालन फलं) देयमिति ॥ ७॥

अत्रोपपतिः

चालनफलस्य धनर्णत्वमतिसुगमम्। बुधशुक्रयोः शरसाधनं तच्छी-घ्रोच्च वशाद् भवति, चन्द्रपातस्य दैनन्दिनो गतिरस्त्यतो युतिकाले शरज्ञानार्थं तेषु चालनमत्यावश्यकम्। अन्येषां पातानां गतिर्वर्षशतेनापि नोपलक्ष्यतेऽतो युतिकाले तच्चालनं शून्यमेवेति। सिद्धान्त शेखरे "योगेगते फलमृणं ग्रहयो-र्विधेयं गम्येधनं कुटिलयोर्विपरीत मत्रे"त्यनेन" श्रीपतिनापि चालन फलस्य धनर्णत्वमाचार्योक्तानुरूपमेवोक्तमिति ॥ ७॥

अब चालनफल के धनत्व और ऋणत्व के विषय में कहते हैं

हि. भा.— गतयोग में "ग्रहयोरन्तरलिप्तास्तथैव भक्ता इत्यादि" से आनीत चालन फल ऋण होता है, एष्य योग में चालन फल धन होता है। वक्री ग्रह में चालन फल विपरीत (उल्टा) होता हैं अर्थात् गत योग में धन और एष्य योग में ऋण इस तरह युतिकाल में ग्रहद्वय समलिप्तिक (राशि-अंश-कला करके तुल्य) होते हैं। यदि बुध शुक्र और चन्द्र किसी ग्रह के साथ युति (योग) करें तो बुध और शुक्र के शीघ्रोच्चों में और चन्द्रपात में भी अपना अपना चालनफल देना चाहिये अर्थात् चालनफल का संस्कार करना चाहिये इति ॥

उपपत्ति

चालन फल की धनर्णता की उपपत्ति अति सुगम है, बुध और शुक्र के शर साधन उनके शीघ्रोच्च वश से होता है, चन्द्रपात की दैनिक (एक दिन सम्बन्धी) गति है इसलिये युतिकाल में शर साधन के लिये उनमें चालन देना अत्यावश्यक है, अन्य ग्रहों के पातों की गति सौ वर्ष में भी नहीं लक्षित होती है इसलिये युतिकाल में उनका चालन फल शून्य ही होता है, सिद्धान्त शेखर में "योगे गते फलमृणं ग्रहयोर्विधेयं" इत्यादि से श्रीपति भी चालन फल की धनर्णता आचार्योक्तानुरूप ही कहते हैं इति ॥ ७॥

इदानीं स्फुटपातानयनमाह

बुधसितपातेऽव्यस्तं मन्दफलमुपान्त्यशीघ्रफलम् ।
शेषाणां स्फुटपाताद्विक्षेपो मध्यमायोगात् ॥८॥

सु. भा.—बुधशुक्रयोर्गणितागतपाते मन्दफलमव्यस्तं यथागतं धनर्णं देयम्। तत्रोपान्त्यशीघ्रफलं व्यस्तशीघ्रफलम् च देयम् । एवं तयोः पातौ स्फुटौ भवतः। शेषाणां भौमगुरुशनीनां पाते च केवलमुपान्त्यशीघ्रफलं व्यस्तशीघ्रफलं देयम् । एवं तेषां पाताः स्फुटा भवन्ति । तस्मात् स्फुटपातान्मध्यमायोगाद्विक्षेपो भवति । अत्रैतदुक्तं भवति। स्फुटपाताद्यदि विक्षेपः साध्यस्तदा स्फुटपाते स्फुटं ग्रहं संयोज्य तस्मात् सपाताद्वक्ष्यमाणविधिना शरः साधनीयः। बुधशुक्रयोः शरानयनार्थं च तच्छीघ्रोच्चयोर्यथागतं तात्कालिकं स्फुटशीघ्रफलं संस्कार्यं शीघ्रोच्चे स्फुटे कार्ये ततस्ताभ्यां तत्स्फुटपातसहिताभ्यां शरानयनमिति ।

अत्रोपपत्तिः। 'ये चात्रपातभगणाः पठिता ज्ञभृग्वो' रित्यादि तथा 'पातेऽथवा शीघ्रफलं विलोम' मित्यादि भास्कर विधिनास्फुटा । तत्र भास्करस्य वासनाभाष्यं च निरीक्षणीयम् ॥८॥

वि. भा.—बुधसित पाते (बुधशुक्रयोर्गणितागत पाते)मन्दफलमव्यस्तं (यथागतं धनमृणं) देयम्। उपान्त्यशीघ्रफलं (व्यस्तशीघ्रफलं च) देयम्। तदा तयोः स्फुटौ पातौ भवेताम्। शेषाणां(कुजगुरुशनीनां)पाते केवलमुपान्त्य शीघ्रफलं(व्यस्तं शीघ्रफलम् (देयम्) तदा तेषां स्फुटपाता भवन्ति, तस्मात्स्फुटपातान्मध्यमायोगा द्विक्षेपो भवत्यर्थाद्यदि स्फुटपाताद्विक्षेपःसाध्यस्तदा स्फुटपाते स्फुटं ग्रहं संयोज्यं तस्माच्छरः साध्यः बुधशुक्रयो : शरसाधनार्थं तयोः शीघ्रोच्चयोर्यथागतं स्फुटशीघ्रफलं संस्कृत्य शीघ्रोच्चे स्फुटे कार्ये ततस्ताभ्यां तत्स्फुटपात सहिताभ्यां शरानयनं कार्यमिति ॥८॥

अत्रोपपत्तिः

पातस्थाना (ग्रहगोलीय क्रान्तिविमण्डलसम्पातात्) न्मन्दस्पष्टग्रहपर्यन्तं सपातमन्दस्पष्टग्रहः । मन्दस्पष्टग्रहो विपरीत शीघ्रफलसंस्कृतस्फुटग्रहसमस्तत्र पाते व्यस्तं शीघ्रफलं संस्कृत्य तेन (व्यस्त शीघ्रफल संस्कृत पातेन) युतो हि स्फुटग्रहः सपातमन्दस्पष्टग्रहो भवति । बुधशुक्रयो र्ये पातभगणाः पठिताः सन्ति ते तयोः शीघ्रकेन्द्रभगणैर्युतास्तदा वास्तवपातभगणा भवन्ति, तत्र लाघवार्थमल्पाः पठिताः सन्तीति प्राचीनोक्तिः । सिद्धान्त शिरोमणौ "येचात्र पातभगणाः पठिता ज्ञभृग्वोस्ते शीघ्र केन्द्रभगणैरधिका यतः स्युः। स्वल्पाः सुखार्थमुदिताश्चलकेन्द्र युक्तौ पातौ तयोः पठितचक्रभवौ विधेयौ॥ चलाद्विशोध्यः किल केन्द्रसिद्धये

केन्द्रे सपाते द्युचरस्तु योज्यः । अतश्चलात् पातयुताज्ज्ञभृग्वोः सुधीभिराद्यैः शर-सिद्धिरुक्ता," इति भास्करोक्तिः ।

अथ बुध शुक्र पातः=पा, अत्र मध्यम शीघ्र केन्द्र योजनेन वास्तवपातः= पा+मशीके, मध्यग्रहोनमुच्चं मध्यमशीघ्रकेन्द्रम् । मध्यग्रहः=विपरीतमन्दफल-संस्कृतमन्दस्पष्टग्रहः । अत्र यदि मन्दफलं धनं कल्प्येत, मध्यग्रह=मन्दस्य— मंफल अतो मध्यशीघ्रकेन्द्रम्=शीउ—मंस्य+मंफल, ततो बुधशुक्रयोर्वास्तव— पातः= –पाः+मशीके=—पाः+शीउ—मंस्य+मंफल ततः सपातमन्दस्पष्टग्रहः= शरसाधनार्थं भुजांशः=—पात+मंस्य=—पात+शीउ—मंस्य+मंफल+मंस्य =—पात+शीउ+मंफल=शीउ—(पात—मंफल) एतेन बुधशुक्रयोर्विक्षेप-केन्द्रमुपपद्यते, अतो वासनायां भास्करः "किंच मन्दस्फुटोनं शीघ्रोच्चं प्रतिमण्डले केन्द्रम् । तत् पाते क्षेप्तुं युज्यते । एवं कृते सति विक्षेपकेन्द्रं मन्दफलेनान्तरितं स्यात्, ग्रहच्छायाधिकारे सितज्ञपातौ स्फुटौ स्तश्चल केन्द्रयुक्तावित्यत्र मन्दस्फुटोनं शीघ्रोच्चं शीघ्रकेन्द्रं पाते क्षिप्तम् । अतस्तत्र मन्द फलान्तरमङ्गीकृतमित्यर्थः । इतरकेन्द्रस्यानुपपत्तेः । अतो मन्दफलं पातेऽव्यस्तं देयम् यतोऽनुपातसिद्धं चलकेन्द्रं मध्यग्रहोनशीघ्रोच्चतुल्यं भवति" इति "पातेऽव्यस्तं देयम्" इति भास्करोक्त-माचार्योक्तसदृशमेव, सूर्यसिद्धान्तकारमते पाते व्यस्तं देयमिति सिध्यति पातस्य चक्राद्विशोधनादिति ॥८॥

अब स्फुट पातानयन को कहते हैं

हि. भा.—बुध और शुक्र के गणितागत पात में मन्द फल को यथागत धन या ऋण देना चाहिये, और शीघ्रफल को विपरीत देना चाहिये । तब दोनों (बुध और शुक्र) के स्फुट पात होते हैं । शेष ग्रहों (भौम, गुरु, और शनैश्चर) के पातों में केवल शीघ्रफल को विपरीत देना चाहिये तब उन सबों के स्फुट पात होते हैं । उस मध्यग्रह योग रहित स्फुटपात से शर साधन करना चाहिये अर्थात् स्फुटपात में स्फुट ग्रह को जोड़ कर जो हो उससे शर साधन करना ; बुध और शुक्र के शर साधन के लिये उन दोनों के शीघ्रोच्चों में यथागत स्फुट शीघ्र फल को संस्कार कर शीघ्रोच्च को स्पष्ट करना चाहिये, तब स्व-स्व स्फुट पात सहित स्फुट शीघ्रोच्चों से शरानयन करना चाहिये इति ॥८॥

उपपत्ति

ग्रहगोल में क्रान्तिवृत और विमण्डल के सम्पात बिन्दु पात हैं, मेषादि से पात विलोम चलता है तथा मन्दस्पष्टग्रह अनुलोम चलता है इसलिये दोनों का अन्तर दोनों के योग करने से पात स्थान से मन्द स्पष्ट ग्रहपर्यन्त होता है, विपरीत शीघ्रफल संस्कृत स्फुटग्रह मन्दस्पष्ट ग्रह होते हैं । यहाँ पात में विपरीत शीघ्र फल का संस्कार कर उससे

(विपरीत शीघ्रफल संस्कृत पात से) रहित स्फुट ग्रह मन्द स्पष्ट ग्रह होते हैं। बुध और शुक्र के जो पात भगण पठित हैं उनमें दोनों के शीघ्र केन्द्र भगणों को जोड़ने से वास्तव पात भगण होते हैं। वहाँ लाघव के लिये स्वल्प ही पठित है, यह प्राचीनों की उक्ति है। सिद्धान्त शिरोमणि में "ये चात्र पातभगणाः पठिता ज्ञभृग्वोस्ते शीघ्र केन्द्र भगणैः" इत्यादि सं. उपपत्ति में लिखित श्लोकों से भास्कराचार्य ने अपना मत प्रदर्शित किया हैं।

बुध या शुक्र के पात = पा, इसमें मध्यम शीघ्र केन्द्र को जोड़ने से वास्तव पात होता है, पा + मशीके = वास्तव पात उच्च में से मध्यमग्रह को घटाने पर मध्यम शीघ्र केन्द्र होता है, परन्तु मध्यमग्र = विपरीत मन्द फल संस्कृत मन्द स्पष्टग्र। यहाँ यदि मन्द फल को धन माना जाय तब मध्यग्रह = मन्दस्पग्र — मन्दफ, इसलिए मध्यशीके = शीउ — मंस्पग्र + मन्दफ इसलिये बुध और शुक्र के वास्तव पात = — पा + मशीके = — पा + शीउ — मन्दस्पग्र + मन्दफ, । अतः सपातमन्दस्पष्टग्रह = शरसाधनार्थं भुजांश = — पा + मंदस्पग्र = पा + शीउ —मंस्पग्र + मन्दफ + मंस्पग्र = —पा + शीउ + मन्दफ = शीउ —(पा — मन्दफ) = विक्षेपकेन्द्र, इससे बुध और शुक्र का विक्षेपकेन्द्रानयन उपपन्न होता है। अतः अपने वासना भाष्य में "किंच मन्द स्फुटोनं शीघ्रोच्चं प्रतिमण्डले केन्द्रम्" यहां से "पातेऽव्यस्तंदेयम्" यहां तक संस्कृतोपपत्ति में लिखित भाष्य से" भास्कराचार्य ने आचार्योक्त के सदृश ही कहा है, सूर्य सिद्धान्तकार के मत में "पाते व्यस्तंदेयम्" यह सिद्ध होता है क्योंकि उनके मत में पात को चक्र (द्वादशराशि) में घटा देने से पात है इति ॥ ८ ॥

अथ गणितागतादेव पातान्मध्यमसंज्ञकाच्छरसाधनोपायमाह।

मन्दफल स्फुटशशिनो विक्षेपो भौमजीवरविजानाम्।
मन्दफलाव्यस्तस्फुटशीघ्राद्बुधशुक्रयोरथवा ॥ ९ ॥

सु. भा.—अथवा मन्दफल स्फुट शशिनो मन्दस्पष्टचन्द्रस्य तथा भौमजीवरविजानां मन्दस्पष्टकुजगुरुशनीनां गणितागतात् पातादेव विक्षेपः साध्यः। बुधशुक्रयोश्च मन्दफलाव्यस्तस्फुटशीघ्राद्यथागतमन्दफलसंस्कृतशीघ्रोच्चाद्गणितागतपाताच्च शरः साध्यः। इति सर्वपूर्वं प्रदर्शितभास्करवचनतः स्फुटम् ॥ ९ ॥

वि. भा.—अथवा मन्दफलस्फुटशशिनः (मन्दस्पष्टचन्द्रस्य) तथा भौमजीवरविजानां (मन्दस्पष्टभौमगुरुशनीनां) गणितागतात्पातादेव विक्षेपः (शरः) साध्यः। बुधशुक्रयोर्मन्दफलाव्यस्तस्फुटशीघ्राद्यथागतमन्दफलसंस्कृतशीघ्रोच्चात्-गणितागतपाताच्च शरः साध्य इति ॥ ९ ॥

अत्रोपपत्तिः

सिद्धान्त शिरोमणौ "मन्द स्फुटो द्राक् प्रति मण्डले हि ग्रहो भ्रमत्यत्र च तस्य पातः। पातेन युक्ताद् गणितागतेन मन्दस्फुटात् खेचरतः शरोऽस्मात् ॥ पातेऽथवा शीघ्रफलं विलोमं कृत्वा स्फुटात्तेन युताच्छरोऽतः। चन्द्रस्य कक्षावलये हि पातः स्फुटाद्विधोर्मध्यमपातयुक्तात् एभिस्तथा येचात्र पातभगणाः पठिता ज्ञभृग्वोरित्यादि पूर्वश्लोकोपपत्तौ लिखित भास्कराचार्योक्तवचनैस्तद्वासना-भाष्याच्च ज्ञातव्या, सिद्धान्त शेखरे श्रीपतिना "मृदुफल स्फुट गुर्विनजासृजां शशधरस्य च बोधन शुक्रयोः। अपरथा कृत मन्द फलाच्चलात् कथितवत् क्रियते शरसाधनम्" अनेनाऽऽचार्योक्तानुरूपमेवोक्तमिति ॥ ९ ॥

अब गणितागत पात ही से शरसाधन में विशेष कहते हैं

हि. भा.— मन्दस्पष्ट चन्द्र के तथा मन्दस्पष्ट कुज, गुरु और शनैश्चर के गणितागत पात ही से शर साधन करना चाहिये, बुध और शुक्र के यथागत मन्दफल संस्कृत शीघ्रोच्च से तथा गणितागत पात से शरसाधन करना चाहिये इति ॥ ९ ॥

उपपत्ति

सिद्धान्त शिरोमणि में "मन्दस्फुटो द्राक् प्रतिमण्डलेहि" से "स्फुटाद्विधोर्मध्यम पात युक्तात्" तक संस्कृतोपपत्ति में लिखित भास्करोक्त वचनों से तथा 'ये चात्र पात-भगणाः पठिता ज्ञभृग्वो" इत्यादि पूर्वश्लोक (८) की उपपत्ति में लिखित भास्कराचार्योक्त वचनों से तथा उन के वासना भाष्य से समझना चाहिये। सिद्धान्त शेखर में "मृदुफल-स्फुटगुर्विनजासृजां, इत्यादि सं० उपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥९॥

इदानीं युतिकाले ग्रहशरसाधनमाह

समलिप्त स्फुट मध्यात् स्वपात युक्ताज ज्ञशुक्रयोः शीघ्रात् ।
जीवाविक्षेपगुणा हृताऽन्त्यकर्णेन विक्षेपः ॥१०॥

सु. भा.—समलिप्त स्फुटमध्याद्युतिकालिकमन्दस्पष्टात् शीघ्राद्यथागतमन्द फलसंस्कृतशीघ्रोच्चात्। अन्त्यकर्णेन स्थिरीभूतेन शीघ्रकर्णेन । शेषं स्पष्टार्थम् ।

अत्रोपपत्तिः। 'मन्दस्फुटात् खेचरतः स्वपातयुक्ताद्भुजज्येत्यादि भास्कर विधिना स्फुटा ॥१०॥

वि. भा.—स्वपातयुक्तात् समलिप्तस्फुटमध्यात् (समकलमन्दस्पष्ट-ग्रहात्) युतिकालिकमन्दस्पष्टग्रहात्, स्वपातयुक्तात् ज्ञशुक्रयोः (बुधशुक्रयोः) शीघ्रात् (शीघ्रोच्चात्) या जीवा (सपातमन्दस्पष्टग्रहभुजज्या सपातबुधशुक्रयोः शीघ्रोच्चज्या च) विक्षेपगुणा (ग्रहगोलीयपठितशरगुणिता) अन्त्यकर्णेन (स्थिरीभूतेन शीघ्रकर्णेन) हृता (भक्ता) तदा विक्षेपो (भगोलीयेष्टशरः) भवेदिति ॥१०॥

अत्रोपपत्तिः

ग्रहगोले क्रान्तिविमण्डलयोः सम्पातः पातसंज्ञकस्तत्रस्थेग्रहे शरा (ग्रह विम्ब केन्द्रोपरिगतं कदम्बप्रोतवृत्तं यत्र क्रान्तिवृत्ते लगति ततो ग्रहबिम्ब-केन्द्रं यावच्छरः) भावः । पातात्त्रिभे ग्रहे परमशरः । पातान्मन्दस्पष्टग्रहपर्यन्तं सपातमन्दस्पष्टग्रहः । ग्रहगोले पातस्थानाद्बिम्बकेन्द्रावधिकर्णः । ग्रहोपरिगत-कदम्वप्रोतवृत्ते ग्रहस्थानाद्बिम्बकेन्द्रावधिशरोभुजः। ग्रहस्थानात्पातस्थानावधि क्रान्तिवृत्ते कोटिः। अत्रचापजात्ये क्रान्तिविमण्डलसम्पातो (पातस्थान) त्पन्नकोणः पातपठितः परमशरः । तत उक्तचापजात्ये कोणानुपातेन ग्रहगोलीयेष्टशरज्या

$$=\frac{\text{ग्रहगोलीय परमशरज्या}\times\text{सपातमन्दस्पष्ट ग्रह भुज्या}}{\text{त्रि}}=\text{ग्रहगोलीयेष्टशरः}$$

(स्वल्पान्तराज्ज्याचापयोरभेदात् $=\frac{\text{ग्रहगोलीयपरमशर}\times\text{सपातमन्दस्पग्रभुज्या}}{\text{त्रि}}$

अत्र विमण्डलीयभुजांशरूपकर्णस्याज्ञानाद्विदितक्रान्तिमण्डलीयसपातसमन्दस्पष्ट-ग्रहभुजज्ययैवेष्टशरानयनं कृतं प्राचीनैस्तन्न युक्तम् । ततो यदि शीघ्रकर्णेऽयं पूर्वानीतग्रहगोलीयेष्ट शरो लभ्यते तदा त्रिज्यया किमिति समागच्छति भगोले

$$\text{शरः}=\frac{\text{ग्रहगो परमशर}\times\text{सपातमंस्पग्रभुज्या}\times\text{त्रि}}{\text{त्रि}\times\text{शीक}}$$

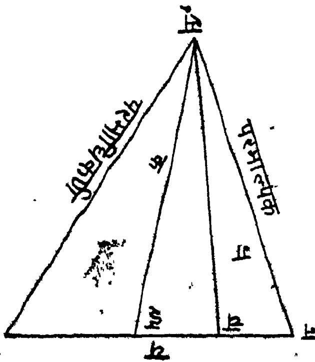
$$=\frac{\text{ग्रहगोपरमशर}\times\text{सपातमन्दस्पग्र भुज्या}}{\text{शीक}}$$ अयमपि भगोलीयेष्टशरो न समीचीनः

पूर्वोक्तानुपातस्यानौचित्यात् । सिद्धान्ततत्त्वविवेके कमलाकरेण साधिताः स्फुट-ग्रहा विमण्डले समागच्छन्तीति स्वीक्रियते तन्न युक्तम् । गणितेन साधिताः स्फुट-ग्रहाः क्रान्तिवृत्त एव समागच्छन्ति यतः क्रान्तिवृत्तधरातलेन कर्तितानां तत्तद्ग्रह-गोलानां कर्तित प्रदेशस्य तत्तद् ग्रहगोले शीघ्र प्रतिवृत्तत्वात्तत्रैव फलादेर्व्यवस्था भवितु मर्हति, गणितागत स्फुट ग्रहस्य विमण्डले स्वीकरणे फलादेर्व्यवस्था न भवेत् विमण्डलधरातलानां प्रत्येक ग्रहगोले भिन्नत्वात् तेनात्र प्राचीनानां साधित स्फुट-ग्रहाः क्रान्तिवृत्तीया भवन्तीति, कथनमेव युक्तियुक्तम्, कमलाकरोक्तं न समीचीन-

मिति गणितज्ञा विभावयन्त्विति। सूर्यसिद्धान्ते "स्वपातोनाद् ग्रहाज्जीवा शीघ्राद् भृगुज सौम्ययोः। विक्षेपघ्नन्त्यकर्णाप्तो विक्षेपः" ऽनेनाऽऽचार्योक्तानुरूपमेवोक्तम्। पातो मेषाद्विलोमं मन्दस्पष्टग्रहश्चानुलोमं भ्रमत्यतस्तदन्तरं तयोर्योगाद् भवति, परं सूर्यसिद्धान्तकारेण पातश्चक्राद्विशोधितः कृतोऽस्त्यतो विपातमन्दस्पष्टग्रह एवाऽऽचार्योक्तसपातमन्दस्पष्टग्रहो भवेत्तदेव शरसाधनार्थं विक्षेपकेन्द्रं कथ्यते तेन, सिद्धान्तशेखरे श्रीपतिना "समकलग्रहपातसमागतात् भुजगुणोऽथ निजेषु कलाहतः निजचलश्रवणेन हृतो भवेदपममण्डलतः स्फुट सायकः" ऽनेन सिद्धान्त शिरोमणौ भास्कराचार्येणाचा "मन्दस्फुटात् खेचरतः स्वपातयुक्ताद् भुजज्या पठितेषु निघ्नी स्वशीघ्र कर्णेन हृताशरः स्यात्सपात मन्दस्फुट गोलदिक्कः" ऽनेनाऽऽचार्योक्तानुरूपमेवोक्तं परं सर्वेषामिदं भगोलीयेष्टशरानयनं न समीचीनमिति पूर्वकथितोपपत्तितः स्फुटमिति।

प्राचीनैर्भगोले विमण्डलं वृत्ताकारकं स्वीकृत्येष्टशरानयनं कृतं परं भगोले विमण्डलस्याकृति वृंत्ताकारा भवति नवेत्येतदर्थं विचार्यते। भूकेन्द्राद्ग्रहगोलीयविमण्डलाधारा सूची (विषमा सूची) कार्या सा भगोलेन च्छिन्ना सती यादृशं वक्रमुत्पादयेत्तादृशमेव भगोले विमण्डलम्। एतदर्थं विचारः। भूकेन्द्राद्ग्रहगोलीय विमण्डलाधारं विषमसूच्यां स्थिरत्रिभुजधरातल विमण्डल धरातलयोर्या योगरेखा सा विमण्डल व्यासरेखा, एतदर्थात्कियन्मितान्तरे तदुपरि लम्बरूपिणी पूर्णज्याग्रगत समकर्णद्वयोत्पन्नकोणः परमस्तत्प्रमाणम्=य, एतौ कर्णौ परमाल्पकर्णपरमाधिककर्णाभ्यां तुल्यान्तरे भवेताम्। एतद्रूपाः स्थितयोऽनेकैः कर्णैरुत्पद्येरन् तेषां मध्ये काभ्यामुत्पन्नः कोणः परमस्तदर्थं विचारः।

अत्र इन=अ, तदा सूचइ त्रिभुजे "भूसंमुखास्रोद्भवकोटिशिञ्जिनी दोर्घ्नि गुण्येत्यादिना"



य^2+क^2—२ इको. क.य.=ग^2, अत्र इको=इकोण कोटिज्या, तथा अ^2—य^2 =तत्स्थानीय पूर्णज्या^{2}, अनयोर्योगे कृते तत्स्थानीय कर्णवर्गः=क$'^2$=क^2+अ^2 —२ इको. य.क., ततोऽनुपातेन

$$\frac{\text{अ}^2-\text{य}^2}{\text{क}^2+\text{अ}^2-2\text{इको. य. क.}}=\text{इष्ट-}$$

कोणज्या^{2}, एतत्परमत्वं तदैव भवेद्यदा तत्तात्कालिकी गतिः शून्या भवेत्तथा सति

—य. २ ताय (अ^2+क^2—२ इको. य^2. क)+इको. क. २ ताय (अ^2—क^2) =०, [अत्र चलराशिः केवलं य, तथा तात्कालिकगतौ नीतायाम्] अपवर्त्तिते

—य (अ^2+क^2)+य^2. इको. २ क—इको. य^2 क=—इको. क. अ^2=—य (अ^2+क^2)+य^2. इको. क=—इको. क. अ^2

$$-\frac{\text{य (अ}^2+\text{क}^2)}{\text{इको. क}}+\text{य}^2=-\text{अ}^2$$, वर्ग पूर्तिकरणेन

$$-\frac{\text{य (अ}^2+\text{क}^2)}{\text{इको. क}}+\text{य}^2+\left(\frac{\text{अ}^2+\text{क}^2}{\text{२इको. क}}\right)^2$$

$$=-\text{अ}^2+\left(\frac{\text{अ}^2+\text{क}^2}{\text{२ इको. क}}\right)^2$$ मूलग्रहणेन

$$\text{य}-\frac{\text{अ}^2+\text{क}^2}{\text{२. इको. क}}=$$

$$\sqrt{\frac{(\text{अ}^2+\text{क}^2)^2-\text{अ}^2(\text{२ इको. क})^2}{(\text{२ इको. क})^2}}$$ वर्गान्तरस्य योगान्तर घात समत्वात्

$$\sqrt{\frac{(\text{अ}^2+\text{क}^2-\text{२ अ. क. इको}).(\text{अ}^2+\text{क}^2+\text{२ इको. अ. क})}{(\text{२ इको. क})^2}}$$

यतः अ^2+क^2—२अ. क. इको=परमाल्पक^2, तथा अ^2+क^2+२ अ. क. इको=परमाधिकक^2

$$\text{अतः य}-\frac{\text{अ}^2+\text{क}^2}{\text{२ इको. क}}=\frac{\text{परमाल्पक. परमाधिक}}{\text{२ इको. क}}$$ पक्षयोः समयोजनेन

$$\text{य}=\frac{\text{अ}^2+\text{क}^2+\text{परमाल्पक.परमाधिक}}{\text{२ इको. क}},$$

$$\text{अथ यतः अ}^2+\text{क}^2=\frac{\text{परमाल्पक}^2+\text{परमाधिक}^2}{\text{२}}$$

तथा क=आधारार्धगामिनी रेखा,

$$\text{अतः }\frac{\text{परमाल्पक}^2+\text{परमाधिक}^2+\text{२ परमाल्पक. परमाधिक}}{\text{४ इको. क}}=$$

$\frac{(\text{परमाल्पक}+\text{परमाधिक})^2}{४\ \text{इको}.\text{क}}=\text{य}$, अतः पूर्वोक्तं सिद्धं जातम् ।

अथ च परमाल्पकर्णपरमाधिककर्णाभ्यामुत्पन्नस्य कोणस्यार्धकारिणी रेखा यत्राधारवृत्तव्यासे लगति स बिन्दुः केन्द्रात्कियन्मितान्तरे भवति तदुत्तरं सुलभेनैव भवतीति स्वयमेव सिद्धान्तज्ञैर्विचार्यं ज्ञेयः ।

अथावशिष्टार्थं विचारः ।

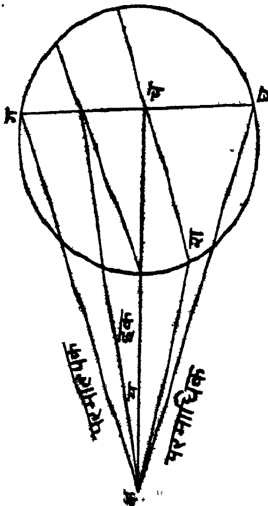
अथ $<\text{गकघ}=<\text{अ}$, $<\text{गकच}=\frac{\text{अ}}{२}$, कच अक्षरेखा गघ आधारे यत्र लग्ना स्तद्बिन्दोस्तद्रेखोपरि या लम्बरूपा पूर्णज्या तद्वर्गमानीयते, आधार लग्न कोणौ ग, घ तदाऽनुपातेन

$$\frac{\text{कच}.\ \text{ज्या}\frac{\text{अ}}{२}}{\text{ज्याग}}=\text{गच},\ \text{तथा}\ \frac{\text{कच}.\ \text{ज्या}\frac{\text{अ}}{२}}{\text{ज्याघ}}=\text{घच}\ \text{अनयोर्घातः}$$

$$\frac{\text{कच}^2.\ \text{ज्या}^2\frac{\text{अ}}{२}}{\text{ज्याग}.\ \text{ज्याघ}}=\text{चश}^2$$

चशक त्रिभुजस्य जात्यत्वात् क शीर्षकोणस्पर्श रेखा^{2}

$$=\frac{\text{कच}^2\ \text{ज्य}^2\frac{\text{अ}}{२}}{\text{कच}^2.\ \text{ज्याग}.\ \text{ज्याघ}}=\frac{\text{ज्या}^2\frac{\text{अ}}{२}}{\text{ज्याग}.\ \text{ज्याघ}}$$



तथेष्टस्थाने, इष्टकर्णेन कोणज्ये विभक्ते तदीय कोणाभ्या- $\frac{\text{अ}}{२}-\text{य}$, $\frac{\text{अ}}{२}+\text{य}$, मेताभ्यामिष्ट स्थानीय पूर्णज्यार्धवर्गः=

$$\frac{\text{इक}^2.\text{ज्या}\left(\frac{\text{अ}}{२}+\text{य}\right).\text{ज्या}\left(\frac{\text{अ}}{२}-\text{य}\right)}{\text{ज्याग}\cdot\ \text{ज्याघ}}$$

अत्र ज्या $\left(\frac{\text{अ}}{२}+\text{य}\right)$. ज्या $\left(\frac{\text{अ}}{२}-\text{य}\right)$

$=$ ज्या$^{1}\frac{\text{अ}}{2}$—ज्या^{1}य, अत इष्ट स्थानीय पूर्णज्यार्धवर्गः$=$

$\frac{\left(\text{ज्या}^{1}\frac{\text{अ}}{2}\text{ज्या}^{1}\text{य}\right).\text{इक}^{2}}{\text{ज्याग}.\text{ज्याघ}}$, कोणस्पर्शरेखावर्गः$=$

$\frac{\text{इक}^{2}\left(\text{ज्या}^{2}\frac{\text{अ}}{2}\text{ज्या}^{2}\text{य ज्या}\right)}{\text{ज्याग}.\text{ज्याघ}.\text{इक}^{2}}=\frac{\text{ज्या}^{1}\frac{\text{अ}}{2}\text{ज्या}^{1}\text{य}}{\text{ज्याग}.\text{ज्याघ}}=$ इष्टस्थानीय कोणस्य^{2}

तथा कोणार्धकारिणी रेखा स्थानीय कोणस्पर्श रे$^{2}=\frac{\text{ज्या}^{2}\frac{\text{अ}}{2}}{\text{ज्याग}.\text{ज्याघ}}$

एतदपेक्षयाऽन्यासां स्पर्शरेखाणां वर्गमानानि न्यूनान्येव भवन्ति। स्पर्शरेखा-खण्डैश्चापे कृते सर्वकोणचापापेक्षया कोणार्धकारिणी रेखा स्थानीयकोणस्पर्श-रेखा जनित चापमेवाधिकं भवेत्। अयमागतः सर्वाधिकः स्पर्शरेखावर्गः$=\frac{\text{अ}}{2}$, स्पर्शरेखावर्गान्न्यूनोऽधिको वेत्यस्य विचारः।

पूर्वोक्तस्पर्शरेखयोर्विषमी करणम् $\frac{\text{ज्या}^{2}\frac{\text{अ}}{2}}{\text{ज्याग}.\text{ज्याघ}}><\frac{\text{ज्या}^{2}\frac{\text{अ}}{2}}{\text{कोज्या}^{2}\frac{\text{अ}}{2}}$

कगघ त्रिभुजे $180-(\text{ग}+\text{घ})=\text{अ}\ \therefore 90-\frac{(\text{ग}+\text{घ})}{2}=\frac{\text{अ}}{2}$

$\therefore 90-\frac{\text{अ}}{2}=\frac{\text{ग}+\text{घ}}{2}=\text{को}\left(\frac{\text{अ}}{2}\right)$

$\frac{\text{ग-घ}}{2}=$प कल्पितं तदा संक्रमणेन. को$\left(\frac{\text{अ}}{2}\right)+\text{प}=\text{ग}$। को $\left(\frac{\text{अ}}{2}\right)$ $-\text{प}=\text{घ}$, एतयोर्ज्याघातः पूर्वस्थितेन ज्याग. ज्याघ समस्तथाकृते ज्या

$\left\{\text{को}\left(\frac{\text{अ}}{2}-\text{प}\right)\right\}.\text{ज्या}\left\{\text{को}\left(\frac{\text{अ}}{2}+\text{प}\right)\right\}=\text{ज्याग}.\text{ज्याघ}$

पूर्वयुक्त्यैव· $कोज्या^{२}\left(\frac{अ}{२}\right) — ज्या^{२}प = ज्याग.\ ज्याघ$

$$\therefore \frac{ज्या^{२}\frac{अ}{२}}{कोज्या^{२}\left(\frac{अ}{२}\right) — ज्या^{२}प} >< \frac{ज्या^{२}\frac{अ}{२}}{कोज्या^{२}\frac{अ}{२}}$$

अत्र भाज्यमानस्य समत्वाद्यस्य हरोऽधिकस्तत्फलमल्पं भवेत्तेन परमाल्प-कर्णं परमाधिक कर्णाभ्यामुत्पन्नः कोणोऽधिकः सिद्ध इति ।

अथ परम कोणबिन्दोरुभयपार्श्वेऽवश्यमेव परमाल्पकर्णपरमाधिककर्ण सम्भूतकोणेन समौ कोणौ जायेते तथा समीकरणेन $\frac{ज्या^{२}\frac{अ}{२} — ज्या^{२}य}{ज्याग.\ ज्याघ}$

$$= \frac{ज्या^{२}\frac{अ}{२}}{कोज्या^{२}\frac{अ}{२}},\ \frac{ग — घ}{२} = प \mid \frac{ग + घ}{२} = को\frac{अ}{२}$$

$ज्याग·\ ज्याघ = कोज्या^{२}\frac{अ}{२} — ज्या^{२}य$ तथा $\frac{ज्या^{२}\frac{अ}{२} — ज्या^{२}य}{कोज्या^{२}\frac{अ}{२} — ज्या^{२}य}$

$$= \frac{ज्या^{२}\frac{अ}{२}}{कोज्या^{२}\frac{अ}{२}} \text{ छेदगमेन}$$

$$कोज्या^{२}\frac{अ}{२} \times \left(ज्या^{२}\frac{अ}{२} — ज्या^{२}य\right) = ज्या^{२}\frac{अ}{२}\left(कोज्या^{२}\frac{अ}{२} — ज्या^{२}प\right)$$

वा. $ज्या^{२}य.\ कोज्या^{२}\frac{अ}{२} = ज्या^{२}प.\ ज्या^{२}\frac{अ}{२}$ अतः

$$\frac{\text{ज्या}^2\frac{\text{अ}}{2}\text{ज्या}^2\text{प}}{\text{कोज्या}^2\frac{\text{अ}}{2}}=\text{ज्या}^2\text{य},\ \text{यतः}\ \text{प}=\frac{\text{ग}-\text{घ}}{2}$$

$$\text{अतः}\ \frac{\text{ज्या}^2\frac{\text{अ}}{2}-\text{ज्या}\left(\frac{\text{ग}-\text{घ}}{2}\right)}{\text{कोज्या}^2\frac{\text{अ}}{2}}=\text{ज्या}^2\text{य}$$ मूलग्रहणेन ज्यायमानं

विदितं भवेत् । तदा 'य' ऽस्योभय दिश्यानीतस्थिरशङ्कुसमं मानद्वयं भविष्यति तदा तदुपरि लम्बस्तदर्धं $\frac{\text{अ}}{2}$ समो भवतीति ।

अथ भगोलविमण्डलवक्रोपयोगि भिन्नोऽपि सिद्धान्तः ।

विषमसूच्यां सूचीशीर्षस्थानादाधारधरातलोपरि यो लम्बस्तन्मूलादाधार-वृत्तस्यानेकाः पूर्णज्याः कार्याः सूचीशीर्षस्थानात्प्रत्येक पूर्णज्या प्रान्तद्वयगता रेखाः कार्यास्तदा पूर्णज्या तत्प्रान्तद्वयगतरेखाभिर्जायमानानां त्रिभुजानां मध्ये कस्य शिरः कोणः सर्वाधिक इत्येतदर्थं विचार्यते ।

पूर्णज्या खण्डे प्र, द्वि, परमाधिककर्ण परमाल्प कर्ण जनित त्रिभुजे पूर्णज्या (आधारवृत्त व्यास) खण्डे $\text{प्र}'$, $\text{द्वि}'$, लम्बपूर्णज्याग्रगतकर्णाभ्यां जायमानौ कोणौ को, $\text{को}'$ लम्बपरमाल्पकर्ण-परमाधिक कर्णाभ्यां जायमानौ कोणौ $\text{को}'$ १, कौ, तदा $\frac{\text{प्र}}{\text{लम्ब}}$

$=\text{स्प को},\ \frac{\text{द्वि}}{\text{लम्ब}}=\text{स्पको}'$ तथा $\frac{\text{प्र}'}{\text{लम्ब}}=\text{स्पकौ}_1,\ \frac{\text{द्वि}'}{\text{लम्ब}}=\text{स्पको}'_1$ तदा कोदण्ड-स्पर्शरेखेत्यादिना ।

$$\text{स्प}(\text{को}+\text{को}')=\text{पूर्णज्या प्रान्तद्वयगत कर्णोत्पन्नस्य}=\frac{\text{स्पको}+\text{स्पको}'}{1-\text{स्पको}.\ \text{स्पको}'}$$

$$=\frac{\frac{\text{प्र}+\text{द्वि}}{\text{लम्ब}}}{1-\frac{\text{प्र}.\ \text{द्वि}}{\text{लम्ब}^2}}$$, तथा परमाल्प कर्णपरमाधिककर्णयोर्लम्बेन सहोत्पन्न-

कोणयोर्युतिस्पर्शरेखा = परमाल्पपरमाधिककर्णयोरुत्पन्न कोणस्पर्श रे =

$$\frac{\text{स्पको}_{१}+\text{स्पको}'_{१}}{\text{१}-\text{स्पको}_{१}\cdot\text{स्पको}'_{१}}=\frac{\dfrac{\text{प्र}'+\text{द्वि}'}{\text{लम्ब}}}{\dfrac{\text{१}-\text{प्र}'.\text{द्वि}'}{\text{लम्ब}^{२}}}$$

परन्तु $\text{प्र. द्वि}=\text{प्र. द्वि}'\cdots$ तथा $\text{प्र}'.+\text{द्वि}' > \text{प्र}+\text{द्वि}\cdots\cdots$ यतः $\text{प्र}+\text{द्वि}=$ आधार-वृत्तव्यासः

$$\therefore \qquad \frac{\dfrac{\text{प्र}'+\text{द्वि}'}{\text{लम्ब}}}{\dfrac{\text{१}-\text{प्र}'\text{द्वि}'}{\text{लम्ब}^{२}}}$$

एषा परमाल्पपरमाधिककर्णयोरुत्पन्नकोणस्य स्पर्शरेखा प्रत्येकपूर्णज्या प्रान्तद्वयगतकर्णरेखयोरुत्पन्नकोणस्पर्शरेखाभ्योऽधिका सिद्धा ततश्चापकरणेन परमाल्पकर्ण परमाधिक कर्णयोरुपन्नः कोणः सर्वकोणापेक्षयाऽधिकःसिद्धः ।

पूर्वलिखित भगोल विमण्डल वक्रोपयोगि सिद्धान्त समष्टयवलोकनेनाधोलिखित-विषया सिध्यंति । कोणार्धकारिणीरेखात उभयपार्श्वे ये ये समानकोणोर्ध्वपादके रेखे भवेतां ते ते यत्राधारे लग्ने तत्तत्स्थानद्वयात्तद्योगरेखोपरि ये ये लम्बरूपिणी पूर्णज्ये निष्पद्येते तदग्रगामिनौ यौ यौ कर्णौ भवेतां ताभ्यामुत्पन्नौ कोणौ सदैव समौ भवितुमर्हतः । तथैतत्कोणयोर्गोले यानि मानानि चापात्मकानि जायन्ते तेषां मध्ये तुल्य तुल्य चापयोर्विरुद्धाग्रगामि चापं परमाल्पकर्णपरमाधिककर्णाभ्यामुत्पन्न-कोणज चापेनार्धितं भविष्यति,तथेदं केन्द्रगामि भवति, अनेनैतद्वक्रार्धकारक चापद्वयं व्यासरूपं जातं तत्रैक (परमाल्पक. परमाधिक.) मेतदुत्पन्नं, द्वितीयमेतदुपरि लम्बरुपं परमं चापं तेनेदमपि सिद्धं यदेतच्चापसम्पातादुभयपार्श्वे तुल्यान्तरे (परमाल्पक परमाधिक) एतदुत्पन्न चापोपरि लम्बरूपे चापे यत्र वक्रपाल्यां स्पृशत-स्तस्मात्समे भवितुमर्हत इति पूर्वलक्षण घटितवक्रं कूर्मपृष्ठाकृतिवक्र-मितिदिक् ॥१०॥

अब युतिकाल में ग्रह के शरसाधन को कहते हैं ।

हि.भा.—अपने पातसहित युतिकालिक मन्दस्पष्टग्रह से तथा स्वपातयुक्त

बुधशीघ्रोच्च और शुक्रशीघ्रोच्च से जो ज्या (सपातमन्दस्पष्टग्रहभुजज्या, सपात बुधशीघ्रोच्चज्या, सपात शुक्रशीघ्रोच्चज्या) हो उनको ग्रहगोलीय पठितशर (परमशर) से गुणा कर स्थिरीभूत शीघ्र कर्ण से भाग देने से स्फुटशर (भगोलीयेष्टशर) होता है ॥१०॥

उपपत्ति

ग्रहगोल में क्रान्तिवृत और विमण्डल के सम्पात विन्दु पात संज्ञक हैं, पातस्थान में ग्रह के रहने से शर (ग्रहविम्व केन्द्रोपरिगत कदम्ब प्रोतवृत्त क्रान्तिवृत्त में जहां लगता है वह ग्रह स्थान है, स्थान से विम्व केन्द्र तक) का अभाव होता है, पात स्थान से तीन राशि पर ग्रह के रहने से परमशर होता है, पातस्थान से मन्दस्पष्ट ग्रहपर्यन्त सपात-मन्दस्पष्ट ग्रह है, पातस्थान से विम्व केन्द्रपर्यन्त विमण्डल में कर्णचाप, बिम्वकेन्द्रोपरिगत कदम्ब प्रोत वृत्त में स्थान से विम्वकेन्द्रतक शर भुज, ग्रहस्थान से पातस्थान पर्यन्त (सपातमन्दस्पष्टग्रहभुजांश) क्रान्ति वृत्त में कोटि, इन तीनों कर्णभुज कोटिचापों से उत्पन्न चापजात्य में क्रान्ति वृत्त और विमण्डल से उत्पन्न पातस्थान लग्नकोण = पाठपठित परमशर,

तब कोणानुपात से $\frac{\text{ग्रहगोलीय परमशज्या} \times \text{सपातमन्दस्पग्रभुज्या}}{\text{त्रि}}$ = ग्रहगोलीयेष्टशरज्या

स्वल्पान्तराज्ज्याचापयोरभेदात् $\frac{\text{ग्रगोलीय परमशर} \times \text{सपातनन्दस्पग्रभुज्या}}{\text{त्रि}}$ = ग्रहगोलीयेष्ठश

यहां विमण्डलीय भुजांश रूप कर्ण विदित नहीं है, क्रान्तिवृत्तीय सपात मन्दस्पष्टग्रह भुजांश विदित है इसलिये क्रान्तिवृत्तीयसपातमन्दस्पष्टग्रहभुजज्या ही से प्राचीनाचार्यों ने जो इष्ट शरानयन किया हैं वह ठीक नहीं है, तब यदि शीघ्र कर्ण में ग्रह गोलीयेष्टशर पाते है तो त्रिज्या में क्या इस अनुपात से भगोल में इष्टशर आता है, जैसे $\frac{\text{ग्रहगो इष्टशर} \times \text{त्रि}}{\text{शीक}}$

$= \frac{\text{ग्रगोपरमशर} \times \text{सपात मन्दस्पग्रभुज्या} \times \text{त्रि}}{\text{त्रि} \times \text{शीक}} = \frac{\text{ग्रगो परमशर} \times \text{सपातमन्दस्पग्रभुज्या}}{\text{शीक}}$

= भगोलीयेष्टशर, यह भी भगोलीयेष्टशर ठीक नहीं है क्योंकि पूर्वोक्तकर्णानुपात ठीक नहीं है। सिद्धान्त तत्व विवेक में 'साधित स्फुटग्रह विमण्डल में आते हैं' कमलाकर कहते हैं सो ठीक नहीं है, गणित से साधित स्फुटग्रह क्रान्तिवृत्त ही में आते हैं क्योंकि क्रान्तिवृत्त धरातल से कटित तत्तद् ग्रहगोल के कटित प्रदेश वृत्ताकार (शीघ्र प्रतिवृत्तरूप) तत्तद् ग्रहगोल में होता है उसी(कटित प्रदेश रूप शीघ्र प्रति वृत्त) में फलादि की व्यवस्था हो सकती है। विमण्डल में साधित स्फुट ग्रहों को स्वीकार करने से फलादि की व्यवस्था नहीं हो सकती है क्योंकि प्रत्येक ग्रहगोल में विमण्डल धरातल भिन्न भिन्न है, इसलिये साधित स्फुटग्रह क्रान्ति वृत्तीय ही होते हैं यह प्राचीनों का कथन युक्तियुक्त है, कमलाकर का कथन यहां पर ठीक नहीं है। सूर्यसिद्धान्त में "स्वपातोनाद् ग्रहाज्जीवा, इत्यादि सं० उपपत्ति में लिखित

श्लोक से" आचार्योक्त के अनुरुप ही कहा गया है, मेषादि से पात विलोम चलता है और मन्द स्पष्टग्रह अनुलोम चलते हैं इसलिये दोनों का अन्तर योग करने से होता है लेकिन सूर्य सिद्धान्तकार ने पात को चक्र में से घटा दिया हैं सूर्यसिद्धान्तोक्त विपात मन्दस्पष्टग्रह आचार्योक्त सपात मन्दस्पष्ट ग्रह के बराबर होते हैं, उसी को शर साधन के लिये विक्षेप केन्द्र कहते हैं । सिद्धान्त शेखर में "समकल ग्रह पात समागतात् इत्यादि सं उपपत्ति में लिखित श्लोक से श्रीपति, तथा सिद्धान्त शिरोमणि में भास्कराचार्य भी "मन्दस्फुटाद् खेचरतः स्वपातयुक्तात्, इत्यादि सं· उपपत्ति में लिखित श्लोक से आचार्योक्तानुरूप ही कहते हैं । लेकिन यह भगोलिये ष्टशरानयन किसी का ठीक नहीं है यह पूर्व कथित उपपत्ति से स्फुट है इति ॥१०॥

प्राचीनाचार्यों ने भगोल में विमण्डल को वृत्ताकार मान कर इष्टशरानयन किया है लेकिन भगोल में विमण्डल की आकृति वृत्ताकार होती है या नहीं इस के लिये विचार करते हैं । भूकेन्द्र से ग्रहगोलीय विमण्डलाधारा सूची विषम सूची होती है, उसको भगोल से काटने से जैसा वक्र बनेगा वेसा ही भगोल में विमण्डल होता है । भूकेन्द्र से ग्रहगोलीय विमण्डलाधार विषम सूची में स्थिर त्रिभुज धरातल और विमण्डल धरातल की योगरेखा विमण्डल की व्यास रेखा है । इसके अर्धबिन्दु से कितने अन्तर पर उसके ऊपर लम्बरूपपिणी पूर्णज्या अग्रगत समकर्णद्वयोत्पन्न कोण परम होता है उसका मान=य मानते हैं, ये दोनों कर्ण परमाल्प कर्ण और परमाधिक कर्णों से तुल्यान्तर में होते हैं, अनेक कर्णों से इस तरह की स्थिति बनती है, उन में किन दो कर्णों से उत्पन्न कोण परम होता है इसके लिये बिचार करते हैं ।

संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । इन=अ । तब सूचइ त्रिभुज में "भूसम्मुखास्त्रोद्भवकोटिशिञ्जिनी" इत्यादि से $य^2 + क^2 - २ \text{ इको}\cdot क.य = ग^2$, यहां इको इष्टकोणकोटिज्या, तथा $अ^2 - य^2 =$ तत्स्थानीय पूर्णज्या^{2}, इन दोनों का योग करने से तत्स्थानीयकर्णवर्ग $= क^2 = क^2 + अ^2 - २ \text{ इको}\cdot य\cdot क =$ इष्टकोणज्या, तब अनुपात से $\frac{अ^2 - य^2}{क^2 + अ^2 - २ \text{ इको}\cdot य.क} =$ इकोणज्या^{2} इस का परमत्व तब ही होगा जब उसकी तात्कालिकपति शून्य होगी, इस तरह मानने से $- य\cdot २ताय \ (अ^2 + क^2 - २\text{इको}\cdot य^2\cdot क) + \text{इको}\cdot क\cdot २ ताय \ (अ^2 - के^2) = ०$ यहां चल राशि केवल य है, अपवर्तित करने से

$$- य(अ^2 + क^2) + य^2\cdot\text{इको}\cdot२क - \text{इको}.य^2.क = -\text{इको}.अ^2 = - य \ (अ^2 + क^2)$$
$$+ य^2\cdot\text{इको}\cdot क = \text{इको}\cdot \ क\cdot अ^2$$

$$- \frac{य^2(अ^2 + क^2)}{\text{इको}\cdot क} + य^2 = - अ^2, \text{ वर्ग पूर्ति करने से } - \frac{य(अ^2 + क^2)}{\text{इको}\cdot क} + य^2 +$$

$$\left(\frac{अ^2 + क^2}{२ \text{ इको}\cdot क}\right)^2 = - अ^2 + \left(\frac{अ^2 + क^2}{२\text{इको}\cdot क}\right)^2 \text{ मूलग्रहण से } य - \frac{अ^2 + क^2}{(२\text{इको}\cdot क)^2} =$$

$\sqrt{\frac{(\text{अ}^2 \pm \text{क}^2) - \text{अ}^2\ (\text{२ इको.क})^2}{(\text{२ इको. क}^2)}}$ वर्गान्तर योगान्तर घात के बराबर होता है इसलिए

$\sqrt{\frac{(\text{अ}^2+\text{क}^2 - \text{२ अ. क. इको}).(\text{अ}^2+\text{क}^2+\text{२ इको. अ. क})}{(\text{२ इको. क})^2}}$, $\because$ $\text{अ}^2+\text{क}^2-$

$\text{२ अ. क. इको} = \text{परमाल्पक}^2$, तथा $\text{अ}^2+\text{क}^2+\text{२ अ. क. इको} = \text{परमाधिक}^2$

$\therefore\ \text{य} - \frac{\text{अ}^2+\text{क}^2}{\text{२ इको. क}} = \frac{\text{परमाल्पक. परमाधिक}}{\text{२ इको. क}}$ दोनों पक्षों में तुल्य जोड़ने से

$\text{य} = \frac{\text{अ}^2+\text{क}^2+\text{परमाल्पक. परमाधिक}}{\text{२ इको. क}}$, यतः $\text{अ}^2+\text{क}^2 = \frac{\text{परमाल्पक}^2+\text{परमाधिक}^2}{\text{२}}$, तथा

क=आधारार्धगामिनी रेखा,

अतः $\frac{\text{परमाल्पक}^2+\text{परमाधिक}^2+\text{२ परमाल्पक. परमाधिक.}}{\text{४ इको. क}} = \frac{(\text{परमाल्पक}+\text{परमाधिक})^2}{\text{४ इको. क}}$

=य, इससे पूर्वोक्त सिद्ध हुआ ।

परमाल्पकर्ण और परमाधिक कर्ण से उत्पन्न कोण की अर्ध कारिणी रेखा आधार-वृत्त व्यास में जहां लगती है वह बिन्दु केन्द्र से कितने अन्तर पर होता है इसका उत्तर बहुत सुलभता से होता है इसको विज्ञ लोग स्वयं विचार कर समझें ।

अवशिष्ट के लिये विचार करते हैं ।

$\angle\text{गकघ} = \angle\text{अ}$, $\angle\text{गकच} = \frac{\text{अ}}{\text{२}}$, कच अक्षरेखा गघ आधार में जहां लगती है

उस बिन्दु से उस रेखा के ऊपर लम्बरूप पूर्णज्या जो होती है उसके वर्ग को लाते हैं ।

आधारलग्न कोणद्वय ग, घ हैं, तब अनुपात से $\frac{\text{कच. ज्या}\frac{\text{अ}}{\text{२}}}{\text{ज्याम}}$=गच, तथा ज्याघ कच·ज्या $\frac{\text{अ}}{\text{२}}$

=घच, दोनों का घात करने से $\frac{\text{कच}^2\text{ज्या}^2\frac{\text{अ}}{\text{२}}}{\text{ज्याग· ज्याघ}}$ = चश², यहां (ख) क्षेत्र को देखिये ।

चशक त्रिभुज जात्य है इसलिये क शीर्षकोण स्पर्शरे^{2} $= \dfrac{\text{कच}^2 \cdot \text{ज्या}^2 \frac{\text{अ}}{२}}{\text{कच}^2 \cdot \text{ज्याग} \cdot \text{ज्याघ}} =$

$\dfrac{\text{ज्या}^2 \frac{\text{अ}}{२}}{\text{ज्याग} \cdot \text{ज्याघ}}$, तथा इष्टस्थान में इष्टकर्ण से कोणज्याद्वय को भाग देने से उसके

$\frac{\text{अ}^2}{२} - \text{य}^2$, $\frac{\text{अ}^2}{२} + \text{य}$ इन कोणों से इष्टस्थानीय पूर्णवर्ग $=$ ज्यार्ध

$\dfrac{\text{इक}^2 \cdot \text{ज्या}\left(\frac{\text{अ}}{२} + \text{य}\right) \text{ज्या}\left(\frac{\text{अ}}{२} - \text{य}\right)}{\text{ज्याग} \cdot \text{ज्याघ}}$, यहां ज्या $\left(\frac{\text{अ}}{२} + \text{य}\right)$ ज्या $\left(\frac{\text{अ}}{२} - \text{य}\right) =$ ज्या^{2}

$\frac{\text{अ}}{२}$ $-$ ज्या^{2}य इसलिये इष्टस्थानीय पूर्णज्यार्ध वर्ग $= \dfrac{\left(\text{ज्या}^2 \frac{\text{अ}}{२} - \text{ज्या}^2\text{य}\right) \text{इक}^2}{\text{ज्याग} \cdot \text{ज्याघ}}$, कोण-

स्पर्शरेखा^{2} $= \dfrac{\text{इक}^2 \left(\text{ज्या}^2 \frac{\text{अ}}{२} - \text{ज्या}^2\text{य}\right)}{\text{ज्याग} \cdot \text{ज्याघ} \cdot \text{इक}^2} = \dfrac{\text{ज्या} \frac{\text{अ}}{२} - \text{ज्या}^2\text{य}}{\text{ज्याग} \cdot \text{ज्याघ}}$ $=$ इष्टस्थानीय

कोस्प^2 तथा कोणार्ध कारिणी रेखा स्थानीय कोणस्पर्शरे^{2} $= \dfrac{\text{ज्या}^2 \frac{\text{अ}}{२}}{\text{ज्याग} \cdot \text{ज्याघ}}$ इसकी अपेक्षा

अन्य स्पर्शरेखाओं के वर्गमान न्यून ही होते है, स्पर्श रेखाखण्डों से चाप करने से सब कोण के चाप की अपेक्षा कोणार्धकारिणी रेखा स्थानीय कोणस्पर्श रेखाजनित चाप ही अधिक

होता है। यह आये हुए सर्वाधिक स्पर्शरेखावर्ग $= \frac{\text{अ}}{२}$, स्पर्शरेखा वर्ग से न्यून होता है या

अधिक इसके लिये विचार करते हैं। पूर्वोक्त स्पर्शरेखाद्वय के विषमीकरण करने से

$\dfrac{\text{ज्या}^2 \frac{\text{अ}}{२}}{\text{ज्याग} \cdot \text{ज्याघ}} >< \dfrac{\text{ज्या}^2 \frac{\text{अ}}{२}}{\text{कोज्या}^2 \frac{\text{अ}}{२}}$, कगघ त्रिभुज में $१८० - (\text{ग} + \text{घ}) = \text{अ}$

$\therefore ९० - \dfrac{(\text{ग} + \text{घ})}{२} = \dfrac{\text{अ}}{२}$

$\therefore\ 90 - \frac{अ}{२} = \frac{ग+घ}{२} = को\left(\frac{अ}{२}\right),\ \frac{ग-घ}{२} = प,$ तब संक्रमण गणित से

$को\left(\frac{अ}{२}\right)+प=ग,\ को\left(\frac{अ}{२}\right)-प=घ$

इन दोनों के ज्याघात पूर्व स्थित ज्याग. ज्याघ के बराबर हैं ज्या $\left\{को\left(\frac{अ}{२}-प\right)\right\}$

$\times ज्या\left\{को\left(\frac{अ}{२}+प\right)\right\} = ज्याग.ज्याघ$

पूर्व युक्ति से $कोज्या^2\left(\frac{अ}{२}\right) - ज्या^2 प = ज्याग.\ ज्याघ$

$$\therefore \frac{ज्या^2\frac{अ}{२}}{कोज्या^2\left(\frac{अ}{२}\right)-ज्या^2 प} >< \frac{ज्या^2\frac{अ}{२}}{कोज्या^2\frac{अ}{२}}$$

यहां भाज्यमान बराबर है इसलिये जिसका हर ज्यादा होगा वह फल अल्प होगा फलतः परमाल्पकर्ण और परमाधिक कर्णों से उत्पन्न कोण सर्वाधिक सिद्ध हुआ . इति ॥

परम कोण बिन्दु से दोनों तरफ अवश्य ही परमाल्पकर्ण और परमाधिककर्ण से उत्पन्न कोण के बराबर कोणद्वय होता है, तथा समीकरण से

$$\frac{ज्या^2\frac{अ}{२}-ज्या^2 प}{ज्याग.\ ज्याघ} = \frac{ज्या^2\frac{अ}{२}}{कोज्या^2\frac{अ}{२}} = \frac{ग-घ}{२} = प,\ \frac{ग+घ}{२} = को\frac{अ}{२}$$

$$ज्याग.\ ज्याघ = कोज्या^2\frac{अ}{२} - ज्या^2 प,\ तथा\ \frac{ज्या^2\frac{अ}{२}-ज्या^2 प}{कोज्या^2\frac{अ}{२}-ज्या^2 प}$$

$$= \frac{ज्या^2\frac{अ}{२}}{कोज्या^2\frac{अ}{२}}$$ छेदगम से

$$\text{कोज्या}^2\frac{\text{म}}{2}\left(\text{ज्या}^2\frac{\text{म}}{2}-\text{ज्या}^2\text{य}\right)=\text{ज्या}^2\frac{\text{म}}{2}\left(\text{कोज्या}^2\frac{\text{म}}{2}-\text{ज्या}^2\text{य}\right),\ \text{वा ज्या}^2\text{प. कोज्या}^2\frac{\text{म}}{2}$$

$$=\text{ज्या}^2\text{प. ज्या}^2\frac{\text{म}}{2}$$

$$\text{अतः}\frac{\text{ज्या}^2\frac{\text{म}}{2}.\ \text{ज्या}^2\text{प}}{\text{कोज्या}^2\frac{\text{म}}{2}}=\text{ज्या}^2\text{य},\ \because\ \text{प}=\frac{\text{ग}-\text{घ}}{2},$$

$$\text{अतः}\ \frac{\text{ज्या}^2\frac{\text{म}}{2}.\ \text{ज्या}\left(\frac{\text{ग}-\text{घ}}{2}\right)}{\text{कोज्या}^2\frac{\text{म}}{2}}=\text{ज्या}^2\text{य}$$

मूल लेने से ज्याय मान विदित हो जायगा, तब 'य' के दोनों तरफ आये हुये स्थिराङ्क के बराबर दो मान होगा, तब उसके ऊपर लम्ब, $\frac{\text{म}}{2}$ इसके बराबर होता है।

भगोल विमण्डल वक्र के उपयोगी भिन्न भी सिद्धान्त लिखते हैं।

विषम सूची में सूची शीर्षस्थान से आधार वृत्त धरातल के ऊपर जो लम्ब होता है उसके मूल से आधार वृत्त की अनेक पूर्णज्यायें कर देना, सूची शीर्ष स्थान से प्रत्येक पूर्णज्या के दोनों प्रान्तों में रेखा करने से पूर्णज्या और उसके प्रान्तद्वयगत रेखाओं से जितने त्रिभुज बनते हैं उनमें किस त्रिभुज का शिरःकोण सर्वाधिक होता है इसके लिये विचार करते हैं।

पूर्णज्या के खण्डद्वय प्र, द्वि, परमाधिक कर्ण, परमाल्पकर्ण और पूर्णज्या (आधार वृत्तव्यास) से उत्पन्न त्रिभुज में पूर्णज्या (आधार वृत्तव्यास) के खण्डद्वय $\text{प्र}^{\prime}$ $\text{द्वि}^{\prime}$, है लम्ब और पूर्णज्याग्रगत कर्णों से उत्पन्न कोणद्वय को, $\text{को}^{\prime}$, है । लम्ब और परमाल्पकर्ण तथा परमाधिककर्ण से उत्पन्न कोणद्वय को_1, $\text{को}^{\prime}_1$ हैं,

तब $\frac{\text{प्र}}{\text{लम्ब}}=\text{स्पको}$, $\frac{\text{द्वि}}{\text{लम्ब}}=\text{स्पको}^{\prime}$ तथा $\frac{\text{प्र}^{\prime}}{\text{लम्ब}}=\text{स्पको}_1$, $\frac{\text{द्वि}^{\prime}}{\text{लम्ब}}=\text{स्पको}^{\prime}_1$ तब 'कोदण्ड

पर्च रेखा इत्यादि' सूत्र से $\text{स्प}(\text{को}+\text{को}^{\prime})$=पूर्णज्या प्रान्त द्वय गत कर्णोत्पन्न कोणस्प=

$$\frac{\text{प्र}+\text{द्वि}}{\text{लम्ब}}$$

$$\frac{\text{स्पको}+\text{स्पको}'}{1-\text{स्पको}.\,\text{स्पको}'}=1-\frac{\text{प्र}.\,\text{द्वि}}{\text{लम्ब}^2}$$, तथा लम्ब के साथ परमाल्प कर्ण और

परमाधिक कर्ण से उत्पन्न कोणद्वय के योग

(परमाल्पकर्ण और परमाधिक कर्ण से उत्पन्न कोण) स्पर्श रेखा $=$

$$\frac{\text{स्पको}_1+\text{स्पको}'_1}{1-\text{स्पको}_1\cdot\text{स्पको}'_1}$$

$$\frac{\frac{\text{प्र}'+\text{द्वि}'}{\text{लम्ब}}}{1-\frac{\text{प्र}'.\,\text{द्वि}'}{\text{लम्ब}^2}}$$ परन्तु. $\text{प्र}\times\text{द्वि}=\text{प्र}'\times\text{द्वि}'$...... तथा $\text{प्र}'+\text{द्वि}'>\text{प्र}+\text{द्वि}$.........

क्योंकि $\text{प्र}'+\text{द्वि}'=$ आधारवृत्तव्या

अत: परमाल्पकर्ण तथा परमाधिक कर्ण से उत्पन्न कोण की स्पर्शरेखा प्रत्येक पूर्णज्या प्रान्तद्वयगत कर्णरेखाद्वय से उत्पन्न कोणस्पर्श रेखाओं से अधिक सिद्ध हुई, चाप करने से परमाल्पकर्ण और परमाधिक कर्ण से उत्पन्न कोण सब कोणों की अपेक्षा अधिक सिद्ध हुआ ।

पूर्व लिखित भगोल विमण्डल वक्रोपयोगी सिद्धान्त समूहों को देखने से अधोलिखित विषय सिद्ध होता है। कोणार्ध कारिणी रेखा से दोनों तरफ जो जो समान कोणोत्पादक रेखाद्वय होता है वह आधार में जहां लगता है उन दोनों स्थानो से उसकी योग रेखा के ऊपर जो जो लम्बरूपिणी दो दो पूर्णज्या होती है उनके अग्रगत जो जो दो कर्ण होते हैं उनसे उत्पन्न कोणद्वय बराबर होता है, तथा इन दोनों कोणों के गोल में जो चापात्मक मान होते हैं उनमें तुल्य-तुल्य चापद्वय के विरुद्धाग्रगामिचाप परमाल्पकर्ण और परमाधिक कर्ण से उत्पन्न कोण के चाप से अर्धित होता है। और यह केन्द्रगत भी होता है इससे इस वक्र का अर्धकारक चापद्वयव्यासरूप हुआ, उनमें एक. (परमाल्पकर्ण और परमाधिक कर्ण) इनसे उत्पन्न. और दूसरा उसके ऊपर लम्बरूप परमचाप, इससे यह भी सिद्ध होता है कि इन चापों के सम्पात से दोनों तरफ तुल्यान्तर पर (परमाल्पकर्ण और परमाधिक कर्ण) इससे उत्पन्न चाप के ऊपर लम्बरूप चापद्वय वक्र पाली में जहां लगते हैं वहां से बराबर होते हैं इससे पूर्व लक्षण घटितवक्र 'कूर्मपृष्ठाकृतिवक्र' सिद्ध हुआ. ॥१०॥

अथ युतिकाले ग्रहयोर्दक्षिणोत्तरान्तरमाह

अन्तरयोगौ तुल्यान्यदिशोर्विक्षेपयोर्ग्रहान्तरकम् ।
आर्यभटादिष्वेवं समलिप्तिकयोर्युतिर्ग्रहयोः ॥११॥

सु. भा.—तुल्यान्यदिशोर्विक्षेपयोरन्तरयोगौ दक्षिणोत्तरं ग्रहान्तरकं भवति । एवमार्यभटादिष्वार्यभटादितन्त्रेषु समलिप्तिकयोर्ग्रहयोर्युतिर्युतिसाधनमस्ति । एवं गोलयुक्त्या कदम्बप्रोते युतिरार्यभटाद्यैरानीता सा ऽऽचार्य संमता न । आचार्य संमता युतिः समसूत्रे तदर्थमग्रे वक्ष्यति ॥११॥

वि. भा.—तुल्यान्य दिशोः (समभिन्न दिक्कयोः) विक्षेपयोः (शरयोः) अन्तरयोगौ दक्षिणोत्तरं ग्रहान्तरकं भवति, एवमार्यभटादिषु तन्त्रेषु समलिप्तिकयोः (समकलयोः) ग्रहयोर्युतिः (युतिसाधनं) अस्ति, इयं युतिर्गोलयुक्त्यैकस्मिन् कदम्बप्रोतवृत्ते ग्रहयोरवस्थाने सत्येव सिद्ध्यति. तदस्या युतेरसमीचीनतां स्वसम्मतां समसूत्रयुतिं चाग्रतो वक्ष्यत्याचार्य इति ॥११॥

अत्रोपपत्तिः

भाष्येनैव स्फुटाऽस्तीति सिद्धान्त शेखरे "समदिगन्यदिशोः शरयोः क्रमात् वियुतिरैक्यमिह ध्रुवरान्तरम् । इति युतिः कथिताऽऽर्यभटादिभिः सदृशलिप्तिकयोर्गगनौकसोः" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति ॥११॥

अब युतिकाल में ग्रहद्वय के दक्षिणोत्तरान्तर साधन को कहते हैं ।

हि. भा.:—कलावयव से बराबर दो ग्रहों के एक दिशा के शरों के योग करने से भिन्न दिशा के शरों के अन्तर करने से दक्षिणोत्तर ग्रहान्तर होता है, इस तरह आर्यभटादि आचार्यों के तन्त्रों में युति साधन है, यह युति गोलयुक्ति से एक कदम्ब प्रोतवृत में ग्रहद्वय के रहने ही से सिद्ध होती है, इस युक्ति की असमीचीनता को तथा स्व सम्मत समसूत्र युति को आचार्य आगे कहते हैं इति ॥११॥

इसकी उपपत्ति भाष्य ही से स्फुट है, सिद्धान्तशेखर में "समदिगन्यदिशोः शरयोः क्रमात् इत्यादि" से श्रीपति आचार्योक्तानुरूप ही कहते हैं इति ॥११॥

अथ कदम्ब प्रोतवृत्तीया युतिर्नशोभनेति दृष्टान्त द्वारा निरूपयति

चित्रा स्वातिवदुदये यथा ऽन्यथाऽस्ते तथा युतौ ग्रहयोः ।
न भवति दृग्गणितैक्यं यथा तदैक्यं तदुक्तितरतः ॥१२॥

सु. भा.—यथाद्वयोर्ग्रहयोरुदये उदयलग्ने न्यूनाधिके अपि तयोरस्ते अस्तलग्ने

अन्यथाऽर्थादधिकन्यूने भवतः । परन्तु तयोर्ग्रहयोर्युतिश्चित्रास्वातिवद्भवति चित्रायाः क्रान्तिवृत्ते यत् स्थानं तदेव स्वात्या न तथापि तयोः प्रतिदिनं षडशीत्यङ्गुलसमे खार्कमितव्यासार्धीये शंकौ समप्रोतीया युतिर्भवति । एवं ग्रहयोः क्रान्तिवृत्तीय स्थान वैषम्येऽपि युतिर्भवति सा च कदम्बप्रोतीययुतितो भिन्ने काले आर्यभटादिमतेन ग्रहयोर्युतौ समप्रोतीयायां न दृग्गणितैक्यं भवति । अतो यथा तदैक्यं तयोर्ग्रहयोरैक्यं युतिदृग्गणितैक्यं तथा तदुक्तिस्तद्युतिसाधनोक्तिरुचिता । चित्रास्वात्योर्युत्यर्थं मदीया दिग्मीमांसा विलोक्या ॥१२॥

वि· भा.:—यथा ग्रहयोरुदये (उदयलग्ने) न्यूनाधिके अपि तयोरस्तलग्नं अन्यथा (अधिकन्यूने) भवतः । परं तयोर्ग्रहयोर्युतिश्चित्रास्वातिवद् भवति। क्रान्ति वृत्ते चित्राया यत्स्थानं तदेव स्वात्या नास्ति, तयोर्दक्षिणोत्तरान्तरमेकोनचत्वारिंश ३९ दंशाः, तयोः प्रत्यहं षड्शो ८६ त्यंङ्गुलसमे खार्क १२० मितव्यासार्धिये शङ्कौ समप्रोतीया युतिर्भवति, एवमेव ग्रहयोः क्रान्तिवृत्तीयस्थानवैषम्येऽपि युतिर्भवति सा च कदम्वप्रोतीययुतितो भिन्ने काले, अत आर्यभटादिमतेन ग्रहयोर्युतौ समप्रोतीयायां दृग्गणितैक्यं न भवति, अतोऽस्मात्कारणात् यथा तदैक्यं (तयोर्ग्रह योर्युतिविषये दृग्गणितैक्यं) तथा तदुक्तिर (तद्युतिसाधनोक्ति रुचिता) स्तीति ॥१२॥

अब कदम्ब प्रोतवृत्तीय युति ठीक नहीं है इसको दृष्टान्त द्वारा दिखाते हैं ।

हि. भा.—जैसे दो ग्रहों के उदयलग्न न्यूनाधिक रहने पर भी उनके अस्तलग्न विपरीत (अधिक न्यून) होते हैं, लेकिन उन दोनों ग्रहों की युति चित्रा नक्षत्र और स्वाती नक्षत्र की युति की तरह होती है, क्रान्तिवृत्त में चित्रा नक्षत्र का जो स्थान है वही स्वाती का भी नहीं है, उन दोनों के दक्षिणोत्तरान्तर ३९ अंश है, दोनों के प्रतिदिन छयासी ८६ अंगुल तुल्य, एक सौ बीस १२० व्यासार्धीय (त्रिज्या) शकु में समप्रोतवृत्तीय युति होती है इसी तरह दोनों ग्रहों के क्रान्तिवृत्तीय स्थान के वैषम्य (भिन्नता) में भी युति होती है वह कदम्ब प्रोतवृत्तीय युति से भिन्न समय में होती है, इसलिए आर्य भट आदि आचार्यों के मत से दो ग्रहों की समप्रोतवृत्तीय युति में दृग्गणितैक्य नहीं होता है, इस कारण से जैसे दोनों ग्रहों के युति विषय में दृग्गणितैक्य होता है वैसे उनके युति साधन उचित है इति ॥१२॥

अथ समप्रोतीययुतिमाह ।

ग्रहयोः स्वोदयलग्ने समलिप्तिकयोस्तथस्तलग्ने च ।
उदयैः स्वोदयलग्ने सषड्ग्रहस्वास्तलग्नसमे ॥१३॥

कृत्वैवं दिनघटिका ग्रहयोः स्वोदयविलग्नयोरूनम् ।
ऊनं चास्तविलग्नादेष्या त्वधिके युतिरतोता ॥१४॥

ऋणमूनं धनमधिकं स्वोदयलग्नात् स्वमस्तलग्नं चेत् ।
भक्तास्तदन्तरकला: पृथक् पृथक् स्वदिन नाडीभि: ।।१५।।
ऋणयोर्वा धनयोर्वाऽन्तरेण युत्या धनर्णयोर्भक्ता: ।
अन्तरलिप्ता: स्वोदयविलग्नयोर्लब्धघटिकाभि: ।।१६।।
उदयास्त विलग्नान्तरकला गुणा: स्वदिननाडिका भक्ता: ।
लब्धकलाधिकमूनं स्वास्तविलग्नादुदयलग्नम् ।।१७।।
यद्यधिकमूनमेवं समलिप्तौ स्वोदयाद्युतौ ग्रहयो: ।
रात्रिविलग्नादूनावधिकौ षड्ग्रहयुताद् दृश्यौ ।।१८।।

सु.भा.—एकस्मिन् कदम्बप्रोते यदा युतिर्जाता तदा तात्कालिकौ ग्रहौ समलिप्तिकौ भवत: क्रान्तिवृत्ते स्थानैक्यात् । अथ तयो: समलिप्तिकयोर्ग्रहयोरुदयास्ताधिकारविधिना तदा स्वोदयलग्ने तदस्तलग्ने च कार्ये । तत उदयै: स्वदेशराश्युदयै: स्वोदयलग्ने सषड्ग्रहस्वास्तविलग्नसमे कृत्वाऽर्थात् स्वोदयै: स्वोदयलग्नस्य भोग्यकालं सषड्भग्रहास्तलग्नस्य भुक्तकालं मध्योदयाँश्चैकीकृत्यैवं ग्रहयोर्दिनघटिका: स्वस्वदिनमानघटिका: साध्या: । यदि द्वयोर्ग्रहयोरुदयलग्नयोर्मध्ये यदूनं तदन्यग्रहस्यास्तलग्नात् सषड्भादप्यूनं तदा युतिरेष्या वाच्या । चेदूनमुदयलग्नमन्यग्रहास्तलग्नात् सषड्भादधिकं तदा युतिरतीता गता वाच्या ।

एवं गतागतं समागमं परिज्ञाय समप्रोतीययुतिज्ञानार्थं संस्कारार्थं धनर्णत्वमाह । ऋणमूनं धनमधिकमिति । यदि स्वमस्तलग्नं सषड्भस्वास्तलग्नं स्वोदयलग्नादूनं भवति तदा वक्ष्यमाण संस्कारफलमृणं यद्यधिकं तदा धनं ज्ञेयमिति भक्तास्तदन्तरकला इति । स्वोदयलग्नसषड्भास्तलग्नयोरन्तरकला: पृथक् पृथक् स्वदिनमानघटिकाभिराप्ता: । द्वे फले प्राक् प्रतिपादितधनर्णाङ्किते पृथक् स्थाप्ये । अथ फलाभ्यां संस्कारानयनमृणयोर्वा धनयोर्वेति । यदि द्वे फले धने वा ऋणे तदा तयोरन्तरं कार्यं । यदि एकं धनमन्यदृणं तदा तयोर्युति: कार्या । एवमेतेनान्तरेण युत्या वा ग्रहोदयलग्नयोरन्तरकला विभक्ता लब्धं घटिकादिकं ग्राह्यम् । एतावद्भिर्लब्ध घटिकाभिर्दृग्युतिरेष्या वा गता भवतीति ज्ञेयम् । अथोदयास्तविलग्नान्तरकला: स्वोदयलग्नसषड्भास्तलग्नान्तरकला लब्धघटिकाभिर्गुणा: स्वदिनमानघटिकाभिर्भक्ता: फलकलाभिरधिकं स्वोदयलग्नं कार्यं यदि सषड्भास्तलग्नादूनं यद्यधिकं तदोनं कार्यम् । एव स्वोदयात् स्वस्वोदयलग्नाद्ग्रहयोर्युतौ समप्रोतीयायां युतौ ग्रहौ समलिप्तौ भवत: । तौ च रात्रिविलग्नाद्रात्र्याविष्टलग्नादूनौ सषड्ग्रहादिष्टलग्नाच्चाधिकौ तदा दृश्यौ भवत इति चतुर्वेदाचार्यसंमता व्याख्या ।

अत्रोपपत्ति:

ग्रहबिंबं यदा प्राक् क्षितिजस्थंतदा क्रान्तिवृत्तस्य य: प्रदेश: क्षितिजलग्न-

स्तदुदयलग्नमतस्तात्कालिकग्रहस्थानशरादिनोदयलग्नसिद्धिर्गोलयुक्त्या भवति। इहाचार्येण कदम्बप्रोतीययुतिकालिकमेव स्थानशरादिकं स्वल्पांतरांद्ग्रहबिम्बोदयकालिकमंगीकृत्योदयलग्नं साधितम्। तथा तदेव शरादिकं पश्चिमक्षितिजस्थे ग्रहबिम्बेऽपि प्रकल्प्य पश्चिमक्षितिजस्थे ग्रहबिम्बे क्रान्तिवृत्तस्य यः प्रदेशः पश्चिमक्षितिजलग्नस्तदस्तलग्नं साधितं तत् षड्भयुतं ग्रहबिम्बास्तकाले प्राक्क्षितिजे लग्नमितिस्फुटम्। ऊदयलग्ने ग्रहबिम्बोदयः सषड्भास्तलग्ने चास्तः। अतस्तदन्तरे स्वोदयै 'ऊनस्य भाग्योऽधिकभुक्तयुक्तो मध्योदयाढ्यैः' रित्यनेनया घटिकास्ता ग्रहदिनमानघटिकाः। तावत्कालपर्यंतं ग्रहबिम्बं क्षितिजोपरि भ्रमतीति ग्रहदिनमानसंज्ञा समुचितैव। अथ यस्य ग्रहबिम्बस्य प्रथममुदयः पश्चादस्तमयस्तेन सहान्यग्रहयोगः क्षितिजादुपरि भविष्यति यतोऽन्यग्रहः प्रथममुल्लङ्घ्यादावेवास्तमेष्यत्यतस्तदा युतिरेष्याऽन्यथा गतेति युक्तितः सिध्यति।

उदयलग्नं ग्रहबिम्बोदयेऽस्तलग्नं सषड्भं लग्नं च ग्रहास्तकालेऽतो ग्रहदिनमानघटिकासु उदयलग्नस्य चलनमुदयलग्नसषड्भास्तलग्नान्तरसमम्। तदन्तरं यथाऽल्पं भवति तथा सषड्भास्तलग्नस्य न्यूनाधिकत्वं कल्प्यम् अर्थात् सषड्भास्तोदयलग्नयोरेकस्मादन्यस्य विशोधनेन यत्राल्पावशेषस्तस्यैवान्यस्य न्यूनत्वमिति युक्तितः सिद्धम्। यथा यदि सषड्भास्तलग्नं तुलान्तम् = ७। उदयलग्नम् = २ वृषान्तम्। तदा ७—२ = ५। २—७ = ७। अत उदयलग्नमूनं सषड्भास्तलग्नं चाधिकमिति ज्ञेयम्। एवं यत्र सषड्भास्त लग्नम् = १। उदयलग्नम् = २। तत्र-१—२ = ११। २—११। अतोऽत्र सषड्भास्तलग्नमूनं ज्ञेयम्। अथ ग्रहदिनमानघटिकाभिर्यदि तदुदयलग्नस्य गतिरुदयसषड्भास्तलग्नान्तरसमं तदैकया घट्या किम्। जातैकरूपवेगे नैकघटिकायां स्वस्वोदयलग्नगतिः। यदि उदयलग्नगत्योरन्तरेणैका घटिका तदा स्वोदयलग्नयोरन्तरेण किंलब्धाः समप्रोतीययुतिकाले गता एष्या वा घटिकास्ताभिर्युतिकाले स्वोदयलग्नस्य यावच्चलनं तत्संस्कारेण समप्रोतीयौ समलिप्तिकौ ग्रहौ भवत एव। एवमुदयलग्नस्य समानवेगेन चलनमंगीकृत्यानुपातेन युतिकालः स्थूलोऽयनाक्षजदृक्कर्मणोः प्रतिक्षणं वैलक्षण्यादुदयलग्नगतेरसमानवेगत्वादिति स्फुटं सिद्धान्तविद्भिः। विजातीययोरुदयलग्नगत्योरन्तरं तद्योगसमं भवतीति धनर्णवासना सर्वा स्फुटा। भास्करेण ग्रहयोर्ध्रुवसूत्रे युतिरानीता सा च 'चित्रास्वातिव' दिति प्रतिपादयताऽऽचार्येण नांगीकृता। यतो नहि चित्र स्वात्योर्ध्रुवप्रोतीयस्यानैक्यमस्ति। अतस्तयोर्ध्रुवप्रोतीययुतेरसम्भव एव। रात्राविष्टलग्नादूनः सषड्भेष्टलग्नाद्योऽधिकः स क्षितिजोपरिगतत्वाद् दृश्यो भवति। एवं ग्रहस्य स्वल्पे शरे क्रान्तिवृत्तीयस्थानासन्न एवोदयलग्नेऽन्यथा स्वेष्ट लग्नाद्यस्योदयलग्नमल्पमस्तलग्नं चाधिकं स एव दृश्य इति युक्तियुक्तं ग्राह्यमिति ॥१३-१८॥

वि. भा.—समलिप्तिकयोः (समकलयोः) ग्रहयोः (एकस्मिन् कदम्ब प्रोत-

वृत्ते यदा युतिर्भवति तदा तात्कालिकग्रहौ समलिप्तिकौ भवतस्तयोः क्रान्तिवृत्त-स्थानाभिन्नत्वात्) स्वोदयलग्ने तदस्तलग्ने चोदयास्ताधिकारोक्तविधिना साध्ये, तत उदयैः (स्वदेशराश्युदयैः) स्वोदयलग्ने सषड्ग्रहस्वास्तलग्नसमे कृत्वा, अय-मर्थः—स्वोदयलग्नस्य भोग्यकालं सषड्ग्रहास्त लग्नस्य भुक्तकालं मध्योदयांश्च सङ्क-लय्य ग्रहयोर्दिनघटिका (स्वस्व दिनमान घटिकाः) भवन्ति । एतेन समकलयोर्ग्रह-योर्दिमानसाधनमुक्तमाचार्येण । स्वोदयविलग्नयो (समलिप्तिक ग्रहयोरुदयाख्य-लग्नयोः) मध्ये यत् ऊनं (राश्यादिनाऽल्पं) तदन्यग्रहस्य सषड्भादस्तलग्ना-दप्यूनं भवेत्तदा युतिरेष्या (भाविनी) कथनीया, अधिके (उदयलग्नेऽन्यग्रहस्य-सषड्भास्तलग्नादधिके) युतिरतीता (विगता) कथनीयेत्येतावता युतेर्गतैष्यत्वं प्रति पादितम् ।।१४।। यदि स्वमस्तलग्नं (पारिभाषिकं स्वकीयमस्तलग्नं) स्वोदयलग्ना-दूनं (अल्पं) तदा वक्ष्यमाणसंस्कारफलमृणं भवति, यदधिकं तदा संस्कारफलं धनं भवति, तदन्तरकला (स्वोदयलग्नस्वास्तलग्नयोरन्तरकलाः) स्वदिननाडीभिः (पूर्वसाधितस्वस्वदिनमानघटिकाभिः) पृथक् पृथक् भक्ताः फलद्वयं प्रतिपादित-लक्षणानुसारेण धनर्णचिन्हितं स्थापनीयमेतेन समप्रोतीययुतेर्गतैष्यत्वे ज्ञाते तद्युति-समयज्ञानार्थमृणधनसंस्कारः कथित इति ।।१५।। ऋणयोर्वाऽन्तरेण (लब्धयोः फलयो ऋणत्वे धनत्वे वाऽन्तरेण) धनर्णयोः (तयोः फलयोर्मध्ये यद्येकं धनमन्यच्च ऋणाख्यं) तदा लब्धफलयोर्युत्या (योगेन) स्वोदयविलग्नयोरन्तरकला भक्ता लब्धघटिकाभिर्द्युतिरेष्या गता वा भवतीति ।।१६।। उदयास्तविलग्नान्तरकलाः (स्वोदयलग्न सषड्भास्तलग्नान्तर कलाः) पूर्वलब्धघटिकाभिर्गुणाः स्वदिननाड़िका भक्ताः (स्वस्वदिनमानघटिकाभिर्भाज्यः) फलकलाभिः स्वोदयलग्नमधिकं कार्यं यदि सषड्भास्तलग्नादुदयलग्नमूनं भवेत्, यदधिकं तदोनं कार्यम् । अयमर्थः—यदि ग्रहोदयलग्नं ग्रहास्तलग्नादधिकं तदा लब्धकलाभिर्युतं यदोनं तदा लब्धकला-भिः ऋणं कार्यमिति, तदा स्वोदयात् (स्वस्वोदयलग्नात्) ग्रहयोर्युतौ (समप्रोती-यायां युतौ) समलिप्तौ (समकालौ) ग्रहौ भवतः । यदि तौ ग्रहौ रात्रिविलग्नात् ऊनौ (न्यूनौ) षड्गृहयुतादिष्ट लग्नादधिकौ भवतस्तदा दृश्यौ (दर्शन योग्यौ) भवेतामिति ।।१६-१७-१८।।

अथैषामुपपत्तयः

पूर्वक्षितिजस्थं यदा ग्रहबिम्बं भवेत्तत्र क्षितिजे क्रान्तिवृत्तस्य यः प्रदेशो लग्नस्तदेव तदुदयलग्नम् । तज्ज्ञानं तात्कालिकग्रहस्थानशरादिना भवति । आचार्येण कदम्बप्रोतीययुतिकालिकमेव स्थानशरादिकं स्वल्पान्तराद् ग्रह-बिम्बोदयकालिकं स्वीकृत्योदयलग्नं साधितम् । तथा पश्चिमक्षितिजस्थेऽपि ग्रहबिम्बे तदेव शरादिकं प्रकल्प्य ग्रहबिम्बे पश्चिमक्षितिजस्थे पश्चिमक्षितिजे क्रान्तिवृत्तस्य यच्चिह्नं लग्नं तदस्तलग्नं साधितं तत् षड्भयुतं ग्रहबिम्बास्तकाले

पूर्व क्षितिजे लग्नं भवति । उदयलग्ने ग्रहविम्बोदयः, सषड्भास्तलग्ने चास्तः । तदन्तरे स्वोदयै "ऊनस्य भोग्योऽधिकभुक्तयुक्तोमध्योदयाढ्यः" रित्यनेनया घटिकास्ता ग्रहदिनमानघटिकाः । तावत्कालपर्यन्तं क्षितिजोपरि ग्रहबिम्बं भ्रमतीति ग्रहदिनमानसंज्ञा समुचितैव, सिद्धान्तशेखरे "दृक्कर्मणो सदृशलिप्तिकयो विधाय साध्ये पृथक् खलु तयोरुदयास्तलग्ने । आद्यं सषड्ग्रहनिजास्तविलग्न तुल्यं कृत्वोदयैर्निजदिने ग्रहयोः प्रसाध्ये" श्रीपत्युक्तमिदं समप्रोतीययुतिशोधनार्थं समकलयोर्ग्रहयोर्दिनमानसाधनमप्युपपन्नम् ।

अथ यस्योदयलग्नमूनं स ग्रहः प्रथममुदेति, यस्याधिकं सोऽनन्तरमिति, तथा यस्यास्तलग्नमूनं स प्रथममस्तमेति, यस्य चाधिकं सोऽनन्तरमिति, यस्य ग्रहबिम्बस्य द्वितीयग्रहबिम्बापेक्षया प्रथममुदयः प्रथममेवास्तमयश्च तस्याग्रत एव योगसम्भावना । यस्य च प्रथममुदयोऽन्यग्रहस्यानन्तरं चास्तमयः स च युक्तो भूत्वाऽग्रतोगत इति विगतो योगः, सिद्धान्तशेखरे "ग्रहयोदरुदयाख्यलग्नयोरूनं यच्च निजास्तलग्नकम् । ऊनं युतिरेष्यती तदा विगता चाभ्यधिके प्रकीर्त्तिता" श्रीपतिनाप्यनेनाचार्योक्तयुतेर्गतैष्यत्वप्रतिपादनसरणिरेव स्वीकृतेति ।

उदयलग्नं ग्रहविम्बोदयेऽस्तलग्नंच ग्रहास्तकालेऽतो ग्रहदिनमानघटिकासु उदयलग्नस्य चलनमुदयलग्नास्तलग्नान्तरसमम् । तदन्तरं यथाऽस्य भवति तथा ऽस्तलग्नस्य न्यूनाधिक्यं कल्पनीयम् । अर्थादस्तोदयलग्नयो रेकतोऽन्यस्य विशोधनेन यत्राल्पशेषस्तत्रै वान्यस्याल्पत्वमिति । यथा यद्यस्तलग्नं तुलान्तम्=७, उदयलग्नम् २ वृषान्तम्, ७−२=५, २−७=७ तेनोदय लग्नमल्पमस्तलग्नं चाधिकमितिबोध्यम् । ततो यदि ग्रहदिनमानघटिकाभिस्तदुदयलग्नस्य गतिरुदयास्तलग्नान्तरसमा लभ्यते तदैकया घट्या किमिति समागच्छत्येकरूपवेगेनैकघट्यां स्वस्वोदयलग्नगतिः । यद्युदयलग्नगत्योरन्तरेणैकघटी लभ्यते तदा स्वोदय लग्नयोरन्तरेण किं समागच्छन्ति समप्रोतीययुतिकाले गता एष्या वा घट्यस्ताभिर्युतिकाले स्वोदयलग्नस्य यावच्चलनं तावत्संस्कारेण समप्रोतीयौ समलिप्तिकौ ग्रहौ भवत एव । एवमुदयलग्नस्य समानवेगेन चलन स्वीकृत्यानुपातेन स्थूलो युतिकालो भवेत् । आयनाक्षदृक्कर्मणोः प्रतिक्षणं वैलक्षण्यादुदयलग्नगतेरसमानवेगत्वादिति विजातीययोरुदयलग्नगत्योरन्तरं तद्योगसमं भवतीति धनर्णयोरन्तरमेव योग इत्यनेनैव स्फुटम् रात्राविष्टलग्नादूनः सषड्भेष्टलग्नाद्योऽधिकः सक्षितिजोपरिगनत्वाद् दृश्यो भवति । एवं ग्रहस्याऽल्पेशरे क्रान्तिवृत्तीयस्थानासन्न एवोदयलग्नेऽन्यथा स्वेष्टलग्नाद्यस्योदय लग्नमल्पमस्तलग्नं चाधिकं स एव दृश्य इति युक्तियुक्तं ग्राह्यम् । सिद्धान्तशेखरे "स्वमस्तलग्नं ह्युदयाख्य लग्नाद्दणाख्यमूनं धनम यथा स्यात् । तदन्तरोत्थाः कलिका विभक्ताः पृथक् पृथक् स्वस्वदिनेन लब्धम् ।" सामनजात्योर्विवरेण भाजिता योगेन वृद्धिक्षयसंज्ञयोस्तयोः ।

विश्लेषलिप्ता उदयास्तलग्नयोः प्रजायते तद्घटिकादिकं फलम् ।
तन्निघ्ना उदयास्तलग्नविवरोद्भूताः कला भाजिताः ॥
स्वस्त्राभिर्घटिकाभिराप्तकलिका संयुक्तमाद्याह्वयम् ।

हीनं वाऽस्त विलग्नतोऽधिकमथो हीनं तदेव ग्रहः ।
स्यादेवं समलिप्तिकौ खलु युतौ व्योमौकसः स्वोदयात् ॥

तौ रात्रि लग्नाद्भवतो विहीनौ षड्भाधिकाच्चेदधिकौ तदानीम् ।
दृश्यौ भवेतां स्फुटमन्यथा तु समुद्गतावप्यनवेक्षणीयौ ॥"

इति समप्रोतीययुतेर्गतैष्यत्वेऽवगते तद्युतिसमयज्ञानार्थमृणधनसंस्कार प्रकारः श्रीपत्युक्त आचार्योक्तप्रकारानुरूप एवेति ॥१३-१४-१५-१६-१७-१८ ॥

अब सम प्रोतीय युति को कहते हैं।

हि. भा.—समलिप्तिक (समान कला वाले) दो ग्रहों (एक कदम्ब प्रोतवृत्त में जब युति होती है तब तात्कालिक दोनों ग्रह समलिप्तिक होते हैं क्योंकि क्रान्तिवृत्त में दोनों के स्थान एक ही हैं) का स्वोदयलग्न और अस्तलग्न उदयास्ताधिकारोक्त विधि से साधन करना चाहिए, उसके बाद स्वदेशीय राश्युदय से स्वोदयलग्न और छः राशियुत ग्रह के स्वास्त लग्न को जोड़ कर अर्थात् स्वोदय लग्न के भोग्यकाल, छः राशियुत ग्रह के अस्तलग्न के भुक्तकाल और मध्योदय (स्वोदय लग्न और छः राशियुत ग्रह के अस्तलग्न के मध्य में वर्तमान राशियों के उदयमान) के जोड़ने से दोनों ग्रहों की दिनमान घटी होती है, इससे समकलात्मक दो ग्रहों के दिनमान साधन आचार्य ने कहे हैं, समलिप्तिक दो ग्रहों के उदय लग्नों में जो राश्यादि से अल्प है वह यदि अन्यग्रह के छ राशियुत अस्तलग्न से भी अल्प हो तो युति एष्य कहनी चाहिए, उदयलग्न अन्यग्रह के छ राशियुत अस्तलग्न से अधिक हो तो युतिगत कहनी चाहिए इससे आचार्य ने युति के गतैष्यत्व को (कब युति गत होती हैं और कब एष्य होती है) कहा है ॥१४॥

यदि पारिभाषिक अस्तलग्न स्वोदय लग्न से अल्प हो तो वक्ष्यमाण (आगे कहे जाने वाला) संस्कार फल ऋण होता है, यदि अधिक हो तो संस्कार फल धन होता है, स्वोदय-लग्न और स्वास्तलग्न की अन्तर कला को पूर्व साधित स्वरूप दिनमान घटी से पृथक्-पृथक् भाग देने से जो दो फल (लब्धि) होते हैं उन्हें कहे हुए लक्षण के अनुसार धन और ऋण समझना, इससे सम प्रोतीय युति के गतैष्यत्व विदित होने से युति समय ज्ञान के लिए ऋण-धन संस्कार आचार्य ने कहे हैं ॥१५॥

पूर्वोक्त दोनों फलों के ऋण वा धन रहने से दोनों के अन्तर से स्वोदय लग्न की अन्तर कला को भाग देने से जो लब्ध घटी हो उससे दृग्युति गत वा एष्य होती है। यदि

पूर्वोक्त दोनों फलों में एक धन हो और दूसरा ऋण हो तो दोनों फलों के योग से स्वोदय कलान्तर कला को भाग देने से जो लब्ध घटी हो उससे दृग्युति गत वा एष्य होती है ॥१६॥

स्वोदय लग्न और छ राशियुत अस्तलग्न की अन्तर कला को पूर्वलब्ध घटी से गुणा कर अपनी-अपनी दिनमान घटी से भाग देने से जो फलकला आती है उसको स्वोदयलग्न में जोड़ देना यदि उदयलग्न छ राशियुत अस्तलग्न से अल्प हो तब, अधिक हो तो फलकला को स्वोदयलग्न में ऊन करना तब समप्रोतीय युति में समलिप्तिक ग्रहोदय होते हैं। यदि वे दोनों ग्रह रात्रि में इष्टलग्न से न्यून हो, छ राशियुत इष्टलग्न से अधिक हो तो वे दर्शन योग्य होते हैं इति ॥१७-१८॥

उपपत्ति

पूर्व क्षितिज में जब ग्रह बिम्ब रहता है तब क्षितिजवृत्त में क्रान्तिवृत्त का जो प्रदेश लगा रहता हैं वही उदय लग्न है तात्कालिक ग्रह स्थान-शर आदि के द्वारा उसका (उदय-लग्न) ज्ञान होता है, आचार्य ने कदम्ब प्रोतीय युति कालिक ही स्थान-शर आदि को स्वल्पान्तर से ग्रह बिम्बोदय कालिक स्वीकार कर उदयलग्न का साधन किया हैं, और पश्चिम क्षितिज में ग्रह बिम्ब के रहने पर भी उन्हीं शरादि को लेकर अस्त लग्न (पश्चिम क्षितिज में ग्रह बिम्ब के रहने से पश्चिम क्षितिज में क्रान्तिवृत्त का जो प्रदेश लगा रहता है) का साधन किया हैं, उसमें छः राशि जोड़ने से ग्रह बिम्बास्त काल में पूर्व क्षितिज में लग्न होता है, उदय लग्न में ग्रह-बिम्ब का उदय होता है, छः राशि युत अस्तलग्न में अस्त होता है, उन दोनों के अन्तर में स्वदेशोदय से "ऊनस्य भोग्योऽधिकभुक्तयुक्तो मध्योदयाढ्यः" इससे, जो घटिकायें होती हैं वे ग्रहदिनमान घटिका होती हैं, उतने काल तक क्षिति के ऊपर ग्रह बिम्ब भ्रमण करता है इसलिए ग्रह दिनमान नाम रखना ठीक ही हैं। 'सिद्धान्त शेखर में "दृक्कर्मणी सङ्कलितैककृत्वो-विधाय साध्ये पृथक् खलु तयोरुदयास्तलग्ने" इत्यादि सं० उपपत्ति में लिखित श्री पति श्लोक भी उपपन्न होता है. जिसका उदयलग्न ऊन रहता है वह ग्रह पहले अस्त होता है। जिसका उदय लग्न अधिक रहता है वह पीछे उदित होता है। तथा जिसका अस्तलग्न ऊन रहता है वह ग्रह पहले अस्त होता है। जिसका अधिक रहता है वह पीछे अस्त होता है। जिस ग्रहबिम्ब का द्वितीय ग्रहबिम्ब की अपेक्षा पहले उदय होता है और पहले ही अस्त होता है उसके आगे योग की सम्भावना होती है, जिस ग्रह का उदय अन्य ग्रह से पहले होता है और अस्त पीछे होता है वह ग्रह योग कर आगे चले जाते हैं इसलिए योग गत होता है, सिद्धान्त-शेखर में "ग्रहयोरुदयाख्यलग्नयोरूनं यच्च निजास्त लग्नकम्" इत्यादि सं० उपपत्ति में लिखित श्लोक से श्रीपति ने भी आचार्योक्त युति के गतैष्यत्व-प्रतिपादन के अनुरूप ही प्रतिपादन किया है।

ग्रहबिम्बोदय काल में उदयलग्न और ग्रहबिम्बास्त काल में अस्त लग्न है इसलिए ग्रह की दिनमान घटी में उदय लग्न का चलन उदयलग्न और अस्तलग्न के अन्तर के बराबर होता है। उसके बाद जैसे अल्प होता है वैसे अस्त लग्न का न्यूनाधिक्य मानना अर्थात् उदयलग्न और अस्तलग्न के मध्य में एक में से दूसरे को घटाने से जहां अल्प शेष रहे वहीं दूसरे की अल्पता होती है। जैसे यदि अस्त लग्न तुलान्त=७ है, उदयलग्न=वृषान्त, तो ७—२=५, २—७=७ इसलिए उदयलग्न को अल्प और अस्तलग्न को अधिक समझना चाहिए। अब अनुपात करते हैं यदि ग्रहदिनमान घटी में उसके उदय लग्न की गति (उदयलग्न और अस्त लग्न के अन्तर तुल्य) पाते हैं तब एक घटी में क्या इससे एक रूप वेग से एक घटी में स्वस्व उदयलग्न गति आती है, अब पुनः अनुपात करते हैं यदि दोनों उदयलग्न गति के अन्तर में एक घटी पाते हैं तो स्वस्व उदयलग्न के अन्तर में क्या इससे समप्रोतीय युतिकाल में गत घटी वा एष्य घटी आती है। उन घटियों में युतिकाल में स्वोदय लग्न का जितना चलन होता है ग्रहद्वय में उसके संस्कार करने से सम प्रोतीय समलिप्तिक ग्रहद्वय होते हैं। इस तरह उदयलग्न के चलन समान वेग में स्वीकार कर अनुपात से स्थूल युतिकाल होता है। आयनदृक्कर्म और आक्षदृक्कर्म के प्रतिक्षण में विलक्षण होने के कारण उदयलग्न गति के अतुल्यवेगत्व से विजातीय उदयलग्न गति का अन्तर उसके योग के बराबर होता है 'धनर्णयोगयोरन्तरमेव योगः' इससे स्पष्ट है। रात्रि में इष्ट लग्न से अल्प और छः राशि युत इष्ट लग्न से जो अधिक होता है वह क्षितिज के ऊपर होने के कारण दृश्य होता है, ग्रह के अल्प शर रहने तथा क्रान्तिवृत्तीय स्थान के आसन्न में उदयलग्न के रहने से ऐसा होता है, नहीं तो स्वेष्टलग्न से जिसका उदयलग्न अल्प होता है और अस्तलग्न अधिक होता है वही दृश्य होता है। (सिद्धान्तशेखर में)।

"स्वयमस्तलग्नं ह्युदयाख्य लग्नाद्दूणाख्यमूनं धनमन्यथा स्यात्" यहां से लेकर "दृश्यौ भवेतां स्फुटमन्यथा तु. समुद्गतावप्यनवेक्षणीयौ" यहाँ तक सं० उपपत्ति में लिखित श्लोकों से श्रीपति ने समप्रोतीय युति के गतैष्यत्व जानकर उसके युति समय ज्ञानार्थ ऋण-धन संस्कार के लिए आचार्योक्त प्रकार के अनुरूप ही कहा है इति ॥१३-१४-१५-१६-१७-१८॥

इदानीं ग्रहयुतौ विशेषमाह.

एवं मानैक्यार्धादधिके मध्यान्तरे न युतिर्ग्रहयोः।
स्थित्यर्धविमर्ददले हीने ताराग्रहोडुयुतौ ॥ १९ ॥

लम्बनमर्क ग्रहणवदसकृत् स्वावनतिलिप्तिकास्पष्टौ।
तात्कालिकविक्षेपौ तदन्तरैक्यं समान्यदिशोः ॥ २० ॥

विक्षेपो मध्यान्तर मूर्ध्वस्य च्छादको ग्रहोऽधस्थः।
मानैक्यार्धादधिके नातिस्पष्टा स्फुटोक्तिरतः ॥२१॥

सु. भा.—एवं मध्यान्तरे ग्रहयोः केन्द्रान्तरे मानैक्यार्धादधिके ग्रहयोर्युतिर्ज्ञेया । मानैक्यार्धाद्धीने मध्यान्तरे च कदम्बप्रोतीययुतिकालमेव गर्भीयदर्शान्तं प्रकल्प्य सूर्यग्रहणवत् स्थित्यर्धविमर्ददले साध्ये । एवं ताराग्रहोडुयुतौ ताराख्पौ यो ग्रहो भौमस्तस्योडोर्नक्षत्रस्य च या युतिस्तस्यामपि क्रिया भवतीति प्रसिद्धम् ।

कदम्बप्रोतीययुतिकाले सूर्यग्रहणवदसकृल्लम्बनं प्रसाध्यम् । ग्रहयोः स्वावनतिलिप्तिकाभिः स्पष्टौ तात्कालिकौ विक्षेपौ च कृत्वा तयोः समान्यदिशोरन्तरैक्यं स्पष्टो विक्षेप एव मध्यान्तरं केन्द्रान्तरं कल्प्यम् । अत्रोर्ध्वस्थस्य ग्रहस्याधः स्थो ग्रहश्छादकः कल्प्यः । एवं सूर्यग्रहणवत् सर्वं प्रकल्प्य स्फुटस्थित्यर्धविमर्ददले साध्ये । इदानीं पूर्वसाधितसमप्रोतीययुतौ विशेषमाह । मानैक्यार्धादधिके इति । केन्द्रान्तरे मानैक्यार्धादधिके पूर्वसाधिता समप्रोतीया युतिर्नातिस्पष्टा भवति अर्थात् स्थूला भवति । अतः स्फुटोक्तिः स्फुटयुतिसाधनस्योक्तिरुचिता ।

अत्रोपपत्तिः । "मानैक्यार्धाद् द्युचरविवरेऽल्पे भवेद्भेदयोग" इत्यादि भास्करोक्तेन स्फुटा ॥ १९-२१ ॥

वि. भा.—एवं ग्रहयोर्मध्यान्तरे (केन्द्रान्तरे) मानैक्यार्धात् (ग्रहयोर्व्याससयोगार्धात्) अधिके सति युतिर्न भवेत् । हीने (मानैक्यार्धादल्पे केन्द्रान्तरे) स्थित्यर्धं विमर्ददले साध्ये ऽर्थात्कदम्बप्रोतवृत्तीययुतिकालमेव गर्भीयामान्तकालं मत्वा सूर्यग्रहणोक्तविधिना ते साध्ये, ताराग्रहोडुयुता (ताराख्पो यो ग्रहो मङ्गलाद्यस्तस्योड़ोर्नक्षत्रस्य) च या युतिस्तस्यामपि, एवं पद्धतिर्भवतीति । कदम्बप्रोतीय युतिकाले ऽर्कग्रहणवत् (सूर्यग्रहणोक्त विधिवत्) असकृत् (वारं वारं) लम्बनं साध्यम् । ग्रहयोः स्वावनति लिप्तिकाभिः स्वस्वनतिकलाभिः, तात्कालिकौ स्पष्टौ विक्षेपौ (शरौ) संसाध्य तयोः (एकभिन्नदिशोः) अन्तरैक्यं कार्यं तदा स्पष्टो विक्षेपो (स्पष्टशरः) भवेत् । तमेव मध्यान्तरं (केन्द्रान्तरं) कल्पनीयम् । ऊर्ध्वस्थस्य ग्रहस्याधःस्थो (नीचस्थ) ग्रहच्छादकः कल्पनीयः । एवं सूर्यग्रहणवत्सर्वं मत्वा स्पष्ट स्थित्यर्धं विमर्दार्धे साध्ये, केन्द्रान्तरे मानैक्यार्धादधिके सति पूर्वानीता समप्रोतीया युतिरतिस्पष्टा न भवत्यतः स्फुटोक्तिः (स्फुटयुतिसाधनार्थमुक्तिः) युक्तियुक्तेति ॥ १९२१ ॥

अत्रोपपत्तिः

"मानैक्यार्धाद् द्युचर विवरे स्यान्न भेदोऽधिके तु न्यूने भेदो ग्रहणवदिहच्छादकोऽधस्तनः स्यात् । साध्यलग्नं युतिसमयतो वित्रिभं तद् विधाय कार्याः सूर्यग्रहणवदखिला लम्बनाद्याः क्रियाश्च" इति सिद्धान्तशेखरे श्रीपत्युक्त्या "मानैक्या-

र्धाद् द्युचर विवरे ऽल्पे भवेद्भेदयोग" इत्यादि सिद्धान्तशिरोमणौ भास्कराचार्योक्तयाच स्फुटा वासनेति, अथाचार्येण कथ्यते ग्रहयुतावपि लम्बन-स्थित्यर्ध विमर्दार्धादिसर्वं सूर्यग्रहणवत् साध्यम् । सिद्धान्त शेखरे श्रीपतिना ग्रहयुतौ तत्साधनं पृथक् पृथक् प्रदर्शितं यथा ग्रहयुतौ लम्बनानयनार्थं तिथिस्वरूपं कथ्यते ।

अब ग्रह युति में विशेष कहते हैं

हि. भा.—एवं दो ग्रहों के केन्द्रान्तर मानैक्यार्ध (व्यासार्धयोग) से अधिक रहे तो युति नहीं होती है, मानैक्यार्ध से अल्प केन्द्रान्तर में स्थित्यर्ध और विमर्दार्ध साधन करना अर्थात् कदम्ब प्रोतीय युति काल ही को गर्भीयामान्त काल मान कर सूर्य ग्रहणोक्त विधि से वे (स्थित्यर्ध और विमर्दार्ध) साधन करना । ताराऱूप जो ग्रह (मङ्गलादि) है उनकी और नक्षत्र की जो युति होती है उसमें भी यही क्रिया होती है । कदम्बप्रोतीय युतिकाल में सूर्य ग्रहणोक्त विधिवत् असकृत् (बार-बार) लम्बन साधन करना, दोनों ग्रहों की अपनी अपनी नीतिकला से तात्कालिक स्पष्टशर साधन कर उन दोनों का एक दिशा में अन्तर करने से भिन्न दिशा में योग करने से स्पष्टशर होता है। उसी (स्पष्टशर) को केन्द्रान्तर कल्पना करना, ऊर्ध्वस्थित ग्रह के अधःस्थ (नीचस्थित) ग्रह को छादक मानना, इस तरह सूर्यग्रहण की तरह सब बातें मानकर स्पष्टस्थित्यर्ध और स्पष्ट विमर्दार्ध साधन करना, मानैक्यार्ध से केन्द्रान्तर को अधिक रहने से पूर्व साधित समप्रोतीय युति अतिस्पष्ट नहीं होती है इसलिये स्फुट युतिसाधन के लिये कहना युक्तियुक्त है इति ।। १९-२१ ।।

उपपत्ति

"मानैक्यार्धाद् द्युचर विवरे स्यान्न भेदोऽधिके तु न्यूने भेदो ग्रहणवदिहच्छादकोऽधस्तनः स्यात्" इत्यादि सं० उपपत्ति में लिखित सिद्धान्तशेखरोक्त श्लोक से तथा "मानैक्यार्धाद्द्युचर विवरेऽल्पे भवेदभेदयोगः" इत्यादि सं० उपपत्ति में लिखित सिद्धान्तशिरोमणिस्थ भास्कराचार्योक्त श्लोक से उपपत्ति स्फुट ही है इति ।।१९-२१।।

'स्वोदयात् समकलौ च यावता खेचरौ च भवतामनेहसा ।
तावती भवति भेदसंयुतौ लम्बनादि विधिसिद्धये तिथिः' ॥

वि. भा.— स्वोदयात् (स्वबिम्बोदयकालात्) यावता ऽनेहसा यत्प्रमितघट्यादिकालेन खेचरौ ग्रहौ समकलौ समलिप्तिकौ, भवेतां । भेदसंयुतौ ग्रहयो र्भेद युद्धे संयुतौ योगार्थं लम्बनादि विधिसिद्धये लम्बननतिस्थित्यर्धादिसाधनार्थं तिथिर्भवतीति ॥

अत्रोपपत्तिः

सूर्यग्रहणे लम्बनावनत्याद्यानयनाय सूर्योदयादमान्तं यावद्यथा तिथिप्रमाणं

गृहीतं तथैवात्र ग्रहोदयतः समकलकालपर्यन्तं कालस्तिथित्वेन ग्रहीतव्यस्तुल्य-समयादिति ॥

हि. भा.—यहां आचार्य कहते हैं कि ग्रहयुति में भी सूर्यग्रहणवत् लम्बन नति स्थित्यर्ध' विमर्दार्ध आदि सब कुछ साधन करना चाहिये । सिद्धान्तशेखर में श्रीपति ने ग्रहयुति में उन सबोंका पृथक् पृथक् साधन दिखलाया हैं जैसे लम्बनानयन के लिये तिथि का स्वरुप कहते हैं।

"स्वोदयात् समकलौ च यावता खेचरौ च भवतामनेहमा" इत्यादि संस्कृत में लिखित श्लोक को देखिये" ।

स्वबिम्बोदय काल से जितने घट्यादि काल में ग्रहद्वय, दोनों ग्रह समलिप्तिक होते हैं, दोनों ग्रहों के भेद युद्ध में और संयुति में, लम्बन, नति, स्थित्यर्ध साधन के लिये तिथि होती है ॥

उपपत्ति

सूर्य ग्रहण में लम्बन नति आदि के आनयन के लिए जैसे सूर्योदय से अमान्त पर्यन्त तिथि प्रमाण ग्रहण किया गया है वैसे यहां ग्रहोदय से समलिप्तिक काल पर्यन्त जो समय है उसको तिथित्व करके ग्रहण करना चाहिये इति ।

अथ ग्रहयुतिकाले लम्बनानयने विशेषमाह

ग्राह्यग्राहकलम्बनाख्यकलिका विश्लेषिता लम्बना ।
एवं चावनतिः पुरा विगणिता लिप्तास्तु षष्ट्या हृताः ॥
ऋज्वोर्वक्रगयोश्च भुक्तिविवरेणाप्ता घटीपूर्वकं ।
वक्रावक्रगयोर्जवैक्यविहृतास्तज्जायते लम्बनम् ॥

वि. भा.— ग्राह्यग्राहकलम्बनाख्यकलिकाः— युत्यर्थं समलिप्तिकयोर्ग्रहयोर्मध्ये ऽधः स्थश्छादक उपरिस्थश्छाद्य इति ग्राहकग्राह्यौ, तयोः पृथक् पृथक् स्वस्व पृष्ठीय दृग्ज्यावशेन या लम्बनकलास्ता विश्लेषिताः अन्तरिताः तदा लम्बनाः कलाःलम्बनसम्बन्धिन्यः कलाः स्युः । एवं पृथक् पृथगवनतिर्भवति । पुरा विगणिता लिप्ताः पूर्वंवदानीता लम्बनकलाः षष्ट्या हृताः ऋज्वोर्वक्रगयोश्च युक्ति विवरेणाप्ताः समलिप्तिकौ ग्रहौ यदि मार्गगामिनौ वक्रगामिनौ वा भवतस्तदा गत्यन्तरेण भक्ताः वक्रावक्रगयोर्जवैक्य विहृताः समलिप्तिकग्रहयोर्मध्ये यद्येको वक्री, अपरश्च मार्गी तदा तयोर्गतियोगेन भक्ताः तदा तद्घटीपूर्वकं घट्यादिकं लम्बनं जायत इति ॥

अत्रोपपत्तिः

भूकेन्द्राद् भूपृष्ठाच्च ग्रहगते रेखे नेये ताभ्यामुत्पन्नः कोणो दृग्लम्बनम्। भूकेन्द्राद्ग्रहं यावद् ग्रहकर्णः। भूपृष्टाद् ग्रहं यावत्पृष्ठीयकर्णः, भूकेन्द्राद् भूपृष्ठं यावद् भूव्यासार्धम्, एभिर्भुजैरुत्पन्नत्रिभुजे पृष्ठीयकर्णभूव्यासार्धाभ्यामुत्पन्न-कोणः =१८०— पृष्ठीयनतांश, कोणज्या कोणोनभार्धांशज्ययोस्तुल्यत्वात् ज्या (१८०—पृष्ठीयनतांश) = पृष्ठीयनतांशज्या = पृदृग्ज्या, तदोक्त त्रिभुजेऽनुपातेन दृग्लम्बनज्या $= \frac{\text{ग्रह पृदृग्ज्या भूव्या}\frac{1}{2}}{\text{ग्रहक}}$, एवमन्यग्रहस्यापि

$\frac{\text{ग्र}'\text{पृदृग्ज्या भूव्या}\frac{1}{2}}{\text{ग्रहक}'} = \text{दृग्लम्बनज्या}'$, एतच्चापयोरन्तरं लम्बनसम्बन्धिन्यः कलाः स्युः। ग्रहदृग्ज्या, दृक्क्षेप दृग्लम्बनज्या वशेन ग्रहयोः पृथक् पृथक् नती साध्ये। घट्यादिलम्बनज्ञानार्थं यदि ग्रहगत्यन्तरकलाभिः षष्टि घटिका लभ्यन्ते तदा लम्बनकलाभिः किं समागच्छन्ति लम्बनघटयः। ग्रहयोर्मध्ये यद्येको वक्री, अपरश्च मार्गी तदा गतियोगेनानुपातेन घट्यात्मकं लम्बनं समागच्छतीति॥

युतिकाल में लम्बनानयन में विशेष कहते हैं।

'ग्राह्य ग्राहक लम्बनाख्य कलिका' इत्यादि ऊपर लिखे श्लोक देखिये।

हि. भा.—युत्यर्थ समलिप्तिक दोनों ग्रहों में अधः स्थित ग्रह छादक होते हैं, ऊपर-स्थित ग्रह छाद्य होते हैं, उन दोनों के पृथक्-पृथक् स्व-स्व पृष्ठीय दृग्ज्यावश से जो लम्बन कलाएँ होती हैं उनके अन्तर लम्बन सम्बन्धिनी कला होती है, एवं पृथक्-पृथक् नति होती है, पूर्ववत् आयी हुई लम्बन कला को साठ से गुणा कर समलिप्तिक ग्रहद्वय के गत्यन्तर (यदि समलिप्तिक दोनों ग्रह मार्ग गामी हो वा वक्रगामी हो तब) से भाग देने से घट्यादिक लम्बन होता है, यदि समलिप्तिक दोनों ग्रहों में एक वक्री हो और दूसरा मार्गी हो तो गति-योग से भाग देने से घट्यादिक लम्बन होता है इति।

उपपत्ति

भूकेन्द्र से और भूपृष्ठ स्थान से ग्रह केन्द्रगत रेखा लाने से दोनों रेखाओं से उत्पन्न कोण दृग्लम्बन है, भूकेन्द्र से ग्रह केन्द्रगत रेखा=ग्रहकर्ण, पृष्ठ स्थान से ग्रहकेन्द्रगतरेखा= पृष्ठीय कर्ण, भूकेन्द्र से भूपृष्ठ स्थान पर्यन्त रेखा= भूव्यासार्ध। इन तीनों रेखाओं से उत्पन्न त्रिभुज में पृष्ठीय कर्ण और भूव्यासार्ध से उत्पन्न कोण=१८०—पृष्ठीय नतांश कोणज्या और कोणोन भार्धांशज्या बराबर होती है इसलिए ज्या (१८०—पृष्ठीय नतांश)=पृष्ठीय

नतांश ज्या=पृदृग्ज्या तब पूर्वोक्त त्रिभुज में अनुपात से $\frac{\text{ग्रह पृदृग्ज्या भूव्या}\frac{1}{2}}{\text{ग्रहकर्ण}}$

=ग्रलम्बनज्या, एवं $\frac{\text{ग्रपृदृग्ज्या भूव्या}}{\text{ग्रकर्ण}}$=ग्रलम्बज्या दोनों के चाप का अन्तर करने से लम्बन सम्बन्धिनी कला होती है, एवं ग्रहदृग्ज्या, दृक्क्षेप, दृग्लम्बनज्या वश से दोनों ग्रहों की पृथक् पृथक् नति साधन करना, घट्यादिक लम्बन ज्ञानार्थ यदि ग्रह गत्यन्तर कला में साठ घटी पाते हैं तो लम्बन कला में क्या इससे लम्बन घटी आती है, दोनों ग्रहों में यदि एक वक्री हो और दूसरा मार्गी हो तो गतियोग से पूर्ववत् अनुपात से घट्यादिक लम्बन होता है इति ॥

अथ ग्रहयुतौ लम्बनानयनमाह ।

ग्राह्य वित्रिभविलग्नविशेषज्या हता त्रिपद लग्न नरेण ।
व्यासखण्डकृतिहृत्फलमाहुर्लम्बनं परमलम्बननिघ्नम् ॥

वि. भा.—ग्राह्यस्य वित्रिभलग्नस्य चान्तरज्या त्रिपदलग्ननरेण (वित्रिभ शङ्कुना) हता (गुणिता) व्यासखण्डकृतिहृत् (त्रिज्यावर्ग भक्ता) फलं परम-लम्बन निघ्नं (परम लम्बनेन गुणितं) तदा लम्बनं भवतीत्याचार्या आहुरिति,

अत्रोपपत्तिः ।

अथ परम लम्बनं=४ घटी, तदा त्रिभोनलग्नार्कविशेषशिञ्जिनीकृता हता व्यासदलेन भाजितेत्यादि भास्करोक्त विधिना घट्यादि लम्बनम्,

$$=\frac{\text{वित्रिभार्कान्तरज्या}\times 4\times\text{वित्रिभ शङ्कु}}{\text{त्रि. त्रि.}}$$

$$=\frac{\text{वित्रिभार्कान्तरज्या}\times\text{परमलं}\times\text{विशङ्कु}}{\text{त्रि. त्रि.}}$$

$$=\frac{\text{ग्राह्यग्रह वित्रिभलग्नान्तरज्या. परमलं. वित्रिभशङ्कु}}{\text{त्रि. त्रि.}}=\text{घट्यादि लम्बनम्}$$

अब ग्रहयुति में लम्बनानयन को कहते हैं ।

हि. भा.— "ग्राह्यवित्रिभविलग्नविशेषज्या हता त्रिपदलग्ननरेण" इत्यादि ऊपर लिखित श्लोक को देखिये ।

ग्राह्यग्रह और वित्रिभ लग्न की अन्तरज्या को वित्रिभशङ्कु से गुणा कर

व्यास खण्ड कृति (त्रिज्यावर्ग) से भाग देने से जो फल हो उसको परम लम्बन से गुणा करने से लम्बन होता है इति ॥

उपपत्ति

"त्रिभोनलग्नार्कविशेषशिञ्जिनी कृता हृता व्यासदलेन भाजिता" इत्यादि भास्करोक्त विधि से घट्यादि लम्बन $= \frac{\text{वित्रिभार्कान्तरज्या} \times ४ \times \text{वित्रिभशङ्कु}}{\text{त्रि. त्रि.}}$

$= \frac{\text{वित्रिभार्कान्तरज्या. परमलं. वित्रिभशङ्कु}}{\text{त्रि. त्रि.}}$, परमलम्बन $=$ ४घटी

$= \frac{\text{ग्राह्यग्रह वित्रिभ लग्नान्तरज्या. परमलं. वित्रिभशङ्कु}}{\text{त्रि. त्रि.}}$ घट्यादिलम्बन इति ॥

इदानीं लम्बन संस्कारार्थं तद्धनर्णत्वमाह ।

त्रिभोनलग्नात् द्युचरेऽधिकर्णे छाद्ये तयोर्लम्बनमूनके स्वम् ।
ऋज्वोस्तथा वक्रगयोर्विधेयं काले युतेर्वक्रितयोः प्रतीपम् ॥
वक्रस्थयोरूनगतौ च तत्र तात्कालिकैस्तैरसकृत् प्रसाध्य; ॥
स्पष्टः स्वपातैस्तु युतेरनेहा………… ‥ ॥

वि. भा.—छाद्ये द्युचरे (छाद्यग्रहे) त्रिभोनलग्नात् (वित्रिभलग्नात्) अधिके सति तयोः (समलिप्तिक ग्रहयोः) ऋज्वोः (मार्गगामिनोः) वक्रगयोश्च (वक्रगामिनोः) सतोः, घट्यादियोगकाले लम्बनमृणं कार्यम् । छाद्यग्रहे वित्रिभलग्नादूनके तयोर्मार्गगामिनोर्वक्र गामिनोश्च सतोः लम्बनं योग काले स्वं (धनं) कार्यम् । वक्रितयोः (एकस्मिन् मार्गगामिनी, अपरस्मिन् वक्रगामिनी च) प्रतीपं (विलोमं) भवति । सूर्यग्रहणाधिकारवत् कस्यापि ग्रहस्य सकृदेव साधितं लम्बनं वास्तवं न भवत्यतोऽसकृल्लम्बनानयनेन ग्रहबिम्बयोरन्तरात्मकलम्बनस्य समलिप्तिककाले संस्कारेण ग्रहयोः स्पष्टो युतिकालो भवतीति । वक्रस्थयोरूनगतौ च तत्रेत्यादि श्लोकस्य चतुर्थचरणःसिद्धान्त शेखरे नास्ति । 'स्पष्टः स्वपातैश्च युतेरनेहा, इति स्फुटमेवेति ॥

अत्रोपपत्तिस्तु भाष्येनैव स्पष्टेति सुधियो विभावयन्तु ॥

अब लम्बन संस्कार के लिये उसकी धनर्णता को कहते हैं ।

'त्रिभोन लग्नात् द्युचरेऽधिकर्णे छाद्ये तयोर्लम्बनमूनके स्वम्' इत्यादि ऊपर लिखित श्लोकों को देखें ॥

हि. भा.—वित्रिभलग्न से छाद्यग्रह के अधिक रहने से उन दोनों मार्गगामी वा वक्रगामी समलिप्तिक ग्रहों के घट्यादियोग काल में लम्बन को ऋण करना चाहिये। वित्रिभलग्न से छाद्यग्रह के ऊन [अल्प] रहने से योग काल में लम्बन को धन करना चाहिये। समलिप्तिक ग्रहों में एक मार्गी हो और दूसरा ग्रह वक्री हो तो लम्बन संस्कार विलोम होता है। सूर्य ग्रहणाधिकारवत् किसी ग्रह का सकृत् प्रकार से साधित लम्बन वास्तवो नहीं होता है इसलिये असकृत् लम्बनानयन से विम्बात्मक ग्रहद्वय के लम्बनान्तर रूप लम्बन व समलिप्तिक काल में संस्कार करने से स्पष्ट ग्रहद्वय का युतिकाल होता है इसलिये 'तात्कालिकैस्तैरसकृत् प्रसाध्यः' कहते हैं। 'वक्रस्थयोरूनगतौच तत्र 'इत्यादि श्लोक का चतुर्थ चरण सिद्धान्तशेखर पुस्तक में नहीं है इति ॥

यहां उपपत्ति भाष्य ही से स्पष्ट है। इसको विवेचक लोग विचार कर देखें इति ॥

इदानीं युतिकाले नतिसाधनपूर्वकं स्फुटशरसाधनमाह।

शङ्कुधत्वं निजबाणसंस्कृतं भास्करग्रहणवद्विधाय च।
तद्गुणो भवति नास्फुटस्ततः प्राग्वदेव खलु दृष्टिशिञ्जिनी ॥

दृग्ज्याकां स्वनति लिप्तिका हतां त्रिज्ययाऽथ विभजेत् फलं नतिः।
तच्छरैक्यविवरं शरः स्फुटः तच्छरान्तरमिह ग्रहान्तरम् ॥

वि. भा.—भास्करग्रहणवत् (सूर्यग्रहणोक्त विधिवत्) शङ्कु धत्व (ग्रहशङ्कुचापं) निजबाणेन (स्वशरेण)संस्कृतं तदा यद्भवति तज्ज्या स्फुटोन (स्पष्टशङ्कुः) भवति। ततः प्राग्वदेव (स्पष्टशङ्कोः पूर्वरीत्यैव) दृष्टिशिञ्जिनी (दृग्ज्या भवति) एवमानीतां दृग्ज्यकां स्वनति लिप्तिकाभिः (परमनतिकलाभिः) हतां (गुणितां) त्रिज्या विभजेत्तदा फलमतिः नतिकला भवति। तच्छरैक्यविवरं तस्या नतेःशरस्य च योगान्तरं स्फुटः शरः स्यात् तच्छरान्तरं एवमानीतयो र्ग्रहयोःस्पष्टशरयोरन्तरं ग्रहान्तरंसमलिप्तिकयोर्ग्रहयोर्दक्षिणोत्तरमन्तरं वतीति।

अत्रोपपत्तिः।

सूर्यग्रहणे रविचन्द्रयोर्नती आनीते, अत्र समलिप्तिकग्रहयोश्छाद्यच्छादकयोश्च कल्पितरविचन्द्रयोः। अन्यत्सर्वं स्फुटमेवेति ॥

अब युतिकाल में नति साधन पुरःसर स्फुटशर साधन को कहते हैं।

"शङ्कुधत्वं निजबाणसंस्कृतं भास्कर ग्रहणवत्' इत्यादि ऊपर लिखे श्लोक को देखें।

अब युतिकाल में नति साधन पुर:सर स्फुटशर साधन को कहते हैं।

हि. भा.—सूर्यग्रहणोक्त विधिवत् ग्रहशङ्कुचाप को अपने शर के साथ संस्कार करने से जो होता है उस की ज्या स्पष्टशङ्कु होती है, उस से पूर्ववत् दृग्ज्या (त्रिज्यावर्ग में स्पष्ट शङ्कुवर्ग को घटा कर मूल लेने से) होती है, इसतरह आयी हुई दृग्ज्या को परमनति कला से गुणाकर त्रिज्या से भाग देने से जो फल होता है वह नतिकला होती है, इस नति और शर के योग और अन्तर करने से स्फुट शर होता है, इस तरह आनीत ग्रहद्वय का स्पष्ट शरान्तर, ग्रहान्तर (समलिप्तिक दोनों ग्रहों के दक्षिणोत्तरान्तर) होता है इति।

उपपत्ति

सूर्यग्रहण में रवि और चन्द्र की नति लाई गई है, यहां समलिप्तिक दोनों ग्रहों (छाद्य और छादक की तरह कल्पित रवि और चन्द्र) की लाई गई है। इति ॥

इदानीं ग्रहयुतौ स्थित्यर्धविमर्दार्धादिसाधनार्थमाह।

तत्स्फुटेषु सहितोनितात् स्वकान्मानयोगदलतः स्थितेर्दलम् ।
तत्रमार्गदलपूर्वमुक्तवत् साधयेन्निजजवैक्यभेदतः ॥

वि. भा. - स्वकान्मानयोगदलतः (ग्राह्यग्राहकविम्वयोर्योगार्धात्) तत् स्फुटेषु सहितोनितात् (तस्य ग्राहकस्य स्पष्टशरेण युतोनितात्) स्थितेर्दलं भवत्यर्थान्मानैक्यार्ध स्फुटशरयोर्योगान्तरघातात्[1] स्थित्यर्धं भवति, विम्बमानैक्यार्ध वर्गाच्छरवर्गं विशोध्य तन्मूलं ग्राहकमार्गखण्डं तत्सम्बन्धिकालो ग्रहणे यथा समानीतस्तथैवानुक्तया नेतव्य इति, (विमर्दार्धादिकं) साधयेदिति ॥ सर्वमिदं सिद्धान्तशेखरोक्तं वैशद्यार्थं लिखितम् ॥

(१) मानैक्यार्धस्फुटशरयोर्योगान्तरघातान्मूलं स्थित्यर्धं भवितु मर्हति, श्लोकोक्त्या तत्स्थित्यर्धं न भवतीति सिद्धान्तग्रन्थनिष्णातानां स्फुट मेवेति मुकुन्द मिश्रः।

अब ग्रहयुति में स्थित्यर्ध और विमर्दार्धादि साधन के लिये कहते हैं।

'तत्स्फुटेषु सहितोनितात् स्वकान्मानयोगदलतःस्थितेर्दलम्' इत्यादि ऊपर लिखे श्लोक को देखिये।

हि. भा.—ग्राह्यविम्ब और ग्राहक विम्ब के योगार्ध (मानैक्यार्ध) में ग्राहक के स्फुटशर को जोड़ने और घटाने से स्थित्यर्ध होता है, विम्बमानैक्यार्ध वर्ग को घटा कर मूल लेने से ग्राहक मार्ग खण्ड होता है तत्सम्बन्धिकाल ग्रहण में जैसे लाया गया है वैसे यहां भी

लाना चाहिये, ग्रहयुति में छाद्य और छादक की गतियों के योगान्तर से पूर्ववत् (चन्द्रग्रहणोक्तरीति से) विमर्दार्ध आदि साधन करना। यहाँ सिद्धान्त शेखरोक्त श्लोक से स्थित्यर्ध साधन ठीक नहीं हो सकता है, इसलिये मानैक्यार्ध में स्फुटशर को जोड़ कर, और घटा कर जो हो उनके घात का मूल स्थित्यर्थं होना चाहिए, परन्तु श्लोक में ऐसा नहीं है! इसलिये श्रीपत्युक्त स्थित्यर्ध साधन ठीक नहीं है यह मेरा मत है। ये सब विषय सिद्धान्तशेखरोक्त लिखे गये हैं॥

इदानीं स्फुटयुतिसाधनमाह।

ऊनदिनोदितगुणितादधिकदिनादूनदिनहृताल्लब्धम्।
अधिकं प्राग्युतिरूनं यद्यधिकदिनोदितात् पश्चात् ॥२२॥

अन्तरमाद्यो भूयोऽन्यदिष्टघटिकाफलोनयुतयोश्च।
प्राक् पश्चाद्वाऽन्तरयोस्तदन्तरेणोद्धृतावाद्यात् ॥२३॥

युत्याऽन्यथेष्ट घटिका गुणितात् फल नाड़िका यथाऽऽद्यवशात्।
प्राक् समलिप्तिककालात् पश्चाद्वा ग्रहयुति र्भवति ॥२४॥

सु॰ भा॰—यस्मिन् काले कदम्बप्रोतीयौ समलिप्तिकौ ग्रहौ जातौ तस्मिन् काले स्वदेशोदयैर्लग्नं साध्यम्। भगोलं परिभ्राम्य तौ ग्रहौ प्राक्क्षितिजस्थौ कृत्वा तयोरुदयलग्ने च साध्ये ततस्तात्कालिकलग्नग्रहोदयलग्नान्तरे लग्नात् कालसाधनवद्ग्रहदिनगता घटिकाः साध्याः। ता एवेहाचार्योक्ता दिनोदिता घटिका ज्ञेयाः। दिनमानघटिकाश्च द्वयोर्ग्रहयोः पूर्वमानीता एव। अथ यस्याल्पदिनप्रमाणं तस्य गता घटिका ऊनदिनोदिता घटिकाः। यस्याधिकं दिनप्रमाणं तस्य गता अधिकदिनोदिताः। अल्पदिन प्रमाणमूनदिनमधिकदिनप्रमाणमधिकदिनमित्याचार्यस्य सङ्केतस्तेनायमर्थः। अधिकदिनादूनदिनोदितगुणितादूनदिनहृताद्यल्लब्धं तद्यद्यधिकदिनोदितादधिकं तदा युतिः प्राग्जाता गतेत्यर्थः। यद्यूनं तदा युतिः पश्चाद्भविष्यतीनि वेदितव्यम्। लब्धघटिकाऽधिकदिनोदितघटिकान्तरमाद्यसंज्ञं भवति। इष्टघटिकाफलोनयुततोर्द्वयोर्ग्रहयोरेवमन्यदर्थादन्यसंज्ञमानेयम्। एतदुक्तं भवति। गतयुतौ गता एष्ययुतावेष्या इष्टघटिकाः कल्प्यास्ताभिस्तौ ग्रहौ प्रचाल्य तयोरुदयलग्नादिना तयोर्गतघटिका आनीय "ऊनदिनोदितगुणितादित्यादिना पुनरन्तरं साध्यं तदन्यसंज्ञं ज्ञेयम्। यद्यन्तरद्वयेनापि प्राग्गता वा पश्चादेष्या युतिस्तदा इष्टघटिका गुणितादाद्यात् तदन्तरेणाद्यान्ययोरन्तरेण हृतात् फलनाडिका आद्यवशात् समलिप्तिकालाद्गता वैष्या भवन्ति। अन्यथा एकेन गताऽपरेणैष्या युतिस्तदाऽऽद्यान्ययोर्युत्या हृतात् फलनाडिका ज्ञेयाः।

अत्रोपपत्ति

त्रैराशिकेन यद्यूनदिनमानेनोनदिनोदिता घटिकास्तदाऽधिकदिनमानेन किं युतिकाले ऽधिकदिनोदित घटिका भवन्ति । एवमत्राचार्येण ग्रहयोर्दिनमानगत-घटिकामध्ये तुल्या निष्पत्तिरङ्गीकृता स्वल्पान्तरतः । यदि लब्धघटिका अधिक-दिनगतघटिकातोऽधिका तदा युतिर्गताऽन्यथैष्येति स्फुटा । द्वयोरन्तरमाद्यसंज्ञं कल्पितम् । इष्टघटिकाभिर्ग्रहौ प्रचाल्य पुनरन्तरमन्यसंज्ञं कृत्वाऽनुपातः । यद्याद्यान्यान्तरतुल्येनापचयेनेष्टघटिकास्तदाऽऽद्यसमापचयेन किं फलनाडिकाभि-राद्यकालात् प्राक्पश्चाद्वाऽन्तरस्याऽऽद्यसमापचयादभावोऽतस्तत्र युतिरिति ग्रहगति-शरगत्योर्वैलक्षण्यादसकृत् कर्म समुचितं तत्स्वल्पान्तरादाचार्यैस्त्यक्तमिति । विजातीययोराद्यान्ययोरन्तरे बीजक्रियया तयोर्युतिरुत्पद्यते तया तदा भक्तात् फलं ग्राह्यमि यादि स्फुटं बीजविदामिति ॥२२-२४॥

वि. भा.—यस्मिन् काले कदम्बप्रोतीयौ समकलौ ग्रहौ जातौ तस्मिन् काले स्वदेश्यराश्युदयैर्लग्नं साध्यम् । गोलभ्रमणेन तौ ग्रहौ पूर्वक्षितिजस्थौ कृत्वा तयोरुदय-लग्ने साध्ये, ततस्तात्कालिकलग्नग्रहोदयलग्नान्तरे लग्नात्कालसाधनवद् ग्रह-दिनघटिकाः साध्यास्ता एवात्र दिनोदिता घटिका बोध्याः । पूर्वमेव तयोर्दिनमान-घटिका आनीता एव । यस्य ग्रहस्य दिनप्रमाणमल्पं तस्य दिनगतघटिका ऊनदिनोदिता घटिकाः । यस्य दिनप्रमाणमधिकं तस्य दिनगतघटिका अधिकदिनो-दिताः । अल्पदिनप्रमाणमूनदिनमधिकदिनप्रमाणमधिकदिनमिति । अधिकदिनात् ऊनदिनोदितगुणितात् ऊनदिनहृताद्यल्लब्धं तद्यद्यधिकदिनोदितादधिकं तदा युतिः प्राग्जाता गतेत्यर्थः । यद्यूनं तदा युतिः पश्चात् (एष्येत्यर्थः) लब्ध-घटिकाया अधिकदिनोदितघटिकायाश्चान्तरमाद्यसंज्ञो भवति । इष्टघटिका-फलोनयुतयोर्ग्रहयोरेवमन्यसंज्ञक भवति । एवमुक्तं भवति गतयुतौ गता एष्ययुतावेष्या इष्टघटिकाः कल्प्यास्ताभिस्तौ ग्रहौ प्रचाल्य तयोरुदयलग्नादिना तयोर्गतघटिका आनीय ऊनदिनोदितगुणितादित्यादिना पुनरंतरं साध्यं तदन्यसंज्ञकं भवति । यद्यन्तरद्वयेनापि प्राक् (गता) पश्चात् (एष्या) वा युतिस्तदे-ष्टगुणितादाद्यान्त्तादन्तरेण (आद्यान्ययोरन्तरेण) हृतात् (भक्तात्) फलंनाड़िका आद्यवशात्समलिप्तिककालाद्गता वैष्या भवन्ति । अन्यथैकेन यदि गता युतिरपरे-णैष्या तदाऽऽद्यान्ययोर्युत्या भक्तात् फलनाडिका ज्ञेयाः ।

अत्रोपपत्तिः

यद्यूनदिनमानेनोनदिनोदितघटिका लभ्यन्ते तदाऽधिकदिनमानेन किं समागच्छन्ति युतिकालेऽधिकदिनोदितघट्यः । अत्राचार्येण ग्रहयो-र्दिनमानगतघटिकामध्ये स्वल्पान्तरात्तुल्या निष्पत्तिः स्वीकृता । यदि लब्ध-

घटिका अधिकदिनगतघटिकातोऽधिकास्तदा युतिर्गताऽन्यथैष्येति । द्वयोरन्तरमाद्यसंज्ञकं कल्प्यम् । ग्रहाविष्टघटिकाभिः प्रचाल्य पुनरन्तरमन्यसंज्ञं कृत्वाऽतुपातो यद्याद्यान्ययोरन्तरतुल्येनापचयेनेष्टघटिकास्तदाऽऽद्यतुल्येनापचयेन किं फलनाडिकाभिराद्यकालात् पूर्वं पश्चाद्वान्तरस्या ऽद्यासमापचयादभावोऽतस्तत्र युतिरिति ग्रहगतिशरगत्योर्वैलक्षण्यादसकृत्कर्म समुचितं तत्स्वल्पान्तरादाचार्यैर्न्यक्तम् । विजातीययोराद्यान्ययोरन्तरे तयोर्युतिरुत्पद्यते तया तदा भक्तात्फल ग्राह्यमिति । सिद्धान्तशेखरे "अल्पद्युखेचरसमुद्गतनाड़िकाभिर्ज्येष्ठं दिनं निहतमल्पदिनेन भक्तम् । लब्ध वृहद्दिनसमुद्गततोऽधिकं चेत् याता तदा युतिरतोऽपरथा च गम्या ॥ आद्यस्तदन्तरमभीष्ट घटीफलोन संयुक्तयोरपरएवमुभावपीमौ । गम्यौ गतौ यदि च तद्विवरं हरःस्याद्योगोऽन्यथा स्वक घटी निहताद्यराशेः ॥ फलघटीभिरिहाद्य वशेन हि ग्रहयुतिः समलिप्तिककालतः । भवति पूर्वमथोत्तरकालिका गणितदृक् समता विधिनाऽमुना ।" एभिःश्लोकैः श्रीपतिनाऽऽचार्योक्तानुरूपमेव सर्वमुक्तमिति ।। २२-२३-२४ ।।

अब स्फुट युति साधन को कहते हैं ।

हि. भा.—जिस समन में कदम्ब प्रोतीय समलिप्तिक ग्रहद्वय हुए हैं उस समय में स्वदेशीय राश्युदयमानों से उदय लग्न साधन करना, भगोल को घुमाकर दोनों ग्रहों को पूर्वक्षितिजस्थित करके दोनों के उदयलग्न साधन करना, उसके बाद तात्कालिक लग्न और ग्रहोदय लग्न के अन्तर में लग्न से काल साधन की तरह ग्रह की दिन घटी साधन करना, वही यहां दिनोदित घटी समझनी चाहिये । पहले दोनों ग्रहों की दिन-मान घटी लाई हुई है, जिस ग्रह के दिन प्रमाण अल्प है उसकी दिनगत घटी ऊनदिनोदित घटी कहलाती है और जिस ग्रह के दिन प्रमाण अधिक है उसकी दिनगत घटी अधिक दिनोदित घटी कहलाती है अल्प दिन प्रमाण ऊनदिन प्रमाण और अधिक दिन प्रमाण अधिक दिन यह आचार्य का सङ्केत है, अधिक दिन को ऊनदिनोदित से गुणा कर ऊन दिन से भाग देने से जो लब्धि हो वह यदि अधिक दिनोदित से अधिक हो तो युति गत समझनी चाहिये, यदि न्यून हो तो युति एष्य समझनी चाहिये । लग्न घटी और अधिक दिनोदित घटी का अन्तर आद्य संज्ञक है, एवं इष्टघटी फल करके ऊन और युत दोनों ग्रह अन्य संज्ञक हैं, गतयुति में गत और एष्य युति में एष्य इष्टघटी मानकर इस से दोनों ग्रहों को चालन देकर दोनों ग्रहों के उदयलग्न आदि से दोनों की गतघटी लाकर 'ऊनदिनोदित गुणिताद्' इत्यादि से पुनः अन्तर साधन करना उसको अन्य संज्ञक समझना । यदि दोनों अन्तर से गत वा एष्य युति हो तो इष्ट गुणित आद्यको आद्य और अन्य के अन्तर से भाग देने से फल घटी होती है वह आद्यवश से समलिप्तिक काल से गत वा एष्य होती है, अन्यथा यदि एक से गतयुति हो और दूसरे से एष्य युति हो तो आद्य और अन्य के योग से भाग देने से फल घटी समझनी चाहिये इति ।।

उपपत्ति

यदि ऊनदिनमान में ऊनदिनोदित घटी पाते हैं तो अधिक दिनमान में क्या उस अनुपात से युतिकाल में अधिक दिनोदित घटी आती है, यहां आचार्य ने दोनों ग्रहों की दिनमान गत घटी के मध्य में तुल्य निष्पत्ति स्वीकार की है। यदि लब्धघटी अधिक दिनगतघटी से अधिक हो तो युतिगत अन्यथा एष्य होती है, दोनों के अन्तर को आद्य कल्पना करना, इष्ट घटी से दोनों ग्रहों को चालन देकर फिर अन्तर को अन्य संज्ञक करके अनुपात करते हैं। यदि आद्य और अन्य के अन्तरतुल्य अपचय में इष्ट घटी पाते हैं तो आद्यतुल्य अपचय में क्या इससे जो फल नाड़ी आती है उससे आद्यकाल से पहले वा पीछे आद्यतुल्य अपचय से अन्तराभाव होता है इसलिये वहां युति होती है, ग्रहगति और शरगति की विलक्षणता के कारण असकृत्कर्म करना उचित है परन्तु आचार्य ने स्वल्पान्तर से उसको छोड़ दिया है। बिजातीय आद्य और अन्य का अन्तर करने से दोनों का योग होता है उससे भाग देकर फल ग्रहण करना चाहिये। सिद्धान्तशेखर में "अल्पद्युखेचरसमुद्गतनाड़िकाभिर्ज्येष्ठं दिनं निहतमल्पदिनेन भक्तम्" से लेकर "भवति पूर्वमथोत्तरकालिका गणितदृक्समता विधिनाऽमुना" तक संस्कृतोपपत्ति में लिखित श्लोकों से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥२२-२३-२४॥

इदानीं कदा युतिर्भवतीत्याह

स्वदिनघटिका विभक्तस्तदुदितपरदिवसनाड़िकाघातः ।
तुल्यः परोदिताभिर्घटिकाभिर्यदि युतिग्रहयोः ॥२५॥

सु. भा.—तदुदितपरदिवसनाडिकाघातः स्वदिनघटिकाविभक्तो यदि परोदिताभिर्घटिकाभिस्तुल्यस्तदा तयोर्ग्रहयोर्युतिर्भवतीति वेदितव्यम्। अत्रैतदुक्तं भवति। एकस्य गता घटिकाः परस्य दिनमानघटिकाभिर्गुणा एकस्य दिनमानेन हृताः फलतुल्या यदि परस्य गतघटिकाः स्युस्तदा तयोर्ग्रहयोः कदम्बप्रोतीया युतिर्वाच्येति पूर्वसाधितयुतिकालतः स्फुटम् ॥ २५ ॥

वि. भा.—तदुदित पर दिवसनाड़िकाघातः स्वदिनघटिकाविभक्तो यदि परोदिताभिर्घटिकाभिस्तुल्यस्तदा तयोर्ग्रहयोयुतिर्भवतीति ज्ञेयम्। अत्रै तदुक्त भवति। एकस्य गतघटिकाः परस्य दिनमानघटिकाभिर्गुणिता एकस्य दिनमानेन भक्ता लब्धतुल्या यदि परस्य गतघटिका भवेयुस्तदा तयोर्ग्रहयोः कदम्बप्रोतीया युतिर्वाच्येति।

अत्रोपपत्तिः

यद्येकस्य दिनमानेन तस्य दिनगतघटिका लभ्यंते तदा परस्य दिनप्रमाणेन किमिति परस्य दिनगतघटिकाः प्रागुक्तचा भवन्तोति तदैवैषा तयोर्ग्रहयोर्युतिर्वक्तुमुचिता नान्यथेति पूर्वकथितयुतिविवेचनया स्फुटा, सिद्धान्त शेखरे "गुणितमपर

वासरेण भक्तं स्वदिनेनोदितमत्र जायते चेत् । कथमपिच परोदितेन तुल्यं युतिविधिरेष विधीयते तदानीम्" ऽनेन श्रीपतिनाऽऽचार्योक्तानुरूपमेवोक्तमिति विज्ञैर्बोध्यम् ॥२५॥

अब कब युति होती है इसको कहते हैं ।

हि.भा.—एकग्रह की गतघटी को अन्य ग्रह की दिनमान घटी से गुणाकर एक ग्रह के दिन प्रमाण से भाग देने से जो फल हो तत्तुल्य यदि अन्य ग्रह की गत घटी हो तो दोनों ग्रहों की कदम्ब प्रोतीय युति कहनी चाहिये इति ॥२५॥

उपपत्ति

यदि एक ग्रह के दिन प्रमाण में उसकी दिनगत घटी पाते हैं तो अन्य ग्रह के दिन प्रमाण में क्या इससे अन्य ग्रह की दिनगत घटी पूर्वोक्ति के अनुसार होती है, तब ही उन दोनों ग्रहों की युति कहना उचित है अन्यथा नहीं यह बात पूर्वकथित युति विचार से स्फुट है । सिद्धान्त शेखर में "गुणितमपरवासरेण भक्तं स्वदिनोदितमत्र जायते चेत्" इत्यादि सं० उपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥२५॥

इदानीमध्यायोपसंहारमाह

विक्षेपमानसमकलदिनघटिका स्वोदयास्तलग्नाद्यैः ।
षड्विंशत्यार्याणां नवमो ग्रहमेलनाध्यायः ॥२६॥

सु. भा—समकलौ समलिप्तौ ग्रहौ । शेषं स्पष्टार्थम् ।

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते ।
हृदि तं विनिधाय नूतनोऽयं रचितो योगविधौ सुधाकरेण ॥

इति श्रीकृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्तनूतनतिलके ग्रहयुत्यधिकारो नवमः ॥ ९ ॥

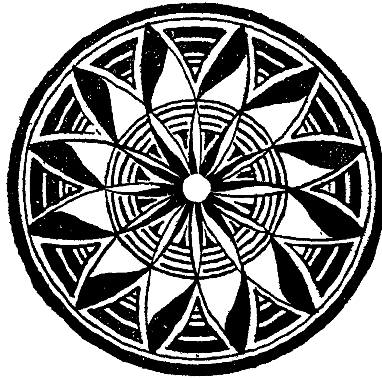
वि. भा.—विक्षेप (शर) मानसाधनम्, समकल (समलिप्तिक) ग्रहयोर्दिनमानसाधनं तद्दिनगतघटिकासाधनं च तयोर्ग्रहयोरुदयास्तलग्नयोः साधनमेतदाद्यैर्विषयैः सम्वलितौ नवमो ग्रहमेलनाध्यायः (ग्रहयुत्यधिकारः) आर्याणां षड्विंशत्या (षड्विंशतिसंख्यकैरार्याश्लोकैः) गत इति ॥२६॥

इति श्री ब्रह्मगुप्तविरचितब्राह्मस्फुटसिद्धान्ते ग्रहयुत्यधिकारो नवमः ॥९॥

अब अध्याय के उपसंहार को कहते हैं ।

हि. भा.—विक्षेप (शर) मान साधन, समलिप्तिक ग्रहद्वय के दिनमान साधन और दिनगतघटी साधन, उन्हीं दोनों ग्रहों के उदयलग्न और अस्तलग्न साधन एतदादि विषयों से युत नवम ग्रह मेलनाध्याय (ग्रहयुत्यधिकार) छब्बीस आर्याश्लोकों से युक्त समाप्त हुआ ॥२६॥

इति श्री ब्रह्मगुप्त विरचित ब्राह्मस्फुटसिद्धान्त में नवम ग्रहयुत्यधिकार समाप्त हुआ ॥९॥



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२२३६, गुरुद्वारा रोड, करौल बाग,
नई दिल्ली-५ (भारत)

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भारत सरकार के शिक्षा मन्त्रालय द्वारा प्रदत्त अनुदान से प्रकाशित ।

*

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प्रथम संस्करण
१९६६

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मूल्य रु० ६०.००

*

मुद्रक :
पद्म श्री प्रकाशन एण्ड प्रिण्टर्स
१२, चमेलियन रोड,
दिल्ली ।

समर्पण :

श्रीयुत एस० के० पाटिल

यूनियन मिनिस्टर फार रेल्वेज

को

सादर समर्पित

Dedicated to

Shri S. K. Patil

Union Minister for Railways

विषयानुक्रमणिका

१०. भग्रहयुत्यधिकारः ५७१–६४६

विषय | पृष्ठ

विषय		पृष्ठ

विषय	पृष्ठ

विषय पृष्ठ

१६. ग्रहणोत्तराध्यायः १०९९–११३६

विषय	पृष्ठ

ब्राह्मस्फुटसिद्धान्तः

भग्रहयुत्यधिकारः

षड्विंशभागा ध्रुवास्तैः । झषे मुनित्रिंशैः । उत्तरभाद्रपदरेवत्योः क्रमेण मीनस्य सप्तत्रिंशांशास्तैरिति । एत एवाश्विन्यादीनां ध्रुवांशा भास्करेणापि स्वभग्रहयुत्यधिकारे पठिताः । ध्रुवाश्चैते राश्याद्याः ।

अ०	भ०	कृ०	रो०	मृ०	आ०	पु०	पु०	श्ले०	म०	पू०
०	०	१	१	२	२	३	३	३	४	४
८	२०	७	१९	३	७	३	१६	१८	९	२७
०	०	२८	२८	०	०	०	०	०	०	०

उ०	ह०	चि०	स्वा०	वि०	अ०	ज्ये०	मू०	पू०	उ०	अ०
५	५	६	६	७	७	७	८	८	८	८
५	२०	३	१९	२	१४	१९	१	१४	२०	२५
०	०	०	०	५	५	५	०	०	०	०

श्र०	ध०	श०	पू०	उ०	रे०
९	९	१०	१०	११	०
८	२०	२०	२६	७	०
०	०	०	०	०	०

वि. भा.—अश्वन्यादीनां योगतारास्थैरेतैर्ध्रुवकांशैर्वक्ष्यमाणविधिना ग्रहेण साकं योगः साध्यः । अश्विन्यादीनां भानां प्रोक्तध्रुवांशानुसारेण स्वकीया योगताराः (प्रधानताराः) स्थिताः सन्ति । एकतारावतां भानां प्रोक्तांशैस्तेषां विपुला कान्तिमती च यैका तारा योगताराख्या सैव तिष्ठतीत्यर्थः । कैरित्याह-मेषेऽष्टनखैरर्थादश्विन्या मेषस्याष्टांशाः । भरण्या विंशत्यंशा ध्रुवकास्तेः । गवि (वृषे) रदलिप्तोनैस्तैरेवाष्टनखैरंशैः, अर्थात् कृत्तिकाया वृषस्याष्टांशा द्वात्रिंशत्कलोनाः । रोहिण्या वृषस्य विंशत्यंशा द्वात्रिंशत्कलोनाः । मिथुने गुणस्वरैरंशैः, अर्थात् मृगशीर्षस्य मिथुनस्य त्र्योंशाः । आर्द्राया मिथुनस्य सप्तांशाः कर्कटके गुणषोडश धृतिभिः पुनर्वसोः कर्कटकस्य त्रयोंऽशाः । पुष्यस्य कर्कटकस्य षोडशांशाः । अश्लेषायाः कर्कटकस्याष्टादशांशास्तैः । सिंहे नवत्रिधनैः मघायाः सिंहस्य नवांशाः । पूर्वफल्गुन्याः सिंहस्य सप्तविंशत्यंशास्तैः । कन्यायां पञ्चनखैः, उत्तरफल्गुन्याः कन्यायाः पञ्चांशाः । हस्तस्य कन्याया विंशत्यंशास्तैः । तुलिनि त्र्यतिधृतिभिः, चित्रायास्तुलायास्त्रयोंऽशाः । स्वात्यास्तुलाया एकोनविंशत्यंशास्तैः । अलिनि (वृश्चिके) सेषुकलैर्द्विचतुर्दशातिधृतिभिः विशाखाया वृश्चिकस्य पञ्चकला सहितौ द्वौ भागौ, अनुराधाया वृश्चिकस्य पञ्चकला सहिताश्चतुर्दशांशाः । ज्येष्ठाया वृश्चिकस्य पञ्चकला सहिता एकोनविंशत्यंशास्तैः । धनुषि शशाङ्कमनुनखतत्त्वैः, मूलस्य धनुषः एकोंऽशः । पूर्वाषाढाया धनुषश्चतुर्दशांशाः । उत्तराषाढाया धनुषो विंशतिरंशाः ।

अभिजितो धनुषः पञ्चविंशतिरंशास्तैः मकरेऽष्टनखैः, श्रवणाया मकरस्याष्टांशाः। धनिष्ठाया मकरस्य विंशतिरंशास्तैः। कुम्भे नखषड्विंशैः, शतभिषः कुम्भस्य विंशतिरंशाः। पूर्वभाद्रपदस्य कुम्भस्य षड्विंशतिरंशास्तैः। झषे (मीने) मुनित्रिंशैः, उत्तरभाद्रपदस्य मीनस्य सप्तांशाः। रेवत्या मीनस्य त्रिंशांशास्तैरिति ॥

एवमेते राश्याद्या ध्रुवा :—

अ	भ	कृ	रो	मृ	आ	पु	पु	श्ले	म	पू	उ	ह	चि	स्वा
०	०	१	१	२	२	३	३	३	४	४	५	५	६	६
८	२०	७	१९	३	७	३	१६	१८	९	२७	५	२०	३	१९
०	०	२८	२८	०	०	०	०	०	०	०	०	०	०	०

वि	अ	ज्ये	मू	पू	उ	अ	श्र	ध	श	पू	उ	रे
७	७	७	८	८	८	८	९	९	१०	१०	११	०
२	१४	१९	१	१४	२०	२५	८	२०	२०	२६	७	०
५	५	५	०	०	०	०	०	०	०	०	०	०

आचार्योक्ता एत एवाश्विन्यादीनां भानां ध्रुवांशाः सिद्धान्तशेखरे श्रीपतिना सिद्धान्तशिरोमणौ भास्कराचार्येणापि भग्रहयुत्यधिकारे पठिताः सन्ति। सूर्यसिद्धान्ते तु "अष्टार्णवाः शून्यकृताः पञ्चषष्टिर्नगेषवः। अष्टार्था अब्धयोऽष्टागा अङ्गागा मनवस्तथा॥ कृतेषवो युगरसाः शून्यबाणा वियद्रसाः। खवेदाः सागरनगा गजागाः सागरर्त्तवः॥ मनवोऽथरसा वेदा वैश्वमाप्यार्धभोगगम्। आप्यस्यैवाभिजित् प्रान्ते वैश्वान्ते श्रवणस्थितिः, इत्यादिभिः श्लोकैर्नक्षत्राणां भोगकलाः पठितास्ततो "प्रोच्यन्ते लिप्तिका भानां स्वभोगोऽथदशाहतः। भवन्त्यतीतधिष्ण्यानां भोगलिप्ता युता ध्रुवाः" ऽनेन नक्षत्राणां ध्रुवानयनमभिमतम्।

यथा भरण्या भोग कलाः=४०, दश गुणिताः=४००
गतनक्षत्रभोगकलाः =८००

अनयोर्योगे जाता भरण्या ध्रुवकलाः =१२०० = ०।२०।
एवं सर्वेषा नक्षत्राणां तदीयभोगकलाभ्यो ध्रुवाः साध्या इति ॥ १-२-३ ॥

अत्रोपपत्तिः

गोलबन्धोक्त विधिना विपुलं गोलयन्त्रं विरचय्य रात्रौ गोलमध्यगतया दृष्ट्या रेवतीतारां विलोक्य क्रान्तिवृत्ते यो मीनान्तस्तं रेवतीतारायां निवेश्य मध्यगतयैव दृष्ट्या तन्नक्षत्रं विलोक्य तदुपरि कदम्बप्रोतवृत्तं ध्रुवप्रोतवृत्तं च कार्यम्। कदम्ब-

प्रोतवृत्तक्रान्तिवृत्त सम्पातात् मेषादिं (क्रान्तिवृत्तनाड़ीवृत्तयोः सम्पातं) यावत्क्रान्तिवृत्ते यें ऽशास्ते सायना ध्रुवाः। नक्षत्रबिम्बोपरिगतध्रुवप्रोतवृत्त क्रान्तिवृत्तयोः सम्पातान्मेषादिं यावदायनदृक्कर्म संस्कृत ध्रुवाः। एवमाचार्येण स्वसमये वेधेन ज्ञात्वा पठिता इति ॥ १-३ ॥

अब भग्रहयुत्यधिकार प्रारम्भ किया जाता है।

इसमे पहले नक्षत्रों के ध्रुवांश को कहते है।

हि. भा.—'अष्टनखैर्मेषे गविरदलिप्तोनैर्गुणस्वरैर्मिथुने' इत्यादि श्लोकों से अश्विनी आदि नक्षत्रों की राश्यादिक ध्रुवा संस्कृत विज्ञान भाष्य में लिखित के अनुसार समझनी चाहिए। अश्विनी आदि नक्षत्रो की ध्रुवा आचार्योक्त जो है वही सिद्धान्त शेखर मे श्रीपति ने तथा सिद्धान्त शिरोमणि में भास्कराचार्य ने भी पठित की है। सूर्य सिद्धान्त मे "अष्टार्णवाः ४८ शून्यकृता ४० पञ्चषष्टि ६५ नगेषवः ५७। अष्टार्था २८ ऽब्धयो ४ ऽष्टागा ७८ अङ्गागा ७६ मनव १४ स्तथा" इत्यादि संस्कृत वि. भाष्य में लिखित श्लोकों से अश्विनी आदि नक्षत्रों की भोग कला पठित की है। उनसे 'प्रोच्यन्ते लिप्तका भाना स्वाभोगोऽथ दशाहताः। भवन्त्यतीत धिष्ण्याना भोगलिप्ता युता ध्रुवाः' इस श्लोक द्वारा नक्षत्रों का ध्रुवानयन कहा है। जैसे भरणी की पठित भोग कला=४०, दस से गुणने से=४०० यहां गत नक्षत्र=१ है, इसकी भोगकला=८०० जोड़ देने से ४००+८००=१२००=२०° इसी तरह सब नक्षत्रों की उनकी भोग कलाओं से ध्रुवा साधन करना चाहिए इति ॥ १-३

उपपत्ति।

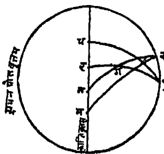
विपुल (बड़ा) गोल यन्त्र बना कर रात्रि में गोल केन्द्रगत दृष्टि से रेवती तारा को देख कर क्रांतिवृत्त में जो मीनान्त बिन्दु है उसको रेवती तारा में निविष्ट कर केन्द्रगत दृष्टि ही से उस नक्षत्र (जिस की ध्रुवा लानी है) को देखकर उसके ऊपर कदम्बप्रोतवृत्त और ध्रुवप्रोतवृत्त कर देना, कदम्बप्रोतवृत्त क्रांतिवृत्त में जहां लगता है वहां से क्रांतिवृत्त और नाड़ीवृत्त के सम्पात पर्यन्त क्रांतिवृत्त में सायन ध्रुवांश है, तथा ध्रुवप्रोतवृत्त क्रांतिवृत्त में जहां लगा है वहां से नाड़ीवृत्त और क्रांतिवृत्त के सम्पात पर्यन्त आयन दृक्कर्म संस्कृत सायन नक्षत्र ध्रुवा है, आचार्य ने नक्षत्रबिम्ब के ऊपर ध्रुवप्रोतवृत्त करके उसके वश से आयन दृक्कर्म संस्कृत ध्रुववेध से जानकर पठित किया है॥ १-३ ॥

इदानीं भग्रहयोगस्य गतगम्यत्वमाह

ध्रुवकादूनः पश्चादधिकः प्राग्वक्रितेऽन्यथा योगः।
अन्यद्ग्रहमेलकवद् ध्रुवकक्रान्तेर्भविक्षेपाः॥ ४ ॥

सु. भा.—ग्रहो भध्रुवकादूनस्तदा योगः पश्चाद्भविष्यति । अधिकस्तदा योगः प्राग्गतः । ग्रहे वक्रिते सति योगोऽन्यथा वाच्यः । अर्थादूने पश्चादधिके गत इति वेदितव्यम् । अन्यद्भग्रहयुतौ ग्रहमेलकवज्ज्ञेयम् । अथ भध्रुवकक्रान्तेरग्राद्भ विक्षेपा वक्ष्यमाणा एते ॥ ४ ॥

वि. भा.—ध्रुवकात् (पूर्वोक्तात्) ग्रह ऊनः (अल्पः) तदा योगः(भग्रहयोर्योगः) पश्चात् (एष्यः) भवति । ध्रुवकाद् ग्रहोऽधिकस्तदा योगः प्राक् (गतः) भवति, ग्रहे वक्रिते सति योगोऽन्यथाऽर्थाद् ग्रहे ऊने गतः । अधिके एष्य इति ज्ञेयः अन्यद्ग्रहमेलक-वत् (ग्रहयुतिवत्) भग्रहयुतौ ज्ञेयम् । भध्रुवकक्रान्तेरग्राद् भविक्षेपाः (नक्षत्रशराः) वक्ष्यमाणा विज्ञेया इति ; सिद्धान्त शेखरे "महति युतिरतीता भध्रुवात् खेचरेऽल्पे भवति हि पुनरेष्या चान्यथा वक्रयाते । द्युचर युतिवदन्यत् कर्म सर्वं विधेयं क्रमश उडुशरांशाः स्वध्रुवापक्रमाग्रात्" इत्यनेन श्रीपतिनाऽऽचार्योक्तानुरूपमेवोक्तम् । सूर्यसिद्धान्तेऽपि "ग्रहमेलकवच्छेषं ग्रहभुक्तया दिनानि च । एष्यो हीने ग्रहे योगो ध्रुवकादधिके गतः । विपर्ययाद्वक्रगते ग्रहे ज्ञेयः समागमः" पूर्वोक्तानुरूपमेव । एवं कदम्बप्रोतीयेन ग्रहेण स्फुटक्रियाऽऽगतेन नक्षत्रयोगो ह्यानीतः । भास्कराचार्येण तु कदम्बप्रोतीययोर्ग्रहयोर्गतैष्ययुतिवदेव ध्रुवप्रोतीययोर्ग्रहयोर्गतैष्या युतिरभिहिता सा न समीचीना, कदम्ब प्रोतीय गतैष्य युति वत्सर्वदा ध्रुव प्रोतीय गतैष्यायुतिर्न भवति कदाचिद्गतैष्यत्वं विलोमत्वं भवति । यथा ध्रु=उत्तर ध्रुवः । क=उत्तर-



कदम्वम् । ग्र=मार्गोमन्दगतिर्ग्रहो यस्य स्थानम्=न, ग्र=अधिक-गतिर्ग्रहोमार्गो यस्य स्थानम्=म, तदा कदम्व प्रोतीया युतिर्गता-ऽधिकगतिग्रहस्याग्रे गतत्वात् । ग्रहयोरुपरि ध्रुवप्रोतवृत्तकरणेन ग्र गृहस्यायन दृक्कर्म संस्कृत स्थानम् =य, ग्र गृहस्यायन दृक्कर्म संस्कृत स्थानम्=र अत्र मन्दगतिगृहादधिकगतिगृहः पृष्ठेऽस्त्यतो युतिरेष्या ; एवं बहुत्र स्थले व्यभिचरित, सिद्धान्ततत्त्वविवेकेकमला करेण भांस्करोक्त युतिसाध-नस्य यत्खण्डनं कृतं तद्युक्तियुक्तमिति ॥ ४ ॥

हि. भा.—पूर्वोक्त पठित ध्रुवा से ग्रह ऊन (अल्प) रहे तो योग एष्य होता है, यदि ध्रुवा से ग्रह अधिक रहे तो योग गत होता है, ग्रह के वक्री रहने से अन्यथा अर्थात् विपरीत होता है (ग्रह के ऊन रहने से योग गत, अधिक रहने से एष्य) अन्य सब कर्म (गत गम्य दिनादि के आनयनादि) ग्रहयुति की तरह समझना चाहिए । भध्रुवक की क्रान्ति के अग्र से वक्ष्यमाण नक्षत्रों का शरांश समझना चाहिए इति ; सिद्धान्त शेखर में "महति युतिरतीता भध्रुवात् खेचरे ऽल्पे भवति हि पुनरेष्या चान्यथा वक्रयाते" इत्यादि सं० भाष्य में लिखित श्लोकों से श्रीपति ने आचार्योक्तानुरूप ही कहा है । सूर्य सिद्धान्त में भी "ग्रहमेलकवच्छेषं ग्रहभुक्त्या दिनानि च । एष्यो हीने" इत्यादि सं० भाष्य में लिखित श्लोकों से पूर्वोक्त सदृश ही

कहा गया है। एवं स्फुट क्रिया द्वारा आए हुए कदम्बप्रोतीय ग्रह से नक्षत्रयोग विचार किया गया है। भास्कराचार्य ने कदम्ब प्रोतीय दो ग्रहों की गतैष्य युति की तरह ध्रुवप्रोतीय दो ग्रहों की गतैष्ययुति का भी विचार किया है, सो ठीक नहीं है कदम्बप्रोतीय गतैष्य युति की तरह सर्वदा ध्रुवप्रोतीय गतैष्य युति नहीं होती है कभी कभी गतैष्यत्व में विपर्यय होता है जैसे—

यहां सं० भाष्य में लिखित क्षेत्र को देखिए। ध्रु=उत्तर ध्रुव। क=उत्तर कदम्ब ग्र=मार्गीमन्दगति ग्रह है जिसका स्थान न है, ग्र=मार्गी अधिकगति ग्रह है जिसका स्थान =म है, तब यहां अधिक गति ग्रह के मन्द गति ग्रह से आगे होने के कारण कदम्बप्रोतीय युति गत होती है, दोनों ग्रहों के ऊपर ध्रुवप्रोतवृत्त करने से ग्र ग्रह के आयन दृक्कर्म संस्कृत स्थान=य, है और ग्र ग्रह के आयन दृक्कर्म सस्कृत स्थान=र है, यहां मन्दगति ग्रह से अधिक गति ग्रह पीछे है इस लिए युति एष्य होती है, इस तरह बहुत स्थलो में व्यभिचार होता है, सिद्धान्त तत्त्व विवेक में कमलाकर ने भास्करोक्त युति साधन का जो खण्डन किया है वह युक्ति युक्त है इति ॥ ४ ॥

इदानीं नक्षत्राणां शरांशानाह

सौम्या दशार्कविषया याम्याः शरदशभवा रसाः सौम्याः ।
खं सप्तदक्षिणाः खं सौम्याः सूर्यत्रयोदशकाः ॥ ५ ॥

दक्षिणतो भवयमलाः सप्तत्रिंशदुदगंशका याम्या ।
अध्यर्धत्रिचतुष्कार्धनवमसत्र्यंशविषयशराः ॥ ६ ॥

सौम्या द्व्यधिका षष्टिस्त्रिंशत् षट्त्रिंशदितरलिप्ताः ।
अष्टादशोत्तरा जिनषड्विंशत्यम्बराण्यंशाः ॥ ७ ॥

प्राजेशयोगतारा विक्षेपांशैः कला त्रिघनहीनैः ।
आग्नेयस्य कलानामेकोनत्रिंशता हीनैः ॥ ८ ॥

पञ्चदश कला हीनैश्चित्रायाः सप्तभिर्विशाखायाः ।
षट्सप्तत्या मैत्रस्यैन्द्रस्य त्रिंशता हीनैः ॥ ९ ॥

सु. *भा.*—अश्विन्यादियोगताराणामेते यथा दिक्काः शरांशा ज्ञेयाः। दश द्वादश पञ्चभागा उत्तराः। पञ्च-दश-एकादशभागा याम्याः। षड्भागा उत्तराः। शून्यम्। सप्तभागा दक्षिणाः। शून्यम्। द्वादश-त्रयोदशभागाः सौम्याः। एकादश-यमलं द्वयं भागा दक्षिणाः। सप्तत्रिंशद्भागाः सौम्याः।

अध्यर्ध सार्धैकभागः १°।।३०'।। अर्धनवमं सार्धाष्टभागाः ८°।३०'।। सत्र्यंशा विषया पञ्चभागाः । ५°।२०' ।। शरा पञ्चभागा याम्याः । द्व्यधिका षष्टिर्द्विषष्टि भागाः, त्रिंशद्भागाः, षट्त्रिंशद्भागा उत्तराः । इतरा दक्षिणा अष्टादशलिप्ताः शरकलाः । चतुर्विंशतिषड्विंशतिशून्यभागा उत्तराः प्राजेशस्य रोहिण्या योगतारा-विक्षेपांशैः पूर्वोदितशरांशैः किं विशिष्टैः कलात्रिघनहीनैः सप्तविंशतिकलारहितै-स्तिष्ठति । आग्नेयस्य कृत्तिकायाश्च योगतारा पूर्वोक्तशरांशैरेको नत्रिंशत्कलाहीनै-श्चित्रायाः पञ्चदशकलाहीनैर्विशाखायाः सप्तभिः कलाभिर्हीनैर्मैत्रस्यानुराधायाः कलानां षट्सप्तत्या भागेनैकेन षोडषकलाधिकेन हीनैरैन्द्रस्य ज्येष्ठायाः कलात्रिंशता हीनैर्योगतारा तिष्ठति । अर्थात् पूर्वोदितशरांशाः पठितकलोनास्तदा नेषां नक्षत्राणां यथोदितदिक्का वास्तवशरभागा वेदितव्या ।

नक्षत्राणां शरांशाश्चैते

अ०	भ०	कृ०	रो०	मृ०	आ०	पु०	पु०	श्ले०	म०	पू०	उ०	ह०	चि०
१०	१२	४°,	४°,	१०	११	६	०	७	०	१२	१३	११	१
उ	उ	३१'	३३'	द	द	उ.	द.	द.	उ.	उ.	उ.	द.	४५
		उ.	द.										द.

स्वा०	वि०	अ०	ज्ये०	मू०	पू०	उ०	अ०	श्र०	ध०	श०	पू०	उ०	रे०
३७	१	१	३	८	५	५	६२	३०	३६	०	२४	२६	०
उ	२३	४४	३०	३०	२०	द.	उ.	उ.	उ.	१८	उ.	उ.	उ.
	द	द	द	द	द					द			

भास्करेण कृत्तिकाया रोहिण्याश्च ४°।३०'। विशाखाः १°।२०'। अनु-राधायाः १°।४५'। शततारकायाः ०°।२०' इति भिन्नाः पठिताः । अन्येषां चाचार्यो-क्तसमा एवेति सुधीभिर्विचिन्त्यम् ।। ५-९ ।।

वि. भा.—सौम्या दशार्कविषया इत्यादयोंऽशका अश्विन्यादियोगताराणां यथादिक्काः शरांशा भवन्तीति । दश, द्वादश, पञ्चभागा उत्तराः । पञ्च, दश, एकादश भागा याम्याः । रसाः (षट्) भागा उत्तराः । खं (शून्यम्) सप्तभागा दक्षिणाः शून्यं-द्वादश-त्रयोदशभागा उत्तराः । भव (एकादश) यमलं (द्वयंभागाः) दक्षिणाः । सप्तत्रिंशद्भागा उत्तराः । अध्यर्ध (सार्धैक भागः १°।३०') । अर्धनवमं (सार्धाष्टभागाः ८°।३०') सत्र्यंशा विषयाः पञ्चभागाः ५°।२०' शराः पञ्चभागा याम्याः । द्व्यधिका षष्टिः (द्विषष्टि भागाः) त्रिंशद्भागा षट्त्रिंशद्भागा उत्तराः । इतरा (दक्षिणाः) अष्टादशकलाः शरकलाः, जिन षड् विंशत्यम्ब-राण्यंशाः (चतुर्विंशतिषड्विंशतिश्शून्य भागाः) उत्तराः, प्राजेयास्य (रोहिण्याः)

योगतारा विक्षेपांशैः (पूर्वकथितशरांशैः) कलात्रिघनहीनैः (सप्तविंशतिकला रहितैः) तिष्ठति। आग्नेयस्य (कृत्तिकायाः) योगतारा कलानामेकोनत्रिंशता हीनैः पूर्वोक्त शरांशैः, चित्रायाः पञ्चदश कलाहीनैः, विशाखायाः सप्तभिः कलाभि र्हीनैः, मैत्रस्य (अनुराधायाः) कलानां षट्सप्तत्या (भागेनैकेन षोडश कलाधिकेन हीनैः, ऐन्द्रस्य (ज्येष्ठायाः) कलात्रिंशता हीनैर्योगतारा तिष्ठत्यर्थात्पूर्व कथित शरांशाः पठित कलोनास्तदा तेषां नक्षत्राणां यथोदित दिक्का वास्तवशरांशा ज्ञातव्या इति।

नक्षत्राणामेते शरांशाः।

अ	भ	कृ	रो	मृ	आ	पु	तु	श्ले	म	पू	उ	ह	चि
१०	१२	४°,	४°,	१०	११	६	०	७	०	१२	१३	११	१
उ	उ	३१′	३३′	द	द	उ	द	द	उ	उ	उ	द	४५
		उ	द										द

स्वा	वि	अ	ज्ये	मू	पू	उ	अ	श्र	ध	श	पू	उ	रे
३७	१	१	३	८	५	५	६२	३०	३६	०	२४	२६	०
उ	२३	४४	३०	३०	२०	द	उ	उ	उ	१८	उ	उ	उ
	द	द	द	द	द					द			

सिद्धान्तशेखरे श्रीपतिनाऽऽचार्योक्ता एवैते नक्षत्राणां शरांशाः स्वीकृताः। सिद्धान्त शिरोमणौ भास्कराचार्येण कृत्तिकायाः ४°।३०′, विशाखायाः १°।२०′, अनुराधायाः १°।४५′ शततारकायाः ०°।२०′ इति भिन्नाः शरांशाः पठिताः। सूर्य सिद्धान्ते बहूनां नक्षत्राणां शरांशा आचार्योक्ताद्भिन्नाः पठिताः सन्तीत्यत्रोपलब्धिरेव कारणमिति ॥

अत्रोपपत्तिः

विपुलं गोल यन्त्रं निर्माय रात्रौ गोलकेन्द्रगतया दृष्ट्या रेवतीतारां विलोक्य क्रान्तिवृत्ते स्वमीनान्तबिन्दुं रेवतीतारायां निवेश्य केन्द्रगतदृष्टचैव नक्षत्रमवलोक्य तद्बिम्बकेन्द्रोपरि कदम्बप्रोतवृत्तं ध्रुवप्रोतवृत्तं च कार्यम्। कदम्बप्रोतवृत्तक्रान्तिवृत्तयोः सम्पातात् (नक्षत्रस्पष्टभोगचिह्नात्) नाड़ीवृत्तक्रान्तिवृत्तयोः सम्पातं (मेषादिं) यावत्सायना ध्रुवाः। नक्षत्रस्पष्टभोगचिह्नान्नक्षत्रबिम्ब केन्द्रावधि कदम्बप्रोतवृत्ते शरः। नाड़ीवृत्त क्रान्तिवृत्तयोः सम्पातात्-ध्रुव प्रोतवृत्त क्रान्तिवृत्तयोः। सम्पातं यावदायनदृक्कर्म संस्कृताः सायना नक्षत्रध्रुवाः। नक्षत्रबिम्बात् ध्रुव प्रोतवृत्तक्रान्तिवृत्तयोः सम्पातं यावत्ध्रुवप्रोतवृत्ते नक्षत्र स्फुटशरः, एवमाचार्येण स्वसमये वेधेन नक्षत्राणां शरांशाः परीक्षिताः। भास्करा-

चार्येण "इत्यभावेऽयनांशानां कृतदृक्कर्मका ध्रुवा" इत्यादि विपरीतविधिना नक्षत्र-स्फुटशरान्मध्यमः शरो (कदम्बप्रोतवृत्तीयः) यः साधितः स च न समीचीनः। यतस्त्रिज्यावर्गादयनवलनज्या कृतिमित्यादिना मध्यमशरा (कदम्बप्रोतवृत्तीयात्) त्स्फुटशरो (ध्रुवप्रोतवृत्तीयः) ऽन्यो भवति। अत्र नक्षत्र बिम्बात्क्रान्तिवृत्तावधि (नक्षत्रस्पष्टभोगचिह्नं यावत्) मध्यमशरः कोटिरूपः। नक्षत्रबिम्बात्क्रान्तिवृत्ता-वधि ध्रुवप्रोतवृत्तेस्पष्टशरः कर्णरूपः, मध्यमशरात्स्पष्टशरोऽत्राधिकः, तद्विलोम-विधिना नक्षत्रस्पष्टशरतोऽप्यधिको महानशुद्धो भविष्यति, तद्वशादन्येऽपि ध्रुवादयो न समीचीना भवन्त्यतो भास्करोक्तं सर्वं निर्युक्तिकं बोध्यम्। अथ नक्षत्रस्पष्टशरः कर्णं एको भुजः। नक्षत्रमध्यमशरः कोटिर्द्वितीयो भुजः। आयन न दृक्कर्म कला-भुजस्तृतीयो भुजः। अस्मिन् चापीयजात्ये नक्षत्रस्पष्टशराऽऽयनदृक्कर्माभ्यामुत्पन्न-कोण आयन वलनकोटिः, नक्षत्रस्पष्टभोगचिह्न लग्न (कदम्ब प्रोतवृत्तक्रान्तिवृत्ता-भ्यामुत्पन्नः) कोणः समकोणोऽस्तोऽनुपातः क्रियते यदि त्रिज्यया नक्षत्र स्फुटशरज्या लभ्यते तदाऽऽयनवलन कोटिज्यया (यष्ट्या) किमिति समागच्छति नक्षत्रमध्यम-शरज्या, तत उक्तत्रिभुजे भुजकोटिज्याकोटिकोटिज्ययोर्घातस्य त्रिज्या कर्णकोटि-ज्ययोर्घातसमत्वात् आयनदृक्कर्मकला कोज्या $\times$ नक्षत्र मध्यशरकोज्या $=$ त्रि $\times$ नक्षत्र स्पशकोज्या, ततः $\frac{\text{त्रि. नक्षत्र स्पशर कोज्या}}{\text{नक्षत्र मध्यशकोज्या}}$ $=$ आयनदृक्कर्म कला कोज्या, अस्याश्चापं नवतेर्विशोध्यं तदाऽऽयनदृक्कर्म कला भवेत्तेनात्र सकृत्कर्मणैव सर्व-मुत्पद्यतेऽस्तोऽशुद्धो भास्करोक्तविधिर्न स्वीकार्य इति ॥ ५-९ ॥

अब नक्षत्रों के शरांशों को कहते है।

हि. भा.—अश्विन्यादि नक्षत्रों के पठित शराश सरकृत भाष्य में लिखित के अनुसार समझना चाहिए। सिद्धान्त शेखर मे श्रीपति ने आचार्योक्त पठित शरांश ही को स्वीकार किया है, सिद्धान्त शिरोमणि मे भास्कराचार्य ने कृत्तिका के ४°। २०′, विशाखा के १°। २०′, अनुराधा के १°। ४५′, शततारा के ०°। २०′ इन नक्षत्रो के शरांश आचार्योक्त से भिन्न कहे हैं सूर्य सिद्धान्त में अनेक नक्षत्रों के पठित शरांश आचार्योक्त से भिन्न कहे गये हैं। इसमें केवल उपलब्धि को (जिनके समय में जो उपलब्धि हुई) ही एक मात्र कारण कह सकते हैं इति ॥ ५-९ ॥

उपपत्ति।

विपुल (बड़ा) गोलयन्त्र बनाकर रात्रि में गोल केन्द्रगत दृष्टि से रेवती तारा को देखकर क्रान्तिवृत्त में मीनान्त बिन्दु को रेवती धारा में निवेश कर केन्द्रगत दृष्टि ही से नक्षत्र को देखकर उसके बिम्ब केन्द्र के ऊपर कदम्ब प्रोतवृत्त और ध्रुव प्रोत वृत्त करना,

कदम्ब प्रोतवृत्त और क्रान्तिवृत्त के सम्पात (नक्षत्रस्पष्टभोग चिह्न) से नाडीवृत्त और क्रान्तिवृत्त के सम्पात (मेषादि) पर्यन्त सायन नक्षत्रध्रुवा है, नक्षत्र स्पष्ट भोग चिह्न से नक्षत्र बिम्ब केन्द्र तक कदम्ब प्रोतवृत्त में नक्षत्र के मध्यमशर है, नाडीवृत्त और क्रन्तिवृत्त के सम्पात से ध्रुवप्रोतवृत्त और क्रान्तिवृत्त के सम्पात पर्यन्त आयन दृक्कर्म सस्कृत सायन नक्षत्र ध्रुवा है, नक्षत्र बिम्ब से ध्रुवप्रोतवृत्त और क्रान्तिवृत्त के सम्पात पर्यन्त ध्रुव प्रोत वृत्त मे नक्षत्र के स्फुटशर है, इस तरह आचार्य ने अपने समय में बेध से नक्षत्रों के शराश को परीक्षित कर पठित किया। भास्कराचार्य "इत्यभावेऽयनांशानां कृत दृक्कर्मका ध्रुवा:" इत्यादि से विलोम-विधि से नक्षत्र स्फुटशर से मध्यमशर का जो साधन किया है सो ठीक नही है, क्योंकि 'त्रिज्यावर्गादयनवलनज्याकृतिं प्रोह्यमूलं' इत्यादि से मध्यमशर से स्फुटशर (ध्रुव प्रोतवृत्तीय कोटिचाप) अल्प होता है, यहां नक्षत्र बिम्ब से क्रान्तिवृत्त पर्यन्त (नक्षत्र स्पष्टभोग चिह्न तक) कदम्बप्रोतवृत में मध्यमशर कोटिरूप है, और नक्षत्र विम्ब से क्रान्ति वृत्तपर्यन्त ध्रुव प्रोतवृत्त में स्पष्टशर कर्णरूप है, मध्यमशर से स्फुटशर यहां अधिक है, विलोम विधि से नक्षत्र स्फुटशर से भी अधिक बहुत अशुद्ध होगा। उसके वश से अन्य ध्रुवा आदि भी समीचीन नही होती है, इसलिये भास्करोक्त सब बातें निर्युक्तिक समझनी चाहिये। नक्षत्र-स्फुटशर कर्ण एक भुज, नक्षत्र मध्यमशर कोटि द्वितीय भुज, क्रान्तिवृत्त मे आयन दृक्कर्मकला भुज तृतीय भुज, इन तीनों अवयवों से उत्पन्न चापीयजात्य में क्रान्तिवृत्त और ध्रुव प्रोत वृत्त से उत्पन्न कोण आयन वलनकोटि है, कदम्ब प्रोत वृत्त और क्रान्तिवृत्त से उत्पन्न कोण समकोण है, इसलिये अनुपात करते हैं यदि त्रिज्या में नक्षत्र स्फुटशरज्या पाते है तो आयन-वलन कोटिज्या में क्या इससे नक्षत्र की मध्यमशरज्या आयी, चाप करने से नक्षत्र का मध्यमशर हुआ, तब उक्त त्रिभुज में भुज कोटिज्या और कोटि कोटिज्या का घात त्रिज्या और कर्ण-कोटिज्या के घात के बराबर होता है, इससे आयन दृक्कर्मकला कोज्या. नक्षत्रमशर कोज्या = त्रि. नक्षत्र स्पशकोज्या, दोनो पक्षों में 'नक्षत्रमशकोज्या' से भाग देने से $\frac{\text{त्रि. नक्षत्रस्पशकोज्या}}{\text{नक्षत्रमशकोज्या}}$ = आयन दृक्कर्मकलाकोज्या, इसके चाप को नवत्यश में से घटाने से आयनदृक्कर्म कला होती है, इसलिये यहां सकृत्कर्म ही से सबों के ज्ञान होते है अतः भास्करोक्त विधि आदरणीय नहीं हैं इति ॥ ५-९ ॥

इदानीं विशेषमाह।

छादयति योगतारां मानार्धोनाधिकाद् भविक्षेपात् ।
स्फुटविक्षेपो यस्याधिकोनको भवति समदिक्स्थः ॥१०॥

सु. भा.—भविक्षेपान्नक्षत्रशरात् किंविशिष्टात् मानार्धोनाधिकाद् ग्रहबिंब-मानार्धेनोनाद्युताच्च यस्य ग्रहस्य स्फुटविक्षेपो ध्रुवप्रोतीयः शरः क्रमेणाधिकोनो भवति स समदिक्स्थो ग्रहो योगतारां छादयति।

अत्रोपपत्तिः। कल्प्यते ग्रहशरो नक्षत्रशरदिक्को नक्षत्रशरादल्पस्तदा द्वयोरन्तरेण केन्द्रान्तरम् नश-ग्रश इदं ग्रहबिम्वमानार्धादल्पं तदाग्रहो योगतारां छादयति। अतस्तदा नश-ग्रश $< \frac{\text{विंमा}}{२}$ ∴ नश $= \frac{\text{विंमा}}{२} <$ ग्रश। एवं यदा नक्षत्रशर दिक्को ग्रहशरोऽधिकस्तदा भेदयोगे ग्रश-नश $< \frac{\text{विमा}}{२}$ ∴ ग्रश $<$ नश $+ \frac{\text{विंमा}}{२}$ अतः आचार्योक्तं स्पष्टमुपपद्यते ॥ १० ॥

वि. भा.—भविक्षेपात् (नक्षत्रशरात्) मानार्धोनाधिकात् (गृहबिम्वमानार्धेन हीनाद्युनाच्च) यस्य गृहस्य समदिक्स्थः स्फुटविक्षेपः (ध्रुवप्रोतवृत्तीयो गृहस्पष्टशरः) क्रमेणाधिकोनो (अधिक हीनः) भवति स गृहो योगतारां छादयतीति ॥१०॥

अत्रोपपत्तिः।

कल्प्यते—एकदिक्कयोर्गृहनक्षत्रशरयोर्मध्ये यदि नक्षत्रशराद् गृहशरोऽल्पस्तदा तयोरन्तरेण केन्द्रान्तरम्=नक्षत्रशर—गृहशर, इद यदि गृहबिम्बार्धाल्यं तदागृहो योगतारां छादयति, अतस्तदा नक्षत्रश—गृहश $< \frac{\text{विंमा}}{२}$ तेन नक्षत्रश $- \frac{\text{विंमा}}{२} <$ गृहश। एवं यद्येकदिक्कयोर्नक्षत्रगृहशरयोर्मध्ये गृहशरोऽधिकस्तदा भेदयोगे गृशर $-$ नक्षत्रश $< \frac{\text{विमा}}{२}$ अतः नक्षत्रश $+ \frac{\text{विमा}}{२} >$ गृशर अत आचार्योक्तमुयपन्नमिति। सिद्धान्तशेखरे "ऋक्षक्षेपान्मानखण्डाधिकोनात् स्पष्टः क्षेपो यस्य हीना धिकश्चेत्। तुल्यांशः स्यात् योगतारां हि धत्ते तद्धिष्ण्यस्य व्योमगामी स नूनम्" इत्यनेन श्रीपतिनाऽचार्योक्तानुरूपमेवोक्तमिति ॥ १० ॥

अब भग्रहयुति में विशेष कहते है।

हि. भा.—नक्षत्र शर में ग्रह बिम्बमानार्ध को हीन और युत करने से जो हो उनसे जिस ग्रह के समदिक् स्थित स्पष्टशर क्रम से अधिक और हीन हो तो वह ग्रह योगतारा को छादित करते है इति ॥ १० ॥

उपपत्ति।

एक दिशा के ग्रहशर और नक्षत्र शर में यदि नक्षत्रशर से ग्रहशर अल्प है तब दोनों के अन्तर करने से केन्द्रान्तर=नक्षत्रश—ग्रहश, यह यदि ग्रहविम्बमानार्धाल्प है तो ग्रह योग-

तारा को छादित करते हैं। इसलिये तव नक्षत्रश − ग्रशर < $\frac{\text{विमा}}{२}$ ∴ नक्षत्रश − $\frac{\text{विमा}}{२}$ < ग्रहश। एवं एक दिशा के नक्षत्रशर और ग्रहशर में यदि ग्रहशर अधिक है तो भेदयोग मे ग्रहश—नक्षत्रश < $\frac{\text{विमा}}{२}$, अतः नक्षत्रश + $\frac{\text{विमा}}{२}$ > ग्रशर इससे आचार्योक्त उत्पन्न हुआ। सिद्धान्त शेखर मे "ऋक्षक्षेपान्मानखण्डाधिको गाज्" इत्यादि सं. उपपत्ति मे लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप हीं कहा है इति ॥ १० ॥

इदानीं रोहिणीशकटभेदमाह।

विक्षेपांश द्वितयादधिको वृषभस्य सप्तदश भागे।
यस्य ग्रहस्य याम्यो भिनत्ति शकटं स रोहिण्याः ॥ ११ ॥

सु. भा.—स्पष्टार्थम्। अत्रोपपत्तिः। रोहिणीशकटस्य ध्रुवभागा वृषस्य सप्तदशांशाः। याम्यः शरश्चांशद्वयाधिकः। अतो ग्रहस्य तादृशि स्थितौ शकटे प्रवेश इति स्फुटम्।

अत्राधिकपदेन रोहिणीशर पर्यन्तमेव गृह्यतेऽन्यथा रोहिणीयोगतारातोऽपि- दक्षिणस्थे ग्रहबिम्बे शकटभेदाभावस्तेनांशद्वयाधिको रोहिणीशरतोऽल्पो याम्यः शरो यस्य स एव रोहिणीशकटं भिनत्ति।

वि. भा. यस्य गृहस्य स्थानं वृषभस्य सप्तदश १७ भागे भवेद्याम्यः (दक्षिणः) शरश्चांशकद्वयादधिकः स गृहो रोहिण्याः शकटं भिनत्तीति ॥ ११ ॥

अत्रोपपत्तिः।

रोहिणी नक्षत्रस्थितिवशेन तदाऽऽकृतिः शकटाकाराऽऽकाशे ऽस्तीति प्राचीनानां विश्वासः। तस्य शकटस्य ध्रुवो वृषस्य सप्तदशां १७ शेऽस्ति, क्रान्ति-वृत्तासन्नतारायाश्च दक्षिणः शरोंऽशद्वयतुल्योऽतो यस्य गृहस्य वृषस्य सप्तदशेंऽशे स्थितिः, दक्षिणः शरश्चांशद्वयादधिकः स शकटान्तर्गतत्वाच्छकटं भेदयेदेव। अत्रांशद्वयाधिक इत्यत्राधिक पदेन रोहिणी शरपर्यन्तमेव गृह्यतेऽन्यथा रोहिणी योगतारातोऽपि दक्षिणस्थे गृहबिम्बेशकट भेदाभावस्तेनांशद्वयाधिको रोहिणी शरतोऽल्पो यस्य गृहस्य दक्षिणः शरो भवेत्स एव रोहिणी शकटं भिनत्तीति ॥

सूर्य सिद्धान्ते "वृषे सप्तदशे भागे यस्य याम्योंऽशकद्वयात्। विक्षेपोऽभ्यधिको भिन्द्याद्रोहिण्याः शकटं तु सः" ऽनेन सिद्धान्त शेखरे "अत्यष्टिसंख्ये वृषभस्य भागे स्थितस्य यस्य द्युचरस्य नूनम्। याम्यःशरोंऽशद्वितयाधिकः स्यात् स रोहिणीनां शकटस्य भेत्ता" ऽनेन श्रीपतिनाप्याचार्योक्तानुरूपमेवोक्तमिति ॥ ११ ॥

अब रोहिणीशकट भेद को कहते है।

हि. भा.—रोहिणी नक्षत्र के स्थितिवश से उसकी आकृति (आकार-स्वरूप) शकट (गाड़ी) के आकार के है यह प्राचीनों के वचन प्रमाण से विदित होता है। उस शकट के ध्रुव वृष (राशि) के सतरह अंश में है, क्रान्तिवृत्त के आसन्न (समीप) स्थित तारा के दक्षिण शर दो अंश के तुल्य है, इसलिये जिस ग्रह की वृष के सप्तदशांश में स्थिति हो और दक्षिण शर दो अंश से अधिक हो वह ग्रह शकट अन्तर्गत होने के कारण शकट को भेदन करता ही है। यहां श्लोक में दो अंश से अधिक कहा गया है, अधिक पद से रोहिणीशर पर्यन्त ही लेना चाहिये नहीं तो रोहिणी योगतारा से भी दक्षिण में ग्रहविम्व के रहने से शकट भेदाभाव होता है इसलिये दो अंश से अधिक और रोहिणीशर से अल्प जिस ग्रह का दक्षिणशर होता है वही (ग्रह) रोहिणीशकट को भेदन करता है। इससे आचार्मोक्त उपपन्न हूआ।

सूर्य सिद्धान्त में "वृषे सप्तदशे भागे यस्य याम्योंऽशकद्वयात्" इत्यादि से, तथा सिद्धान्त शेखर में "अत्यष्टि संख्ये वृषभस्य भागे" इत्यादि सं. उपपत्ति में लिखित श्लोक से श्रीपति ने भी आचार्योक्त के अनुरूप ही कहा है इति ॥ ११ ॥

इदानीं भेदे विशेषमाह।

विक्षेपान्ते सौम्ये तृतीयतारां भिनत्ति पित्र्यस्य।
इन्दुर्भिनत्ति पुष्यं पौष्णं वारुणमविक्षिप्तः ॥१२॥

सु. भा.—इन्दुः सौम्ये विक्षेपान्ते सौम्यशरस्य परमे पित्र्यस्य मघायास्तृतीयतारां भिनत्ति। एवमविक्षिप्तःशररहित इन्दु पुष्यं पौष्णं रेवतीं वारुणं शततारकां च भिनत्ति।

अत्रोपपत्तिः। मघातृतीयताराया: शर उत्तरश्चन्द्रपरमशरसमो ध्रुवश्च-पूर्वोक्ताः ४ रा। ९ अं। अतस्तत्रैव ग्रहबिम्बे भेदयोगोभवत्येवात्र किं चित्रम्। शेषोपपत्तिरप्यत्र पूर्वयुक्त्या स्फुटा। यस्या मघायोगताराया ध्रुवाः शून्यशरभागाश्च पठितास्तां चाविक्षिप्त एवेन्दुर्भिनत्ति ॥१२॥

वि. भा.—इन्दुः (चन्द्रः) सौम्ये विक्षेपान्ते (उत्तरे परमशरे) पित्र्यस्य

(मघायाः) तृतीयतारां भिनत्ति (भेदयति) एवं अविक्षिप्तः (शररहित) चन्द्रः पुष्यं, पौष्णं (रेवती) वारुण (शततारकां) भिनत्तीति ॥१२॥

अत्रोपपत्तिः ।

मघातृयीयताराया उत्तरः शरश्चन्द्रपरमशर २७०°=(४°।३०') तुल्या
रा अं
ध्रुवश्च पूर्वकथितः ४।९, अतस्तत्र विद्यमानश्चन्द्रो मघातृतीयतारां भिनत्तीति,
रा अं
यस्या मघा योगताराया ध्रुवः=४।९, शराभावश्चोक्तस्तां शरहीन एव चन्द्रो भिनत्ति, तथैव शराभाववतां पुष्य शतभिषग्रेवतीनां नक्षत्राणां पृथक् पृथक् ध्रुवकैस्तुल्यः शररहितश्चन्द्रस्तेषां भेत्ता भवतीति ॥ सिद्धान्तशेखरे "चन्द्रो मघाध्रुवसमः परमोत्तरेषुः पित्राभिधस्य हि भिनत्ति तृतीयताराम् । क्षेपोज्झितो वरुणपूष सुरेज्यभानां भेत्ता तदा भवति तद्ध्रुवकैः समश्चेत्" अनेन श्रीपतिनाऽऽचार्योक्तानुरूपमेवोक्तमिति सुधीभिश्चिन्त्यम् ॥१२॥

अब भेद में विशेष कहते है ।

हि. भा.—चन्द्रमा ऊत्तर परमशर में मघा की तृतीयतारा को भेदन करते है, एवं शर रहित चन्द्र पुष्य, रेवती, और शततारा को भेदन करते हैं इति ॥१२॥

उपपत्ति ।

मघा तृतीय तारा का उत्तर शर चन्द्र के परमशर २७०°=४° । ३०' के तुल्य
रा अं
है और पूर्वोक्त ध्रुवा ४।९, है इसलिये उस में स्थित चन्द्र मघा की तृतीय तारा को भेदन
रा अं
करते ही हैं। जिस मघायोगतारा की ध्रुवा=४ । ९ और शराभाव है उसको शरहीन ही चन्द्र भेदन करते है। उसी तरह शराभाव वाले पुष्य, रेवती और शततारक, इन नक्षत्रों के पृथक् पृथक् ध्रुवक के तुल्य शर रहित चन्द्र भेत्ता (भेदन करने वाले) होते है ।

सिद्धान्त शेखर में "चन्द्रो मघा ध्रुवसमः परमोत्तरेषुः "इत्यादि सं. उपपत्ति मे लिखित श्लोक से श्रीपति" आचार्योक्त के अनुरूप ही कहा है इति ॥१२॥

इदानीं नक्षत्रादि दृक्कर्म साधने कारणमाह ।

कृत्वापि दृष्टिकर्म श्रीषेणार्यभटविष्णुचन्द्रोक्तम् ।
प्रतिदिनमुदयेऽस्ते वा न भवति दृग्गणितयोरैक्यम् ॥१३॥

भमुनि मृगव्याधानां यतस्ततो दृष्टिकर्म वक्ष्यामि।
दृग्गणितसमं देयं शिष्याय चिरोषितायेदम् ॥१४॥

सु. भा.—श्रीषेणार्यभट विष्णुचन्द्रोक्तं दृष्टिकर्म कृत्वापि प्रतिदिनं भमुनिमृगव्याधानां नक्षत्रागस्त्यलुब्धकानामुदयेऽस्ते वा यतो दृग्गणितयोरैक्यं न भवति ततस्तस्मात् कारणाद् दृग्गणितसमं दृष्टिकर्म वक्ष्यामि। इदं दुर्लभं वक्ष्यमाणं दृक्कर्म चिरोषिताय भक्ताय शिष्याय देयं नान्येभ्य इति ॥१३-१४॥

वि. भा.—यतः (यस्मात् कारणात्) श्रीषेणार्यभट विष्णुचन्द्रोक्तं (श्रीषेण-आर्यभटादि कथितम्) दृष्टिकर्म (आयनं दृक्कर्माक्षजं दृक्कर्म च) कृत्वापि (नक्षत्रादिषु तत्संस्कार दानेनापि) प्रतिदिनं भमुनिमृगव्याधाना (नक्षत्रागस्त्यलुब्धकानां) मुदयेऽस्तेवा दृग्गणितयोरैक्यं (वेधगणितसाम्यम्) न भवति, ततः (तस्मात् कारणात्) दृग्गणितसमं (दृष्टया वेधेन-गणितेन च तुल्यं) दृष्टिकर्म (दृक्कर्म) वक्ष्यामि, इदमपूर्व वक्ष्यमाणं दृक्कर्म चिरोषिताय (स्वान्ते चिरवासिने) शिष्याय देयं-नान्येभ्य इति :।१३-१४॥

अब नक्षत्र आदि के दृक्कर्म साधन में कारण कहते हैं।

हि. भा.— जिस कारण से श्रीषेण-आर्यभट-विष्णुचन्द्र आचार्य कथित दृष्टि कर्म (आयन दृक्कर्म और आक्षदृक्कर्म) को नक्षत्रादि में संस्कार करने से भी प्रतिदिन नक्षत्र अगस्त-लुब्धक इन सबों के उदय और अस्त में दृग्गणितैक्य (वेधागत और गणितागत उदयकाल औंर और अस्तकाल में समता) नहीं होता है, उस कारण से वेध से और गणित से तुल्य आने वाले दृष्टि कर्म को कहता हूं। यह दुर्लभ आगे कहे जाने वाले दृक्कर्म अपने निकट में बहुत दिन तक रहने वाले शिष्य को देना चाहिये, दूसरे को नहीं इति ॥१३-१४॥

अथ भमुनिव्याधाक्षज दृक्कर्मार्थं स्फुटक्रान्तिज्यां प्रतिपादयति।

क्रान्तिज्या तत्क्रान्तिर्विक्षेपक्रान्तिचापभागानाम्।
संयोगान्तरजीवा स्वक्रान्तिज्यैकभिन्नदिशाम् ॥१५॥

सु. भा.—नक्षत्रमुनिव्याधध्रुवकेभ्यो ध्रुवज्या जिनज्यागुणा त्रिज्याभक्तेति विधिना क्रान्तिज्या साध्या सा तत्क्रान्तिरुच्यते। तत एकभिन्नदिशां विक्षेपक्रान्तिचापभागानां संयोगान्तरजीवा स्वक्रान्तिज्या स्फुटा भवति।

अत्रोपपत्तिः। आचार्येण ध्रुवप्रोतीया ध्रुवाः शरांशाश्चा पटिताः। अतो

ध्रुवक्रान्तिर्नक्षत्रध्रुवप्रोते नक्षत्रस्थाननाडीमण्डलान्तरांशास्तत्र ध्रुवप्रोतीयशरसं-स्कारेण नाडीमण्डलान्नक्षत्रविम्बावधि ध्रुवपोतेऽंशाः स्पष्टक्रान्त्यंशा भवन्तीति गोलयुक्त्या स्फुटम् । संस्कार वासना चाति सुगमा ॥१५॥

वि. भा.—नक्षत्रमुनिव्याधध्रुवकेभ्यो ध्रुवज्या जिनज्या गुणा त्रिज्या भक्ता फलं क्रान्तिज्या सा तत्क्रान्तिः कथ्यते । तत एकभिन्नदिशां विक्षेपक्रान्ति-चापभागानां संयोगान्तरजीवा स्फुटा स्वक्रान्तिज्या भवतीति ॥१५॥

अत्रोपपत्तिः

आचार्येण ध्रुवाः शरांशाश्च ध्रुवप्रोतवृत्तीयाः पठिताः । अतो ध्रुवक्रान्ति-र्नक्षत्रस्थानोपरिगतध्रुवप्रोतवृत्तनाड़ी वृत्तसम्पातान्नक्षत्र स्थानं यावत्तत्र नक्षत्र-बिम्बोपरिगतध्रुवप्रोतवृत्तनक्षत्रस्थानीयाहोरात्रवृत्तयोः सम्पातान्नक्षत्रबिम्ब यावन्न-क्षत्रस्पष्टशरस्य संस्कारेण नक्षत्रबिम्बोपरिगतध्रुवप्रोतवृतनाडीवृत्तयोः सम्पातान्न-क्षत्रबिम्बं यावद् ध्रुवप्रोतवृत्ते नक्षत्रस्पष्टक्रान्तिर्भवेदिति । सूर्यसिद्धान्ते 'विक्षेपाप-क्रमैकत्वे क्रान्तिर्विक्षेपसंयुता । दिग्भेदे वियुता स्पष्टे' त्यनेन या हि ग्रहाणां स्पष्ट क्रान्तिः साधितास्ति सा न समीचीना, यतो हि सूर्य सिद्धान्तकारेण ध्रुव प्रोतवृत्तीयः स्पष्टशरो न साधितः, तदा विजातीय ध्रुवप्रोतवृत्तीयमध्यक्रान्तिकदम्ब-प्रोतवृत्तीयभगोलीयस्फुटशरयोर्योगान्तराभावात्स्फुटक्रान्तिसिद्धिर्न भवितुमर्हतीति विज्ञैर्ज्ञेयम् ॥१५॥

अब नक्षत्र मुनि व्याधो के अक्षज दृक्कर्म के लिये स्फुट क्रान्तिज्या को कहते है।

हि. भा.—नक्षत्र मुनि व्याधो के ध्रुवकों से जो ध्रुवज्या हो उनको जिनज्या से गुणाकार त्रिज्या से भागदेने से फल क्रान्तिज्या होती है उसका चाप क्रान्ति है, एक दिशा में और भिन्नदिशा में शर चाप (स्पष्टशरचाप) और क्रान्तिचाप का योग और अन्तर करने से स्फुट क्रान्ति चाप होता है उसकी ज्या स्फुट क्रान्तिज्या होती है इति ॥१५॥

उपपत्ति ।

आचार्य ने ध्रुवा और शरांश ध्रुव प्रोतवृत्तीय पठित किया है । इसलिये नक्षत्र स्थानोपरिगत ध्रुवप्रोतवृत्त और नाडीवृत्त के सम्पात से नक्षत्रस्थान पर्यन्त ध्रुवक्रान्ति है, तथा नक्षत्र बिम्बोपरिगतध्रुवप्रोतवृत्त और नक्षत्र स्थानीयाहोरात्रवृत्त के सम्पात से नक्षत्र बिम्बपर्यंत नक्षत्र का स्पष्टशर है, इन दोनों का योगान्तर करने से नक्षत्रविम्बोपरिगतध्रुव प्रोतवृत्त और नाड़ीवृत्त के सम्पात से नक्षत्र बिम्बपर्यन्त ध्रुव प्रोतवृत्त में नक्षत्र की

स्पष्टक्रान्ति होती है। सूर्य सिद्धान्त मे "विक्षेपापक्रमैक्यत्वे क्रान्ति विक्षेप संयुता। दिग्भेदे वियुता स्पष्टा" इस से जो ग्रहो की स्पष्ट क्रान्ति साधित है सो ठीक नही है, क्योकि सूर्य सिद्धान्तकार ने ध्रुव प्रोतवृत्तीय स्फुटशर का साधन नही किया है। तब विजातीय ध्रुव प्रोतीय ध्रुव प्रोतवृत्तीय मध्यम क्रान्ति और कदम्ब प्रोतवृत्तीय भगोलीय स्फुट शर के योग और अन्तर न होने के कारण स्फुट क्रान्ति की सिद्धि नही होती है, नक्षत्र के लिये भी वही प्रक्रिया है जो ग्रह के लिये सूर्य सिद्धान्तकार कहते है इति ॥१५॥

इदानीं विशेषमाह।

एवंभमुनि ध्रुवयोर्ग्रह तत्क्रान्त्या च दृग्टिकर्माद्यम्।
कृत्वा ग्रहे भमुनिवत् तस्मात् स्वक्रान्तिजीवा च ॥१६॥

सु. भा.—एवं भमुनिध्रुवयोः पूर्वप्रकारेण स्पष्टक्रान्तिज्यानयनं कार्यं। नक्षत्रध्रुवा वेधेनाऽऽयनदृक्कर्मसंस्कृता एव पठिताः। अतो ग्रहतत्क्रान्त्या च ग्रहे चाद्यं दृग्टिकर्मायनं दृक्कर्म सजातीयत्वात् कृत्वा तस्मादायनदृक्कर्म संस्कृताद् ग्रहाद् भमुनिवत् स्वक्रान्तिजीवा ग्रहस्पष्टक्रान्तिज्या च साध्या।

अत्रोपपत्तिः। आचार्येण ग्रहकदम्बप्रोतीयः शर एव स्वल्पान्तराद् ध्रुवप्रोतीयः कल्पितो ग्रहशराणामल्पत्वात्। तत आयनदृकर्म संस्कृतग्रहक्रान्ति शरसंस्कारेण नक्षत्रवत् स्फुटक्रान्तिज्यासाधनं कृतम्। भास्कराचार्येण च 'त्रिज्यावर्गादयनवलनज्याकृतिं प्रोह्य' त्यादिविधिना ध्रुवप्रोतीयः स्फुटशरः क्रान्तिसंस्कारयोग्यः साधितः। स च स्थानीय बिम्बीयाहोरात्रवृत्तयोरन्तरचापसमश्चापीयत्रिकोणमिति युक्त्या न भवतीति भास्करसाधितः स्फुटशरः स्थूलोऽतः कमलाकरेण भास्करशरसाधनस्य यत् खण्डनं कृतं तत् समीचीनमेव। 'ब्रह्मगुप्तादिभिः स्वल्पान्तरत्वान्न कृतः स्फुटः' इत्यादिना भास्करेण स्वदृक्कर्मवासनायां गोलाध्याये ह्याचार्यपक्षः समर्थित इति सर्व स्फुटं सिद्धान्तविदाम् ॥१६॥

वि. भा.—भमुनिध्रुवयोः पूर्वोक्तया स्पष्टक्रान्तिज्यानयनं कार्यम् वेधेनाऽऽयनदृक्कर्म संस्कृता एव नक्षत्र ध्रुवाः पठिताः। अतो ग्रहतत्क्रान्त्या च ग्रहेऽऽद्यं दृष्टिकर्म (आयनं दृक्कर्म) कृत्वा तस्मात् (आयन दृक्कर्म संस्कृता द्ग्रहात्) भमुनिवत् स्वक्रान्तिजीवा (ग्रह स्पष्ट क्रान्तिज्या) साध्येति ॥ १६ ॥

अत्रोपपत्तिः

ग्रहशराल्पत्वात् ग्रह कदम्बप्रोतवृत्तीयशर (मध्यमशरः) एव ध्रुवप्रोतवृत्तीयशरः (स्पष्टशरः) कल्पितः। ततो नक्षत्रवदेवाऽऽयनदृक्कर्म संस्कृतग्रहक्रान्ति-

शरसंस्कारेण स्फुट क्रान्तिज्यानयनं कृतमाचार्येण । "त्रिज्यावर्गादयनवलनज्याकृतिं प्रोह्यमूल" मित्यादिना भास्करेण ध्रुवप्रोतवृत्तीयः स्फुटशरः यः साधितः स च न समीचीनः, वस्तुतस्तदानयनेन स्फुटशरप्रदेशोनाऽऽयाति, तथा च तदानयनेऽन्या अप्यनेकास्त्रुटयः सन्तीति तदुपपत्तिदर्शनेनैव स्फुटाः सन्तीति सिद्धान्त तत्त्वविवेके तत्खण्डनं कमलाकरेण युक्तियुक्तं कृतम् । गोलाध्याये "ब्रह्मगुप्तादिभिः स्वल्पान्तरत्वान्न कृतः स्फुटः" इत्यादिना भास्कराचार्येणाऽऽचार्यपक्षस्य समर्थनमेवकृतमिति सर्वं विवेचकै र्विवेचनीयम् ॥१६॥

अब विशेष कहते हैं ।

हि. भा.—नक्षत्र में ध्रुव का और मुनि (अगस्त्य) ध्रुव का पूर्वोक्त प्रकार से स्पष्ट क्रान्तिज्यानयन करना चाहिये । वेध से आयन दृक्कर्म सस्कृत ही नक्षत्र ध्रुवा पठित है, इसलिये ग्रह और उसकी क्रान्ति से साधित आद्य (प्रथम) दृष्टि कर्म (अर्थात् आयन दृक्कर्म) ग्रह में संस्कार कर उस से (आयन दृक्कर्म सस्कृत ग्रह से) नक्षत्र और मुनि (अगस्त्य) की तरह ग्रह की स्पष्टक्रान्तिज्या साधन करना इति ॥१६॥

उपपत्ति ।

ग्रहों के शर की अल्पता के कारण स्वल्पान्तर से ग्रह के कदम्बप्रोतवृत्तीयशर (मध्यमशर) ही को ध्रुवप्रोतवृत्तीय शर (स्पष्टशर) आचार्य ने स्वीकार कर लिया है । उसके बाद नक्षत्र ही की तरह आयन दृक्कर्म संस्कृत ग्रह की क्रान्ति और शर के सस्कार से स्फुट क्रान्तिज्यानयन किया है । "त्रिज्यावर्गादयनवलनज्याकृतिं प्रोह्यमूलम्" इत्यादि से भास्कराचार्य ने ध्रुव प्रोतवृत्तीय स्फुटशर क्रान्ति संस्कार योग्य जो साधन किया है सो ठीक नहीं हैं, वस्तुतः उन के आनयन प्रकार से स्फुटशर का प्रदेश नही आता है, और उनके आनयन प्रकार में अन्य भी अनेक त्रुटियां हैं जो उस की उपपति देखने से ही स्फुट है, सिद्धान्त-तत्त्व विवेक में कमलाकर ने उस का खण्डन युक्ति युक्त किया हैं । गोलाध्याय में "ब्रह्मगुप्तादिभिः स्वल्पान्तरत्वान्न कृतः स्फुटः" इत्यादि से भास्कराचार्य ने पक्ष के समर्थन ही किया है इति ॥१६॥

इदानीमायनं दृक्कर्माह ।

त्रिज्याप्तासुभिरुदयैर्घाताद्विक्षेपसत्रिभक्रान्त्योः ।
ऋणधनमेकान्यदिशोस्तयोर्ग्रहे न भमुनिध्रुवके ॥१७॥

सु. भा.—विक्षेपस्य सत्रिभग्रहक्रान्तेः सत्रिभग्रहक्रान्तिज्यायाश्च वधात्

त्रिज्यया याऽऽप्ता तैरसुभिरुदयैर्निरक्षराश्युदयैर्याः क्षेत्रकलास्तास्तयोः शरसत्रिभ-क्रान्त्योरेकान्यदिशोर्ग्रहे ऋणं धनं कार्याः एवमायनं दृक्कर्म ग्रहे देयम् । भमुनिध्रुवके वेधेनैव दत्तायनदृक्कर्मोपलब्धेर्न देयमित्यर्थाज्ज्ञायते ।

अत्रोपपत्तिः । उदयास्ताधिकारे सत्रिभग्रहक्रान्तिज्यामायनं वलनं त्रिज्या-समां द्युज्यां क्षेत्रकालामितानायनदृक्कर्मासून् प्रकल्प्यायनं दृक्कर्म साधितम् । इहायन-दृक्कर्मसुभ्यः क्षेत्रकलानयनं 'व्यक्षोदयासुभिरष्टादशशतक्षेत्रकलास्तदाऽऽयनदृक्कर्मा-सुभिः किं' मित्यनुपातेन सूक्ष्ममानीतम् । तच्च 'आयनं वलनमस्फुटेषुणा संगुणं द्युगुणभाजितं हृत' मित्यादि भास्कर विधिना $\frac{\text{आव} \times \text{श} \times १८००}{\text{द्यु} \times \text{निउ}}$

$= \frac{\text{स. ग्र. क्राज्या} \times \text{श} \times १८००}{\text{त्रि} \times \text{निउ}}$ स्वल्पान्तरादित्युपपद्यते । नक्षत्राणां ध्रुवाः कृता-यनदृक्कर्मकाः अतस्तत्र पुनरायनदृक्कर्मसंस्कारोऽनुचितः । अत्र चतुर्वेदाचार्येण सत्रिभग्रहक्रान्तिः सत्रिभग्रहोत्क्रमज्या वशेन या क्रान्तिरिति व्याख्याता तदर्थं 'ब्रह्मगुप्तकृतिरत्र सुन्दरी साऽन्यथा तदनुगैर्विचार्यते' इत्यादि भास्करेण लिखित-मिति । चतुर्वेदाचार्यवाक्यं च 'ग्रहस्फुटविक्षेपसत्रिराश्युत्क्रमक्रान्त्योर्यो घातस्त-स्मात्' ॥ १७ ॥

वि. भा.—विक्षेपसत्रिभक्रान्त्योः (शरसत्रिभग्रहक्रान्तिज्ययोः) घातात् त्रिज्यया भक्ताद्याऽऽप्ता तैरसुभिः, उदयैः (निरक्षोदयासुभिः) या क्षेत्रकलास्ता विक्षेपसत्रिभक्रान्त्योरेकान्यदिशोर्ग्रहे ऋणं धनं कार्याः तदाऽऽयनदृक्कर्मसंस्कृत-ग्रहा (ग्रहबिम्बकेन्द्रोपरिगतध्रुवप्रोतवृत्तक्रान्तिवृत्तयोः सम्पातरूपाः) भवेयुः । भमुनिध्रुवकेऽऽयनदृक्कर्म संस्करणीयं यतो वेधेनाऽऽयनदृक्कर्मसंस्कृता एव तद्ध्रुवाः पठिताः सन्तीति ॥१७॥

अत्रोपपत्तिः

अथ ग्रहबिम्बकेन्द्रोपरिगतं कदम्बप्रोतवृत्तं क्रान्तिवृत्ते यत्र लगति तदेव ग्रहस्थानम् । ग्रहबिम्बकेन्द्रोपरि ध्रुवप्रोतवृत्तं च कार्यं तत्क्रान्तिवृत्ते यत्र लगति तस्माद् ग्रहस्थानं यावत्क्रान्तिवृत्तीयचापमायन दृक्कर्म कला ।

ध्रु=ध्रुवः । क=कदम्बः, विं=ग्रहबिम्बकेन्द्रम् । स्था = ग्रहस्थानम् । स्थानोपरिगतध्रुवप्रोतवृत्तम्=ध्रुश विं बिम्बोपरिगत ध्रुव प्रोतवृत्तम्=ध्रुप, बिं बिन्दुतः ध्रुश वृत्तोपरि विंन लम्बवृत्तं कार्यम् ।

ध्रुविं=बिम्बीय द्युज्याचापम् । विंस्था=ग्रहमध्यशरः $<$विंस्थान = स्थानीयायनवलनम्=आयनव $<$न=९०,

स्थाम = आयन दृक्कर्म कला, शप = आयनदृक्कर्मासु । तदा विस्थानचापीयजात्ये कोणानुपातेन $\frac{\text{मध्यशरज्या} \times \text{आयनवलनज्या}}{\text{त्रि}}$ = ज्या विन अत्र स्वल्पान्तरात् मध्यशरज्या = मशर, आयनवलनज्या = आयनवलन स्वीकृतम् तदा $\frac{\text{मशर} \times \text{आयनवलन}}{\text{त्रि}}$ = ज्याविन = लम्बवृत्तीयचापज्या, ततः ध्रुविन, ध्रुशप चापीय जात्य त्रिभुजयोर्ज्याक्षेत्र साजात्यात् $\frac{\text{ज्याविन} \times \text{त्रि}}{\text{बिम्बीयद्यु}}$ = ज्याशप = आयन दृ- कर्मासुज्या = $\frac{\text{मशर} \times \text{आयनवल} \times \text{त्रि}}{\text{त्रि बिम्बीयद्यु}}$ = आयनदृक्कर्मासु स्वल्पान्तरात् = $\frac{\text{मश} \times \text{आयनवल}}{\text{बिम्बीयद्यु}}$ अत्रस्वल्पान्तरात् बिम्बीयद्यु = स्थानीयद्यु तदा $\frac{\text{मश} \times \text{आयनवलन}}{\text{स्थानीयद्यु}} = \frac{\text{मश} \times \text{आयनवल}}{\text{द्यु}}$ = आयनदृक्कर्मासु (क) परन्तु सत्रिभग्रह- क्रान्ति = द्युज्याग्रीयायनवयन $\therefore \frac{\text{मश. सत्रिभग्रहक्रां}}{\text{त्रि}}$ = आयनदृक्कर्मासु । यतः $\frac{\text{आयनवलन} \times \text{द्यु}}{\text{त्रि}}$ = द्युज्याग्रीयायनवल । ततोऽनुपातो यदिनिरक्षराश्युदयासु-भिरष्टा दशशत कलाराशि कला लभ्यन्ते तदाऽऽयन दृक्कर्मासुभिः किं समागच्छन्त्यायन दृक्कर्मकलास्तत्स्वरूपम् = $\frac{१८०० \times \text{आयनदृक्कर्मासु}}{\text{निउ}} = \frac{१८०० \times \text{मश} \times \text{सत्रिभग्रहक्रां}}{\text{त्रि. निउ}}$ एतेनाऽऽचार्योक्ताऽयन दृक्कर्मानयनमुपपन्नम् ।

अथ $\frac{१८०० \times \text{आयनदृक्कर्मासु}}{\text{निउ}}$ = आयन दृक्कर्म कला, अत्र (क) चिन्हस्था- ऽऽयनदृक्कर्मासुस्वरूपेणोत्थापनेन $\frac{१८०० \times \text{मशर} \times \text{आयनवलन}}{\text{द्यु. निउ}}$ = आयनदृक्कर्म- कला, एतेने "आयनं वलनमस्फुटेषुणा संगुणं द्युगुणभाजितं हृतम् । पूर्ण पूर्ण- धृतिभिर्ग्रहाश्रितव्यक्षभोदयहृदायनाः कलाः" ति भास्करोक्तमप्युपपद्यते । अथ विस्थाम त्रिभुजेऽनुपातेन $\frac{\text{ज्याविस्था. ज्या} < \text{स्थाविम}}{\text{ज्या} < \text{म}} = \frac{\text{शरज्या} \times \text{आयनवज्या}}{\text{त्रि}}$ शरस्याल्पत्वात् विम = विस्था लघुज्या प्रकारेण $\frac{२\ \text{शरक}}{६०}$ = शरज्या, सत्रिभग्रह- क्रांज्या = द्युज्या ग्रीयायनवज्या = $\frac{\text{क्रांभा} \times २}{१२०}$, त्रि = १२०, $\frac{२\ \text{शरक}}{६०} \times$

$\frac{\text{क्रांभा}\times 2}{120}$ = आयनदृक्कर्मज्या, इयं द्विभक्ता दृक्कर्मभागास्ते षष्टिवर्गेण गुणास्तदा ऽऽयन दृक्कर्म विकलाः $= \frac{\text{२शरक}}{2\times 60}\times\frac{3600\times\text{क्रांभा}\times 2}{120}$ = शरक. क्रांभा एतेने "सत्रिभग्रहजक्रान्तिभागघ्नाः क्षेपलिप्तिकाः। विकलाः" ति सूर्यसिद्धान्तोक्ताऽऽयनदृक्कर्म विकलानयनमुपपद्यते। परन्त्वेतेष्वायनदृक्कर्मानयनेषु न कस्यापि समीचीनमिति तदुपपत्तिदर्शनेनैव स्फुटं भवतीति संस्कारोपपत्तिस्तु "ता ग्रहेऽयनपृषत्कयोः क्रमादेकभिन्नककुभोर्ऋणं धनम्" भास्करोक्तेनानेन स्फुटैवेति ॥ १७ ॥

अब आयन दृक्कर्म को कहते हैं।

हि. भा.—शर और सत्रिभग्रह क्रान्ति के घात में त्रिज्या से भाग देने से फलासु हो उनसे और निरक्षोदयासु से जो क्षेत्र कला होती है उसको शर और सत्रिभग्रह की क्रान्ति की एक दिशा रहने से ग्रह में से ऋण करना चाहिये, और भिन्न दिशा रहने से ग्रह में धन करना चाहिये तब आयन दृक्कर्म संस्कृतग्रह (ग्रहबिम्बकेन्द्रोपरिगतध्रुवप्रोतवृत्त और क्रान्ति वृत्त के सम्पात रूप) होते है। नक्षत्रध्रुवक में और मुनि (अगस्त्य) ध्रुवक मे आयन दृक्कर्म सस्कार नहीं करना चाहिये क्योंकि उनकी ध्रुवा वेध से आयन दृक्कर्म संस्कृत ही पठित है इति।

उपपत्ति

यहां संस्कृतोपपत्ति में लिखित क्षेत्र को देखिये। ग्रह बिम्ब केन्द्रोपरिगत कदम्ब प्रोतवृत्त क्रान्तिवृत्त में जहां लगता है वह ग्रह स्थान है। ग्रहबिम्बकेन्द्रोपरिगतध्रुवप्रोतवृत्त क्रान्तिवृत्त में जहां लगता है वहां से ग्रह स्थान पर्यन्त क्रान्तिवृत्तीय चाप आयनदृक्कर्म कला है। ध्रु=ध्रुव, क=कदम्ब, विं=ग्रहबिम्बकेन्द्र, स्था=ग्रह स्थान, स्थानोपरिगत ध्रुव प्रोतवृत्त=ध्रुश, बिम्बोपरिगत ध्रुव प्रोतवृत्त=ध्रुप, विं बिन्दु से ध्रुश वृत्त के ऊपर विंन लम्ब वृत्त करना, ध्रुविं=बिम्बीय द्युज्या चाप, विंस्था=ग्रहमध्यमशर, ध्रुस्था=स्थानीय द्युज्या चाप, ∠विंस्थान=स्थानीयायनवलन=आयन वलन, ∠न=९०, स्थाम= आयन दृक्कर्म कला, शप=आयन दृक्कर्मासु, तब विंस्थान चापीयजात्य त्रिभुज में कोणानुपात से $\frac{\text{मध्यशरज्या}\times\text{आयनवलनज्या}}{\text{त्रि}}$ =ज्या विंन, यहां स्वल्पान्तर से मध्यशरज्या=मशर.

तथा आयनवलनज्या=आयनवलन, स्वीकार किया है, तब $\frac{\text{मशर}\times\text{आयनवलन}}{\text{त्रि}}$ =ज्याविंन =लम्बवृचापज्या, ध्रुविन, ध्रुशप दोनों चापीय त्रिभुजों के ज्याक्षेत्र सजातीय है इसलिये

अनुपात करने से $\frac{\text{ज्यार्विन} \times \text{त्रि}}{\text{बिम्बीयद्यु}}$ = ज्याशप = आयनदृक्कर्मासुज्या = $\frac{\text{मशर} \times \text{आयनवलन} \times \text{त्रि}}{\text{त्रि बिम्बीय}}$

= आयन दृक्कर्मासु स्वल्पा $\frac{\text{मशर} \times \text{आयनवलन}}{\text{बिम्बीय द्यु.}}$ यहां स्वल्पान्तर से बिम्बीयद्यु = स्थानीयद्यु

= द्यु, तब $\frac{\text{मशर} \times \text{आयनवलन}}{\text{द्यु}}$ = आयन दृक्कर्मासु······(१) । परन्तु सत्रिभग्रह क्रान्ति =

द्युज्याग्रीयायनवलन, इसलिये $\frac{\text{मशर} \times \text{सत्रिभग्रक्रां}}{\text{त्रि}}$ = आयन दृक्कर्मासु, क्योंकि

$\frac{\text{आयनवलन} \times \text{द्यु}}{\text{त्रि}}$ = द्युज्याग्रीयायनवल, अब अनुपात करते है यदि निरक्षदेशीय राश्युदयासु में राशिकला पाते हैं तो आयनदृक्कर्मासु में क्या इस से आयन दृक्कर्म कला आती है, उसका स्वरूप = $\frac{\text{१८००} \times \text{आयनदृक्कर्मासु}}{\text{निउ}} = \frac{\text{१८००} \times \text{मशर} \times \text{सत्रिभग्रक्रा}}{\text{त्रि. निउ}}$ इससे आचार्योक्त आयन दृक्कर्मानयन उपपन्न हुआ । $\frac{\text{१८००} \times \text{आयनदृक्कर्मासु}}{\text{निउ}}$ = आयनदृक्कर्मकला, इस में (१) एतच्चिन्हस्थ आयन दृक्कर्मासु स्वरूप से उत्थापन देने से $\frac{\text{१८००} \times \text{मशर} \times \text{आयनवलन}}{\text{द्यु. निउ}}$ = आयनदृक्कर्मकला इस से "आयनं वलनमस्फुटेषुणा सगुणम्" इत्यादि से उपपत्ति में लिखित भास्करोक्त उपपन्न होता है ।

विंस्थाम त्रिभुज में अनुपात से $\frac{\text{ज्याविंस्था} \times \text{ज्या} \angle \text{स्थाविंम}}{\text{ज्या} \angle \text{म}} = \frac{\text{शरज्या} \times \text{आयनवज्या}}{\text{त्रि}}$ = ज्यास्थाम, यहाँ शर की अल्पता के कारण विंम = विंस्था स्वीकार किया है । लघुज्या प्रकार से $\frac{\text{२ शरक}}{\text{६०}}$ = शरज्या, सत्रिभग्रह क्रान्तिज्या = द्युज्याग्रीयायनवज्या = $\frac{\text{क्रांभा} \times \text{२}}{\text{१२०}}$ त्रि = १२०, तब $\frac{\text{२ शरक}}{\text{६०}} \times \frac{\text{क्रांभा} \times \text{२}}{\text{१२०}}$ = आयनदृज्या, इस को दो से भाग देने से दृक्कर्म भाग होता है इसको साठ के वर्ग = ३६०० से गुणा करने से आयन दृक्कर्म विकला, होती है, $\frac{\text{२ शरक}}{\text{२} \times \text{६०}} \times \frac{\text{३६००} \times \text{क्रांभा} \times \text{२}}{\text{१२०}}$ = शरक. क्रांभा = आयन दृक्कर्म विकला इससे "सत्रिभग्रहजक्रान्तिभागघ्ना इत्यादि" सं. उपपत्ति में लिखित सूर्यसिद्धान्तोक्त आयन दृक्कर्म विकलानयन उपपन्न होता है । परन्तु इन आयनदृक्कर्मानयनों में किसी भी आचार्य का ठीक नहीं है यह उसकी उपपत्ति देखने से ही स्फुट है, संस्कारोपपत्ति 'ता ग्रहेष्वन पृषत्कयोः क्रमात्' । इत्यादि भास्करोक्त से स्पष्ट ही है इति ॥१७॥

इदानीं चन्द्रादीनां महति शरे सूक्ष्ममाक्षदृक्कर्माह।

तत्स्वक्रान्तिज्याभ्यां चन्द्रादीनां पृथक् चरप्राणान्।
कृत्वाऽर्कवत् तदन्तरसंयोगौ तुल्यभिन्नदिशोः ॥१८॥

तत्प्राणैर्विक्षेपे सौम्ये हीनो ग्रहोऽधिको याम्ये।
उदये भध्रुवको वाऽगस्त्यध्रुवकोऽथवा लग्नम् ॥१९॥

उदये ग्रहभमुनीनामस्तमये षड्गृहाधिकात् सौम्ये।
अधिको याम्ये हीनः षड्राशियुतोऽस्तमयलग्नम् ॥२०॥

सु. भा.—चन्द्रादीनां चन्द्रनक्षत्रादीनां शरे महति तत्स्वक्रान्तिज्याभ्यां स्थानीयबिम्बीयक्रान्तिज्याभ्यां पृथक् पृथगर्कवच्चरप्राणान् चरासून् कृत्वा तयोस्तुल्यभिन्नदिशोश्चरासुमानयोर्यथाक्रममन्तरसंयोगौ कार्यौ। एवमक्षजदृक्कर्मासवो भवन्ति। सौम्ये विक्षेपे तैरसुभिर्ग्रहो हीनो याम्ये शरे चाधिकोऽर्थात् सौम्ये शरे कृतायनदृक्कर्मग्रहाद्विपरीतं याम्ये शरे चानुलोमं तैरसुभिर्यल्लग्नं स्वदेशे तदुदये ग्रहबिम्बोदये लग्नं भवेत्। एवं भध्रुवकोऽथवाऽगस्त्यध्रुवकश्च हीनो वाधिकः कार्योऽर्थात् तत्स्थानीयबिम्बीयक्रान्तिभ्यां पृथक् पृथक् चरासून् प्रसाध्य तद्योगान्तरतोऽक्षजदृक्कर्मासून् विधाय तैरसुभिः शरवशान्नक्षत्रध्रुवतोऽगस्त्यध्रुवतश्च क्रमेणोत्क्रमेण वा स्वदेशे लग्नं प्रसाध्य तयोरुदयलग्ने साध्ये। एवं ग्रहभमुनीनामुदये लग्नसाधनम्। अस्तमये च सौम्य उत्तरशरे सषड्भाद् ग्रहाद् ध्रुवाद्वा तैरसुभिरधिकोऽर्थात् क्रमलग्नं याम्ये शरे च हीनोऽर्थादुत्क्रमलग्नं यत् प्राक्क्षितिजे तत् षड्राशिसहितं ग्रहनक्षत्रबिम्बे पश्चिमक्षितिजस्थे ऽस्तमयलग्नं भवेत्।

अत्रोपपत्तिः। 'स्फुटास्फुटक्रान्तिजयोश्चरार्धयो' रित्यादिभास्करविधिना स्फुटा। भास्करेण पश्चिमक्षितिजस्थे बिम्बे प्राक्क्षितिजे क्रान्तिवृत्तस्य यः प्रदेशस्तदस्तलग्नमुच्यते। इहाऽऽचार्येण तदा पश्चिमक्षितिजे क्रान्तिवृत्तस्य यः प्रदेशस्तदस्तलग्नमन्वर्थकमेव साधितमिति ॥१८-२०॥

वि. भा.—चन्द्रादीनां (चन्द्रनक्षत्रादीनां) महति शरे तत्स्वक्रान्तिज्याभ्यां (स्थानीय बिम्बीय क्रान्तिज्याभ्यां) पृथक् पृथक् अर्कवत् (पलप्रभा संगुणिता पमज्या तद्द्वादशांशो भवति क्षितिज्ये'' त्यादि भास्कर विधिना चरप्राणान् कृत्वा तयोर्मध्यस्फुटक्रान्तिजनितचरार्धयोस्तुल्यभिन्नदिशोरन्तरसंयोगौ कार्यौ तदाऽक्षजदृक्कर्मासवो भवन्ति। सौम्ये विक्षेपे (उत्तरे शरे) तत्प्राणैः (आक्षदृक्कर्मासुभिः) ग्रहो हीनो याम्ये विक्षेपे (दक्षिणे शरे) ऽधिकोऽर्थात्-उत्तरे शरेऽयन दृक्कर्मसंस्कृत-

ग्रहाद्विलोमं दक्षिणे शरे चानुलोमं तैरसुभिः स्वदेशे यल्लग्नं भवेत्तत्तदुये (ग्रहबिम्बोदये) लग्नं भवेत्। एवं भ ध्रुवकोऽगस्त्य ध्रुवकश्च हीनोऽधिको वा कार्योऽर्थात् तत्स्थानीय बिम्बीय क्रान्तिज्याभ्यां पृथक् पृथक् चरासून् संसाध्य तद्योगान्तरवश तोऽक्षजदृक्कर्मासवो नेयास्तैरसुभिः शरवशान्नक्षत्रध्रुवतो ऽगस्त्य ध्रुवतश्च क्रमेण व्युत्क्रमेण वा स्वदेशे लग्नं प्रसाध्य तयोरुदय लग्ने साध्ये। एव ग्रहभमुनीनामुदये लग्नसाधनम्। अस्तमये उत्तरशरे सषड्भाद् ग्रहाद ध्रुवाद्वा तैरसुभिरधिकोऽर्थात्क्रमलग्नं याम्ये (दक्षिणे) शरे च हीनोऽर्थादुत्क्रमलग्नं पूर्व क्षितिजे यत्तत् षड्राशिसहितं ग्रहनक्षत्रबिम्बे पश्चिमक्षितिजस्थेऽस्तलग्नं भवेदिति ॥१८-२०॥

अत्रोपपत्तिः।

$\sqrt{\text{त्रि}^2 - \text{मक्रांज्या}^2} = \text{मद्यु}$, तथा $\sqrt{\text{त्रि}^2 - \text{स्पक्रांज्या}^2} = \text{स्पद्यु}$; ततोऽक्षक्षेत्रानुपातेन $\frac{\text{पभा. मक्रांज्या}}{१२} = \text{मकुज्या}$ एवं $\frac{\text{पभा. स्पक्रांज्या}}{१२} = \text{स्पकुज्या}$, त्रिज्याग्रे परिणामनेन $\frac{\text{मकुज्या. त्रि}}{\text{मद्यु}} = \text{मध्यक्रान्ति जनितचरज्या}$ एवं $\frac{\text{स्पकुज्या. त्रि}}{\text{स्पद्यु}}$ = स्पष्ट क्रान्तिजनित चरज्या, एतयोश्चापे तदा मध्यचरार्ध स्पष्टचरार्ध च स्याताम् यदा ग्रहस्थानं क्षितिजे भवेत्तदा तद्बिम्बं क्षितिजादध ऊर्ध्वं वा भवेत्, स्थानोपरिगत ध्रुवप्रोतवृत्त नाडीवृत्तयोः सम्पातात्पूर्वस्वस्तिकं यावन्नाड़ीवृत्तीयचापं मध्यक्रान्तिजनितचरार्धम्, यतः स्थानतो नाड़ीवृत्तपर्यन्तं स्थानोपरि गतध्रुव प्रोतवृत्ते मध्यमक्रान्तिः। तथा बिम्बोपरिगतं ध्रुव प्रोतवृत्तं नाड़ीवृत्ते यत्र लगति तस्मात्पूर्वस्वस्तिकावधि नाड़ीवृत्तीयचापं स्पष्टक्रान्तिजनितचरार्धम्। यतो बिम्बतो नाड़ीवृत्तपर्यन्तं बिम्बोपरिगतध्रुवप्रोतवृत्ते स्पष्ट क्रान्तिः। उत्तरदक्षिणगोलयोरेतयोश्चरार्धयोरन्तर योगौ कार्यौ तदा स्थानोपरिगत ध्रुवप्रोतवृत्तबिम्बोपरिगतध्रुवप्रोतवृत्तयो रन्तर्गतं नाड़ीवृत्तीयचापमक्षजदृक्कर्मासवो भवन्ति। अन्यत्सर्वं भाष्येनैव स्फुटम्। सिद्धान्त शेखरे "स्वस्वध्रुवापक्रमकार्मुकात् पृथक् यथोक्तमात्मीयशरेण संस्कृतात्। स्वसाधनैरर्कवदिन्दुवत् तथा पृथक् चरार्धद्वितयं प्रसाधयेत्॥ तुल्य भिन्न ककुभोश्चरार्धयोरन्तरैक्यजनितास्तु येऽसवः, तैर्विहीन उदयध्रुवो भवेत् लग्नमुत्तरशरेऽन्यथा युतः॥ उद्गमेऽस्तसमयेऽथ षड्भयुक् सौम्ययाम्यशरयोः क्रमाद् ध्रुवः। संयुतो विरहितोऽस्त लग्नकस्तैरिहासुभिरभीष्टलग्नवत्" नक्षत्रध्रुवाद् भुजज्यामानीय तया क्रान्तिज्यामानयेत् सा मध्यक्रान्तिज्या, तस्याश्चापं ध्रुवापक्रमकार्मुकम्। ध्रुवापक्रमकार्मुकात् नक्षत्रशरेण संस्कृतात् या ज्या सा स्पष्टक्रान्तिज्या, आभ्यां मध्यस्पष्टक्रान्तिज्याभ्यामर्कवच्चन्द्रवच्च चरार्धद्वयं साध्यं शेषं सुगमम्॥" एभिरुपर्युक्तैः श्लोकैः श्रीपतिनाऽऽचार्योक्तानुरूपमेव सर्वं कथितम्। सिद्धान्त-

शिरोमणौ "स्फुटास्फुटक्रान्तिजयोश्चरार्धयोः समान्यदिक्त्वेऽन्तरयोगजासवः। पलोद्भवाख्या भनभः सदा शर महति" याम्योत्तरे क्रमविलोमविधानलग्नं खेटात् कृतायनफलादुदयाख्य लग्नम्। सौम्ये क्रमेण विपरीतमिषौ तु याम्ये भार्धाधिकात् खचरतोऽस्त विलग्नमेवम्" भास्करोक्तमिदमाचार्यानुरूपं श्रीपत्युक्तानुरूपं वेति। तथा "इत्यभावेऽयनांशानां कृतदृक्कर्मध्रुवाः। कथिताश्च स्फुटा बाणाः सुखार्थं पूर्व सूरिभिः।" भास्करोक्तमिद "नक्षत्राणां स्फुटा एव स्थिरत्वात् पठिताः शराः। दृक्कर्मणाऽयनेनैषां संस्कृताश्च तथा ध्रुवाः।" इत्युक्ते च "आयनेन खलु दृष्टि-कर्मणा भध्रुवेषु विहिताऽत्र संस्कृतिः" इत्यादि श्रीपत्युक्ति गृहीत्वैव लिखितं भास्करेणेति ॥

अब चन्द्रादियों के महान् शर रहने पर सूक्ष्म अक्षदृक्कर्म को कहते है।

हि. भा.— चन्द्र और नक्षत्र आदि के महान शर रहने पर उन की स्थानीय क्रान्ति और बिम्बीय क्रान्ति से पृथक् पृथक् रवि की तरह (पल प्रभा सगुणितापमज्या तद्द्वादशांशो भवति क्षितिज्या) इत्यादि भास्करोक्त विधि से चरासुओं का साधन कर दोनों (मध्य-क्रान्तिजनित चरासु और स्पष्ट क्रान्ति जनित चरासुओं) का एक-एक दिशा में अन्तर और भिन्न दिशा में योग करने से अक्षज दृक्कर्मासु प्रमाण होता है। उत्तरशर में अक्षजदृक्कर्मासु को ग्रह में से हीन करना और दक्षिणशर के ग्रह में जोड़ना अर्थात् उत्तरशर में आयन दृक्कर्म संस्कृत ग्रह से विलोम (उल्टा) और दक्षिण शर मे अनुलोम उन असुओं से स्वदेश में जो लग्न होता है वह ग्रह बिम्बोदय काल मे लग्न होता है, इस तरह नक्षत्र ध्रुवक को और मुनि (अगस्त्य) ध्रुवक को हीन या युत करना अर्थात् उनको स्थानीय क्रान्ति और बिम्बीय क्रान्ति से पृधक् पृथक् चरासुओं के साधन कर उन दोनो के योग और अन्तर वस से अक्षज दृक्कर्मासु लाना उन असुओं से शरवश से नक्षत्र ध्रुव से और अगस्त्य ध्रुव से क्रम सेवा विलोम से स्वदेश मे लग्न साधन कर दोनों के उदय लग्न साधन करना, एवं ग्रह, नक्षत्र और मुनियों के उदय में लग्न साधन हुआ, अस्त समय में उत्तर शर मे छः राशि सहित ग्रह से वा ध्रुव से उन असु (आक्षदृक्कर्मासु) से अधिक अर्थात् क्रम लग्न, दक्षिणशर में हीन अर्थात् उत्क्रम लग्न पूर्वक्षितिज में जो होता है उसमें छः राशि जोड़ने से पश्चिमक्षितिज मे ग्रह बिम्ब और नक्षत्र बिम्ब के स्थित रहने पर अस्तलग्न होता है इति ॥१८-२०॥

उपपत्ति।

मध्यम क्रान्ति = मक्रां, स्पष्ट क्रान्ति = स्पक्रां, मध्यद्युज्या = मद्यु। स्पस्टद्युज्या = स्पद्यु. $\sqrt{\text{त्रि}^2 - \text{मक्रांज्या}^2}$ = मद्यु। $\sqrt{\text{त्रि}^2 - \text{स्पष्ट क्रांज्या}^2}$ = स्पद्यु, तव अक्षक्षेत्र के अनुपात से $\frac{\text{पभा. मक्रांज्या}}{१२}$ = मकुज्या। एवं $\frac{\text{पभा. स्पक्रांज्या}}{१२}$ = स्पकुज्या, त्रिज्याग्र में

परिणामन करने से $\frac{\text{मकुज्या. त्रि}}{\text{मद्यु}}$ = मध्यक्रान्ति जनित चरज्या, एव $\frac{\text{स्पकुज्या. त्रि}}{\text{स्पद्यु}}$ = स्पष्ट क्रान्ति जनित चरज्या,

इन दोनों के चाप करने से मध्यचरार्ध और स्पष्ट चरार्ध होते हैं। जब ग्रह स्थान क्षितिज में रहता है तो ग्रह बिम्ब क्षितिज से नीचा या ऊपर होता है, स्थानोपरिगतध्रुव प्रोत वृत्त और नाडीवृत्त के सम्पात से पूर्व स्वस्तिक पर्यन्त नाडीवृत्तीय चाप मध्यम क्रान्ति जनित चरार्ध है, क्यो कि स्थान से नाड़ीवृत्त पर्यन्त स्थानोपरिगतध्रुव प्रोतवृत्त में मध्यम क्रान्ति है, तथा बिम्बोपरिगत ध्रुवप्रोतवृत्त और नाडीवृत्त के सम्पात से पूर्व स्वस्तिक पर्यन्त नाड़ीवृत्तीय चाप स्पष्ट क्रान्ति जनित चरार्ध है, क्यो कि बिम्ब से नाड़ीवृत्तपर्यन्त बिम्बोपरिगत ध्रुव प्रोतवृत्त में स्पष्ट क्रान्ति है, एक दिशा मे इन दोनों चरार्धों का अन्तर करने से और भिन्न दिशा में योग करने से अक्षज दृक्कर्मासु प्रमाण होता है। शेष विषय भाष्य ही से स्पष्ट है। ग्रहबिम्ब केन्द्रोपरिगत ध्रुव प्रोतवृत्त और ग्रह बिम्ब केन्द्रोपरिगत सम प्रोतवृत्त के अन्तर्गत क्रान्तिवृत्तीय चाप अक्षज दृक्कर्म कला है।

सिद्धान्त शेखर में "स्वस्वध्रुवापक्रमकार्मुकात् पृथक् यथोक्तमात्मीयशरेण संस्कृतात्" इत्यादि सस्कृतोपपत्ति में लिखित श्लोकों से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है। सिद्धान्तशिरोमणि में "स्फुटास्फुटक्रान्तिजयोश्चरार्धयोः समान्यदिक्त्वेऽन्तरयोगजासवः" इत्यादि, "याम्योत्तरे क्रमविलोमविधानलग्न खेटात् कृतायनफलादुदयाख्यलग्नम्" इत्यादि सं. उपपत्ति में लिखित श्लोकों से भास्कराचार्य ने बिलकुल आचार्योक्त के अनुरूप वा श्रीपत्युक्त के अनुरूप ही कहा है। तथा "इत्यभावेऽयनांशानां कृत दृक्कर्मका ध्रुवाः" इत्यादि, तथा "नक्षत्राणां स्फुटा एव स्थिरत्वात् पठिताः शराः" इत्यादि संस्कृतोपपत्ति मे लिखित श्लोको से भास्कराचार्य ने "आयनेन खलु दृष्टि कर्मणा भध्रुवेषु" इत्यादि श्रीपत्युक्त विषयों को लेकर ही लिखा है इति ॥१८-२०॥

इदानीं दृश्यादृश्यत्वमाह।

उदयविलग्नादधिके षड्राशियुतास्तलग्नभाद्धीने।
रात्रि विलग्ने दृश्यो दिनेऽपि चन्द्रोऽन्यथाऽदृश्यः ॥२१॥

सु. भा.—स्पष्टार्थम् उपपत्तिश्चोदयास्ताधिकारे प्रतिपादितैव ॥२१॥

वि. भा.—रात्रि विलग्ने (प्राक् क्षितिजे क्रान्तिवृत्तस्य लग्नप्रदेशे) उदयविलग्नादधिके षड्राशियुतास्तलग्नात् हीने तदा ग्रहो दृश्यो भवति, एवं सति चन्द्रो दिनेऽपि दृश्यो भवत्यन्यथाऽदृश्यो भवतीति; एतत्कथनस्यात्राऽऽवश्यकता नाऽऽसीत्प्रागेवाऽस्योक्तत्वादिति ॥१॥

अत्रोपपत्तिः

उदयलग्नसमे रात्राविष्टलग्ने ग्रहः प्राक् क्षितिजे उदेति, पश्चिमक्षितिजस्थे ग्रहबिम्बे पश्चिमक्षितिजे लग्नस्य क्रान्तिवृत्तप्रदेशस्यास्तलग्नसंज्ञा ऽऽचार्येण कृताऽस्ति, तेन सषड्भास्तलग्नं प्राक्क्षितिजे लग्नं भवति, तस्मादिष्टलग्ने न्यूने उदयलग्नाच्चाधिके बिम्बस्य क्षितिजादुपरि विद्यमानत्वात्तद्दर्शनं भवेदेव, एवं स्थितौ दिनेऽपि चन्द्रबिम्बदर्शनं भवितुमर्हत्यन्यथा नेति ।।२१।।

अब दृश्यादृश्यत्व के विषय में कहते है ।

हि॰ भा॰—रात्रि में इष्ट लग्न ग्रह के उदय लग्न से अधिक हो तथा छः राशि युत अस्तलग्न से हीन हो तो वह ग्रह दृश्य होते है, इस तरह दिन में भी चन्द्र दृश्य होते है अन्यथा दृश्य नहीं होते है इति ।।२१।।

उपपत्ति

ग्रह के उदय लग्न के तुल्य रात्रि मे इष्ट लग्न रहने से वह ग्रह प्राक्क्षितिज में उदित होता है, पश्चिम क्षितिज में ग्रह बिम्ब के रहने से पश्चिम क्षितिज मे क्रान्तिवृत्त का जो प्रदेश लगा रहता है उसी को आचार्य अस्तलग्न कहते है, इसलिये अस्त लग्न में छः राशि जोड़ने से पूर्व क्षितिज मे लग्न होता है, उस से इष्ट लग्न न्यून हो तथा उदय लग्न से भी अधिक हो तो क्षितिज से ऊपर ग्रह बिम्ब के रहने के कारण उन का दर्शन होता ही है; इस तरह की स्थिति में दिन मे भी चन्द्र दृश्य होते हैं अन्यथा अदृश्य होते है । इस विषय का कहना यहाँ निरर्थक मालूम होता है क्यो कि पहले चन्द्रच्छायाधिकार में यह विषय कहा जा चुका है इति ।।२१।।

इदानीं ग्रहोदयस्य गतागतत्वमाह ।

प्रागुदयलग्नमूनं लग्नादधिकं ग्रहोदयः पश्चात् ।
ऊनमधिकेन तुल्यं कृत्वा घटिकाः स्वराश्युदयैः ।।२२।।

सु॰ भा॰—लग्नादिष्ट लग्नादुदयलग्नमूनं तदा ग्रहोदयः प्राग्गतः । यद्यधिकं तदा ग्रहोदयः पश्चाद्भविष्यतीति । स्वराश्युदयैरूनमधिकेन तुल्यं कृत्वाऽर्था 'दूनस्य भोग्योधिक भुक्त युक्त' इत्यादिना तदन्तरघटिकाः साध्या इति ।

अत्रोपपत्तिः । इह भगोलस्य पश्चिमभ्रमेण ग्रहस्य नित्यमुदयो यस्तस्यैव गतैष्यत्वं प्रदर्श्यते । उदयलग्ने प्राक् क्षितिजस्थे ग्रहोदयोऽतस्तस्मिन् इष्टलग्ना-

ढूने ग्रहबिम्बोदयो जातः क्षितिजोपरि गतत्वादन्यथा क्षितिजाधःस्थत्वाद् ग्रह बिम्वमुदेष्यतीति। अन्तरघटिकासाधनोपपत्तिर्लग्नात् कालसाधनोपपत्तिवत् स्पष्टा ॥ २२ ॥

वि. भा.—लग्नात् (इष्टलग्नात्) उदयलग्नमून (अल्प) तदा ग्रहोदयः प्राक् (गतः) यदीष्टलग्नादुदयलग्नमधिकं तदा ग्रहोदयः पश्चात् (एष्य) भवति राश्युदयैरूनमधिकेन तुल्यं कृत्वाऽर्थात् 'ऊनस्य भोग्योऽधिकभुक्तयुक्त' इत्यादिना, घटिकाः (तदन्तर घटिकाः) साध्या इति ॥२२॥

अत्रोपपत्तिः

अत्र भगोलस्य पश्चिमभ्रमणेन नित्यं ग्रहस्योदयो यो भवति तस्यैव गतैष्यत्वं विचार्यते। प्राक् क्षितिजस्थे उदयलग्ने ग्रहोदयोऽतस्तस्मिन् इष्टलग्नादल्पे क्षितिजोपरिगतत्वाद् ग्रहबिम्बोदयो भवेदन्यथा क्षितिजादधः स्थितत्वाद् ग्रहबिम्बमुदेष्यतीति, लग्नात् कालसाधनोपपत्तिवदन्तरघटिकासाधनोपपत्तिः स्फुटैवास्तीति ॥२२॥

अब ग्रहोदय के गतैष्यत्व को कहते हैं।

हि. भा.—इष्टलग्न से उदय लग्न अल्प हो तो ग्रहोदय गत होता है, यदि इष्ट लग्न से उदय लग्न अधिक हो तो ग्रहोदय पश्चात् (एष्य) होता है। राश्युदयों से ऊन को अधिक के साथ कर अर्थात् "ऊनस्य भोग्योऽधिकभुक्तयुक्तो मध्योदयाढ्यः" इस से अन्तर घटी साधन करना इति ॥२२॥

उपपत्ति

भगोल के पश्चिम भ्रमण से नित्य ग्रहों का जो उदय होता है उसी के गतैष्यत्व का विचार करते हैं। उदय लग्न पूर्व क्षितिज में रहता है तो ग्रह का उदय होता है इसलिये इष्ट लग्न से उदय लग्न के अल्प रहने से ग्रह बिम्ब के क्षितिज से ऊपर होने के कारण उदय होता है, अन्यथा क्षितिज से अधः स्थित होने के कारण ग्रह बिम्ब उदित होगा, लग्न से काल साधन के लिये जो उपपत्ति है उसी तरह यहां अन्तर घटी साधन की उपपत्ति समझनी चाहिये इति ॥२२॥

इदानीं ग्रहास्तस्य गतैष्यत्वमाह।

प्रागस्तमयो लग्नादूनं षड्राशिसंयुतास्तमयलग्नम्।
अधिकं घटिकाः पश्चात् कृत्वा सममूनमधिकेन ॥२३॥

सु. भा.—लग्नादिष्टलग्नाद्यदि षड्राशिसंयुतास्तलग्नमूनं तदा ग्रहबिम्बास्तमयः प्राग्जात इति । अधिकं चेत् तदाऽस्तमयः पश्चाद् भविष्यति । अत्राप्यधिकेन सममूनं कृत्वार्था 'दूनस्य भोग्योऽधिकभुक्त युक्त' इत्यादिविधिना तदन्तरघटिकाः साध्याः ।

अत्रोपपत्तिः । आचार्यसाधितमस्तलग्नं सषड्भं ग्रहबिम्बास्तकाले प्राक्क्षितिजस्य लग्नं भवेत् । तत्समे स्वेष्ट लग्ने पश्चिमक्षितिजे ग्रहास्तमयः । ऊने ग्रहबिम्बस्य क्षितिजाधःस्थत्वादस्तमयो गतः । अधिके च बिम्बस्य क्षितिजोपरिवर्तमानत्वादस्तं यास्यतीति स्फुटा वासना ॥२३॥

वि. भा.—लग्नात् (इष्टलग्नात्) षड्राशिसंयुतास्तमयलग्नं यद्यूनं (अल्पं) भवेत्तदाऽस्तमयः प्राक् (पूर्वं) जातो गतइत्यर्थः । अधिकं चेत्तदाऽस्तमयः पश्चात् (एष्यः) भवति, अधिकेन समं (साकं) ऊनं कृत्वा ऽर्थात् "ऊनस्य भोग्योऽधिकभुक्तयुक्तो मध्योदयाढ्य" इत्यादिना तदन्तरघटिकाः साध्या इति ॥२३॥

अत्रोपपत्तिः ।

आचार्योक्तमस्तलग्नं षड्राशियुतं तदाग्रहबिम्बास्तसमये पूर्वं क्षितिजस्थं लग्नं भवेत् । तत्तुल्ये स्वेष्टलग्ने पश्चिमक्षितिजे ग्रहास्त । अल्पे ग्रहबिम्बस्य क्षितिजादधः स्थित्वादस्तमयो गतः । अधिके तु क्षितिजोपरिवर्त्तमानाद्बिम्बस्यास्तमयो भविष्यतीति । अन्तरघटयानयनोपपत्तिर्लग्नात्कालसाधनोपपत्तिवद् बोध्येति ॥२३॥

अब ग्रहास्त के गतैष्यत्व को कहते है ।

हि. भा.— यदि इष्ट लग्न से छः राशियुत अस्त लग्न अल्प हो तो अस्तमय गत होता है । यदि अधिक हो तो अस्तमय एष्य होता है अधिक के साथ ऊन (अल्प) को करके अर्थात् 'ऊनस्य भोग्योऽधिक भुक्त युक्तः' इत्यादि से अन्तर घटी साधन करना इति ॥२३॥

उपपत्ति ।

आचार्योक्त अस्त लग्न में छः राशि जोड़ने से ग्रह बिम्बास्त काल में पूर्व क्षितिज स्थित लग्न होता है, उसके बराबर स्वेष्ट लग्न के रहने से पश्चिम क्षितिज में ग्रहास्त होता है, अल्प रहने से ग्रह बिम्ब के क्षितिज से अधः स्थित होने के कारण अस्तमय गत होता है, अधिक रहने से बिम्ब के क्षितिज से ऊपर होने के कारण अस्तमय एष्य होता है, अन्तर घट्यानयन की उपपत्ति लग्न से कालसाधन की उपपत्तिवत् समझनी चाहिये इति ॥२३॥

इदानीं चन्द्रस्य विशेषमाह ।

तात्कालिकोपकरणादसकृद्गतनाड़िकाभिरन्ह्यीन्दोः ।
रात्रौ वा प्रतिघटिकं प्राग्वत् शृङ्गोन्नतिः कार्या ॥२४॥

सु. भा.—गतनाडिकाभिः पूर्वागताभिस्तात्कालिकोपकरणादिन्दोरसकृद्-गता नाड्योऽह्नि दिवसे वा रात्रौ स्फुटाः साध्यास्ततः प्रतिघटिकं प्राग्वत् शृङ्गोन्नतिः कार्याः ।

अत्रोपपत्तिः । यस्मिन् काले गतो वैष्य उदय इति परीक्षा क्रियते तस्मिन् काले तात्कालिकग्रहज्ञानात् तस्मादेव ग्रहादुदयलग्नमस्तलग्नं च साधितम् । अपेक्षितं तु क्षितिजस्थे ग्रहबिम्बे । अतोऽसकृद्विधिना तात्कालिकेन ग्रहशरदृक्कर्मा-दिना स्फुटमुदयलग्नमस्तलग्नं च भवति । एवं या असकृद्विधिना नाड्यस्ता आर्क्ष्यस्ताभिर्ग्रहं प्रचाल्याग्रे क्रिया समुचिता । अन्येषां ग्रहाणामल्पगतित्वाद सकृद्विधिं हित्वा ऽऽचार्येण चन्द्रस्यैवासकृद्विधिरुक्तः । एवमसकृद्विधिना ऽऽनीता नाड्य आर्क्ष्यो भवन्ति । ताभ्यश्चन्द्रस्य छाया न साध्या । चन्द्रस्य छाया तु तत्सावनाभिरिष्टकालिकोदयलग्नेष्टलग्नान्तरभवाभिः साध्येति सर्वं भास्करेण छायाधिकारे ग्रहगणिताध्याये स्पष्टमुपपादितम् ॥२४॥

वि. भा.—गतनाडिकाभिः पूर्वानीताभिस्तात्कालिकोपकरणात् (तात्कालि-कोपयुक्तसामग्रीकदम्बात्) इन्दोः (चन्द्रस्य) असकृत् गता नाड्योऽह्नि (दिवसे) रात्रौ वा स्फुटाः साध्यास्ततः प्रतिघटिकं प्राग्वत् शृङ्गोन्नतिः कार्येति ।

अत्रोपपत्तिः

यस्मिन् काले गत एष्यो वा समय इत्यन्विष्यते तस्मिन् काले तात्कालिकग्रह ज्ञानात्तत एवोदयलग्नमस्तलग्नं च साधितम् । परन्त्वपेक्षितं तु क्षितिजस्थे ग्रह-बिम्बे, अतस्तात्कालिकेन ग्रहशरदृक्कर्मादिनासकृत्कर्मणा स्फुटमुदयलग्नमस्त-लग्नं च भवति । एवमसकृत्कर्मणा या घटिकास्ता नाक्षत्र्य (आर्क्ष्यः) स्ताभिर्ग्रहं प्रचाल्याग्रे क्रिया समुचिता, अन्येषां ग्रहाणां गत्यल्पत्वादसकृत्कर्म त्यक्तमाचार्येण केवलं चन्द्रस्यैवकृतेऽसकृत्कर्मोक्तम् । एवमसकृत्कर्मणा समागता घटिका आर्क्ष्यो भवन्ति ताभ्यश्चन्द्रस्य छाया न साध्या, चन्द्रस्य छाया तु तत्सावनाभिरिष्ट कालिको-दयलग्नेष्ट लग्नान्तरोत्पन्नाभिः साध्या, एतत्प्रसंगे शिद्धान्तशिरोमणौ भास्करा-चार्येण "चन्द्र प्रभार्थमसकृद्विधिनोदितं यत्कृतं खलु न सत्तदसावनत्वात्" त्यादिना समीचीनं बहु प्रतिपादितमिति ॥ २४ ॥

अब चन्द्र के लिये विशेष कहते है।

हि. भा.—पूर्वागत गतनाड़िकाओं से तात्कालिक उपयुक्त सामग्री समूहों से असकृत् कर्म से चन्द्र की स्फुट गत नाडी दिन में वा रात्रि में साधन करना तब प्रत्येक घटी में शृङ्गोन्नति करनी चाहिये ॥२४॥

उपपत्ति

जिस समय में गत वा एष्य समय की परीक्षा करनी है उस समय में तात्कालिक ग्रहज्ञान से उदयलग्न और अस्त लग्न के साधन किये है। परन्तु अपेक्षित है क्षितिजस्थ ग्रह बिम्ब के समय मे इसलिये ग्रहशर और दृक्कर्म आदि से असकृत्कर्म से स्फुट उदयलग्न और अस्त लग्न होता है, इस तरह असकृत्कर्म से जो घटिकाये होती है वे नाक्षत्री होती है उन से ग्रह को चलाकर आगे क्रिया समुचित है, अन्य ग्रहों की गति की अल्पता के कारण मे आचार्य असकृत् कर्म को छोड दिया, केवल चन्द्र ही के लिये असकृत्कर्म कहा है। इस तरह असकृत् कर्म से आई हुई घटिकाये नाक्षत्री होती है उन से छाया साधन नहीं करना चाहिये, चन्द्र की छाया उनकी इष्ट कालिक उदय लग्न-इष्टलग्न के अन्तर से उत्पन्न सावन घटी से साधन करना चाहिये। इस के प्रसङ्ग में शिद्धान्त शिरोमणि मे भास्कराचार्य ने "चन्द्र प्रभार्थमसकृद्विधिनोदित यत्" इत्यादि से बहुत समीचीन बातें कही है इति ॥२४॥

इदानीं विशेषमाह।

मध्यच्छाया रविवत् स्वक्रान्त्या दर्शने सतीष्टा च।
एवं ग्रहभमुनीनामन्तरघटिका गुणां भुक्तिम् ॥२५॥

सु. भा.— ग्रहस्य भस्य वा दर्शने सति स्वक्रान्त्या ग्रहस्य वा भस्य स्फुटक्रान्त्या रविवत् इष्टा मध्यच्छाया याम्योत्तर वृत्तस्थे बिम्बे छाया साध्या। एवं ग्रहभोदययोर्वा ग्रहभास्तयोरथवा ग्रहमुन्युदययोर्वाऽस्तमययोः स्फुटान्तरघटिकाज्ञानार्थमादाविष्टकालिकग्रहवशेन तदुदयास्तलग्ने कृत्वा ग्रहभोदययोरस्तयोर्वा पूर्ववदन्तरघटिकाः साध्याः। ताभिर्भुक्ति ग्रहभुक्ति गुणामित्यस्याग्रे सम्बन्धः।

अत्र चतुर्वेदाचार्यः। 'पलालभक्षणमेतत्'। अर्थाद्यदा पलालस्य नीरसशुष्कतृणस्य (लोके पुआल इति प्रसिद्धस्य) भक्षणे रसप्राप्तिर्न तथैवैतत्प्रकारेणाऽऽचार्यस्य यशः प्राप्तिर्न यत इदं सर्वमानयनं सर्वत्रैव प्रसिद्ध मिति ॥२५॥

वि. भा.—ग्रहस्य नक्षत्रस्य वा दर्शने सति स्वक्रान्त्या (ग्रहस्फुटक्रान्त्या नक्षत्रस्फुटक्रान्त्या च) रविवत् मध्यच्छाया (याम्योत्तरवृत्तस्थिते बिम्बे छाया

साध्या) एवं ग्रहनक्षत्रोदययोर्ग्रहनक्षत्रास्तयोर्वा-ग्रहमुन्युदययोरस्तयोर्वा स्फुटान्तर घटिकानयनार्थं प्रथममिष्टकालिकग्रहवशेन तदुदयास्तलग्ने संसाध्य ग्रहनक्षत्रोदययोरस्तयोर्वा पूर्ववदन्तर घटिकाः साध्याः । ताभिर्भुक्ति गुणामित्यस्याग्रे सम्बन्धः एतैरानयनैराचार्यस्य न किमपि वैशिष्ठ्यं लक्ष्यते यत इद सर्वमानयन प्रसिद्धमेवेति ॥२५॥

हि. भा.—ग्रह या नक्षत्र दृश्य होने पर ग्रह की स्फुटक्रान्ति से तथा नक्षत्र की स्फुट क्रान्ति से रवि की तरह मध्यच्छाया अर्थात् याम्योत्तर वृत्त में बिम्ब के स्थित रहने से छाया साधन करना चाहिये । इसी तरह ग्रह और नक्षत्र की उदयान्तर घटी वा अस्तान्तर घटी वा ग्रह और मुनि की उदयान्तर घटी वा अस्तान्तर घटी के आनयन के लिये पहले इष्टकालिक ग्रहवश से उन के उदयलग्न और अस्तलग्न साधन कर पूर्ववत् ग्रह और नक्षत्र की उदयान्तर घटी वा अस्तान्तर घटी साधन करना, उस से गति को गुणा करना इसका अगले श्लोक के साथ सम्बन्ध है । इन आनयनो से आचार्य की कुछ भी विशिष्टता नही मालूम पडती है क्यों कि यह सब आनयन प्रसिद्ध ही है ॥२५॥

इदानी नक्षत्रोदयास्तवशेन ग्रहोदयास्तयोः साधनमाह ।

षष्ट्या विभजेल्लब्धं प्रागुदयास्तमययोर्ग्रहे शोध्यम् ।
पश्चात् क्षेप्यं प्रतिदिनमुदयास्तमयावसकृदेवम् ॥२६॥

सु० भा०—पूर्वागत घटीगुणां भुक्तिं षष्ट्या गणको विभजेत् । लब्धं चालनफलं पूर्वप्रकारेणोदयास्तमययोः प्राग्गते लक्षणे ग्रहे शोध्यं पश्चादेष्यलक्षणे क्षेप्यमेवं चालितग्रहात् पुनस्तदुदयास्तलग्ने कृत्वा ग्रहभोदययोरस्तमययोर्वा ऽन्तरघटिकाः साध्या । एवमसकृद्विधिना प्रतिदिनं ग्रहस्योदयास्तमयौ भवत इति ।

अत्रोपपत्तिः पूर्वविधिना स्फुटा ॥२६॥

वि. भा.—पूर्वागतघटी गुणां भुक्तिं षष्ट्या विभजेत् । लब्धं फलं पूर्वप्रकारेणोदयास्तयोर्गते लक्षणे ग्रहे शोध्यम् । पश्चात् (एष्यलक्षणे) ग्रहे क्षेप्यं (योज्यम्) । एवं पूर्वलब्धफलेन चालिताद् ग्रहात्पुनस्तुदयास्तलग्नयोः साधनं कृत्वा ग्रहनक्षत्रयोरुदयान्तरघटिका वा अस्तान्तरघटिका वा साध्याः । एवमसकृत्कर्मणा प्रति दिनंग्रहस्योदयास्तौ भवेतामिति ॥२६॥

अत्रोपपत्तिः पूर्वोक्त्यैव स्फुटेति ॥२६॥

अब नक्षत्र के उदय और अस्त वश से ग्रह के उदय और अस्त का साधन कहते है ।

हि. भा.—पूर्वागत ग्रह और नक्षत्र की उदयान्तर घटी वा अस्तान्तर घटी से गति को गुणा कर साठ से भाग देना लब्ध चालन फल को पूर्व प्रकार से उदय और अस्त के गत लक्षण के ग्रह में से घटा देना, एष्य लक्षण के चालन फल को ग्रह में जोडना, इस तरह चालित ग्रह से पुनः उसके उदय लग्न और अस्त लग्न साधन कर ग्रह और नक्षत्र की उदयान्तर घटी वा अस्तान्तर घटी साधन करना, एव असकृत्कर्म से प्रतिदिन ग्रह का उदय और अस्तमय होता है ॥२६॥

उपपत्ति पूर्व विधि से स्फुट है इति ॥२६॥

इदानीं प्रकारान्तरेण ग्रहोदयास्तयोः साधनमाह ।

इष्टात् कालाद् भानोरुदयास्ताद्वा ग्रहोदयास्तमयौ ।
तात्कालिकैर्विलग्नं ग्रहोदयास्तमयलग्नाद्यैः ॥ २७ ॥

सु. भा. - इष्टात् कालाद्वा भानोरुदयास्तात् पूर्वविधिना ग्रहोदयास्तमयौ साध्यौ किं नक्षत्रव्यपदेशेन । अत्र यदीष्टलग्नमपेक्षितं तदा तात्कालिकैर्ग्रहोदयास्तमयलग्नाद्यैर्लग्नं साध्यम् । अर्थाद् ग्रहस्य तात्कालिकोदयलग्नमस्तलग्नं वा रविं ग्रह दिनगतशेषा घटिका इष्टघटिकाः प्रकल्प्य स्वदेशोदयैर्लग्नमपि साध्यं भवतीति सर्वं स्फुटम् ।

अत्र चतुर्वेदाचार्यः । 'एवमेतत् क्रियते कर्म कः सन्देहोऽथान्यथा कर्त्तनजातिमूर्खोऽपि जानाति ॥२७॥

वि. भा.—इष्टात् कालाद्वा भानोः (सूर्यस्य) उदयास्तात् पूर्वोक्तरीत्या ग्रहस्योदयास्तौ साध्यौ, यद्यत्रेष्टलग्नमपेक्षितं तदा तात्कालिकैर्ग्रहोदयास्तमयलग्नाद्यैर्विलग्नं साध्यम् । अर्थाद् ग्रहस्य तात्कालिकमुदयलग्नमस्तलग्नं वा रविं प्रकल्प्य ग्रहदिनगतशेष घटिका इष्टघटिकाः प्रकल्प्य स्वदेशोदयैर्लग्नानयनवल्लग्नं साध्यं तदेवेष्टलग्नं भवेदिति । आचार्येणैतावता न किमपि वैशिष्ट्यं प्रतिपाद्यत इति सिद्धान्तविद्भिः परीक्ष्य ज्ञेयमिति ॥२७॥

अब प्रकारान्तर से ग्रह के उदय और अस्त का साधन कहते हैं ।

हि. भा.—इष्टकाल से वा सूर्य के उदय और अस्त समय से पूर्वोक्त रीति से ग्रह का उदय और अस्त साधन करना । यदि यहां इष्ट लग्न अपेक्षित हो तो तात्कालिक ग्रहोदय

लग्न और ग्रहास्त-लग्न आदि से लग्न साधन करना अर्थात् ग्रह के तात्कालिक उदयलग्न को वा अस्त लग्न को रवि मानकर तथा ग्रह की दिनगत घटी वा दिन शेष घटी को इष्ट घटी मान कर स्वदेशीय राश्युदयों से लग्नानयन की तरह लग्न साधन करना वही इष्ट लग्न होता है, इससे आचार्य कोई विशिष्ट बात नही कहते है इस को विचार कर समझना चाहिये इति ॥२७॥

इदानी पुनः ग्रहोदयास्तयोः साधनमाह ।

प्रागुदयलग्नमुदयैर्लग्नसमं लग्नमुदयलग्नेन ।
पश्चात् तद्घटिकाभिः कृत्वा तात्कालिकैरसकृत् ॥२८॥

उदयः प्रागस्तमयो लग्नेन सषड्गृहास्तमय लग्नम् ।
पश्चाल्लग्नं चक्रार्धसंयुतास्तमयलग्नेन ॥२९॥

सु० भा० – तात्कालिकैर्ग्रहशराद्यैरसकृदुदयः साध्यः । शेषं 'प्रागुदय-लग्नमूनं' तथा 'प्रागस्तमयो लग्नादूनम्' इत्यार्याद्वयेन स्पष्टार्थम् ।

अत्र चतुर्वेदाचार्यः । पिष्टपेषणमेतत् ॥२८-२९॥

वि. भा.—तात्कालिकैर्ग्रहशराद्यैरसकृत्प्रकारेणोदयः साध्यः । अवशिष्टं 'प्रागुदयलग्नमून मित्यादि' "प्रागस्तमयो लग्नादूनमित्यादिना च" स्पष्टमिति, पिष्टपेषण मात्रमेवैतदाचार्यस्येति ॥२८-२९॥

अब पुनः ग्रह के उदय और अस्त का साधन कहते है ।

हि. भा.—तात्कालिक ग्रह के शर आदि से असकृत्प्रकार से उदय साधन करना । शेष बातें "प्रागुदयलग्नमून इत्यादि से" तथा "प्रागस्तमयो लग्नादूनं" इत्यादि से स्पष्ट है, आचार्य का यह कथन बिलकुल निरर्थक है, इस कथन की कोई जरूरत नही थी इति ॥२८-२९॥

इदानी ग्रहोदयास्तयोर्दिग्ज्ञानमाह ।

ऊनोऽल्पभुक्तिरुदितः प्रागथवोदेष्यति ग्रहः सूर्यात् ।
पश्चादधिकोऽधिकगतिरल्पगती वक्रिणौ ज्ञसितौ ॥३०॥

प्रागूनोऽधिकभुक्तिः पश्चादधिको ऽल्पभुक्तिरस्तमितः ।
यास्यत्यथवा ऽस्तमयं यतस्ततो दृश्यघटिकोक्तिः ॥३१॥

सु० भा०—अल्पभुक्तिर्ग्रहः सूर्याद्यदोनस्तदा प्राक् प्राच्यां दिशि उदितो वोदेष्यति । अर्कग्रहान्तरघटिकानां दृश्यघटिकातोऽधिकन्यूनवशात् । एवमधिकगतिर्ग्रहः सूर्यादधिकः पश्चादुदितो वोदेष्यति इति वेदितव्यम् । बुधशुक्रौ यदा वक्रिणौ भवतस्तदा तावल्प्यगती कल्प्यौ । अर्थात् तदा तयोः पूर्वदिश्युदय इति वेदितव्यम् । एवं सूर्यादधिकगतिर्ग्रह ऊनः प्राक् प्राच्यां दिशि अल्पभुक्तिर्ग्रहश्चाधिकः पश्चात् पश्चिमायां दिशि अस्तमितोऽस्तं गतो वाऽस्तमयं यास्यति । यत उदयास्तगतैष्यज्ञानं दृश्यघटिकाभिः कालांशघटिकाभिरतो दृश्यघटिकोक्ति रुचितेति ।

अत्रोपपत्तिः । 'रवेरूनभुक्तिर्ग्रहः प्रागुदेति' तथा 'ज्ञशुक्रावृजू प्रत्यगुग्दम्य वक्रां गतिं प्राप्येत्यादि भास्कर विधिना स्फुटा ।

अत्र चतुर्वेदाचार्यः । 'प्रागूनभुक्तिरून' इत्यार्यया गतार्थमिदमार्ययोर्द्वयं । विशेषश्च यदुक्तमूनो ऽल्पभुक्तिरित्यादिना बुधसितयोर्वक्रिणोरेव संभवति स्वल्पगतित्वं तदा च तयोः पश्चादस्तमयः प्रागुदयश्चे' त्यादि ॥३०-३१॥

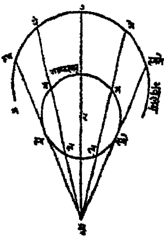
वि. भा.—सूर्यादल्पभुक्तिर्ग्रहो यदोनः (सूर्यादल्पः) तदा प्राक् (पूर्वदिशि) उदितो वोदेष्यति । दृश्यघटिकातो (कालांशघटीतः) रविग्रहान्तरघटीनामधिकन्यूनवशात् । ज्ञसितौ (बुधशुक्रौ) यदा वक्रिणौ भवतस्तदा तावल्पगती कल्प्यावर्था त्तदा तयोः पूर्वदिश्युदयो बोध्यः । एवं सूर्यादधिकगतिर्ग्रह ऊनः (अल्पः) प्राक् (पूर्वदिशि), अल्पभुक्तिः (अल्पगतिः) ग्रहश्चाधिकः पश्चात् (पश्चिम दिशि) अस्तमितोऽस्तं गतो वाऽस्तं यास्यति, यतः (यस्मात् कारणात्) उदयास्तयोर्गतैष्यज्ञानं दृश्यघटिकाभिः (कालांशघटिकाभिः) भवत्यतो दृश्यघटिकोक्तिरुचितेति ॥३०-३१॥

अत्रोपपत्तिः ।

रवेः सकाशादल्पगतिर्ग्रहः पूर्वदिशि कालांशान्तरित उदेति, पश्चिम दिश्यस्तमेति, यथा कुज गुरुशनयो रवितोऽल्पाः कालांशान्तरिता रात्रिशेषे पूर्वदिशि रव्युदयात्पूर्वमेवोदयं गच्छन्ति लोकैश्च दृश्या भवन्ति, रवितोऽभ्यधिकास्त एव कालांशान्तरिताः पश्चिमदिश्यस्तं यान्ति, योऽ धिकगतिग्रहोऽसौ पश्चिमायामुदेति, पूर्वदिशि प्रतितिष्ठति यथा चन्द्रः । बुधशुक्रौ मार्गिणौ रवितोऽधिकगतित्वात् पश्चिमायामुद्गच्छतः । ततस्तत्रैव वक्रतां प्राप्यास्तं गच्छतः । ततोवक्रतयैव पूर्व दिश्युद्गम्य ततोऽवक्रतां प्राप्याधिकगतित्वात् पूर्वदिश्ये वास्त व्रजेताम् ।

नवीनास्तु ग्रहाणां भ्रमणं दीर्घवृत्ते स्वीकुर्वन्ति, यस्यैकनाभौ रविः स्थि-

रोऽस्ति, यस्य दीर्घवृत्तस्य केन्द्रे रविः स्थिरो ऽस्ति स्वल्पान्तरादृत्तवृत्तमिव प्रतिभाति, भूश्च स्वकक्षा वृत्ते भ्रमणवृत्ते रवेः परितो (चतुर्दिक्षु) भ्रमति, तत्रभुवं स्थिरां प्रकल्प्य शुक्रस्य कक्षावृत्तं स्पय उ स्पल कल्प्यते, भवलयं च ततोऽतिदूरे मेस्वप, य उ मस्प, कल्प्यते, यत्र मेषादीनां गणना मेषादितः पूर्वाभिमुखे भवति तदा स्व कक्षायां स्प, य, उ म, स्प बिन्दु गतः शुक्रो भवलये भू निवासिभिः क्रमेण स्प, य, उ, म, स्य, लक्ष्यते, स्प बिन्दुतः स्प, बिन्दु पर्यन्त स्वकक्षायां स्थितः शुक्रः पूर्वाभिमुखगतित्वाद् भवलये स्प, बिन्दु-तः स्प बिन्दु पर्यन्तं गच्छन्निव प्रतिभाति, अतो यदा भवलये उ बिन्दुगतः शुक्रो भवेत्तदा तत्र रविशुक्रयोस्तुल्यत्वात्परमास्तकालो भवेत्। ततः कालांशान्तरिते मे बिन्दुगते शुक्रे भू उ रेखायां प्रवहेणास्तं गते रवौ म बिन्दुगतस्य शुक्रस्य पश्चिमदिशि दर्शनं भवेत्। ततः पश्चिमदिशि प्रतिदिनं रविशुक्रान्तर महद्भवेदतः प्रतिदिनं शुक्रबिम्बं द्युतिमत् दृश्यते स्प, बिन्दुगतः शुक्रो महाद्युतिमान्। तदा स्वकक्षायां शुक्रः स्प बिन्दौ भवेत्। ततः क्रमेण स्वकक्षायां भ्रमन् शुक्रो भवलये स्प, बिन्दुत उत्तरोत्तरं पश्चिमदिशि बिलोक्यते, ततो वक्रगतेः पुनः य बिन्दुगतः शुक्रो रवितः कालांशान्तरितत्वात् नावलोक्यते, अतो मार्गः शुक्रः पश्चिमायामुदेति वक्रगतिं प्राप्य तत्रैवास्तं याति, एव वक्रगतेर्यदा उ स्थानात् म बिन्दुगतो भवेत्तदा कालांशान्तरितत्वात् रात्रिशेषे रव्युदयात्पूर्व पूर्वदिशि शुक्रबिम्बं दृश्यते। ततोऽनन्तरं यावत् स्प, बिन्दुगतो लक्ष्यते सूर्यान्महान्तरितः स्यात्। तदा स्वकक्षायां शुक्रः स्प बिन्दुगतो भविष्यति। शुक्र कक्षावृत्तस्य भूस्प, भूस्प, रेखे भू (स्थिर



बिन्दु) तः स्पर्श रेखे ज्ञेये, ततः स्वकक्षायां स्प बिन्दुतः क्रमेण गच्छन् शुक्रो भवलये मार्गगतिर्लक्ष्यतेऽनो मार्गगतत्वात् रव्यासन्ने पुनः पूर्वदिश्यदृश्यो भवति। एवमेव स्थितिर्बुधस्यापि भवति। एतावताऽऽचार्योक्तबुधशुक्रोदयास्तदिक्स्फुटमुपपद्यते। सूर्य सिद्धान्तेऽपि "सूर्यादभ्यधिकाः पश्चादस्तं जीवकुजाऽर्कजाः। ऊनाः प्रागुदयं यान्ति शुक्रज्ञौ वक्रिणौ तथा। ऊनाः विवस्वतः प्राच्यामस्तं चन्द्रज्ञभार्गवाः। व्रजन्त्यभ्यधिकाः पश्चादुदयं शीघ्रयायिनः" इति बुधशुक्रोदयास्त दिक्प्रति पादनमाचार्योक्त सदृशमेवास्ति, एतदुपपत्तिदर्शनेन प्राचीनानां मनसि सूर्यकेन्द्राभिप्रायिकैव कक्षा स्थितिरासीत्। लोकप्रतीत्यर्थं भुवः समन्ताद् ग्रहाणां कक्षाः प्रतिपादितास्तैरिति कल्पना युक्तियुक्तम्। पूर्वोपपत्त्या च

'ज्ञशुकाव्रजू प्रत्यगुद्गम्य वक्रां गतिं प्राप्य तत्रैव यातः प्रतिष्ठाम्। ततः प्राक् समुद्गम्य वक्रावृजूत्व'' मित्यादिभास्कराचार्योक्त' स्फुटमुपपद्यत इति ॥३०-३१॥

अब ग्रहों के उदय और अस्त के दिशाज्ञान को कहते हैं।

हि. भा.—सूर्य से अल्पगति वाले ग्रह जब सूर्य से अल्प होते है तब वे पूर्व दिशा में उदित होते है या उदित होगे। कालांश घटी से रवि और ग्रह की अन्तर घटी के अधिक न्यून वश से, बुध और शुक्र जब वक्री होते हैं तो उन दोनों को अल्पगतिक मानना चाहिये अर्थात् उन दोनों का उदय पूर्व दिशा में समझना चाहिये। एवं सूर्य से अधिकगतिग्रह सूर्य से ऊन (अल्प) रहने से पूर्व दिशा में, अल्पगतिक ग्रह अधिक रहने से पश्चिम दिशा में अस्तं गत होते हैं या होगे जिस कारण से उदय और अस्त का गतैष्य ज्ञान कालांश घटी से होता है इस कारण से दृश्यघटी के सम्बन्ध में कहना उचित ही है ॥३०-३१॥

उपपत्ति।

रवि से अल्पगति वाले ग्रह कालांशतुल्य अन्तर पर पूर्व दिशा में उदित होते हैं। जैसे कुज, गुरु, और शनैश्चर रवि से अल्प होने के कारण कालांश तुल्य अन्तर में रात्रिशेष में पूर्वदिशा में रवि के उदय से पहले ही उदित होते हैं और लोगों से देखे जाते है। रवि से अधिक वे ही ग्रह कालांशान्तरित होने से पश्चिम दिशा में अस्त होते है। जो अधिक गति-ग्रह है वह पश्चिम दिशा में उदित होता है और पूर्व दिशा में अस्तगत होता है, जैसे चन्द्र, मार्गी बुध और शुक्र रवि से अधिकगतिक होने के कारण पश्चिमदिशा में उदित होते हैं। अनन्तर वही (पश्चिमदिशा ही में) वक्रता को प्राप्त कर अस्तंगत होते हैं। बाद में वक्रता ही से पूर्व दिशा में उदय होकर फिर बाद में अवक्रता को प्राप्त कर अधिक गतित्व से पूर्व दिशा ही में अस्तंगत होते हैं।

नवीन लोग ग्रहों का भ्रमण दीर्घवृत्ताकार कक्षावृत्तों में मानते है। जिसकी एक नाभि स्थान में रवि स्थिर है, वहां स्वल्पान्तर से दीर्घवृत्त वृत्त की तरह भासित होता है जिसके केन्द्र में रवि स्थिर है। भू (पृथ्वी) रवि के चारों तरफ अपने कक्षावृत्त में भ्रमण करती है, वहां भू को स्थिर मानकर शुक्र के कक्षावृत्त स्प य उ$'$ स्प$'$ ल मानते हैं भवलय (नीलाम्बर गोलीय क्रान्तिवृत्त) उस (शुक्रकक्षावृत्त) से बहुत दूर में स्प, य$'$, उ, म$'$ स्प$'_{1}$, है जहां मेषादि की गणना से मेषादि से पूर्वाभिमुख होती है स्वकक्षावृत्त में स्प य$'$, उ$'$, म$'$, स्प, विन्दुओं में स्थित शुक्र भवलय में क्रम से स्प$_{1}$, य$'$, उ, म$'$, स्प$'_{1}$, बिन्दुओं में भू निवासी द्वारा देखे जाते हैं। स्प बिन्दु से स्प$'$ बिन्दु पर्यन्त स्वकक्षा में स्थित शुक्र पूर्वाभिमुख गति के कारण भवलय में स्प$_{1}$ बिन्दु से स्प$'_{1}$ बिन्दु पर्यन्त जाते हुये मालूम पड़ते हैं

इसलिये जब भवलय में शुक्र उ बिन्दुगत होते है तो वहाँ रवि और शुक्र के तुल्यत्व के कारण परमास्तकाल होता है, उसके बाद कालाँशान्तर मे म बिन्दुगत शुक्र के होने से भूउ रेखा में प्रवह से रवि के अस्तगत होने पर म बिन्दुगत शुक्र का दर्शन पश्चिम दिशा मे होता है, उसके बाद पश्चिम दिशा में प्रत्येक दिन रवि और शुक्र का अन्तर बहुत बडा होता है इसलिये प्रत्येक दिन शुक्र बिम्ब द्युतिमान् (कान्तिवान् चमकदार) देखने मे आता है, स्प, बिन्दुगतशुक्र बहुत द्युतिमान् होता है उस समय स्वकक्षावृत्त में शुक स्प बिन्दु मे रहते है, उसके बाद क्रम से स्वकक्षावृत्त में भ्रमण करते हुए शुक्र भवलय मे स्प, बिन्दु से उत्तरोत्तर पश्चिम दिशा में देखे जा सकते है। इसलिए मार्गी शुक्र पश्चिम दिशा मे उदित होते है वही वक्रगति प्राप्त कर अस्तगत होते है। एव वक्रगति से जब शुक्र उ स्थान से म बिन्दुगत होते है तो कालाँशतुल्य अन्तर होने के कारण रात्रिशेष में रवि के उदय से पहले पूर्व दिशा में देखे जाते है (यहाँ सं. उपपत्ति मे लिखित क्षेत्र को देखिये) उसके बाद यावत् शुक्र स्प, बिन्दुगत लक्षित होते है सूर्य से बहुत अन्तरित होते हे। उस समय में अपनी कक्षा में शुक्र स्प बिन्दुगत होंगे। भू बिन्दु से शुक्र कक्षा वृत्त की भू स्प, भूस्प, दोनों रेखायें स्पर्श रेखाये समझनी चाहिये। अपनी कक्षा में स्प बिन्दु मे क्रम से जाते हुए शुक्र भवलय में मार्गगतिक लक्षित होते है। इसलिये मार्ग गतित्व मे रवि के समीप में फिर पूर्वदिशा में अदृश्य होते हैं। इसी तरह की स्थिति बुध की भी होती है। इससे आचार्योक्त बुध और शुक्र के उदय और अस्त का दिक्ज्ञान प्रकार स्फुट उपपन्न होता है, सूर्यसिद्धान्त में भी :"सूर्यादभ्यधिका: पश्चादस्तं जीव कुजार्कजा:। ऊना: प्रागुदयं यान्ति" इत्यादि आचार्योक्त के सदृश ही है, इन उपपत्तियों के देखने से प्राचीनों के मन में सूर्य केन्द्राभिप्रायिक ही कक्षा स्थिति थी, मालूम पड़ता है, लोगों में प्रतीति उत्पन्न करने के लिये पृथ्वीं की चारों तरफ ग्रहों की कक्षा प्रतिपादित है। उन लोगों से, यह कल्पना युक्तियुक्त है, पूर्वोपपत्ति ही से "ज्ञशुक्रावृजू प्रत्यगुदगम्य वक्रां गतिं प्राप्य तत्रैव यात: प्रनिष्ठाम्" इत्यादि भास्करोक्त भी स्फुट उपपन्न होता है इति ॥३०-३१॥

इदानी दृश्य घटिका (कालांश घटिका) आह

घटिकाद्वयेन चन्द्रो दृश्योऽर्कात् सितगुरुज्ञशनिभौमा:।
अध्यर्धया घटिकया त्रिभाग घटिकोत्तराधिकया ॥ ३२ ॥

सु० भा०—अर्काद् घटिकाद्वयेनान्तरितश्चन्द्रो दृश्यो भवति। शुक्रगुरुबुधशनि-भौमाश्च अध्यर्धया घटिकया सार्धैकघट्या किं विशिष्टया त्रिभागघटिकोत्तराधिकया दृश्या भवन्ति। अर्थात् शुक्रस्य कालांशघटिका सार्धैका १। ३०। गुरो: सार्धैका

त्रिभागाधिका ।१।५०। एवं बुधस्य १।५०+२०=२।१०। शनेः २।१०+२०=२।३०। भौमस्य २।३०+२०=२।५०। एताः षड्गुणाश्चन्द्रादीनां कालांशाः च=१२। शु.=९। गु.=११। बु.=१३। श.=१५। मं.=१७। द्वादशभिः शीतांशुरित्यादिपाठपठितसमाः ॥ ३२ ॥

वि. भा.—अर्कात् (रवितः) घटिकाद्वयेनान्तरितश्चन्द्रो दृश्यो भवति। सितगुरुज्ञशनिभौमाः त्रिभाग २० घटिकोत्तराधिकया (विंशत्या घटिकया युतया)ऽध्यर्धया घटिकया (सार्धैक घट्या) दृश्या भवन्त्यर्थात् शुक्रस्य कालांशघटिका सार्धैका १।३०, गुरोस्त्रिभागाधिका सार्धैका १।३०+२०—१।५०, बुधस्य १।५०+२०=२।१०। शनेः=२।१०+२०=२।३०, भौमस्य=२।३०+२०=२।५० एताः षड्गुणास्तदा चन्द्रादिग्रहाणां कालांशा भवन्ति, यथा चन्द्रस्य=१२, शुक्रस्य=९, गुरोः=११ बुधस्य=१३, शनेः=१५, भौमस्य=१७ इति 'द्वादशभिः शीतांशु' रित्यादि पाठपठित समा जाता इति सूर्यसिद्धान्ते "एकादशामरेज्यस्य तिथि सङ्ख्यार्कजस्य च। अस्तांशा भूमिपुत्रस्य दश सप्ताधिकास्ततः॥ पश्चादस्तमयोऽष्टाभिरुदयः प्राङ् महत्तया। प्रागस्तमुदयः पश्चादल्पत्वाद्दशभिर्भृगोः। एवं बुधो द्वादशभिश्चतुर्दशिभरशकैः। वक्री शीघ्रगतिश्चार्कात् करोत्यस्तमयोदयौ॥ अस्तांशाः कालांशा उदयांशाश्चैकपर्यायवाचिनः शब्दाः। अमरेज्यस्य (गुरोः) कालांशा एकादश, अर्कजस्य (शनेः) कालांशाः पञ्चदश, भूमिपुत्रस्य (मङ्गलस्य) कालांशाः सप्तदश, भृगोः (शुक्रस्य) बिम्बमहत्वान्नीचासन्नगतत्वाच्चाष्टाभिः कालांशैः पश्चादस्तः, पूर्वदिश्युदयश्च। तथोच्चासन्नगतत्वाद्बिम्बाल्पत्वाच्च दशभिः कालांशैः पूर्वदिश्यस्तं पश्चादुदयश्च। एवं वक्री बुधो रवितो द्वादशभिः कालांशैर्बिम्बमहत्वादस्तोदयौ करोति, शीघ्रगतिर्बुधश्च बिम्बाल्पत्वाद्रवितश्चतुर्दशभिः कालांशैरस्तोदयौ करोति, अत्र बुधशुक्रयोरस्तोदययोः कालांशा, आचार्योक्तकालांशतो भिन्ना दृश्यन्ते इति॥

अत्रोपपत्तिः

ग्रहबिम्बस्य लघुत्वं महत्त्वं चोच्चनीचस्थितिवशेन भवति, बिम्बान्तरसूत्रवशाद्रवेस्तेजसो ग्रहबिम्बोपरि न्यूनाधिकत्वं भवत्यतः कालांशाः स्थिरा न भवितुमर्हन्ति, तस्मादेव कारणात् लोकव्यवहारार्थमसकृद्वेधेन प्राचीनैः स्थूलाः कालांशाः समवगत्य पठिताः। बिम्बस्य स्थूलत्व सूक्ष्मत्व वशात्तेषां (कालांशानां) न्यूनाधिकता भवन्त्यतो वक्रगयोर्बुधशुक्रयोर्बिम्बस्य महत्वाद्द्विहीना सूर्यसिद्धान्तकारेण कृता, सिद्धान्त शिरोमणौ भास्करेण "ज्ञशुक्रयोर्वक्रगयोर्द्विहीना" ऽप्यनेन तदेव कथ्यते इति॥ ३२॥

अब दृश्य घटी (कालांश घटी) को कहते है ।

हि. भा.—रवि से दो घटी अन्तर पर चन्द्र दृश्य होते है, शुक्र, गुरु, बुध, शनि, और भौम (मङ्गल) ये ग्रह डेढ घटी १ । ३० में त्रिभाग घटिकोत्तर (वीस घटी वृद्धि) करके दृश्य होते है अर्थात् शुक्र की कालांश घटी=१ । ३०, गुरु की कालाश घटी=१ । ३०+२०=१ । ५०, बुध की कालांश घटी=१ । ५०+२०=२ । १० शनि की कालाश घटी=२ । १०+२०=२ । ३० । भौम की कालांश घटी=२ । ३०+२०=२ । ५०, इनको छः से गुणने से चन्द्र आदि ग्रहों के कालांश होते है, चन्द्र के कालाश=१२, शुक्र के कालांश=९, गुरु के कालांश=११, बुध के कालांश=१३, शनि के कालांश=१५, भौम के कालांश=१७ ये 'द्वादशभिः शीतांशुः' इत्यादि पाठपठित कालांश के तुल्य ही है । सूर्य सिद्धान्त में "एकादशामरेज्यस्य तिथिसङ्ख्यार्कजस्य च । अस्तांशा भूमिपुत्रस्य दश सप्ताधिकास्तत" इत्यादि संस्कृत विज्ञान भाष्य में लिखित श्लोकों के अनुसार गुरु के कालाश=११, शनि के कालाश=१५, भौम के कालाश=१७, शुक्र के नीचासन्न मे रहने से बिम्ब के महत्त्व के कारण ८ कालांश में पश्चिम दिशा में अस्त और पूर्व दिशा मे उदय होता है । तथा उच्चासन्न में रहने से बिम्ब की अल्पता के कारण दश कालाश मे पूर्व दिशा में अस्त और पश्चिम दिशा में उदय होता है । एवं वक्री बुध रवि से बारह कालाश में बिम्ब के महत्त्व के कारण अस्त और उदित होते हैं, शीघ्रगतिक बुध विम्ब की अल्पता के कारण चौदह कालांश में अस्त होते हैं और उदित होते हैं, बुध और शुक्र का कालाश यहां आचार्योक्त कालांश से भिन्न कहा गया है इति ॥ ३२ ॥

उपपत्ति ।

उच्च और नीच के वश से ग्रह बिम्ब का लघुत्व और महत्त्व होता है । बिम्बान्तर सूत्रवश से रवि के तेज ग्रह विम्ब के ऊपर न्यून और अधिक होता है इसलिये कालांश स्थिर नहीं हो सकता है, इसी कारण से लोक व्यवहार के लिये प्राचीनाचार्यो ने वार-वार वेध से कालाँश को जानकर स्थूल कालाँश पठित किया है । बिम्ब की स्थूलता और सूक्ष्मतावश से उन (कालाँश) की न्यूनता और अधिकता होती है, इसलिये वक्रगत बुध और शुक्र की बिम्ब स्थूलता के कारण दो घटाया गया है, सूर्य सिद्धान्तकार के मत में, सिद्धान्त शिरोमणि में भास्कराचार्य ने भी "ज्ञशुक्रयोर्वक्रगयोर्द्विहीना" इससे उसी बात को कहा है इति ॥ ३२ ॥

इदानीमन्तर घटिकाभिस्तात्कालिकीकरणं कालज्ञानंचाऽऽह ।

ग्रहसूर्यान्तर घटिका स्वदृश्य घटिकान्तरं ततोलिप्ताः ।
प्राग्वत् तदन्तर हृता हीनाधिकनाड़िका दिवसाः ॥ ३३ ॥

विपरीतमृणधनं सौम्यशुक्रयोर्वक्रिणोः स्वभुक्तिकलाः ।
एवमुदयास्तमययोर्विपरीतं वक्रिणि स्वफलम् ॥ ३४ ॥

सु. भा.—ग्रहसूर्यान्तरघटिकानां स्वदृश्यघटिकानां चान्तरं कार्यम् । ततस्तदन्तराल्लिप्ताः साध्याः । अर्थादन्तरघटिकासवो ऽष्टादशशतकलाभिः संगुणा ग्रहाधिष्ठितराश्युदयासुभिर्भाज्याः फलं क्षेत्रकलाः स्युः ततस्ताः क्षेत्रकलाः प्राग्वत् तदन्तरहृतास्तयो रविग्रहयोर्भुक्त्यन्तरेण हृताः शुक्रबुधयोर्वक्रिणोः सतोस्तद्रविभुक्तियोगेन हृताः फलं होनाधिकनाडिका दिवसाः एष्यगतदिवसा भवन्ति । अर्थादिष्टकालांशाः पठितेभ्यो ऽल्पास्तदा हीनसंबंन्धिनो दिवसा अधिकास्तदाऽधिकसंबंधिनो दिवसा ज्ञेयाः, तैर्दिवसैः स्वभुक्तिकलाः स्वभुक्तितश्चालनकलाः साध्यास्तत्संस्कारेण ग्रहोदयास्ते ग्रहो रविश्च भवति । ततः पुनस्तदन्तरघटिकाः साध्याः । एवमसकृद्यावत् तदन्तरघटिका दृश्यघटिका समाः स्युः । स्थिरीभूते काले च ग्रहार्कान्तरघटिकानां दृश्यघटिकासमत्वाद्ग्रहस्योदयो वाऽस्त इति । बुधशुक्रयोर्वक्रिणोस्तयोः स्वभुक्तिकलाश्चालनकला विपरीतमृणधनं कार्यं । एवं ग्रहे वक्रिणि सति स्वचालनफलमुदयास्तमययोर्विपरीतं धने ऋणमृणे धनमिति ज्ञेयमिति ।

अत्रोपपत्तिः । 'उक्तेभ्य ऊनाभ्यधिका यदीष्टाः' इत्यादि भास्करविधिना स्फुटा ॥ ३३-३४ ॥

वि. भा.—ग्रहसूर्यान्तरघटिकानां स्वदृश्यघटिकानां (स्वकालांश घटिकानां) चान्तरं कार्यम् । ततस्तदन्तरात् लिप्ताः साध्याः । अन्तरघटिकासवो ऽष्टादशशत कलाभिर्गुणनीया ग्रहाधिष्ठितराश्युदयासुभिर्भाज्याः फलमन्तरघटिकासु सम्बन्धिन्यः कलाः (क्षेत्रकलाः) स्युः । ततस्ताः क्षेत्रकलाः प्राग्वत् तदन्तरहृताः (रविग्रहयोर्गत्यन्तरेण भक्ताः), शुक्रबुधयोर्वक्रिणोस्तद्रविगतियोगेन भक्ताः फलं हीनाधिकनाड़िका दिवसाः (एष्यगत दिनानि) भवन्ति, अर्थाद्यदीष्टकालांशाः पठितकालांशेभ्योऽल्पास्तदा हीनसम्बन्धिनो दिवसाः अधिकास्तदाऽधिक सम्बन्धिनो दिवसाबोध्याः । तैर्दिवसैः स्वभुक्तिकलाः (स्वगतितश्चालनकलाः) साध्यास्तत्संस्कारेण ग्रहोदयास्ते ग्रहो रविश्च भवति, ततः पुनस्तदन्तरघटिकाः साध्या एवमसकृद्यावत्तदन्तरघटिका दृश्यघटिकासमाः स्युः । स्थिरी भूते काले च ग्रहार्कान्तरघटिकानां दृश्य घटिकासमत्वाद् ग्रहस्योदयो वाऽस्तः । बुधशुक्रयोर्वक्रिणोस्तयोः स्वभुक्तिकलाः (चालन कलाः) विपरीतमृणधनं कार्यम् । एवं ग्रहे वक्रिणि सति स्वचालनफल मुदयास्तमययो विपरीतमर्थात् धने ऋणमृणे धनमिति विज्ञैर्ज्ञेयम् ॥ ३३-३४ ॥

अत्रोपपत्तिः ।

पठितकालांशघटिकानामिष्टकालांशघटिकानां चान्तरं कार्यं ततोऽनुपातो यदि ग्रहाधिष्ठित राश्युदयासुभिरष्टादशशतकला राशिकला लभ्यन्ते तदा कालांश-घटिकान्तरासुभिः कि फलं तत्सम्बन्धिन्यः क्षेत्रकलाः स्यः । पठितकालांशेष्टकालां-शान्तरकलाः कालवृत्तेऽतस्तत्सजातीयग्रहकालगत्योरन्तरेण वक्रिणि ग्रहे च गतियोगेनैकं दिनं लभ्यते तदा कालांशान्तरकलाभिः किमिति फलं दिनादिकम् । कालगत्यानयनार्थमनुपातो यद्यष्टादशशतकलाभी राशिकलाभि र्ग्रहनिष्ठराश्युदया-सवो लभ्यन्ते तदा ग्रहगतिकलाभिः किमिति फलं कालगतिः । पठितकालांशतो यदीष्टकालांशा भिन्नदिशि भवेयुस्तदा पठित कालांशेष्टकालांशयुते. कलाभिर्गन्तै-ष्यदिवसाः साध्याः, सूर्य सिद्धान्ते ।

"तत्कालांशान्तर कला भुक्तयन्तरविभाजिताः ।
दिनादितत्फलं लब्धं भुक्तियोगेन वक्रिणः ॥
तल्लग्नासु हते भुक्ती अष्टादश शतोद्धते ।
स्यातां कालगती ताभ्यां दिनादिगतगम्ययोः ॥ इति श्लोकाभ्यां
सूर्यसिद्धान्तकारेण सर्व स्फुटीकृतमेव ।
सिद्धान्तशिरोमणौ भास्कराचार्येण "उक्तेभ्य ऊनाभ्यधिका यदोष्टाः
खेटोदयो गम्यगतस्तदा स्यात् ।
अतोऽन्यथा वाऽस्तमयोऽवगम्यः प्रोक्तेष्टकालांशवियोगलिप्ताः ॥
खाभ्राष्टभूघ्ना द्युचरोदयाप्ताः खेटार्कभुक्तयन्तरभाजिताश्च ।
वक्रे तु भुक्तयैकहृता अवाप्तास्तदन्तराले दिवसा गतैष्याः ॥
तात्कालिकाभ्यां रविहग्ग्रहाभ्यां मुहुः कृतास्ते स्फुटतां प्रयान्ति ।"
एभिः सर्व स्फुटीकृतमेवेति ॥ ३३-३४ ॥

अब अन्तर घटी से तात्कालिकी करण और काल ज्ञान को कहते हैं ।

हि. भा.—ग्रह और रवि की अन्तर घटी तथा स्वदृश्य घटी (स्वकालांश घटी) का अन्तर करना, तब उस अन्तर से कला-साधन करना अर्थात् अन्तर घटिकासु को अठारह सौ कला (राशि कला) से गुण कर ग्रहाधिष्ठित राशि (जिस राशि में ग्रह है) की उदयासु से भाग देने से फल अन्तर घटिकासु सम्बन्धिनी कला (क्षेत्र कला) होती है। इन क्षेत्र कलाओं को पूर्ववत् रवि और ग्रह के गत्यन्तर से भाग देना, बुध और शुक्र के वक्री रहने से रवि और वक्री बुध या वक्री शुक्र के गतियोग से भाग देना, फल एष्य दिन और गत दिन होते हैं । अर्थात् यदि इष्ट कालांश पठित कालांश से अल्प हो तो हीन सम्बन्धी दिन और अधिक हो तो अधिक सम्बन्धी दिन समझना चाहिये। उन दिनों से अपनी गति से चालन कला साधन करना उसके संस्कार करने से ग्रहोदय और ग्रह के अस्त समय में ग्रह और रवि होते है। उनसे

पुनः रवि और ग्रह अन्तर घटी साधन करना इस तरह असकृत्कर्म तब तक करना चाहिये जब तक अन्तर घटी दृश्यघटी (कालांश घटी) के बराबर हो; उस समय में ग्रह और रवि की अन्तर घटी दृश्य घटी (कालांश घटी) के बराबर होने का कारण ग्रह का उदय वा अस्त होता है। वक्री बुध और शुक्र की चालन कला को विपरीत (उल्टा) ऋण धन करना, एवं ग्रह के वक्री रहने से चालन फल को उदय अस्त मे विपरीत अर्थात् धन रहने से ऋण और ऋण रहने से धन करना चाहिये इति ।। ३३-३४ ।।

उपपत्ति

पठित कालांश घटी और इष्ट कालांश घटी का अन्तर करना, तब अनुपात करते हैं। यदि ग्रहाधिष्ठित राशि की उदयासु में अठारह सौ कला राशिकला पाते हैं तो कालांश घटिकान्तरासु में क्या इससे कालांश घटिकान्तरासु सम्बन्धिनी क्षेत्र कला आती है। पठित कालांश और इष्ट कालांश की अन्तर कला कालवृत्त में है इसलिये उसके सजातीय ग्रहगति और कालगति के अन्तर से ग्रह के वक्री रहने से गति योग में यदि एक दिन पाते हैं तो कालांशान्तर कला में क्या इससे फल दिनादि आता है, कालगति के ज्ञान के लिये अनुपात करते है यदि क्रान्तिवृत्तीय अठारह सौ कला में ग्रहनिष्ठ राश्युदयासु पाते हैं तो क्रान्तिवृत्तीय ग्रहगति कला में क्या इससे फल कालगति होती है, पठित कालांश से यदि इष्ट कालांश भिन्न दिशा में हो तो पठित कालांश और इष्ट कालाँश की योग कला से गत दिन और एष्यदिन साधन करना। सूर्य सिद्धान्त में "तत्कालांशान्तर कला भुक्त्यन्तरविभाजिताः। दिनादि-तत्फलं लब्धं भुक्ति योगेन वक्रिणः" इत्यादि श्लोकों से सूर्य सिद्धान्तकार ने सब बातें स्पष्ट कर दी है। सिद्धान्त शिरोमणि में भास्कराचार्य ने भी "उक्तेभ्य ऊनाभ्यधिका यदीष्टाः खेटोदयो गम्यगतस्तदा स्यात्। अतोऽन्यथा वाऽस्तमयोऽवगम्यः" इत्यादि श्लोकों से सब विषय को स्पष्ट कर दिया है इति ।। ३३-३४ ।।

इदानीमगस्त्यध्रुवशरांशास्तदुदयास्तार्कसाधनं चाह ।

विक्षिप्तो दक्षिणतस्तत् क्रान्तेर्भागसप्तसप्तत्या ।
मिथुनस्य सप्तविंशे भागेऽगस्त्यो नतैर्भागैः ।। ३५ ।।

नवतेरूनैर्दृश्यो घटिकाद्वितयेन तदुदयविलग्नम् ।
उदयैरधिकं कृत्वा तदुदयसूर्योऽस्तमयलग्नम् ।। ३६ ।।

षड्भयुतमूनमुदयैः षड्राशियुतं तदस्तमयसूर्यः ।
घटिका द्वितयेनैवं षड्भागयुतेन मृगहर्त्तुः ।। ३७ ।।

सु० भा०—अगस्त्यो मिथुनस्य सप्तविंशे भागे तत्क्रान्त्या स्थानीयक्रान्त्यग्राद्भागसप्तसप्तत्या दक्षिणतो विक्षिप्तः। अर्थात् सप्ताशीतिभागा ध्रुव. सप्तसप्तत्यंशा दक्षिणः शरोऽगस्त्यस्य। अयमगस्त्यो नवतेरूनैर्भागैर्नतैर्दृश्योऽर्थाद्यदाऽगस्त्यस्य खस्वस्तिकान्नवतेरल्पा नतभागास्तदैव क्षितिजोपरिस्थितत्वादगस्त्यो दृश्यः। एवं सूर्याद्घटिकाद्वयेनान्तरितोऽगस्त्यो दृश्यो भवति। अर्थादगस्त्यस्य द्वादश कालांशा इति। अथ तदुदयलग्नं घटिका द्वितयेनोदयैः स्वदेशोदयैरधिकं कृत्वाऽगस्त्यस्योदयसूर्यः साध्यः। उदयलग्नं तात्कालिकमर्कं प्रकल्प्य घटीद्वयमिष्टं च यल्लग्नं भवति सोऽगस्त्यस्योदयसूर्यः। तादृशेऽर्केऽगस्त्यः स्वदेशे उदेतीति। एवं षड्भयुतमस्तलग्नमुदयैः स्वदेशोदयैर्घटिकाद्वयेनोनं कृत्वा तत् षड्राशियुतमगस्त्यस्यास्तसूर्यो भवति। अगस्त्यास्तलग्नं सषड्भं तात्कालिकमर्कं घटीद्वयमिष्टं च प्रकल्प्योत्क्रम विधिना यल्लग्नं तत् षड्राशियुतमस्तसूर्यः स्यादिति। तादृशे सूर्येऽगस्त्योऽस्तमेतीति। एवं षड्भागयुतेन घटिकाद्वितयेन मृगहर्तुर्व्याधस्योदयास्तसूर्यौ भवतः। अर्थाद्व्याधस्य त्रयोदशकालांशास्तेभ्यस्तदुदयास्तसूर्यसाधन कार्यम्।

अत्रोपपत्तिः। आचार्योक्तमस्तलग्नं गृहीत्वा 'दृक्कर्मणा पलभवेन तु केवलेन भानां मुनेर्मृगरिपोरुदयास्तलग्ने' इत्यादि भास्कर विधिना स्फुटा ज्ञेयेति। एवं मध्याह्ननतांशाः परमाल्पा भवंति ते क्रान्त्यक्षसंस्कारेण भवन्ति। अगस्त्यस्फुटक्रान्तिश्च स्वल्पांतरात् ७७—२४=५३° दक्षिणा अतो यत्राक्षांशाः ३७ सप्तत्रिंशतोऽधिकास्तत्र मध्यनतांशानां नवतेरधिकत्वादगस्त्यो न दृश्यो भवतीति स्फुटम्।

अत्रटीकायां चतुर्वेदाचार्येण कान्यकुब्जस्य २६°।३५' अक्षांशान् विलिख्य कान्यकुब्जेऽगस्त्यमध्यनतांशाः: ७९°।३७' एते साधिताः। अगस्त्यस्य सूक्ष्मा स्फुटक्रान्तिश्च ५३°।२' दक्षिणाऽऽनीता ॥ ३५-३७ ॥

वि. भा.—अगस्त्यो मिथुनस्य सप्तविंशे२७ऽंशे तत्क्रान्तेः (तत्स्थानीयक्रान्त्यग्रात्) भागसप्तसप्तत्या दक्षिणतो विक्षिप्तो भवति। अर्थादगस्त्यस्य सप्ताशीत्यंशा ध्रुवः। सप्तसप्तत्यं ७७शा दक्षिणः शरः। नवतेरूनैः (नवत्यंशाल्पैः) नतैर्भागैः (नतांशैः) अगस्त्यो दृश्यो भवत्यर्थाद्यदाऽगस्त्यस्य खस्वस्तिकान्नवत्यंशाल्पा नतांशा (खस्वस्तिकादगस्त्यं यावत्) स्तदैव क्षितिजादुपरिस्थितत्वाद् दृश्यो भवति। एवं सूर्याद् घटिका द्वितयेनान्तरितोऽगस्त्यो दृश्यो भवति. २घटो×६=१२अंशाः, अर्थादगस्त्यस्य कालांशा द्वादश, अथ तदुदयलग्नं घटिका द्वितयेनोद्रयैः (स्वदेशोदयैः) रधिकं कृत्वाऽगस्त्योदयसूर्यः साध्यः उदयलग्नं तात्कालिकरविं प्रकल्प्य घटिकाद्वयमिष्टकालं प्रकल्प्य ततो लग्नानयनेन यल्लग्नं भवति सोऽगस्त्योदयसूर्यः। तत्सदृशेऽर्केऽगस्त्यः स्वदेशे उदेति। एवं षड्राशियुतमस्तलग्नं स्वदेशोदयै र्घटिकाद्वयेनोनं (हीनं) कृत्वा

तत् षड्राशियुतमगस्त्यस्यास्तसूर्यो भवति । अगस्त्यस्यास्तलग्नं षड्राशियुतं तात्कालिकं रविं घटीद्वयमिष्टकालं प्रकल्प्य विलोमविधिना यल्लग्नं तत् षड्राशियुतं तदाऽस्तसूर्यो भवेत् । तादृशेऽर्केऽगस्त्योऽस्तमेति । एवं षड्भागयुतेन घटिका द्वितयेन मृगहर्त्तुः (व्याधस्य) उदयास्तसूर्यौ भवतः । अर्थाद् व्याधस्य कालांशास्त्रयोदश १३, एभ्यस्तदुदयास्तसूर्यसाधनं कर्त्तव्यमिति ॥ ३५-३७ ॥

अत्रोपपत्तिः ।

आचार्यकथितमस्तलग्नं गृहीत्वा 'दृक्कर्मणा पलभवेन तु केवलेन भानां मुनेर्मृगरिपोरुदयास्तलग्ने', इत्यादि । भास्करोक्तया वासना स्फुटैव बोध्या । एवं मध्यक्रान्त्यक्षांशयोः संस्कारेण परमाल्पा मध्याह्न नतांशा भवन्ति । अगस्त्य स्फुटक्रान्तिः स्वल्पान्तरात् ७७° — २४° = ५३° दक्षिणा, अतो यत्राक्षांशाः ३७ सप्तत्रिंशतोऽधिकास्तत्र मध्यनतांशा नवतेरधिका अतस्तत्रागस्त्यो न दृश्यो भवति । सूर्य सिद्धान्ते "अशीतिभागैर्याम्यायामगस्त्यो मिथुनान्तगः । विंशे च मिथुनस्यांशे मृगव्याधो व्यवस्थितः ॥ विक्षेपो दक्षिणे भागैः खार्णवैः स्वादप क्रमात्" इति सूर्यसिद्धान्तकारोक्तयागस्त्यध्रुवः=९०°, दक्षिणःशरश्च=८०°, मृगव्याधस्य ध्रुवः=८०°, तस्य दक्षिणशरांशाः=४०°, सिद्धान्तशेखरे "नक्षत्रांशैः संयुतं राशियुग्मं ८७° लोपा मुद्रावल्लभस्य ध्रुवः स्यात् । शैलाभ्यस्तैः रुद्रतुल्यैश्च भागैः "विक्षिप्तोऽयं दक्षिणे स्वापमाग्रात्" इति श्रीपत्युक्तया गस्त्यध्रुवः=८७° अगस्त्यस्य दक्षिण शरांशाः=७७°, आचार्योक्तानुरूपमेव श्रीपत्युक्तमस्ति, किन्तु सूर्य सिद्धान्तोक्तादाचार्योक्तौ महदन्तरं दृग्गोचरी भूतं भवति प्रत्यक्षमेव तद्दर्शनेन ज्ञातुं शक्यत इति ध्रुवशरांशयोरुपपत्ती भग्रहयुत्यधिकारारम्भ एवं प्रतिपादिते मया ते तत एवावगन्तव्ये ॥ ३५-३७ ॥

अब अगस्त्य के ध्रुव और शरांश को तथा उनके उदयार्क और अस्तार्क के साधन को कहते है ।

हि. भा. अगस्त्य मिथुन के सताईस अंश में स्थित होकर उसके स्थानीय क्रान्ति के अग्र से सतहत्तर ७७ अंश करके दक्षिण दिशा मे विक्षिप्त होते है अर्थात् अगस्त्य के ध्रुव=२ राशि+२७°=६०°+२७°=८७°, तथा दक्षिण शर=७७° नवत्यंश से अल्प नतांश होने से अगस्त्य दृश्य होते हैं अर्थात् खस्वस्तिक से अगस्त्य पर्यन्त अगस्त्य के नतांश नवत्यंशाल्प रहने से वे अगस्त्य क्षितिज से ऊपर रहते हैं अतः वे तब दृश्य होते हैं । एवं सूर्य से दो घटी पर अगस्त्य के रहने से वे दृश्य होते हैं २ घटी × ६=१२° अर्थात् अगस्त्य के कालांश १२ बारह अंश है, उनके उदयलग्नको तात्कालिक रवि मान कर तथा घटिका द्वितय

याने दो घटी को इष्ट काल मान कर स्वदेशोदय से लग्नानयन विधि मे जो लग्न होता है वही अगस्त्य के उदयसूर्य होते है । उदय सूर्य के बराबर रवि के होने से स्वदेश में रवि उदित होते है । एवं अगस्त्य के अस्त लग्न में छः राशि जोडने से जो हो उस को तात्कालिक रवि मान कर घटी द्वय (दो घटी) को इष्ट काल मान कर विलोम विधि से जो लग्न होता है उसमें छः राशि जोड़ने से अस्त सूर्य होते है। अस्त सूर्य के बराबर रवि के रहने से अगस्त्य अस्त होते है। एव मृगव्याध के षड्भागयुत दो घटी मे उदय सूर्य और अस्त सूर्य होते है अर्थात् मृग व्याध के कालांश १३ होते हैं, इन्हीं से उन (मृग व्याध) के उदय सूर्य और अस्तसूर्य का साधन करना चाहिये इति ।। ३५-३७ ।।

उपपत्ति ।

आचार्य कथित अस्त लग्न को ग्रहण कर 'दृक्कर्मणापल भवेन तु केवलेन भाना मुनेर्मृगरिपोरुदयास्त लग्ने' इत्यादि भास्करोक्त विधि से उपपत्ति स्फुट ही है । एव मध्यक्रान्ति और अक्षांश के संस्कार से परमाल्पमध्यान्ह नतांश होता है, अगस्त्य की स्फुट क्रान्ति स्वल्पान्तर से ७७° —२४°=५३°, अतः जिस देश में अक्षांश ३७ सैंतीस अंश से अधिक है वहाँ मध्मनतांश नवत्यंश से अधिक होता है इसलिये वहाँ अगस्त्य दृश्य नही होते है । सूर्य सिद्धान्त में "अशीतिभागैर्याम्याया मगस्त्यो मिथुनान्तगः" इत्यादि म. उपपत्ति में लिखित पद्यो से अगस्त्य के ध्रुव=९०°, दक्षिणशर=८०°, सिद्धान्तशेखर में "नक्षत्रागै. मयुतं राशियुग्मं लोपामुद्रावल्लभस्य ध्रुवः स्यात्" इत्यादि स. उपपत्ति में लिखित श्लोक से श्रीपत्युक्त अगस्त्य ध्रुव=८७°, अगस्त्य के दक्षिण शरांश=७७°, आचार्योक्त के अनुरूप ही श्रीपत्युक्त भी है, लेकिन सूर्य सिद्धान्तोक्त से आचार्यकथन में वहुत अन्तर देखने में आता है, ध्रुव और शरांश की उपलब्धि की उपपत्ति भग्रहयुत्यधिकार के प्रारम्भ में ही दिखलायी गई है ये वहीं से समझनी चाहिये इति । ३५-३७ ।।

इदानीं नक्षत्रस्य सदोदितत्वं सदाऽस्तमितत्वं चाह ।

एवं नक्षत्राणां घटिका द्वितयेन सत्रिभागेन ।
उदयार्कोऽस्तमयार्काद्यस्योनस्तत् सदा दृश्यम् ॥३८॥

सु. भा.—एवमन्यनक्षत्राणां घटिकाद्वितयेन त्रिभागाधिकेनोदयास्तसूर्यौ साध्यौ। अर्थादन्येषां तारतम्येन चतुर्दशकालांशाः कल्प्याः । यस्यास्तमयार्काद्उदयार्क ऊनस्तद्भं सदा दृश्यं भवति। तिग्मांशुसान्निध्यवशेन तस्यास्तो नेति । आचार्योक्तास्तसूर्यः सषड्भो वा विभार्धो भास्करास्तमयसूर्यो भवति तेन "यस्योदयार्कादधिकोऽस्तभानुः प्रजायते सौम्यशरातिदैर्ध्यात्" इत्यादि भास्करोक्तमेतदनुरूपमेव ।

अत्रोपपत्तिः । नक्षत्रबिम्बोदये उदयलग्नं तदुदयाद्दृश्यघटिकानन्तरमुदय-[सू]र्योदयः । एवमाचार्योक्तास्तसूर्यास्तानन्तरं दृश्यघटी मिते काले नक्षत्रास्तलग्न-[स्]यास्तमयः । कल्प्यते भोदयलग्नोदयानन्तरं द्विगुणदृश्यघटीतोऽधिके काले सषड्-[भ]ास्त लग्नोदयः । रविश्च भोदय लग्नोदयार्कमध्ये किल वर्त्तते । तदा प्राक्क्षि-[ति]जे नक्षत्रोदयानन्तरं दृश्यघटीतोऽल्पेन कालेनार्कोदयात् प्राक् क्षितिजे नक्षत्र-[द]र्शनाभावः । भबिम्बोदयानन्तरं दृश्यघटीमितेन कालेन सषड्भास्तसूर्यचिह्न-[द्व]योदयोऽत उदयार्कात् सषड्भार्कोऽधिकस्तथाऽऽचार्योक्तास्तसूर्यश्चोदयार्का-[द]ल्प इति स्थितिः । अस्यां स्थितौ प्राक् क्षितिजे दर्शनाभावः परन्तु पश्चिमक्षि-[ति]जे सूर्यास्तानन्तरमुदयसूर्यचिह्नस्य ततोऽस्तसूर्यचिह्नस्य ततोऽस्तलग्नस्यार्था-[द्]भबिम्बस्यास्तमयः । अतः पश्चिमक्षितिजे नक्षत्रबिम्बदर्शनं भवति । एवं यदि [प]श्चिमक्षितिजे नक्षत्रास्तसूर्यास्तलग्नमध्ये सूर्यस्य स्थितत्वाद्भबिम्बदर्शनाभाव-[स्]तदा तस्मिन्नेव दिने प्राक् क्षितिजे रात्रिशेषे भबिम्बदर्शनं भवति । अत एतादृ-[श]ास्थितौ रविसान्निध्यवशेन भबिम्बादृश्यत्वं नेति सुधीभिः सम्यग् विचार्यम् । [अ]नेन भास्करोक्तमपि स्पष्टमुपपद्यते ॥३८॥

अत एवात्र मदीयो विशेषः ।
यस्योदयार्कादधिकोऽस्तभानुरित्यत्र वक्ष्ये बहुधा विशेषम् ।
यद् गूढतां दूरत एव बुद्ध्वा बुधाः पलायन्त अहो नवीनाः ॥
धिष्ण्योदयाढ्यारिभभास्तकाख्यलग्ने तु कृत्वेन विलग्नमाने ।
य इष्टकालो दलितः स चेत् स्याद्भजेष्ट घट्यैव समः सदोदयः ॥
स एव कालोऽधिक इष्टघट्या यदा तदाऽप्यत्र सदोदयः स्यात् ।
न्यूनो न नूनं हि सदोदयः स्याद्धिष्ण्यस्य सान्निध्यवशात् खरांशोः ॥
यद्वोदयाख्यस्य विलग्नकस्य चरं स्फुटक्रान्तिचरं च साध्यम् ।
धिष्ण्यस्य चेत् तद्वियुतिः समाना निजेष्टघट्याऽस्य सदोदयः स्यात् ॥

वि. भा.—एवमन्यनक्षत्राणां सत्रिभागेन घटिका द्वितयेनोदयास्तसूर्यौ साध्यौ । अर्थादन्येषां तारतम्येन कालांशाश्चतुर्दश भागमिताः कल्प्याः । यस्यास्तार्कादुदयार्क ऊनस्तन्नक्षत्रं सदा दृश्यं भवति, सूर्यसान्निध्यवशेन तस्यास्तो न भवति, आचार्यकथितास्तसूर्यः षड्राशियुतो वा षड्राशिरहितस्तदा भास्करकथितास्तमयसूर्यो भवति, तेन "यस्योदयार्कादधिकोऽस्तभानुः प्रजायते सौम्यशराति दैर्घ्यात्" इत्यादि भास्कराचार्योक्तमेतदनुरूपमेवेति ॥

अत्रोपपत्तिः ।

"नक्षत्र बिम्बोदये उदयलग्नं तदुदयाद् दृश्यघटिकानन्तरमुदयसूर्योदयः । एवमाचार्योक्तास्तसूर्यास्तानन्तरं दृश्यघटीमिते काले नक्षत्रास्तलग्नस्यास्तमयः

कल्प्यते भोदयलग्नोदयानन्तरं द्विगुणदृश्यघटीतो ऽधिके काले सषड्भास्त-लग्नोदयः । रविश्च भोदयलग्नोदयार्कमध्ये वर्त्तते किल, तदा प्राक्क्षितिजे नक्षत्रोदयानन्तरं दृश्यघटीतोऽल्पेन कालेनार्कोदयात् प्राक्क्षितिजे नक्षत्रदर्शना-भावः । भबिम्बोदयानन्तरं दृश्यघटीमितेन कालेन तदुदयार्कचिन्हस्योदयः सषड्भास्तलग्नोदयात् प्राक् दृश्यघटीमितेन कालेन सषड्भास्तसूर्यचिन्हस्यो-दयोऽत उदयार्कात् सषड्भार्कोऽधिकस्तथाऽऽचार्योक्तास्त सूर्यश्चोदयार्कादल्प इति स्थितिः। अस्यां स्थितौ प्राक् क्षितिजे दर्शनाभावः परन्तु पश्चिमक्षितिजे सूर्यास्तानन्तरमुदयसूर्यचिन्हस्य ततोऽस्तसूर्यचिन्हस्य ततोऽस्तलग्नस्यार्थात् भबिम्बस्यास्तमयः। अतः पश्चिमक्षितिजे नक्षत्रविम्वदर्शनं भवति । एवं यदि पश्चिमक्षितिजे नक्षत्रास्तसूर्यास्तलग्नमध्ये सूर्यस्य स्थितत्वान्नक्षत्रविम्बदर्शना-भावस्तदा तस्मिन्नेव दिने प्राक् क्षितिजे रात्रिशेषे नक्षत्रबिम्वदर्शन भवति । अत एतादृश स्थितौ रविसान्निध्यवशेन नक्षत्रबिम्बादृश्यत्वं नेति सुधीभिर्विचार्यम्। अनेन भास्करोक्तमप्युपपद्यते ।"

अत्र म. म. पण्डित सुधाकर द्विवेदिकथितो विशेषः-

"यस्योदयार्कादधिकोऽस्तभानुरित्यत्र वक्ष्ये बहुधा विशेषम् । यद्गूढतां दूरत एव बुद्ध्वा बुधाः पलायन्त अहो नवीनाः ॥ धिष्ण्योदयाढ्याग्भिभास्तका-ख्यलग्ने तु कृत्वेन विलग्नमाने । य इष्टकालो दलितः स चेत् स्याद् भजेष्टघट्यैव समः सदोदयः ॥ स एव कालोऽधिक इष्टघट्या यदा तदाऽप्यत्र सदोदयः स्यात् । न्यूनोन नूनं हि सदोदयः स्यात् धिष्ण्यस्य सान्निध्यवशात् खरांशोः ॥ यद्वोदयाख्य-स्य विलग्नकस्य चरं स्फुटक्रान्तिचरं च साध्यम् । धिष्ण्यस्य चेत् तद्वियुतिः समाना निजेष्ट घट्याऽस्य सदोदयः स्यात्" इति सूर्यसिद्धान्ते "अभिजिद् ब्रह्महृदयं स्वातीवैष्णववासवाः। अहिर्बुध्न्यमुदक्स्थत्वान्न लुप्यन्तेऽर्करश्मिभि." अभिजित् ब्रह्महृदयम्। स्वातीश्रवणधनिष्ठाः । अहिर्बुध्न्यं (उत्तरभाद्रपदाः) एतानि नक्षत्राणि-उत्तरदिक्स्थत्वात् रविकिरणैर्न लुप्यन्ते, स्वल्पान्तरादभिजिदुत्तरस्पष्ट-क्रान्तिः=३८°, ब्रह्महृदया स्फुटा क्रान्तिः=४७° उत्तरा, स्वात्युत्तर स्फुटाक्रान्तिः =२९°, श्रवणोत्तरा स्फुटा क्रान्तिः=७° धनिष्ठाया उत्तरस्फुटक्रान्तिः=१५°, उत्तर भाद्रपदाया उत्तरस्फुटक्रान्तिः १७°, अत्र यदि श्रवणाया उत्तरा क्रान्तिः परमाल्पा गृह्यते तत्तुल्यो लम्बांशश्च तदाऽक्षांशाः=८३° समायान्ति, परन्तु तत्रा-न्यानि बहूनि नक्षत्राणि लम्बांशाधिकोत्तर क्रान्तित्वात् 'लम्बाधिका क्रान्तिरुदक् च यावत्तावद्दिनं सन्ततमेव तत्रेति भास्करोक्त्या, सर्वदा दृश्यानि भवन्ति यानि चा चार्येण न पठितानि सन्ति, अतो "यस्योदयार्कादधिकोऽस्तभानुरि" त्यादि भास्कररीत्या पाठपठितानि नक्षत्राणि सदोदितानि भवन्ति, तस्मिन्नेव देशे सूर्यसिद्धान्त रचना जातेति ज्ञातव्या सूर्यसिद्धान्तकारेण चाधिकोत्तरशराणि

गृहीतानि यतोऽभिजितः शरः=६२°, ब्रह्महृदयस्य=३०° स्वात्याः=३७°, श्रवणस्य=३०, धनिष्ठायाः=६°, उत्तर भाद्रपदायाः=२६° देशज्ञानं बिना सदोदित नक्षत्राणां ज्ञानं न भवति, निरक्षे च सौम्यध्रुवोऽप्यदृश्योऽतः केनचिद्गोलानभिज्ञेनायं श्लोकः प्रक्षिप्त" इति मन्मतम् सूर्यसिद्धान्तसुधावर्षिण्यां म. म. सिद्धान्त सुधाकर द्विवेद्युक्तमिति न समीचीनम्। सिद्धान्त शेखरे "अस्तादित्यो महान् स्यादुदय दिनकराद्यस्य धिष्ण्यध्रुवस्य तन्नक्षत्रं कदा चिद् दिवसपतिवशान्नास्तमायाति नूनम्। यस्यापक्रान्तिचापं शरयुतवियुतं संस्कृत स्वाक्षभागैर्यस्मिन् देशे च राशि त्रितयसमधिकं दृश्यते तन्न तत्र" ऽनेन श्लोकेन श्रीपतिना नक्षत्रस्य सदोदितत्वं सदाऽस्तमितत्वं प्रदर्शितमिति ॥३८॥

अब नक्षत्रों के सदोदितत्व और सदा अस्तमितत्व को कहते हैं।

हि. भा.—एवं अन्य नक्षत्रों के त्रिभाग सहित दो घटी से उदयार्क और अस्तार्क साधन करना। अर्थात् अन्य नक्षत्रों के कालांश तारतम्य से चौदह मान लिया गया, जिस नक्षत्र के अस्तार्क से उदयार्क ऊन (अल्प) हो वह नक्षत्र सदा दृश्य होता है, सूर्यसान्निध्य वश से उसका अस्त नही होता है, आचार्य कथित अस्त सूर्य में छः राशि जोडने से वा घटाने से भास्कराचार्य कथित अस्तमय सूर्य होते हैं। अतः 'यस्योदयार्कादधिकोऽस्तभानुः प्रजायते सौम्यशरातिदैर्घ्यात्' इत्यादि भास्कराचार्योक्त आचार्योक्त के अनुरूप ही है इति ॥३८॥

उपपत्ति

नक्षत्र बिम्बोदय लग्न के उदय से दृश्य घटिकानन्तर उदयसूर्य का उदय होता है, एवं आचार्योक्त अस्त सूर्यास्त के बाद दृश्य घटी तुल्यकाल में नक्षत्रास्त लग्न का अस्तमय होता है, कल्पना करते हैं नक्षत्रोदय लग्न के उदय के बाद द्विगुणित दृश्य घटी से अधिक काल में सषड्भास्तलग्न का उदय है, नक्षत्रोदय लग्न और उदयार्क के मध्य मे रवि है, तब पूर्व क्षितिज में नक्षत्रोदयानन्तर दृश्यघटी से अल्पकाल में अर्कोदय (रवि के उदय) से पहले क्षितिज में नक्षत्रदर्शनाभाव होता है, नक्षत्र बिम्बोदय के बाद दृश्यघटी तुल्य काल में उसके उदयार्क चिन्ह का उदय होता है, सषड्भास्त लग्न के उदय से पहले दृश्य घटी तुल्यकाल में सषड्भास्त सूर्य चिन्ह का उदय होता है, इसलिये उदयार्क से सषड्भार्क अधिक तथा आचार्योक्त अस्तसूर्य उदयार्क से अल्प है यह स्थिति है। इस स्थिति में पूर्व क्षितिज में दर्शनाभाव है, परन्तु पश्चिम क्षितिज में सूर्यास्त के बाद उदय सूर्य चिन्ह का उसके बाद अस्त सूर्य चिन्ह का, उस के बाद अस्त लग्न का अर्थात् नक्षत्र बिम्ब का अस्तमय होता है, इसलिये पश्चिम क्षितिज में नक्षत्र बिम्ब का नर्शन होता है। एवं यदि पश्चिम क्षितिज में नक्षत्रास्त सूर्य और अस्त लग्न के मध्य में सूर्य के रहने के कारण नक्षत्र बिम्ब दर्शनाभाव हो

तो उसी दिन में पूर्व क्षितिज में रात्रिशेष में नक्षत्र बिम्ब दर्शन होता है, इसलिये इस तरह की स्थिति मे रवि सान्निध्यवश से नक्षत्र बिम्ब का अदृश्यत्व नही होता है इसका विचार करना चाहिये, इससे भास्कराचार्योक्त भी उपपन्न होता है। यहाँ म. म. पण्डित सुधाकर द्विवेदी जी का विशेष कथन निम्न लिखित है।

"यस्योदयार्कादधिकोऽस्तभानुरित्यत्र वक्ष्ये बहुधा विशेषम्" इत्यादि मे "धिष्ण्यस्य चेद् तद्द्युतिः समाना निजेष्टघटयाऽस्त सदोदयः स्यात्" यहाँ तक स. उपपत्ति में लिखित श्लोकों को देखना चाहिये इति ।। सूर्यसिद्धान्त में "अभिजिद् ब्रह्महृदय स्वाती-वैष्णव-वासवाः । अहिर्बुध्न्यमुदक्स्थत्वान्न लुप्यन्तेऽर्करश्मिभिः" इस श्लोक में कथित नक्षत्र उत्तर दिशा में स्थित रहने के कारण रवि किरणो से लुप्त नही होते है। इस तरह कहा गया है। स्वल्पान्तर से अभिजित् की उत्तर स्पष्टक्रान्ति = ३८°, ब्रह्महृदय की उत्तर स्फुट क्रान्ति = ४७°, स्वाती की उत्तर स्फुट क्रान्ति = २९° श्रवण की उत्तर स्फुट क्रान्ति = ७°, धनिष्ठा की उत्तर स्फुट क्रान्ति = १५° उत्तर भाद्र पदा की उत्तर स्फुट क्रान्ति = १७°, यहाँ यदि श्रवण की उत्तरा क्रान्ति परमाल्प लेते है तथा उस के बराबर लम्बांश ग्रहण करते है तो अक्षांश ८३° आते है। लेकिन वहा अन्य भी बहुत नक्षत्र लम्बांशाधिक उत्तरा क्रान्तिवश से "लम्बाधिका क्रान्तिरुदक् च यावत्तावद्दिन सन्ततमेव तत्र" इस भास्करोक्त से सर्वदा दृश्य होते है जो कि सूर्य सिद्धान्तकार ने पठित नही किया है। इसलिये "यस्योदयार्कादधिकोऽस्त भानुः" इत्यादि भास्करोक्त विधि से पाठ पठित नक्षत्र सदोदित है। उसी देश में सूर्य सिद्धान्त की रचना हुई यह समझना चाहिये । सूर्य सिद्धान्तकार ने उत्तरशर अधिक ग्रहण किये है क्यों कि अभिजित् का शर = ६२°, ब्रह्म हृदय का = ३०°, स्वाती का = ३७°, श्रवण का = ३०°, धनिष्ठा का = ६°, उत्तर भाद्रपदा का = २६°, "देश ज्ञान बिना सदोदित नक्षत्रों का ज्ञान नही होता है। निरक्ष देश में उत्तर ध्रुव भी अदृश्य है इसलिये गोल को न जानने वाले किसी गणक के द्वारा से यह श्लोक इस मे दे दिया गया है यह मेरा मत है" सूर्य सिद्धान्त की सुधा वर्षिणी टीका मे म. म पण्डित सुधाकर द्विवेदी जी ने लिखा है लेकिन उनका कथन ठीक नहीं है।

सिद्धान्त शेखर में "अस्तादित्यो महान् स्यादुदयदिनकराद्यस्य धिष्ण्यध्रुवस्य" इत्यादि सं. उपपत्ति में लिखित श्लोक से श्रीपति ने नक्षत्रों का सदोदितत्व और सदाऽस्तमितत्व दिखलाया है इति ।।३८।।

इदानीं नक्षत्रबिम्बं कदा दृश्यत इत्याह ।

उदयास्तसूर्ययोरन्तरे रवौ दृश्यतेऽन्यथा ऽस्तमितम् ।
ऊनाधिका रविकला रविभुक्त्या भाजिता दिवसाः ।।३९।।

सु० भा०—नक्षत्रोदयास्तसूर्ययोन्तरे रवौ सति नक्षत्रबिम्बं क्षितिजोपरि-

स्थितत्वाद् दृश्यते। अन्यथाऽस्तमितं गतम्। अत्रोदयार्कादस्तार्काद्वा तात्कालिक-रविकला ऊनाधिकारविभुक्त्या भाजितास्तदैष्या गता वा दिवसा भवन्ति।

अत्रोपपत्तिः 'अत्राधिको न कलिकारविभुक्तिभक्ता' इत्यादि भास्कर-विधिना स्फुटा ॥३९॥

वि. भा.—नक्षत्रोदयास्तसूर्ययोरन्तरे रवौ सति नक्षत्रबिम्बस्य क्षितिजोपरि स्थित्वाद् दृश्यते। अन्यथाऽस्तमितं गतम्। अत्रोदयार्कादस्तार्काद्वा तात्कालिक-रविकला ऊनाधिका रविभुक्त्या भाजितास्तदैष्या गता वा दिवसा भवन्तीति ॥३९॥

अत्रोपपत्तिः

उदयसूर्यतुल्ये सूर्ये उदयोऽस्त सूर्यतुल्ये सूर्ये चास्त इति नियमेन एतदभ्यन्तरस्थायिन्येव सूर्ये तन्नक्षत्रदर्शनमिति स्फुटमेव, तदनुअस्तसूर्यसमसूर्यकालादारभ्य यावदुदयसूर्यसमः सूर्यो न भवेत्तावत्तस्यादर्शनमिति स्फुटमेवपरिभाषा स्वरूपेणेति। सिद्धान्तशेखरे "उदय दिनकरास्तब्रध्नयोर्मध्यगः स्याद् दिनमणिरिह यावद् दृश्यते तावदेव। न भवति पुनरस्तार्कोदयार्कान्तरस्थे दिवसकृतीति" ऽनेन श्रीपतिना ऽऽचार्योक्तानुरूपमेवोक्तमिति उदयास्तार्कयोर्मध्यगा याः कलास्ता रवि-स्पष्टगत्या भक्ताः फलमुदयास्तयोर्दिनादि स्यात्। एतदुक्तं भवति अस्तार्कमुदयार्काद्विशोध्य कलीकृत्य रविगतिकलाभिर्विभजेत् लब्धानि यावन्ति दिनानि तेषुअगस्त्यो मृगव्याधो नक्षत्रं वा न दृश्यते, एवमुदयार्कमस्तार्काद्विशोध्य कलीकृत्य रविगति कलाभिर्विभजेल्लब्धानि यावन्ति दिनानि तेषुअगस्त्यो मृगव्याधो नक्षत्रं वा दृश्यते, सिद्धान्त शेखरे "मध्यगास्तदुभयोः कला हि यास्ता भजेत् स्फुटजवेन भास्वतः। स्याद्दिनादिफलमुद्गमास्तयो. कुम्भजस्य मृगयोरुडोरपि" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति ॥३९॥

अब नक्षत्र बिम्ब का कब देखते है कहते है।

हि. भा.—नक्षत्र के उदय सूर्य और अस्त सूर्य के मध्य में रवि के रहने से वह नक्षत्र बिम्ब क्षितिज से ऊपर रहता है इसलिये दृश्य होता है, अन्यथा अस्तगत होता है, यहां उदयार्क से वा अस्तार्क से तात्कालिक रवि हीन अधिक हो तो दोनों के अन्तर कला में रविगति से भाग देने से एष्य दिन वा गत दिन होता है।

उपपत्ति

उदय सूर्य तुल्य सूर्य के रहने से उदय होता है और अस्त सूर्य तुल्य सूर्य के रहने

से अस्त होता है इस युक्ति से इन दोनों के अभ्यन्तर में सूर्य के स्थायी रहने से उस नक्षत्र बिम्ब का दर्शन स्फुट है, उसके बाद अस्त सूर्य तुल्य सूर्य काल से लेकर जब तक उदय सूर्य के बराबर सूर्य नही होते है तबतक उसका अदर्शन होता है यह केवल परिभाषा ही से स्फुट है, सिद्धान्त शेखर में "उदय दिनकरास्तव्रध्नयोर्मध्यगः स्यात्" इत्यादि स. उपपत्ति मे लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है उदयार्क और अस्तार्क के मध्यगत कला के रवि की स्फुट गति से भाग देने से फल नक्षत्र के उदय दिन और अस्त दिन होते हैं अर्थात् उदयार्क में से अस्तार्क को घटा कर कलात्मक बनाकर रवि गति कला से भाग देने से जितने लब्ध दिन होते हैं उतने दिनों में नक्षत्र बिम्ब दृश्य नही होता है एव अस्तार्क में से उदयार्क को घटा कर कलात्मक बना कर उस में रवि गति कला से भाग देने से जितने लब्ध दिन होते है उन दिनों में अगस्त्य-लुब्धक और नक्षत्र बिम्ब दृश्य होते हे, सिद्धान्त शेखर में "मध्यगास्तदुभयोः कला हि यास्ता भजेत् स्फुट जवेन भास्वतः स्याद् दिनादि फल-मुद्‌गमास्तयोः कुम्भजस्य मृगयोरुड़ोरपि" इस से श्रीपति ने आचार्योक्तानुरूप ही कहा हे इति ।।३९।।

इदानीं लुब्धकस्य ध्रुवशरांशानाह ।

षड्विंशे मिथुनांशेऽशक चत्वारिंशता मृगव्याधः ।
तत्क्रान्तेर्दक्षिणतो विक्षिप्तोऽगस्त्यवच्छेषम् ।। ४० ।।

सु. भा.—शेषमुदयास्तार्क साधनमगस्त्यवत् । शेषं स्पष्टार्थम् ।।४०।।

वि. भा.—मृगव्याधः (लुब्धकः)षड्विंशे मिथुनांशे स्थितो दक्षिणतस्तत्क्रान्तेः (दक्षिण क्रान्त्यग्रात्) अंशकचत्वारिंशता विक्षिप्तो भवति, अर्थात् लुब्धकस्य ध्रुवः =४०°, शेषं कर्म उदयास्तार्क साधनादिकं सर्वमगस्त्यवत्कर्त्तव्यमिति शेषः । सूर्य सिद्धान्त मतेन लुब्धकस्य ध्रुवः=८०°, दक्षिण शरांशाश्च=४०° शरांशाश्चो-भयत्र समाना एव, केवलं ध्रुवयोरन्तरमस्ति यच्च प्रत्यक्षमेव दृग्गोचरीभूतं भवति । सिद्धान्त शेखरे "उत्क्रत्यांशैर्लुब्धको वैणिकर्क्षे विक्षिप्तोऽसौर्दक्षिणे चाभ्रवेदैः । इष्टःकालः षड्दलाढये च नाड्यौ शेषंकर्मागस्त्यवत् तस्य सर्वम्" अनेन श्रीपत्युक्ते लुब्धकस्य ध्रुवदक्षिणशरप्रमाणे आचार्योक्तानुरूपे एवेति इष्टः कालः षड्दलाढ्ये च नाड्याविति श्रीपत्युक्त "घटिका द्वितयेनैवं षड्भागयुतेन मृगहर्त्तु" रित्याचार्योक्तानुरूपमेवेति सुधीभिर्विभावनीयम् ।।४०।।

अब लुब्धक के ध्रुव और शरांश को कहते हैं ।

हि. भा.—लुब्धक मिथुन राशि के छब्बीस अश में स्थित है, तथा उसकी दक्षिण क्रान्ति के अग्र से अर्थात् क्रान्तिवृत्त से चालीश अंश में विक्षिप्त होते है अर्थात् क्रान्तिवृत्त

से दक्षिण चालीस अंश पर रहते हैं। अर्थात् लुब्धक के ध्रुव=८६°, तथा दक्षिण शरांश =४०°, शेषकर्म (उदयार्क और अस्तार्क आदि के साधन) अगस्त्य की तरह करना चाहिये। सूर्यसिद्धान्तमत से लुब्धक के ध्रुव=८०°, दक्षिणशर=४७° शरांश दोनों के मत में तुल्य ही हैं किन्तु ध्रुव में अन्तर देखने में आता है, सिद्धान्तशेखर में "उत्कृत्यांशैर्लुब्धको वैणिकर्क्षे विक्षिप्तोऽशैर्दक्षिणे चाभ्रवेदैः" इत्यादि स. भाष्य मे लिखित श्लोक से श्रीपति आचार्योक्त के अनुरूप ही लुब्धक के ध्रुव और शरांश कहते हैं, इष्टकाल (कालांश) भी आचार्योक्त "घटिका द्वितयेनैव षड्भाग युतेन मृगहर्त्तुः" के अनुरूप ही कहे हैं इति ॥४०॥

इदानीमग्रासाधनमाह।

गुणिता व्यासार्धेन स्वक्रान्तिज्यावलम्बक हृताऽग्रा।
प्रतिदिनमुदयास्तमयावग्राग्रे भग्रहमुनीनाम् ॥४१॥

सु. *भा*.—स्वक्रान्तिज्या व्यासार्धेन त्रिज्यया हृतावलम्बकेन लम्बज्यया हृताऽग्रा भवति। भग्रहमुनीनां प्रतिदिनमग्राग्रे उदयास्तमयौ भवतः॥

अत्रोपपत्तिः। लम्बज्या कोटचा त्रिज्या कर्णस्तदा क्रान्तिज्या कोटचा क इति जाताऽग्रा। अग्राग्रयोर्बद्धं सूत्रमुदयास्तसूत्रमुच्यते ततस्तदग्रे भस्य ग्रहाणामगस्त्यस्य चोदयास्तौ इति सर्वं स्फुटम् ॥४१॥

वि. भा.—स्वक्रान्तिज्या (अगस्त्यादीनां क्रान्तिज्या) व्यासार्धेन (त्रिज्यया) गुणिता, अवलम्बकेन (लम्बज्यया) हृता (भक्ता) तदाऽग्राभवति, भग्रहमुनीनां (नक्षत्र ग्रहागस्त्यादीनां) प्रतिदिनमग्राग्रे उदयास्तमयौ भवतः इति ॥४१॥

अत्रोपपत्तिः

अक्षज्या भुजः। लम्बज्या कोटिः। त्रिज्या कर्ण इत्येकमक्षक्षेत्रम्, कुज्या भुजः क्रान्तिज्या कोटिः। अग्राकर्ण इति द्वितीयमक्षक्षेत्रमनयोः साजात्यादनुपातो यदि लम्बज्यया त्रिज्या लभ्यते तदा क्रान्तिज्यया किं समागताऽग्रा, अग्राग्रयोर्बद्धं सूत्रमुदयास्तसूत्रम्। तदग्रे ग्रहादेरुदयास्तौ भवत इति सर्वं स्फुटमेव, मन्मतेत्वत्राग्रा साधनस्याऽऽवश्यकता नाऽऽसीत्, किं समवगत्यात्राग्रासाधनं कृतमिति त एव (आचार्या एवं) ज्ञातुं शक्नुवन्तीति, सिद्धान्तशेखरे "अग्रां ग्रहागस्त्यकलुब्धकानां प्राग्वत् स्फुटक्रान्ति गुणात् प्रसाध्य। अग्रप्रदेशेऽन्वहमग्रकायाः समुद्गमश्चास्तमय श्च तेषाम्" ऽनेन श्रीपतिनाप्याचार्यस्यैवानुकरणं कृतमिति ॥ ४१ ॥

अब अग्रा-साधन कहते हैं।

हि. भा.—नक्षत्र आदि की स्पष्ट क्रान्तिज्या को त्रिज्या से गुणा कर लम्बज्या

से भाग देने से अग्रा होती है, नक्षत्र ग्रह मुनि (अगस्त्य) इन सबों के प्रति दिन अग्राग्र मे उदय और अस्त होता है इति ।।४१।।

उपपत्ति ।

अक्षज्याभुज, लम्बज्या कोटि, त्रिज्या कर्ण यह एक अक्षक्षेत्र तथा कुज्याभुज, क्रान्तिज्या कोटि, अग्रा कर्ण यह द्वितीय अक्षक्षेत्र है, ये दोनो अक्षक्षेत्र सजातीय है इसलिये अनुपात करते है यदि लम्बज्या मे त्रिज्या पाते है तो क्रान्तिज्या में क्या इस से अग्रा प्रमाण आता है, दोनो अग्राग्र में बद्धसूत्र उदयास्त सूत्र है, अग्राग्र मे ग्रह आदि के उदय और अस्त होते हैं । मेरे मत से यहां अग्रा साधन की आवश्यकता नही थी, क्या समझकर यहा आचार्य ने अग्रा का साधन किया है यह बात आचार्य ही जान सकते है। सिद्धान्त शेखर मे 'अग्रा ग्रहागस्त्यक लुब्धकानां प्राग्वत् से स्फुटक्रान्तिगुणात् प्रसाध्य" इत्यादि स उपपत्ति मे लिखित श्लोक से श्रीपति ने भी आचार्योक्त का ही अनुकरण किया है इति ।।४१।।

इदानी भुजसाधनमाह ।

अग्रा शङ्कुतलैक्यं तुल्यदिशोरन्तरं तथाऽन्यदिशोः ।
प्राच्यपरायाः शङ्कोस्तलं तदग्रे ग्रहो भं च ॥ ४२ ॥

सु. भा.—तुल्यदिशोरग्रा शङ्कुतलयोरैक्यं तथाऽन्यदिशोरन्तरं प्राच्यपरायाः पूर्वापरतः शङ्कोस्तलं शङ्कोर्मूलपर्यन्तं स्यात् । तदग्रे शङ्क्वग्रे ग्रहो वा भं च भवति ।

अत्रोपपत्तिः । शङ्कुमूलप्राच्यपरान्तरं भुजसाधनं सिद्धान्तयुक्त्या स्फुटम् । शङ्क्वग्रे ग्रहो भवतीति स्पष्टम् ॥ ४२ ॥

वि. भा. तुल्यदिशोः (एकदिक्कयोः) अग्राशङ्कुतलयोरैक्यं (योगः) तथाऽन्यदिशोः (भिन्नदिक्कयोः) अग्राशङ्कुतलयोरन्तरं प्राच्यपरायाः (पूर्वापर रेखातः) शङ्कोस्तलं (शंकुमूलपर्यन्तं) भुजो भवेत् । तदग्रे (शङ्क्वग्रे) ग्रहो नक्षत्रं च भवतीति ॥ ४२ ॥

अत्रोपपत्तिः ।

स्वोदयास्तसूत्रपूर्वापरसूत्रयोरन्तरं सर्वत्राऽग्रा, शङ्कुमूलतः स्वोदयास्तसूत्रोपरि यो लम्बस्तच्छङ्कुतलम् । शङ्कुमूलात्पूर्वापरसूत्रोपरि यो लम्बः स एव भुजः । एकदिशोरग्रा शङ्कुतलयोर्योगेन भिन्नदिशोस्तयोरन्तरेण शङ्कुमूलात्पूर्वापर सूत्रपर्यन्तं पूर्वापरसूत्रोपरि लम्बरूपो भुजो भवति । वा अग्रा

छाया कर्णव्यासार्धगोले परिणता सती कर्णवृत्ताग्रा व्यस्तगोला भवति, छाया कर्णगोले तु पलभा शङ्कुतलतुल्या भवति, पलभा च सर्वदैवोत्तरा, तयोः संस्कारतश्छायाग्रपूर्वापरसूत्रयोरन्तरं भुजो भवेत्, छायाग्रशब्देन शङ्कुमूलं बोध्यम्। सिद्धान्तशेखरे "पूर्वापरा शङ्कुतलान्तर यत् वाहुः स एवोत्तर दक्षिणः स्यात्" अनेन श्रीपतिनाप्याचार्योक्तमेव कथ्यते। इति ॥ ४२ ॥

अब भुज साधन को कहते है।

हि. भा.—एक दिशा की अग्रा और शङ्कुतल के योग करने से तथा भिन्न दिशा की अग्रा और शङ्कुतल के अन्तर करने से पूर्वापर रेखा से शङ्कुमूल पर्यन्त भुज होता है, शङ्कु के अग्र मे ग्रह वा नक्षत्र होते है इति ॥ ४२ ॥

उपपत्ति।

स्वोदयास्त सूत्र और पूर्वापर सूत्र के अन्तर में सर्वत्र अग्रा है, शङ्कुमूल से स्वोदयास्त सूत्र के ऊपर जो लम्ब होता है वह शङ्कुतल है, शङ्कुमूल से पूर्वापर सूत्र के ऊपर जो लम्ब होता है वह भुज है। एक दिशा में अग्रा और शङ्कुतल के योग करने से तथा भिन्न दिशा में अग्रा और शङ्कुतल के अन्तर करने से शङ्कुमूल से पूर्वापर सूत्रपर्यन्त पूर्वापर सूत्र के ऊपर लम्बरूप भुज होता है, वा अग्रा को छायाकर्ण व्यासार्ध में परिणत करने से कर्णवृत्ताग्रा व्यस्त गोलक होती हे। छाया कर्ण गोल में पलभा शङ्कुतल के बराबर होती है, पलभा की दिशा सर्वदा उत्तर है, दोनों के सस्कार से छायाग्र और पूर्वापर सूत्र के अन्तर भुज होता है, छायाग्र ही शङ्कुमूल है, सिद्धान्त शेखर में "पूर्वापराशङ्कुतलान्तरं यत् बाहुः" इत्यादि स. उपपत्ति में लिखित श्लोक से श्रीपति ने भी आचार्योक्त के सदृश ही कहा है इति ॥ ४२ ॥

इदानीं पूर्वापरकोटिसाधनमाह।

शङ्कुतल प्राच्यपरान्तरं भुजो दक्षिणोत्तरं कर्णः।
दृग्ज्या तद्वर्गान्तरमूलं दिङ्मध्यतः कोटिः ॥ ४३ ॥

सु० भा०—स्पष्टार्थमुपपत्तिश्च जात्यक्षेत्रतः स्फुटा ॥ ४३ ॥

वि. भा.—शङ्कुतल प्राच्यपरान्तरं (शङ्कुमूलपूर्वापरसूत्रयोरन्तरं) दक्षिणोत्तरं भुजो भवति, दृग्ज्या कर्णस्तयोर्दृग्ज्या भुजयोर्वर्गान्तर मूलं दिङ्मध्यतः (केन्द्रात्) कोटिर्भवेदिति।

अत्रोपपत्तिः

दिक्सूत्रसम्पातगतशङ्कोश्छायाग्रात्पूर्वापर सूत्रोपरि यो लम्बः स भुजः।

दिक् सूत्र सम्पातगत शङ्कुमूलात् छायाग्रं यावद्दृग्ज्या कर्णः । भुजाग्राच्छङ्कुमूलं (दिक् सूत्र सम्पातं) यावत्पूर्वापरसूत्रे कोटिः, इति भुजकर्णकोटित्रयैरुत्पन्नजात्य त्रिभुजे $\sqrt{\text{दृग्ज्या}^2\text{-भुज}^2}$=कोटिः । सिद्धान्तशेखरे "दृग्ज्याश्रुतिस्तत्कृतिभेदमूलं पूर्वापरां कोटिमुशन्ति मध्यात्" ऽनेन श्रीपतिना, सिद्धान्तशिरोमणौ "दिक्सूत्र-सम्पातगतस्य शङ्कोछायाग्रपूर्वापरसूत्रमध्यम् । दोर्दो प्रभावर्ग वियोगमूलं कोटिर्नरात् प्रागपरा ततः स्यादि" त्यनेनाचार्योक्तानुरूपमेव कथ्यत इति ।। ४३ ।।

अब पूर्वापर कोटि साधन कहते है ।

हि. भा.—शङ्कुमूल और पूर्वापर सूत्र के अन्तर दक्षिणोत्तरभुज होता है, दृग्ज्या कर्ण होती है, दोनों (दृग्ज्या और भुज) के वर्गान्तर मूल दिङ्मध्य (केन्द्र) से कोटि होती हे इति ।। ४३ ।।

उपपत्ति

दिक् सूत्र सम्पात (केन्द्र) गत शङ्कु के छायाग्र से पूर्वापर सूत्र के ऊपर लम्ब भुज है, दिक् सूत्र सम्पातगत शङ्कुमूल से छायाग्रपर्यन्त दृज्या कर्ण, भुजाग्र से शङ्कुमूल (दिक् सूत्र सम्पात) पर्यन्त पूर्वापरसूत्र मे कोटि संज्ञक कोटि है, इन भुज, कर्ण और कोटि से उत्पन्न जात्य त्रिभुज में $\sqrt{\text{दृग्ज्या}^2 \text{ भुज}^2}$=कोटि, सिद्धान्त शेखर में "दृग्ज्याश्रुतिस्तत्कृतिभेद-मूलं" इत्यादि से श्रीपति, तथा सिद्धान्त शिरोमणि में "दिक्सूत्रसम्पातगतस्य शङ्कोश्छायाग्र-पूर्वापरसूत्रमध्यम् । दोर्दो प्रभावर्ग वियोगमूलं कोटिर्नरात् प्रागपरा ततः स्यात्" इससे भास्कराचार्य ने भी आचार्योक्तानुरूप ही कहे हैं ।। ४३ ।।

इदानीं भग्रहयुतिदर्शनप्रकारमाह ।

ऊनाधिक शङ्कुगुण स्वशङ्कुभक्ता पृथक् स्वदृग्ज्याग्रे ।
कृत्वोनाधिकशङ्कू दृष्टि कृत्वोनशङ्क्वग्रे ।। ४४ ।।

प्रतिघटिकमधिकशङ्कोर्ग्रहमध्ये दर्शयेच्च भानि ।
त्रिप्रश्नोक्त्या रविवत् शङ्कुभ्रमणादिक मशेषम् ।। ४५ ।।

सु. भा.=भग्रहयुतिकाले यस्योना पूर्वसाधिता कोटिः साऽधिककोटेः शङ्कुगुणा स्वशङ्कुना भक्ता फलमधिककोटेः कोटिर्भवति । अथ पृथक्-पृथक् स्वदृग्ज्याग्रे ऊनाधिकशङ्कू कृत्वा ऊनशंक्वग्रे दृष्टि च कृत्वाऽधिकशङ्कोर्ग्रहमध्ये प्रतिघटिकं भानि दर्शयेत् । अर्थादधिकशंक्वग्रे ग्रहबिम्बकेन्द्रं प्रकल्प्य तद्बिम्बं विलेख्यं । तन्मध्ये युतिकाले गणको लोकस्य नरपतेश्च विनोदाय भानि दर्शयेत् । भानामशेषं

सर्वं शङ्कुभ्रमणादिकं च त्रिप्रश्नोक्त्या रविवत् साध्यम् ।

अत्रोपपत्तिः । भग्रहयुतिकाले दृष्टिस्थानाद् ग्रहकेन्द्रोपरिगतं सूत्रं भबिम्बोपरिगतं भवति । अतस्तदा तयोर्नतांशसाम्यात् स्वस्वगोलीयानि भुजकोटिदृग्ज्याशङ्कु योजनानि मिथः सजातीयानि । अत एकस्य कोटिरपरशङ्कुना गुणा स्वशङ्कुभक्ताऽपरकोटिर्भवति । ततः परिलेखरचना च सजातीयक्षेत्रत्वात् स्फुटा । अन्यत् सर्वं च प्रसिद्धम् ।

अत्राभीष्टाङ्केन ग्रहकर्णं भकर्णं चापवर्त्य सुखार्थं तद्व्यासार्धेन ग्रहगोलस्य भगोलस्य च रचनां कृत्वा स्वस्वगोलीयं दृग्ज्यादिकं विरचय्य भग्रहयुतिं प्रदर्शयेदित्यनुक्त मपि बुद्धिमता ज्ञायते ।। ४४-४५ ।।

वि. भा.—भग्रहयुतिदर्शनार्थं द्वयोर्भग्रहयोरूनशङ्कुसम्बन्धिनी कोटिरधिकशङ्कुना गुणिता तथाऽधिकशङ्कुसम्बन्धिनी कोटिरूनशङ्कुना गुणिता स्वशङ्कुभक्ता ऽर्थादेकस्य कोटिरपर शङ्कुना गुणिता स्वशङ्कुभक्ता तदाऽपर कोटिर्भवति । अथ स्वदृग्ज्याग्रे पृथक्-पृथक् ऊनाधिकशङ्कू-कृत्वा, ऊनशङ्क्वग्रे च दृष्टिं कृत्वा ऽधिकशङ्क्वोर्ग्रहमध्ये प्रतिघटिकं भानि दर्शयेदर्थान्न्यूनशङ्क्वग्रे स्थापितेन चक्षुषा बृहच्छङ्कोरग्रे वर्त्तमानं नक्षत्रादिकं लोकानां राज्ञो वा मनोरञ्जनाय गणको दर्शयेत् । अशेषं (सकलं) शङ्कुभ्रमणादिकं त्रिप्रश्नाधिकारोक्तरीत्या रविवत्साध्यमिति ।। ४४-४५ ।।

अत्रोपपत्तिः ।

भग्रहयुतिकाले दृष्टिस्थानाद् ग्रहबिम्बकेन्द्रोपरिगतं सूत्रं भबिम्बकेन्द्रोपरिगतं भवति, अतस्तदातयोर्नतांशसाम्यात् स्वस्वगोलीय भुजकोटि दृग्ज्या शङ्कु योजनानि मिथः सजातीयानि, अत एकस्य कोटिरपरशङ्कुना गुणा स्वशङ्कुभक्ता ऽपरकोटिर्भवति, ततः परिलेखरचना च सजातीयक्षेत्रत्वात् स्फुटा, अत्राभीष्टाङ्केन ग्रहकर्णं भकर्णं चापवर्त्य सुखार्थं तद्व्यासार्धेन ग्रहगोलस्य भगोलस्य चरचनां कृत्वा स्वस्वगोलीयं दृग्ज्यादिकं विरचय्य भग्रहयुतिं प्रदर्शयेदिति बुद्धिमता ऽनुक्तमपि ज्ञायते । सिद्धान्तशेखरे "दृष्टयुच्छ्रितोच्चतर शङ्कुगुणाः स्वकर्णदोः कोटयः पृथगथो निजशङ्कुभक्ताः । भामण्डले परिणता निजदृग्गुणाग्रे कृत्वा दृगुच्छ्रित तदुच्चतरौ च शङ्कू ।। ह्रस्वशङ्कुशिखरस्थया दृशा दर्शयेदधिकशङ्कुकोटिगम् । खेचरं भमुनिलुब्धकांस्तथा भाभ्रमादिकमशेषमर्कवत् ।। इति श्लोकाभ्यामाचार्यानुरूपमेव सर्वं श्रीपतिनोक्तमिति ।। आचार्येण "भानिदर्शयेत्" कथ्यते तत्र भमित्युपलक्षणम् । श्रीपतिना तस्यैवा "खेचरं भमुनिलुब्धकान्" ऽनेन स्फुटी करणं कृतम् ।

सूर्यसिद्धान्ते युतिकाले द्वयोर्ग्रहयोर्दर्शनार्थं प्रकारोऽभिहितोऽस्ति यथा "पञ्चहस्तोच्छ्रितौ शङ्कू यथादिग्भ्रमसंस्थितौ। ग्रहान्तरेण विक्षिप्तावधो हस्तनिखातगौ॥ छायाकर्णौ ततो दद्याच्छायाग्राच्छङ्कुमूर्धगौ। छायाकर्णाग्र सयोगे संस्थितस्य प्रदर्शयेत्। स्वशङ्कुमूर्धगौ व्योम्नि ग्रहौ दृक्तुल्यतामितौ"

व्याख्या—दर्शनयोग्यौ यदा ग्रहौ भवेतां तदा पञ्चहस्तप्रमाणदीर्घौ शङ्कू काष्ठघटितसरलदण्डाकारौ वा वंशजौ यथा दिग्भ्रम संस्थितौ कार्यौ। युतिकाले त्रिप्रश्नाधिकारोक्तरीत्या ग्रहयोः शङ्कू कार्यौ तौ पूर्वापररेखातो यद्दिशि यत्कपाले गणितेन सिद्धौ भवतस्तथा स्वच्छायाभूमाविमौ स्थाप्यौ यथावास्तवशङ्कुरूपौ स्याताम्। युतिकाले ग्रहयोः पूर्वापरशङ्कुमूलान्तररूपौ भुजौ दिग्मध्यतः पूर्वापरसूत्रे यथा दिक्के कोटी च विधाय तत्संस्कारेण स्पष्टभुजं स्पष्टकोटिं च कृत्वा तद्वर्गयोगमूलं ग्रहयोः शंकुमूलान्तरं स्यात्। तन्मितौ विक्षिप्तावन्तरितौ यथादिक्कौ स्थाप्यौ, क्षितिजे लम्बरूपस्थित्यर्थं तौ च भूम्यधौ हस्तमितनिखानगौ कार्यौ यथा तयोरधः पतनं न भवेत्। ततः स्वस्वच्छायादानेन यत्र तदग्रं स्यात् तस्मात् स्वस्वशङ्कुमूर्धगौ छायाकर्णौ दद्यात्। छायाकर्णसूत्रं वर्धनेन ग्रहकेन्द्रोपरिगतं स्यादिति छायाक्षेत्रेण प्रसिद्धम्। अतश्छायाकर्णस्थदृष्ट्याग्रहस्य दर्शनं भवेत्। अतस्तयोश्छायाकर्णयोः संयोगस्थाने यदि दृष्टिस्तदा केवलं दृष्टिसंचालनेन द्वयोर्ग्रहयोर्दर्शनं भविष्यतस्तत्रारोपितदृष्टेः संस्थितस्य शिष्यस्य राज्ञो वा प्रतीत्यर्थमाकाशे स्वस्वशङ्कुशिरोगतौ दृक्तुल्यतां प्राप्तौ ग्रहौ प्रदर्शयेदत्र ग्रहान्तरेण कदम्बप्रोतीयान्तरं रङ्गनाथेन स्वगूढार्थप्रकाशे व्याख्यातं तद्गोल वासना वहिर्भूतमिति॥ ४४-४५॥

अब भग्रह युति दर्शन प्रकार को कहते हैं।

हि. भा.—भ (नक्षत्र) और ग्रह के युति दर्शन के लिये दोनों (भ और ग्रह) में ऊन (अल्प) शङ्कु सम्बन्धिनी कोटि को अधिक शङ्कु से गुणा करना। तथा अधिक शङ्कु सम्बन्धिनी कोटि को ऊन शङ्कु से गुणा करना स्वशङ्कु (अपने शङ्कु) से भाग देना अर्थात् एक की कोटि को अपरशङ्कु (दूसरे शङ्कु) से गुणा कर स्वशङ्कु से भाग देना तब अपर कोटि होती है, अपनी दृग्ज्या के अग्र में पृथक्-पृथक् (अलग-अलग) ऊनशङ्कु और अधिकशङ्कु को करके ऊन शङ्कु के अग्र में दृष्टि को करके अधिकशङ्कु और ग्रह के मध्य में प्रत्येक क्षण नक्षत्र को दिखाना चाहिये अर्थात् न्यून शङ्कु के अग्र में स्थापित नेत्र (दृष्टि) से वृहत् शङ्कु के अग्र में वर्त्तमान नक्षत्र आदि को लोगों के अथवा राजा के मनोविनोद के लिये गणक (ज्यौतिषिक) दिखावें। अशेष (सम्पूर्ण) शङ्कु भ्रमण आदि त्रिप्रश्नाधिकारोक्त रीति से रवि की तरह साधन करना इति॥ ४४॥

उपपत्ति ।

भ (नक्षत्र) और ग्रह के युति काल में दृष्टिस्थान से ग्रह बिम्ब केन्द्रो परिगत सूत्र नक्षत्र बिम्ब केन्द्रो परिगत भी होता है, इसलिये तब दोनों के नतांश बराबर (तुल्य) होने के कारण स्वस्व गोलीय 'भुज, कोटि, दृग्ज्या, शङ्कु' योजन परस्पर सजातीय होते हैं। इसलिये एक की कोटि को अपर शङ्कु से गुणा कर स्व (अपने) शङ्कु से भाग देने से अपर कोटि होती है। उसके बाद परिलेखन रचना भी स्फुट ही है, यहां किसी अभीष्ट अङ्क से ग्रह कर्ण को और भकर्ण (नक्षत्र कर्ण) को अपवर्तन देकर लाघव के लिये उस व्यासार्ध से ग्रहगोल की और भगोल की रचना कर स्वस्वगोलीय दृग्ज्या आदि की रचना कर भग्रह युति को दिखावे। सिद्धान्त शेखर में "दृष्टयुच्छ्रितोच्चतर शङ्कुगुणाः स्वकर्णदोः कोटयः पृथगथो निजशङ्कुभक्ता" इत्यादि से श्री पति ने आचार्योक्त के अनुरूप ही कहा है, आचार्य "भानि दर्शयेत्" कहते हैं यहां 'भ' उपलक्षण है, श्रीपति 'खेचरं भमुनिलुब्धकान्' इससे उसी का स्पष्टीकरण किया है। सूर्य सिद्धान्त में युतिकाल में दो ग्रहों के दर्शनार्थ प्रकार कहा गया है, जैसे "पञ्च-हस्ताच्छ्रितौ शङ्कू यथादिग्भ्रम सस्थितौ" इत्यादि स. उपपत्ति मे लिखित श्लोकों को देखिये अर्थात् जब दर्शन योग्य दो ग्रह हो तो पांच हाथ के दो शङ्कु (काठ के सरलाकार या वंश के) बनाना चाहिये, युति काल में त्रिप्रश्नाधिकारोक्त रीति से दोनों ग्रहो के शङ्कु साधन करना, वे पूर्वापर रेखा से जिस दिशा मे जिस कपाल में गणित से सिद्ध है इस तरह स्वच्छ भूमि में इन दोनो को स्थापन करना जिससे वास्तव शङ्कु रूप हो, युतिकाल मे दोनों ग्रहों के पूर्वापर रेखा और शङ्कुमूल के अन्तर रूप भुजद्वय तथा दिग्मध्य से पूर्वापर रेखा में यथा दिक्क (जिस दिशा के कोटिद्वय है उस दिशा में) कोटिद्वय को देकर, उन दोनों भुजों के संस्कार से स्पष्ट भुज तथा दोनों कोटियों के संस्कार से स्पष्ट कोटि लाकर दोनों के वर्गयोग मूल दोनों ग्रहों के शङ्कुमूलान्तर लाना चाहिये। तत्तुल्यान्तरित में यथादिक्क के शङ्कुद्वय को स्थापित करना, उन दोनों को क्षितिज के ऊपर लम्बरूप स्थिति के लिये भूमि के नीचा एक हाथ खात (खद्दा) मे गाड देना चाहिये जिससे उन दोनों के नीचे पतन (गिरजाना) न हो। वहां से अपनी-अपनी छायादान से जहां उनके अग्र हो वहां से अपने-अपने शङ्कु के शीर्षगत छाया कर्णो को दान देना। छाया कर्ण सूत्र को बढ़ाने से ग्रह केन्द्रगत होता है यह छाया क्षेत्र से प्रसिद्ध है। इसलिये छाया कर्ण स्थित दृष्टि से ग्रह दर्शन होता है। अतः उन दोनों छायाकर्णों के संयोग स्थान में यदि दृष्टि स्थान हो तो केवल दृष्टि संचालन ही से दोनों ग्रहों का दर्शन होगा इसलिये वहां रखी हुई शिष्य दृष्टि से या राजा की दृष्टि से उनकी प्रतीति के लिये आकाश में स्वस्वशङ्कु के शीर्ष स्थानगत दृक्तुल्यता को प्राप्त किये हुये ग्रहद्वय को दिखाना चाहिये। इति ॥ ४४-४५ ॥

इदानीं द्वादशाङ्गुलशङ्कुभुजात् क्रान्तिसाधनमाह।

शङ्कुप्राच्यपरान्तरविषुवच्छायैक्यमुत्तरे नृतले ।
याम्येऽन्तरं गुणहृतं स्वक्रान्तिर्लम्ब कर्णाभ्याम् ॥ ४६ ॥

सु. भा.—पूर्वापररेखात उत्तरे नृतले शंकुतले ऽर्थादुत्तरे भुजे शंकुप्राच्यपरान्तर पलभयोरैक्यं कार्य। याम्ये भुजे ऽन्तरं कार्यमेवं कर्णवृत्ताग्रा त्रिप्रश्नाधिकारे साधितैव। तदैक्यं वाऽन्तरं लम्बकर्णाभ्यां गुणहृतमर्थात् पूर्वागता कर्णवृत्ताग्रा लम्बेन लम्बज्यया गुणा कर्णेनेष्टभाकर्णेन हृता भस्य स्वक्रान्तिर्बिम्बीयस्पष्टापमज्या भवति।

अत्रोपपत्तिः। त्रिप्रश्नोक्त्या स्फुटा ॥ ४६ ॥

वि. भा.—उत्तरे नृतले (पूर्वापर रेखात उत्तरे शंकुतले ऽर्थादुत्तरे भुजे) शंकु प्राच्यपरान्तर (भुज) विषुवच्छायै (पलभा) क्यं कार्य याम्ये (दक्षिणे भुजे तयोरन्तरं कार्य तदा कर्णवृत्ताग्रा भवति, तदैक्यं वाऽन्तरं लम्बकर्णाभ्यां गुणहृतमर्थात्पूर्वागता कर्णवृत्ताग्रा लम्बज्यया गुणा कर्णेन (इष्टच्छाया कर्णेन) हृता (भक्ता) तदा स्वक्रान्तिः (नक्षत्रस्य बिम्बीय स्पष्ट क्रान्तिः) भवतीति ॥ ४६ ॥

अत्रोपपत्तिः।

"त्रिभज्याहृताऽर्काग्रका कर्णनिघ्नी भवेत्कर्णवृत्ताग्रका व्यस्तगोलेति" भास्करोक्त्या कर्णवृत्ताग्रा भवति अग्राशङ्कुतलयोः संस्कारेण भुजो भवति, छायाकर्णगोले शङ्कुतलं पलभातुल्यं भवत्यतो विलोमेन शङ्कुतलभुजयोरर्थात्पलभा भुजयोः संस्कारेण कर्णवृत्ताग्रा भवेत्। पूर्वोक्तभास्करोक्त सूत्रेण कर्णवृत्ताग्रा $=\frac{\text{अग्रा. छाक}}{\text{त्रि}}$ अतः अग्रा. छाक $=$ त्रि. कर्णवृत्ताग्रा, तत $\frac{\text{त्रि. कर्णवृत्ताग्रा}}{\text{छाक}}$ $=$ अग्रा, ततोऽक्षक्षेत्रानुपातेना 'त्रिज्याकर्णेन लम्बज्या कोटिर्लभ्यते तदाऽग्राकर्णेन कि लब्धा क्रान्तिज्या' नेन क्रान्तिज्या $=\frac{\text{लंज्या}\times\text{अग्रा}}{\text{त्रि}}=\frac{\text{लज्या}\times\text{त्रि}\times\text{क.वृ.अ.}}{\text{त्रि}\times\text{छाक}}$

$=\frac{\text{लंज्या}\times\text{कर्णवृत्ताग्रा}}{\text{छाक}}$ एतावताऽऽचार्योक्तमुपन्नम्। सूर्यसिद्धान्तेऽपि "इष्टाग्राघ्नीतु लम्बज्या स्वकर्णाङ्गुल भाजिता। क्रान्तिज्येत्यनेन" कर्णवृत्ताग्रातः क्रान्तिज्या ज्ञानमाचार्योक्त सदृशमेवास्ति। सिद्धान्तशेखरे "शङ्कोश्च पूर्वापररेखिकाया यदन्तरं तद्विषुवत्प्रभैक्यम्। सौम्ये नराग्रेऽन्तरमन्यथा तु लम्बाहतं तच्छ्रवणेन भक्तम् ॥ क्रान्तिज्यके" त्यनेन श्रीपतिनाऽऽचार्योक्तानुरूपमेवोक्तमिति विज्ञैर्विभावनीयम् ॥ ४६ ॥

अव द्वादशाङ्गुलशङ्कु के भुज से क्रांति साधन को कहते है।

हि. भा.—उत्तर शङ्कुतल (पूर्वापर रेखा से उत्तर शङ्कुतल में अर्थात् उत्तर भुज) में भुज और विषुवच्छाया (पलभा) का योग करना, दक्षिण भुज में उन दोनों का अन्तर

करना तब कर्णवृत्ताग्रा होती है, उन योग और अन्तर को अर्थात्पूर्वागत कर्णवृत्ताग्रा को लम्बज्या से गुणाकर इष्ट छाया कर्ण से भाग देने से नक्षत्र की बिम्बीय स्पष्ट क्रांतिज्या होती है इति ॥ ४६ ॥

उपपत्ति ।

अग्रा और शङ्कुतल के संस्कार करने से भुज होता है इसके विपरीत शङ्कुतल और भुज के संस्कार करने से अग्रा होती है, परन्तु छायाकर्ण गोल में शङ्कुतल पलभा के समान होता है इसलिये पलभा और भुज का संस्कार करने से कर्णवृत्ताग्रा होती है, 'त्रिभज्याहृताऽर्काग्रका कर्ण निघ्नी भवेत्कर्णवृत्ताग्रका व्यस्तगोला' इस भास्करोक्त विधि से $\frac{\text{अग्रा. छाक}}{\text{त्रि}}$ = कर्णवृत्ताग्रा, छेदगम करने से अग्रा. छाक = त्रि. कर्णवृत्ताग्रा

$\therefore \frac{\text{त्रि. कर्णवृत्ताग्रा}}{\text{छाक}}$ = अग्रा, तब 'त्रिज्याकर्ण में लम्बज्या कोटि पाते हैं तो अग्राकर्ण में क्या, इस अक्षक्षेत्रानुपात से लब्धि क्रान्तिज्या आती है। $\frac{\text{लंज्या अग्रा}}{\text{त्रि}}$ = क्रांज्या, यहाँ अग्रा का उत्थापन करने से $\frac{\text{लंज्या . त्रि. कर्णवृत्ताग्रा}}{\text{त्रि. छाक}}$ = क्रांज्या = $\frac{\text{लंज्या. कर्णवृत्ताग्रा}}{\text{छाक}}$ इससे आचार्योक्त उपपन्न हुआ। सूर्यसिद्धान्त में "इष्टाग्राघ्नीतु लम्बज्या स्वकर्णाङ्गुलभाजिता" इत्यादि सं. उपपत्ति में लिखित श्लोक से कर्णवृत्ताग्रा से क्रान्ति साधन प्रकार के सदृश ही आचार्योक्त प्रकार है। सिद्धान्त शेखर में "शङ्कोश्च पूर्वापर रेखिकाया यदन्तरतद्विषुवत्प्रभैक्यम्' इत्यादि सं. उपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥ ४ ॥

इदानीं नक्षत्रशरानयनमाह ।

तच्चापांशाः सदृशैर्भध्रुवकापक्रमांशकैरूनाः ।
विक्षेपांशा व्यस्ता व्यस्त विशुद्धा विसदृशांशैः ॥ ४७ ॥

सहिता विक्षेपांशास्तच्चापांशक वशादुदग्याम्याः ।
एवं विक्षेपांशैस्तत्क्रान्त्यंशा ध्रुवो रविवत् ॥ ४८ ॥

सु० भा०—तच्चापांशाःपूर्वसाधितबिम्बीयस्पष्टापमज्याचापांशाः स्पष्टक्रान्त्यंशा इत्यर्थः। सदृशैरेकजातीयैर्भध्रुवकापक्रमांशैर्हीना भस्य विक्षेपांशाः स्पष्टक्रान्तिदिक्का भवन्ति । व्यस्तविशुद्धा विक्षेपांशा व्यस्ताव्यस्तदिक्का भवन्ति। अर्थाद्यदि स्पष्टक्रान्त्यंशा एव शोधने ध्रुवक्रान्तिभागेभ्यो विशुद्धा भवन्ति तदा विक्षेपांशाः स्पष्टक्रान्तिभिन्नदिक्का ज्ञेयाः। यदि भध्रुवक्रान्तिभागा भिन्नदिक्का विजा-

तीयास्तदा विसदृशांशैर्ध्रुवापमभागैः सहितास्ते स्पष्टापमांशास्तच्चापांशकवशात् स्पष्टापमदिग्वशादुदग्याम्या विक्षेपांशा भवन्ति। एवं व्यस्तविधिना स्पष्टापमज्ञाने विक्षेपांशैस्तत्क्रान्त्यंशा भस्य स्थानापमभागा भवन्ति। तेभ्यो रविवत् 'जिनज्यया त्रिज्या तदा क्रान्तिज्यया किम्' इत्यनुपातादिना भस्य ध्रुवो भवतीति।

अत्रोपपत्तिः। गोल संस्थानतः स्फुटा ॥ ४७-४८ ॥

वि. भा.—तच्चापांशाः (पूर्वसाधित बिम्बीय स्पष्टक्रान्तिज्याया चापांशा) स्पष्ट क्रान्त्यंशा भवन्ति, सदृशैः (एकजातीयैः) नक्षत्रध्रुवक्रान्त्यंशैरूनाः (वर्जिताः) गन्तो विक्षेपांशाः (नक्षत्रस्य शरांशकाः) स्पष्टक्रान्तिदिक्का भवन्ति. व्यस्तविशुद्धा विक्षेपांशा व्यस्तदिक्का भवन्त्यर्थात् शोधने यदि स्पष्टक्रान्त्यंशा एव ध्रुवक्रान्तिभागे विशुद्धा भवन्ति तदा नक्षत्रशरांशाः स्पष्टक्रान्तेर्भिन्नदिक्का भवन्ति। यदि भध्रुव क्रान्त्यंशा भिन्नदिक्का (विजातीयाः) स्तदा विसदृशांशै ध्रुवक्रान्त्यशैः सहितास्ते स्पष्टक्रान्त्यंशास्तच्चापांशकवशात् (स्पष्टक्रान्ति वशात्) उदग्याम्या विक्षेपांशा भवन्ति। एवं व्यस्तविधिना स्पष्टक्रान्तिज्ञाने-विक्षेपांशैस्तत्क्रान्त्यंशा (नक्षत्रस्य स्थानीय क्रान्त्यंशाः) भवन्ति, तेभ्यो रविवत् "अपमधनुषो मौर्व्या क्षुण्णा गृहत्रय-शिञ्जिनी" त्यादिना नक्षत्रस्य ध्रुवो भवतीति ॥ ४७-४८ ॥

अत्रोपपत्तिः।

पूर्वसाधित नक्षत्र स्पष्ट क्रान्तिज्यायाश्चापं नक्षत्रस्य बिम्बीया स्पष्टा क्रान्तिर्भवेत्साच नक्षत्रस्य मध्यमक्रान्त्यंशैः (भध्रुवापमांशैः) सहितोना तदा नक्षत्रस्य शरांशा भवन्तीति क्रान्ति स्पष्टक्रान्ति शरांशादि स्वरूप भावनया स्फुटैव। संस्कार-विषयेऽपि विपरीत शोधनाद्युक्तक्रिया वैचित्र्यादि सर्व विज्ञैर्ज्ञेयम्। विपुलं गोल यन्त्रं विरचय्य रात्रौ गोलमध्यगतदृष्ट्या रेवती तारां विलोक्य क्रान्तिवृत्ते यो मीनान्तस्तं रेवतीतारायां निवेश्य मध्यगतदृष्ट्यैव नक्षत्रं विलोक्य तदुपरि ध्रुवप्रोतवृत्तं कदम्ब प्रोतवृत्तं च कार्यम्। ध्रुवप्रोतवृत्तं क्रान्तिवृत्ते यत्र लग्नं तस्माद्गोलसन्धि (नाडीक्रान्तिवृत्तयोः सम्पातं) यावत् येऽशास्ते सायना ध्रुवाः। नक्षत्रबिम्बोपरिगतं कदम्बप्रोतवृत्तं क्रान्तिवृत्ते यत्र लगति तन्नक्षत्रस्थानम्। स्थानोपरि गतमहोरात्रवृत्तं कार्यं तद् ध्रुवप्रोतवृत्ते यत्र लगति तस्मान्नाडीवृत्तावधि नक्षत्रबिम्बोपरिगतध्रुवप्रोतवृत्ते नक्षत्रमध्यमा क्रान्तिः। नक्षत्र बिम्बात्-ध्रुवप्रोतवृत्तनाडीवृत्तसम्पातावधि ध्रुवप्रोतवृत्ते नक्षत्रस्पष्टा क्रान्तिः। नक्षत्र-बिम्बात् स्थानीयाहोरात्रवृत्तध्रुवप्रोतवृत्तयोः सम्पातं यावन्नक्षत्रस्पष्टशरः। अत्रैकदिशायां स्पष्टक्रान्ति-मध्यमक्रान्त्योरन्तरेणाऽर्थात् 'स्पक्रान्ति-मध्यमक्रान्ति =स्पष्टशरः'। यो नक्षत्रस्फुटशरो भवति स स्पष्टक्रान्तिदिक्को भवति। विलोम शोधनेऽर्थात् मध्यमक्रान्ति-स्पष्टक्रान्ति = स्फुटशरः। यो नक्षत्रस्फुटशरः स स्पष्टक्रान्तेर्भिन्नदिक्को भवति। यदि स्पष्टक्रान्तिमध्यमक्रान्तिदिशोर्भिन्नत्वं

तदा तयोर्योगकरणेन उत्तरो दक्षिणश्च नक्षत्र स्फुटशरो भवति । अतो विलोम-विधिना स्पष्ट क्रान्ति-स्पष्टशरयोरन्तरेण योगेन च नक्षत्र मध्यमक्रान्तिर्भवेदेव ततो जिनज्यया यदि त्रिज्या लभ्मते तदा नक्षत्रमध्यमक्रान्त्या किं समागच्छति नक्षत्र भुजज्या $=\frac{\text{त्रि. नक्षत्रमक्रांज्या}}{\text{जिज्या}}$ अस्याश्चापम् = नक्षत्रध्रुवः। एतत्सम्बन्धे सूर्य-सिद्धान्ते केवलं 'गोलं बद्ध्वा परीक्षेत विक्षेपं ध्रुवकं स्फुटम्' लिखितम् इति ॥ ४७-४८ ॥

हि. भा.— पूर्वसाधित बिम्बीय स्पष्ट क्रान्तिज्या के चाप करने से स्पष्ट क्रान्ति होती है; उसमे एक जातीय नक्षत्र ध्रुवक्रान्ति को घटाने से नक्षत्र का शरांश होता है, स्पष्ट क्रान्ति जिस दिशा की है उसी दिशा का यह (नक्षत्र शरांश) भी होता है । यदि विपरीत शोधन हो अर्थात् नक्षत्र धुवक्रान्ति में से यदि स्पष्ट क्रान्ति घट जाय तब जो नक्षत्र शरांश होगा उसकी दिशा स्पष्ट क्रान्ति की दिशा से विपरीत होगी । यदि नक्षत्र ध्रुवक्रान्त्यश भिन्न दिशा (विजातीय) के हैं तब भिन्न दिशा के नक्षत्र ध्रुवक्रान्त्य को स्पष्ट क्रान्ति मे जोडने से स्पष्ट क्रान्तिवश से उत्तर-दक्षिण नक्षत्र शरांश होता है । एवं विलोम विधि से स्पष्ट क्रान्ति और नक्षत्र शराश के सस्कार से नक्षत्र की स्थानीय (मध्यम) क्रान्ति होती है। मध्यम क्रान्ति ज्ञान से रवि की तरह $\frac{\text{त्रि} \times \text{नक्षत्रस्थानीय क्रांज्या}}{\text{जिज्या}}$ = नक्षत्र भुज्या, इसका चाप नक्षत्र भुजज्या = नक्षत्रध्रुव होता है ॥ ४७-४८ ॥

उपपत्ति

नक्षत्र बिम्बोपरिगत ध्रुव प्रोतवृत्त क्रान्तिवृत्त के सम्पात से गोल सन्धि (नाडी वृत्त क्रान्तिवृत के सम्पात बिन्दु) पर्यन्त क्रान्तिवृत्तीय चाप नक्षत्र का सायन ध्रुव है । नक्षत्र बिम्बोपरि ध्रुवप्रोतवृत्त क्रान्तिवृत्त के सम्पात से नक्षत्र बिम्बतक ध्रुवप्रोतवृत्ति में नक्षत्र के स्पष्टशर है । नक्षत्र बिम्बोपरिगत कदम्ब प्रोतवृत्त और क्रान्ति वृत्त का सम्पात बिन्दु नक्षत्र का स्थान है। नक्षत्र स्थानोपरिगत अहोरात्रवृत्त और नक्षत्र बिम्बोपरिगत ध्रुव प्रोतवृत्त के सम्पात बिन्दु से ध्रुव प्रोतवृत्त नाड़ीवृत्त के सम्पात पर्यन्त नक्षत्र मध्यम क्रान्ति है । नक्षत्र-बिम्बोपरिगत ध्रुवप्रोतवृत्त और स्थानीयाहोरात्रवृत के सम्पात से नक्षत्रबिम्ब तक नक्षत्र का स्पष्टशर है नक्षत्रबिम्ब से नाड़ीवृत्त पर्यन्त नक्षत्र बिम्बोपरिगत ध्रुव प्रोतवृत्तीय चाप (स्पष्टक्रान्ति) में यदि स्थानीय-होरात्रवृत्त, और ध्रुवप्रोतवृत्त के सम्पात से नाड़ीवृत्त पर्यन्त नक्षत्र बिम्बोपरिगत ध्रुवप्रोतवृत्तीय चाप (मध्यम क्रान्ति) को एकदिशा में अन्तर करने से अर्थात् स्पष्ट क्रान्ति-मध्यम क्रान्ति और भिन्न दिशा में दोनों का योग करने से नक्षत्र स्पष्ट शर (नक्षत्र बिम्ब से स्थानीयाहोरात्रवृत्त ध्रुवप्रोतवृत्त के सम्पात पर्यन्त) होता है । एवं विपरीत विधि से नक्षत्र स्पष्ट क्रान्ति और स्पष्टशर के सस्कार से नक्षत्र की मध्यम क्रान्ति

होती है। मध्यम क्रांतिज्ञान से $\frac{\text{त्रि} \times \text{नक्षत्रम क्रांज्या}}{\text{जिज्या}}$ = नक्षत्र भुजज्या, इसका चाप करने से नक्षत्र ध्रुव होता है। इसके सम्बन्ध में सूर्य सिद्धान्त में केवल 'गोल बध्वा परीक्षेत विक्षेप ध्रुवकं स्फुटम्' लिखा है अर्थात् गोल यन्त्र बनाकर अश्विन्यादि नक्षत्रों के स्फुटशर और ध्रुव की परीक्षा कर अर्थात् गोल-यन्त्र द्वारा वेध से स्फुटशर और ध्रुव का ज्ञान करे। एक गोल यन्त्र को बनाकर रात्रि मे गोल केन्द्रगत दृष्टि से रेवती तारा को देखकर क्रान्तिवृत्त मे जो मीनान्त बिन्दु है उसको रेवती तारा में निवेशकर गोल-केन्द्रगत दृष्टि से ही नक्षत्र को देखकर उसके ऊपर ध्रुव प्रोतवृत्त और कदम्ब प्रोतवृत्त कर देना चाहिए उसके बाद उपर्युक्त युक्तिसे नक्षत्र ध्रुवज्ञान करना चाहिए. इति ॥ ४७-४८ ॥

इदानी युतिलक्षणमाह ।

ऊने मानैक्यार्धाद् ग्रहयोर्मध्यान्तरे युतिर्ग्रहयोः ।
समलिप्तिकयोर्ग्रहणवदधिके स्फुटमानयोगार्धात् ॥४९॥

सु० भा०—'मानैक्यार्धादधिके' इतिग्रहसमागमोक्ते न स्फुटा व्याख्योपपत्तिश्च ॥ ४९ ॥

वि. भा.—समकलयोर्ग्रहयोर्मध्यान्तरे (केन्द्रान्तरे) ऽर्थाद् ग्रहयोरन्तरे तयोर्बिम्बयोगार्धादूने (न्यूने) तदायुतिर्भवेदर्थाद्ग्रहणवदाच्छादनं भवेत्-अर्थादुपरिस्थो ग्रहो ग्राह्यः स्यात्-अधःस्थो ग्रहो ग्राहकः स्यादित्यर्थः । ग्रहयोरन्तरे स्फुटमानयोगार्धा (स्पष्ट बिम्बयोर्योगार्धात्) दधिके सति तयोर्युति (आच्छादनं ग्रहणवत्) र्न स्यादिति । सिद्धांतशेखरे "मानैक्यार्धाद् द्युचरविवरे स्यान्न भेदोऽधिके तु न्यूने भेदो ग्रहणवदिहच्छादकोऽधस्तनः स्यात्" श्रीपत्युक्तमिदं-सिद्धान्तशिरोमणौ 'मानैक्यार्धाद् द्युचरविवरेऽल्पे भवेद् योग' इत्यादि भास्करोक्तं चाचार्योक्तानुरूपमेवास्ति ॥ ४९ ॥

अब युति लक्षण को कहते हैं।

हि. भा.—सम कलात्मक दो ग्रहों के अन्तर यदि दोनों ग्रहों के बिम्बयोगार्ध से न्यून हों तब ग्रह द्वय की युति होती है अर्थात् ग्रहणवत् आच्छादन (उपरिस्थ ग्रह ग्राह्य और अधःस्थित ग्रह ग्राहक) होता है। यदि दोनों ग्रहों के अन्तर स्फुट बिम्बयोगार्ध से अधिक हो तब ग्रह की युति नहीं होती। सिद्धान्त शेखर में 'मानैक्यार्धाद् द्युचरविवरे स्यान्नभेदोऽधिके तु' इत्यादि विज्ञान भाष्य में लिखित श्लोकार्ध से श्रीपति सिद्धान्त शिरोमणि में 'मानैक्यार्धाद् द्युचर विवरेऽल्पे भवेद् योगः' इत्यादि से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है इति ॥ ४९ ॥

इदानीं समलिप्तिककाले ग्रहयोर्दिनगतघटीसाधनमाह ।

समपिप्तिकालिकार्कात् कृत्वा लग्नं स्वदेशराश्युदयैः ।
ग्रहयोः समलिप्तिकयोः स्वदिनोदित नाड़िकाः प्राग्वत् ॥ ५० ॥

सु. *भा.*—अत्रैवाध्याये प्रागुदयलग्नमूनमित्यादिना ऽऽचार्योक्तेन व्याख्योपपत्तिश्च स्फुटा ॥ ५० ॥

वि.भा.—यस्मिन् काले कदम्बप्रोतीयौ समलिप्तिकौ ग्रहौ जातौ तस्मिन् काले स्वदेशराश्युदयै रिष्टलग्नं साध्यम् । भगोल परिभ्राम्य तौ ग्रहौ पूर्वक्षितिजे समानीय तयोरुदयलग्ने ससाध्य तत इष्टलग्नग्रहोदयलग्नान्तरे लग्नादिष्टकाल-साधनवत् समागता ग्रहस्य दिनगता घटिकास्ता एवाचार्योक्त्या दिनोदिता घटिका इति ॥ ५० ॥

अब समलिप्तिक काल (जिस काल में दो ग्रह समकलात्मक हुए है) मे ग्रहद्वय की दिनगत घटी के साधन कहते है ।

हि. भा.—जिस काल मे दो ग्रह कदम्ब प्रोतवृत्तीय समलिप्तिक हुए है उस काल में रवि और स्वदेशीय राश्युदय-मानों से इष्टलग्न साधन करना चाहिए। भगोल को घुमाकर उन दोनों ग्रहों को पूर्व क्षितिज में ले आकर दोनो ग्रहों का उदय लग्न साधन करना चाहिए। तब इष्टलग्न और ग्रहोदयलग्न के अन्तर में लग्न से इष्टकाल साधन की तरह जो घटी आवेगी वह ग्रह की दिनगत घटी है वही आचार्योक्त स्वदिनोदित घटी है इति ॥ ५० ॥

इदानीं स्फुटयुतिकाल साधनमाह ।

अधिकदिनोदितघटिकाभिरूनदिननाड़िका गुणा भक्ताः ।
अधिकदिननाड़िकाभिः फलनाड्यो यदि भवन्त्यूनाः ॥ ५१ ॥

ऊनदिवसोदिताभ्यो घटिकाभ्यः प्रागथाधिकाः पश्चात् ।
योगस्तद्घटिकान्तरमाद्यं कृत्वेष्टघटिकाभिः ॥ ५२ ॥

गुणिताः स्वभुक्तिलिप्ताः षष्टिहृताः प्रागृणं धनं पश्चाद् ।
आद्यवदन्तरमन्यं प्राक् पश्चाद्वाऽन्तरद्वितयम् ॥ ५३ ॥

यद्याद्यान्यान्तरयोरन्तरहृतमन्यथा तदैक्येन ।
आद्यान्तरमिष्टाभिर्घटिकाभिर्गुणितमाप्ताभिः ॥ ५४ ॥

घटिकाभिराद्यवशतः प्राक् पश्चाद्वा युतिः प्रथमकालात् ।
कृत्वा पृथग्दिनोदितघटिकास्तात्कालिकग्रहयोः ॥ ५५ ॥

उदितघटिका यदि हृता गुणिताश्च स्वान्यदिवसघटिकाभिः ।
अन्योदितघटिकाभिस्तुल्या योगो न चेदसकृत् ॥ ५६ ॥

सु. भा.—उदितघटिकाः स्वदिवसघटिकाभिर्हृता अन्यदिवसघटिकाभिर्गुणाः। शेषं ग्रहसमागमाध्यायोक्तेन 'ऊनदिनोदितगुणितादित्यादिना' स्पष्टार्थम् । इहाऽऽचार्येण सजात्यादूनदिनोदितस्थानेऽधिकदिनोदितग्रहणं कृतमित्येव विशेषः ॥५१-५६॥

वि. भा.—समलिप्तिकयोर्ग्रहयोर्दिनमानप्रमाणे दिनगतघटिका प्रमाणे च पूर्वमानीते । यस्य ग्रहस्य दिनमानप्रमाणमधिकं तस्य दिनगतघटिका अधिकदिनोदितघटिकास्ताभिर्यस्य ग्रहस्य दिनप्रमाणमल्पं तद्दिननाड़िका गुणा अधिकदिननाड़िकाभि (यस्य दिनप्रमाणमधिकं तद्दिननाडिकाभिः) भक्तं फलनाड्यो (लब्धघटिकाः) यस्य दिन प्रमाणमल्पं तद्दिवसोदिताभ्यो घटिकाभ्यो यद्यूना (अल्पाः) स्तदाग्रहयोर्योगः प्राक् (पूर्व) गतो भवति, अधिकाश्चेदर्थाल्लब्धघटिका अल्पदिनस्य ग्रहस्य दिनगतघटिकातोऽधिकास्तदा योगः पश्चात् (गम्य) भवति । तद्घटिकान्तर (लब्धघटिकाया अल्पदिनस्य ग्रहस्य दिनगत घटिकाश्चान्तर) माद्यसंज्ञको भवति। ततः षष्टिघटिकाभिर्ग्रहगतिकला लभ्यन्ते तदेष्ट घटीभिः किमित्यनुपातागतेन पृथक् पृथगभीष्टघटीफलेनोनसंयुक्तयो ग्रहयोः एवमन्य संज्ञः स्यात् एतदुक्तं भवति । गतयुतौ गताः, एष्ययुतावेष्या इष्टघटिकाः कल्प्यास्ताभिस्तौ ग्रहौ प्रचाल्य तयोरुदयलग्नादिना गतघटिका आनीय 'अधिकदिनोदितघटिकाभि' रित्यादिना पुनरन्तरं साध्यं तदन्यसंज्ञकं भवति । इमावाद्यान्यौ गम्यौ गतौ च यदि भवतः । अयमर्थः यद्यन्तरद्वयेनापि प्राग्गता पश्चादेष्या वा तदाऽऽद्यान्ययोरन्तरेण, अन्यथा यद्येकेन गतायुतिरन्येनैष्या तदाऽऽद्यान्ययोगेनेष्टघटीगुणिताऽऽद्य संज्ञको भक्त आप्ताभिर्घटिकाभिः । यद्यन्तरद्वयेनापि गता गम्या वा युतिस्तदेष्टघटिका गुणितादाद्यात् आद्यान्ययोरन्तरेण भक्तात् । यदि चैकेन गताऽन्येन च गम्या युतिस्तदाऽऽद्यान्ययोयोगेन भक्तात् फलघटीभिः समलिप्तिक कालत आद्यवशेन पूर्वं पश्चात् ग्रहयुतिर्भवति । स्वदिनस्य गतघटिकादिकं इतर ग्रहस्य दिनमान घटिकाभिर्गुणितं स्वदिनप्रमाणेन भक्तं चेदितरग्रहस्य दिनगतघटिकाभिस्तुल्यं कथमपि जायते तदा एष पूर्वोक्तो विधिः प्रयुज्यते ऽन्यथाऽसकृत्कर्म कर्त्तव्यम् इति ॥५१-५६॥

अत्रोपपत्तिः ।

यद्यधिकदिनमानघटिकाभिरधिकदिनोदितघटिका स्तदाऽल्पदिनमानघटिकाभिः किं जाता युतिकाले ऽल्पदिनोदितघटिकाः । अत्राचार्येण ग्रहयोर्दिनमानगतघटिकामध्ये स्वल्पान्तरात्तुल्या निष्पत्तिः स्वीकृता लब्धघटिका यदि-अल्प-

दिनोदितगतघटिकातोन्यूनास्तदायुतिर्गताऽन्यथैष्येति । द्वयोरन्तरमाद्यसंज्ञकं कल्पितम् । इष्टघटिकाभिग्रहौ प्रचाल्य पुनरन्तरं साध्यं तदन्यसंज्ञकम् । ततोऽनुपातो यद्यान्यतुल्येनापचयेनेष्टघटिकास्तदाऽऽद्यतुल्यापचयेन किं फलघटीभिराद्यकालात् पूर्वं पश्चाद्वा ऽन्तरस्याद्यसमापचयादभावोऽतस्तत्र युतिरिति । ग्रहगतिशरगत्योर्वैलक्षण्यादसकृत्कर्म समुचितम् । यद्येकस्य दिनप्रमाणेन तस्य दिनगतघटिकास्तदा द्वितीयस्य दिनप्रमाणेन किमिति द्वितीयस्य दिनगतघटिकाः पूर्वयुत्तया भवन्तीति तदैवैषा युतिर्वक्तुमुचिता नान्यथेति । सिद्धान्तशेखरे "अल्पद्युखे च समुद्गतनाड़िकाभिर्ज्येष्ठं दिनं निहतमल्पदिनेन भक्तम् । लब्धं बृहद्दिनसमुद्गततोऽधिकंचेत् याता तदा युतिरतोऽपरथा च गम्या । आद्यस्तदन्तरमभीष्टघटीफलोनसंयुक्तयोपर एवमुभावपीमौ गम्यौ गतौ यदि च तद्विवरं हरः स्याद्योगोऽन्यथा स्वकघटीनिहताद्यराशेः । फलघटीभिरिहाद्यवशेन हि ग्रहयुतिः समलिप्तिककालतः । भवति पूर्वमथोत्तरकालिका गणितदृक्समता विधिनाऽमुना । गुणितमपरवासरेण भक्तं स्वदिनेनोदितमत्र जायते चेत् । कथमपि च परोदितेन तुल्यं युतिविधिरेष विधीयते तदानीम् ।" श्रीपत्युक्तमिदमानयनं "ऊनदिनोदित गुणितादित्यादि" रीतिवदस्ति, अत्राचार्येण 'ऊनदिनोदित स्थाने ऽधिकदिनोदित ग्रहणं सर्व कथितं साजात्यादिति ॥५१-५६॥

अब स्फुट युतिकाल साधन को कहते है ।

हि. भा.—समलिप्तिक (समकलात्मक) दो ग्रहो के दिनमान प्रमाण और दिनगतघटी प्रमाण पहले लाये गये है । जिस ग्रह के दिनमान प्रमाण अधिक है उसकी दिनगतघटी अधिक दिनोदितघटी कहलाती है, जिस ग्रह के दिनमान प्रमाण अल्प है उसके दिन नाड़ी से अधिक दिनोदित घटी को गुणाकर अधिक दिन नाडी (जिसके दिनमान अधिक हैं उसकी दिन नाडी) से भाग देने से जो लब्धघटी हो वह अल्पदिनोदित घटी से यदि ऊन (अल्प) हो तब ग्रहयुति गत होती है । यदि अधिक (लब्धघटी यदि अल्प दिनोदित घटी से अधिक) हो तब ग्रहयुति गम्य (भावी) होती है । लब्धघटी और अल्पदिनग्रह की दिनगतघटी के अन्तर आद्य सज्ञक हैं । तब साठ घटी में यदि ग्रह गति कला पाते हैं तो इष्ट घटी में क्या इस अनुपात से दोनो ग्रहों के पृथक् पृथक् इष्ट घटीफल को ग्रहद्वय में ऊन-युत करना चाहिये । इस तरह अन्य होता है अर्थात् गतयुति में गत और एष्य युति में एष्य इष्टघटी कल्पनाकर उस से दोनों ग्रहों को चालन देकर दोनों ग्रहों के उदय लग्न आदि से गत घटी लानी चाहिये । तब आचार्योक्त 'अधिक दिनोदितघटिकाभिः' इत्यादि सूत्र से पुनः अन्तर साधन करना अन्य संज्ञक होता है । यदि दोनों अन्तर से पहले गत-पश्चात् एष्य हो तब आद्य और अन्य के अन्तर से अन्यथा यदि एक से युति गत हो और अन्य से एष्य हो तब आद्य और अन्य के योग से इष्टघटी से गुणित आद्य को भाग देने से लब्ध घटिकाओं से—यदि अन्तर द्वय से भी गत वा गम्ययुति हो तब इष्टगुणित आद्य को आद्य और अन्य के अन्तर

से भाग देना—यदि एक से गत और अन्य से गम्य युति हो तब आद्य और अन्य के योग से भाग देने से जो लब्धघटी हो उतने काल में समलिप्तिक काल से आद्यवश से पहले पीछे ग्रहयुति होती है । अपने दिन के घटिकादि को इतर (भिन्न) ग्रह के दिनमान घटी से गुणा कर अपने दिन प्रमाण से भाग देना जो लब्ध हो वह यदि इतर ग्रह के दिनगत के बराबर किसी तरह हो तब पूर्वोक्त विधि का प्रयोग करना चाहिये अन्यथा असकृत् कर्म करना चाहिये इति ।।५१-५६।।

उपपत्ति ।

यदि अधिक दिनमानघटी में अधिक दिनोदित घटी पाते है तो अल्पदिनमान घटी मे क्या इस से युतिकाल मे अल्पदिनोदित घटी आई, यहा आचार्य ने दोनों ग्रहो की दिनमान गतघटी के मध्य में स्वल्पान्तर से तुल्य निष्पत्ति स्वीकार की है । लब्धघटी यदि अल्प दिनोदित गतघटी से अल्प हो तब युति गत होती है अन्यथा एष्ययुति होती है । दोनों के अन्तर आद्यसंज्ञक है । इष्टघटी सम्बन्धी फल से दोनो ग्रहो को चालन देकर पुनः अन्तर साधन करना वह अन्य सज्ञक है । तब अनुपात करते है यदि अन्यतुल्य अपचय मे इष्टघटी पाते है तो आद्यतुल्य अपचय में क्या फल घटी मे आद्यकाल से पहले वा पीछे अन्तर के आद्यतुल्य अपचय से अभाव होता है इसलिये वहा युति होती है । ग्रहगति और शरगति की विलक्षणता के कारण असकृत् कर्म उचित ही है । यदि एक ग्रह के दिन प्रमाण मे उसकी दिनगत घटी पाते हैं तो द्वितीयग्रह के दिनप्रमाण में क्या इससे द्वितीय ग्रह की दिन गतघटी होती हैं' । सिद्धान्तशेखर में 'अल्पद्युखेचसमुदगतनाड़िकाभिः' इत्यादि सस्कृतोपपत्ति मे लिखित श्लोकों से 'श्रीपत्युक्त आनयन 'ऊनदिनोदित गुणितात्' इत्यादि रीति के अनुसार है यहां आचार्य 'ऊनदिनोदित 'स्थान में' 'अधिकदिनोदित' ग्रहण किया है इति ।।५१-५६।।

अथ ग्रहयोगे एकस्थितया दृष्ट्या ग्रहदर्शनार्थमाह ।

अन्येष्टनाड़िकाभिः कृत्वा तुल्या यदा तदा योगः ।
कार्यो शृङ्गोन्नतिवद् ग्रहयोर्मध्यान्तरे योगे ।। ५७ ।।

बाहू संयोगान्तरमग्रा शङ्क्वग्रयोः समान्यदिशोः ।
कर्णौ दृग्ज्ये कोटी स्वकर्णभुजकृतिवियोगपदे ।। ५८ ।।

कोटिभुजकर्णशङ्कून् यष्टिगुणान् व्यासदलहृतान्मध्यात् ।
कोटी पृथक् प्रसार्य प्राच्यां प्रागपरयोः पश्चात् ।। ५९ ।।

कोट्यग्राभ्यां बाहू कर्णौ दिङ्मध्यतो भुजाग्रान्तौ ।
वाग्रहयोः स्वशङ्कू यष्टी मध्यात् तदग्रान्ते ।। ६० ।।

दिङ्मध्यस्थितदृष्ट्या पृथग्ग्रहौ दर्शयेत् स्वशङ्क्वग्रे ।
योगेऽशङ्क्वग्रान्तरमन्तरमेवान्यदा हि तयोः ।। ६१ ।।

सु. भा.—भुजकोटिकर्णानां यष्टिव्यासार्धे परिणामनार्थं तान् यष्टिगुणान् व्यासार्धहृतान् गणकः कुर्यात् । एवं ग्रहयोर्योगे तयोरशङ्क्वग्रान्तरं भवेदर्थात् शङ्क्वग्रान्तराभावः शङ्कोर्भुजादीनां च समत्वात् । अन्यदा तयोः शङ्क्वोरन्तरं भवेदेव । शेषं स्पष्टार्थम् ।

अत्रोपपत्तिः । गोलयुक्त्या भुजकोटिकर्णशङ्कुसंस्थानवशतः स्फुटा शृङ्गोन्नत्यध्याये चापीदृशी युक्तिराचार्येण प्रतिपादिता ।। ५७-६१।।

वि. भा.—यदाऽन्येष्टनाडिकाभिस्तुल्याः कृत्वा तदा योगो भवेत् । योगे (ग्रहयुतौ) ग्रहयोर्मध्यान्तरे (विम्बकेन्द्रान्तरे सति) श्टङ्गोन्नतिवत् (चन्द्रश्टङ्गोन्नतिवत्) समान्यदिशोः (एकभिन्नदिक्कयोः) अग्राशङ्क्वग्रयोः (अग्राशङ्कुतलयोः) संयोगान्तरं (योगोऽन्तरं) बाहू (भुजौ) कार्यावित्यर्थान्मध्यान्तरयोगवतोर्ग्रहयोः प्रत्येकस्य शङ्कुतलस्याग्रायाश्च योगान्तरं तयोर्भुजौ भवत इत्यर्थः । ग्रहयोर्दृग्ज्ये कर्णौ भवतः । स्वकर्णभुजकृतिवियोगपदे (स्वकर्णभुजयोर्वर्गयोरन्तरमूले) कोटी भवतः । एवं ग्रहयोः कोटिभुजकर्णशङ्कून् यष्टिगुणान् (कल्पितेष्टयष्टिगुणान्) व्यासदलहृतान् (त्रिज्याभक्तान्) कुर्युरर्थादेवं करणेन कोटिभुजकर्णशङ्कवो यष्टिव्यासार्धपरिणता भवेयुः । प्रागपरयोः (यष्टिव्यासार्धपरिणतपूर्वापररेखानुरूपयोः) प्राच्यां (पूर्वदिशि) पश्चात् (पश्चिम दिशि) पृथक् कोटी प्रसार्य कोटचग्राभ्यां बाहू (भुजौ) दत्वा दिङ्मध्यतो (मध्य बिन्दोः) भुजाग्रान्तौ (भुजाग्रबिन्द्वोर्लग्नौ) कर्णौ च दत्वा बाह्वग्रयोः (स्वभुजाग्रयोः) स्वशङ्कू देयौ, मध्यात् तदग्रान्ते (स्वशंक्वग्रयोर्लग्ने) यष्टी च पूर्वकल्पिते देये । दिङ्मध्यस्थितदृष्ट्या (मध्यबिन्दुस्थापितेन चक्षुषा) स्वशङ्क्वग्रे पृथक् ग्रहौ दर्शयेत् । योगे (ग्रहयोर्योगे) तयोरशङ्क्वग्रान्तरं भवेदर्थात् शङ्क्वन्तराभावः, (शंकुभुजादीनां समत्वात्) अन्यदा (ग्रहयुतेर्भिन्नेऽवसरे) तयोः शङ्क्वोरन्तरं भवेदेव, अत्र 'योगे शङ्क्वग्रान्तरमन्तरमेवान्यदा हि तयोः' तादृशपाठे योगे (ग्रहयुतौ) शङ्क्वग्रान्तरं ग्रहयोरन्तरं ज्ञेयम् अन्यदा (ग्रहयुतेर्भिन्नकालेपि) प्येवं ज्ञेयमिति ।। ५७-६१ ।।

अत्रोपपत्तिः ।

मध्यान्तरयोगवतोर्ग्रहयोर्भुजकोटिकर्णानामानयनं प्रसिद्धमेव । तेषां भुजकोटिकर्णानां शंकोश्च यष्टिव्यासार्धे परिणामनार्थं ते यष्टिगुणास्त्रिज्या भाजिताश्च कृताः । यष्टिव्यासार्धपरिणतानां भुजकोटिकर्णानां शंकोश्चोक्तसंस्थानवशेन गोलयुक्त्या शङ्क्वग्रे तयोर्ग्रहयोर्दर्शनं भवेदेव । चन्द्रश्टङ्गोन्नत्यधिकारेऽप्येवमेव भुजादिसंस्थापनवशेन चन्द्रशृङ्गोन्नतेरवलोकनं प्रतिपादितमाचार्येण । एवं ग्रहयोः (ग्रहबिम्बयोः) सर्वात्मना योगे शंकोर्भुजकोटिकर्णानां च सर्वथैव समत्वात् शङ्क्वग्रयोरन्तराभावः । मध्यान्तरयोगे च शङ्क्वग्रयोरन्तरं ग्रह-

योरन्तरं भवतीति । ग्रहदर्शनविधिर्ग्रहयुत्यतिरिक्तेऽपि समये भवितुमर्हति तुल्यन्यायादिति । सिद्धान्तशेखरे. "ग्रहयुतौ विवरे सति मध्ययोः शशिविषाण-समुन्नतिवत् पृथक्। स्वनृतलाग्रकयोः सदृशाशयोर्युतिरथान्यदिशोर्वियुतिर्भुजौ. । दृग्ज्ये श्रुती श्रुतिभुजाकृतिभेदमूले कोटी नरश्रवणकोटिभुजांश्च हन्यात् । यष्ट्या भजेत् त्रिभगुणेन ततश्च कोटी पूर्वापरे निजभुजावथ कोटिकोटेः । दत्वा च मध्यात् श्रवसी भुजाग्रसक्ते स्वशङ्कू स्वभुजाग्रयोश्च । यष्टी च मध्यात् स्वनराग्रसक्ते दृष्ट्याऽथ मध्यस्थितया प्रदृश्यौ । ग्रहौ स्वशङ्क्वग्रगतौ जनस्य कुतूहलार्थं यदि वा नृपस्य । शङ्क्वग्रयोरन्तरमन्तरं च द्युचारिणोर्ज्ञेयमिहान्यदापि" इति श्लोकैः श्रीपतिना सर्वमाचार्योक्तानुरूपमेवोक्तं । सूर्यसिद्धान्तेपि "पञ्चहस्तोच्छ्रितौ शङ्कू यथा दिग्भ्रम संस्थिता" वित्यादिभिः श्लोकैर्युतिकाले ग्रहयोर्दर्शनार्थं प्रकारोऽभिहितोस्ति यद् व्याख्यानं मयाऽस्यैवाधिकारस्य ४४-४५ श्लोकयोरुपपत्तौ प्रदर्शितमिति तत्रैवावलोकनीयमिति ॥ ५७-६१ ॥

अब ग्रहयुति में एक स्थित दृष्टि से ग्रहदर्शन के लिए कहते हैं ।

हि. भा.—यदि अन्य इष्ट घटी के साथ समेलन करते है तब योग होता है । ग्रहयुति में दो ग्रहों के बिम्ब केन्द्रान्तर रहने से चन्द्रश्रृङ्गोन्नति की तरह एक दिशा मे अग्रा और शकुतल के योग करने से तथा भिन्न दिशा मे अग्रा और शकुतल के अन्तर करने से दोनों ग्रहों के भुज होते है । दोनों ग्रहों की दृग्ज्या कर्ण होती है , कर्ण (दृग्ज्या) और भुज के वर्गान्तर मूल ग्रहद्वय की कोटि होती हैं । इस तरह सिद्ध दोनो ग्रहो की कोटि, भुज कर्ण और शंकु को कल्पित इष्ट यष्टि से गुणा कर त्रिज्या से भाग देना चाहिए तब यष्टि-व्यासार्ध में परिणत कोटि, भुज, कर्ण और शकु होते है । यष्टि व्यासार्ध परिणत पूर्वापर रेखानुरूप में पूर्व दिशा में और पश्चिम दिशा में पृथक् कोटि को देनी चाहिए । दोनों कोटियों के अग्र बिन्दुओ से दोनो भुजों को दान देकर दिङ्मध्य (मध्य) बिन्दु मे भुजाग्र बिन्दुद्वय संसक्त दोनो कर्णों को दान देकर अपने-अपने भुजाग्र में अपने-अपने शंकु को देना, मध्य से अपने अपने शंकु के अग्र में लगी हुई पूर्व कल्पित यष्टि देनी चाहिए । मध्य बिन्दु में स्थापित नेत्र द्वारा अपने शकु के अग्र में पृथक् ग्रहों को दिखावें । योग (दो ग्रहों के योग) में उन दोनों के शकु का अन्तराभाव होता है । क्योंकि वहाँ शंकु भुजा आदि बराबर होते हैं । ग्रहयुति से भिन्न समय में उन दोनों के शकु का अन्तर होता ही है इति ॥-५७-६१ ॥

उपपत्ति ।

दो ग्रहों के बिम्ब केन्द्रान्तर रहने से उनके भुज, कोटि और कर्ण के आनयन प्रसिद्ध ही हैं । उन भुज, कोटि, कर्ण और शंकु को यष्टि व्यासार्ध मे परिणामन के लिए उनको यष्टि से गुणा कर त्रिज्या से भाग देना चाहिए । यष्टि व्यासार्ध में परिणत भुज, कोटि, कर्ण और शंकु के कथित संस्थान वश से गोलयुक्ति से शंकु के अग्र मे उन दोनों ग्रहों का दर्शन होता ही है । चन्द्रश्रृङ्गोन्नति अधिकार में भी इसी तरह भुज आदि के संस्थापनवश से

चन्द्रशृङ्गोन्नति के दर्शन प्रकार आचार्य कह चुके हैं। एवं ग्रह बिम्बो के सर्वतो भावेन योग में शंकु, भुज, कोटि, वर्णो का सर्वथा समत्व के कारण शकु का अग्रान्तरा भाव होता है, मध्यान्तर योग में शकु का अग्रान्तर दोनों ग्रहो का अन्तर होता है, ग्रहयुति से भिन्न समय मे भी ग्रह दर्शन विधि हो सकती है, सिद्धान्त शेखर में "ग्रहयुतौ विवरे सति मध्ययोः शशि-विषाणसमुन्नतिवत् पृथक्" से लेकर "शङ्क्वग्रयोरन्तरमन्तरंच द्युचारिणोर्ज्ञेयमिहान्य दापि" तक स. उपपत्ति में लिखित श्लोकों से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है। सूर्यसिद्धान्त में भी "पञ्चहस्तोच्छ्रितौ शकु" इत्यादि श्लोकों से युतिकाल में दो ग्रहों के दर्शन के लिए प्रकार कहा गया है जिसकी व्याख्या इसी अधिकार के ४४-४५ श्लोको की उपपत्ति में की गयी है. यह वही देखना चाहिए इति ॥५७-६१ ॥

इदानीमात्मगणितस्य प्रशंसामाह ।

नाचार्यो ज्ञातैरपि तन्त्रैरार्यभटविष्णुचन्द्राद्यैः ।
यो ब्राह्म धूलिकर्मविदाचार्यत्वं भवति तस्य ॥६२॥

सु. भा.—आर्यभटविष्णुचन्द्राद्यैस्तन्त्रैर्ज्ञातैरपि गणको ज्योतिषशास्त्रे आचार्यो न भवति । यो गणको ब्राह्मधूलिकर्मविद् ब्रह्मोक्तगणितवेत्ता तस्यैवाऽऽचार्यत्वं भवतीति स्फुटोऽर्थः ॥६२॥

वि. भा.—ज्ञातै (विदितैः) रप्यार्यभटविष्णुचन्द्राद्यैः (आर्यभटादिरचितैः) तन्त्रैर्गणको ज्योतिः शास्त्रे आचार्यो न भवति, यो गणको ब्राह्मधूलिकर्मवित् (ब्रह्मोक्त गणितज्ञः) तस्यैवाऽऽचार्यत्वं भवतीति ॥६२॥

अब अपने गणित की प्रशसा को कहते है ।

हि. भा.—आर्य भट, बिष्णु, चन्द्र आदि से रचित तन्त्रो को जान करके भी गणक ज्यौतिष शास्त्र में आचार्य नही होते है अर्थात् वे आचार्यत्व को नही प्राप्त करते है। जो गणक ब्रह्म कथित गणित को जानने वाले होते हैं। उन्ही को आचार्यत्व प्राप्त होता है इति ॥६२॥

इदानो ग्रहगतिज्ञस्य फलं वर्णयति ।

रविशशितमस्त्रिचरितं ब्रह्मोक्तं पुण्यमद्भुतं ज्ञात्वा ।
रविचन्द्रराहुलोकान् प्राप्नोति पुमानिह यशश्च ॥६३॥

सु० भा०—रवेः शशिनस्तमसो राहोरिति त्रिचरितम् । शेषं स्पष्टार्थम् ॥६३॥

योरन्तरं भवतीति । ग्रहदर्शनविधिर्ग्रहयुत्यतिरिक्तेऽपि समये भवितुमर्हति तुल्यन्यायादिति । सिद्धान्तशेखरे. "ग्रहयुतौ विवरे सति मध्ययो. शशिविषाग्ग-समुन्नतिवत् पृथक् । स्वनृतलाग्रकयोः सदृशाशयोर्युतिरथान्यदिशोर्वियुनिर्भुजौ. । दृग्ज्ये श्रुती श्रुतिभुजाकृतिभेदमूले कोटी नरश्रवणकोटिभुजाश्च हन्यात् । यष्ट्या भजेत् त्रिभगुणेन ततश्च कोटी पूर्वापरे निजभुजावथ कोटिकोटेः । दत्वा च मध्यात् श्रवसी भुजाग्रसक्ते स्वशंकू स्वभुजाग्रयोश्च । यष्टी च मध्यात् स्वनगाग्रसक्ते दृष्ट्याऽथ मध्यस्थितया प्रदृश्यौ । ग्रहौ स्वशङ्कवग्रगतौ जनस्य कुतूहलार्थं यदि वा नृपस्य । शङ्कवग्रयोरन्तरमन्तरं च द्युचारिणोर्ज्ञेयमिहान्यदापि" इति श्लोकैः श्रीपतिना सर्वमाचार्योक्तानुरूपमेवोक्तं । सूर्यसिद्धान्तेपि "पञ्चहस्तोच्छ्रितो शकु यथा दिग्भ्रम संस्थिता" वित्यादिभिः श्लोकैर्युतिकाले ग्रहयोर्दर्शनार्थं प्रकारोऽभिहितोस्ति यद् व्याख्यानं मयाऽस्यैवाधिकारस्य ४४-४५ श्लोकयोरुपपत्तौ प्रदर्शितमिति तत्रैवावलोकनीयमिति ॥ ५७-६१ ॥

अब ग्रहयुति में एक स्थित दृष्टि से ग्रहदर्शन के लिए कहते हैं ।

हि. भा.—यदि अन्य इष्ट घटी के साथ समेलन करते हे तब योग होता है । ग्रहयुति में दो ग्रहों के बिम्ब केन्द्रान्तर रहने से चन्द्रशृङ्गोन्नति की तरह एक दिशा मे अग्रा और शकुतल के योग करने से तथा भिन्न दिशा में अग्रा और शंकुतल के अन्तर करने से दोनों ग्रहों के भुज होते है । दोनों ग्रहो की दृग्ज्या कर्ण होती हैं, कर्ण (दृग्ज्या) और भुज के वर्गान्तर मूल ग्रहद्वय की कोटि होती है । इस तरह सिद्ध दोनो ग्रहों की कोटि, भुज कर्ण और शकु को कल्पित इष्ट यष्टि से गुणा कर त्रिज्या मे भाग देना चाहिए तब यष्टि-व्यासार्ध में परिणत कोटि, भुज, कर्ण और शकु होते हैं । यष्टि व्यासार्ध परिणत पूर्वापर रेखानुरूप मे पूर्व दिशा में और पश्चिम दिशा मे पृथक् कोटि को देनी चाहिए । दोनों कोटियों के अग्र बिन्दुओ से दोनो भुजो को दान देकर दिङ्मध्य (मध्य) बिन्दु मे भुजाग्र बिन्दुद्वय ससक्त दोनों कर्णो को दान देकर अपने-अपने भुजाग्र में अपने-अपने शंकु को देना, मध्य से अपने अपने शंकु के अग्र में लगी हुई पूर्व कल्पित यष्टि देनी चाहिए । मध्य बिन्दु मे स्थापित नेत्र द्वारा अपने शकु के अग्र में पृथक् ग्रहों को दिखावें । योग (दो ग्रहों के योग) में उन दोनों के शकु का अन्तराभाव होता है । क्योकि वहाँ शंकु भुजा आदि बराबर होते है । ग्रह युति से भिन्न समय मे उन दोनो के शकु का अन्तर होता ही है इति ॥-५७-६१ ॥

उपपत्ति ।

दो ग्रहों के बिम्ब केन्द्रान्तर रहने से उनके भुज, कोटि और कर्ण के आनयन प्रसिद्ध ही हैं । उन भुज, कोटि, कर्ण और शंकु को यष्टि व्यासार्ध में परिणामन के लिए उनको यष्टि से गुणा कर त्रिज्या से भाग देना चाहिए । यष्टि व्यासार्ध में परिणत भुज, कोटि, कर्ण और शंकु के कथित संस्थान वश से गोलयुक्ति से शंकु के अग्र में उन दोनों ग्रहों का दर्शन होता ही है । चन्द्रशृङ्गोन्नति अधिकार में भी इसी तरह भुज आदि के संस्थापनवश से

चन्द्रशृङ्गोन्नति के दर्शन प्रकार आचार्य कह चुके है। एव ग्रह बिम्बो के सर्वतो भावेन योग में शकु, भुज, कोटि, वर्णो का सर्वथा समत्व के कारण शकु का अग्रान्तरा भाव होता है, मध्यान्तर योग में शंकु का अग्रान्तर दोनों ग्रहों का अन्तर होता है, ग्रहयुति से भिन्न समय मे भी ग्रह दर्शन विधि हो सकती है, सिद्धान्त शेखर मे "ग्रहयुतौ विवरे सति मध्ययोः शशिविषाणसमुन्नतिवत् पृथक्" से लेकर "शङ्क्वग्रयोरन्तरमन्तरंच द्युचारिणोर्ज्ञेयमिहान्यदापि" तक स. उपपत्ति में लिखित श्लोकों से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है। सूर्यसिद्धान्त में भी "पञ्चहस्तोच्छ्रितौ शकु" इत्यादि श्लोको से युतिकाल में दो ग्रहों के दर्शन के लिए प्रकार कहा गया है जिसकी व्याख्या इसी अधिकार के ४४-४५ श्लोको की उपपत्ति में की गयी है. यह वही देखना चाहिए इति ।।५७-६१ ।।

इदानीमात्मगणितस्य प्रशंसामाह ।

नाचार्यो ज्ञातैरपि तन्त्रैरार्यभटविष्णुचन्द्राद्यैः ।
यो ब्राह्म धूलिकर्मविदाचार्यत्वं भवति तस्य ।।६२।।

सु. भा.—आर्यभटविष्णुचन्द्राद्यैस्तन्त्रैर्ज्ञातैरपि गणको ज्योतिषशास्त्रे आचार्यो न भवति । यो गणको ब्राह्मधूलिकर्मविद् ब्रह्मोक्तगणितवेत्ता तस्यैवाऽऽचार्यत्वं भवतीति स्फुटोऽर्थः ।।६२।।

वि. भा.— ज्ञातै (विदितैः) रप्यार्यभटविष्णुचन्द्राद्यैः (आर्यभटादिरचितै.) तन्त्रैर्गणको ज्योतिः शास्त्रे आचार्यो न भवति, यो गणको ब्राह्मधूलिकर्मवित् (ब्रह्मोक्त गणितज्ञः) तस्यैवाऽऽचार्यत्वं भवतीति ।।६२।।

अब अपने गणित की प्रशंसा को कहते है ।

हि. भा.—आर्य भट, बिष्णु, चन्द्र आदि से रचित तन्त्रों को जान करके भी गणक ज्यौतिष शास्त्र मे आचार्य नही होते है अर्थात् वे आचार्यत्व को नही प्राप्त करते है। जो गणक ब्रह्म कथित गणित को जानने वाले होते है। उन्ही को आचार्यत्व प्राप्त होता है इति ।।६२।।

इदानो ग्रहगतिज्ञस्य फलं वर्णयति।

रविशशितमस्त्रिचरितं ब्रह्मोक्तं पुण्यमद्भुतं ज्ञात्वा ।
रविचन्द्रराहुलोकान् प्राप्नोति पुमानिह यशश्च ।।६३।।

सु० भा०—रवेः शशिनस्तमसो राहोरिति त्रिचरितम् । शेषं स्पष्टार्थम् ।।६३।।

वि. भा.—ब्रह्मोक्तं (ब्रह्मगुप्तकथितं) अद्भुतं (आश्चर्यकरं) पुण्यं (पुण्य जनकं) रविशशितमसां (रविचन्द्र राहूणां) त्रयाणां चरित (पुराण वर्णनमेतेषां ग्रहणादिकारणम्) ज्ञात्वा पुमान् रविचन्द्रराहुलोकान् प्राप्नोति, इह (अस्मिन् लोके यशश्च प्राप्नोति ॥६३॥

अब ग्रहगतिवेत्ता के फल को कहते है ।

हि. भा.—ब्रह्मगुप्तकथित आश्चर्यकारक तथा पुण्योत्पादक रवि, चन्द्र, राहु इन तीनों के चरित (पुराणों में ग्रहण आदि से सम्बन्धित इन सबो के माहात्म्य वर्णन बहुत विस्तृत है इस के लिये पुराणों को देखना चाहिये) को जानकर मनुष्य सूर्यलोक, चन्द्र लोक, राहुलोक को पाते हैं, और इस लोक (भूर्लोक) मे यश को पाते है इति ॥६३॥

इदानीमन्यमतेनाप्यदृष्टफलमाह ।

अन्यैरप्युक्तमिदं योऽमुं सम्यग्ग्रहं विजानाति ।
याति स हि ग्रहलोकं ग्रहाष्टकज्ञः परं ब्रह्म ॥६४॥

सु० भा०—अन्यैराचार्यैरपीदमुक्तमदृष्टफलम् । ग्रहाष्टज्ञोऽष्टग्रहाणां रविचन्द्रकुजबुधगुरुशुक्रशनितमसां गतिज्ञः ।

तथा च भगवान् गर्गः ।

न संवत्सरपाठी च नरकेषूपपद्यते ।

ब्रह्मलोकप्रतिष्ठां च लभते दैवचिन्तकः इति ॥६४॥

वि. भा.—अन्यैराचार्यैरपि इदं (अदृष्टफलं) उक्तं (कथितम्) योऽमुं ग्रहं सम्यक् (शोभनरूपेण) विजानाति स ग्रहाष्टकज्ञः (अष्टग्रहाणां रविचन्द्रभौमबुधगुरुशुक्रशनिराहूणां गतिज्ञः) ग्रहलोकं याति (गच्छति) तथा परं (उत्कृष्टं) ब्रह्मलोकं यातीति, एतद्विषये चोक्तं वराहसंहितायाम् ।

न साम्वत्सरपाठाच्च नरकेषूपपद्यते । ब्रह्मलोकप्रतिष्ठां च लभतेदैव चिन्तकः । भगवता गर्गेणाप्येवमेवोक्तम् । वराहसंहितायामेव "ग्रन्थतश्चार्थतश्चैव कृत्स्नं जानाति यो द्विजः । अग्रभुक् स भवेच्छ्राद्धे पूजितः पङ्क्तिपावनः इति ॥६४॥

तब अन्य मत से भी अदृष्ट फल को कहते हैं ।

हि. भा.—अन्य आचार्य भी इस अदृष्ट फल को कहते हैं जो मनुष्य इस ग्रह को अच्छी तरह जानते हैं वह ग्रहलोक को पाते हैं तथा वह ग्रहाष्टकज्ञ (रवि, चन्द्र, भौम,

बुध, गुरु, शुक्र, शनि और राहु' इन आठों ग्रहों की गति को जानने वाला) परम उत्कृष्ट ब्रह्म लोक को पाता है। इस विषय में वराह संहिता में कहा गया है जैसे

'न साम्वत्सरपाठाच्च नरकेषूपपद्यते' इत्यादि सं. भाष्य मे लिखित श्लोक को देखिये, भगवान् गर्ग ने भी इसी तरह कहा है इति ॥६४॥

अथाध्यायनामानि ग्रन्थसंख्यां चाह।

मध्यगतिस्पष्टगतित्रिप्रश्नाश्चन्द्रभास्करग्रहणे ।
उदयास्तमयौ प्रतिघटिकमिन्दुश्रृङ्गोन्नतिच्छाये ॥६५॥

ग्रहयोगो भग्रहयुतिरार्या त्रिशती युताऽष्टसप्तत्या ।
अध्यायैर्दशभिर्धूलिकर्म दोषैर्विना ब्राह्मे ॥६६॥

सु० भा०—ब्राह्म सिद्धान्ते दशभिरध्यायैर्यद् धूलिकर्म गणितं तद्दोषैर्विना ऽस्तीति। शेषं स्पष्टार्थम्।

अत्र चतुर्वेदाचार्यः। 'यदि नामार्याणां त्रीणि शतानि पंचसप्ततियुतानि अस्माभिर्व्याख्यातानि दशसु मध्यगत्याद्येष्वध्यायेषु परास्तिस्रो ऽत्रार्या न पूर्यन्ते-ऽत्र श्रृङ्गोन्नत्यध्याये केचिद्विंशतिमार्याणां पठन्ति तथा समागमे षड्विंशतिं तथा च संख्या पूर्यते। बलभद्रस्यायं पाठः "आर्या त्रिशती युताष्ट सप्तत्या" इति ॥

एतेन ब्रह्मसिद्धान्तोपरि बलभद्रस्यापि टीका वर्त्तत इत्यनुमीयते।

अत्रोपलब्धपुस्तकानुसारेण। 

मध्यमाध्याये	=	६३	
स्पष्टाध्याये	=	६७	(योगसाधनश्लोकं हित्वा)
त्रिप्रश्ने	=	६६	
चन्द्रग्रहणे	=	२०	
सूर्यग्रहणे	=	२७	
उदयास्तयोः	=	१३	
श्रृंगोन्नतौ	=	१८	
चन्द्रछायाधिकारे	=	९	
ग्रहयुत्यधिकारे	=	२६	(मद्विरचितमध्यबिम्बकलापाठ श्लोकं गृहीत्वा)
भग्रहयुतौ	=	६६	(उपरिलिखितार्या पर्यन्तम्)
आर्यायुतिः	=	३७५	

उपरिलिखिताध्यायश्लोकसंख्याऽध्यायोपसंहारश्लोकसंख्या महिना । अतः सूर्यग्रहणाधिकारे उपसंहारश्लोके 'षड्विंशत्या' इत्यत्र 'नगविंशत्या' तथोदयास्ताधिकारोपसंहारे 'द्वादशभिः' इत्यत्र त्रयोदशवाचिपदमुचितम् । चतुर्वेदाचार्यलिखितानुसारेण ग्रहसमागमे २५ श्लोकाः । अतो मद्विरचितो नोपयुक्तः श्लोकः। एवमत्र योगसाधनश्लोकं गृहीत्वा स्पष्टगतौ ६८ संख्या भवेत् तदा सर्वयुतिः ३७५ । एवं चेत् ग्रहयुत्युपसंहारे षड्विंशतिस्थाने पञ्चविंशतिवाचिपदमुचितमिति सर्व धीमद्भिर्भृशं विचिन्त्यम् ।

उदयास्ताधिकारे २५, स्पष्टाधिकारे ६७, अस्याधिकारस्योपसंहारपर्यन्तं ७० गृहीत्वा यदि युतिः क्रियते तदा ३७८ इयं युतिरायातीति ॥६५-६६॥

वि. भा.—मध्यगतिस्पष्टगतित्रिप्रश्नाः (मध्यमाधिकार-स्पष्टाधिकार-त्रिप्रश्नाधिकाराः) चन्द्रभास्करग्रहणे (चन्द्रग्रहणाधिकारसूर्यग्रहणाधिकारौ) प्रतिघटिकमुदयास्तमयौ (उदयास्ताधिकारः) इन्दुशृङ्गोन्नतिच्छाये (चन्द्रशृङ्गोन्नत्यधिकारच्छायाधिकारौ) ग्रहयोगो (ग्रहयुत्यधिकारः) भग्रहयुतिः (भग्रहयुत्यधिकारः) आर्याणां त्रिशत्या युताष्टसप्तत्याऽर्थात् ३७८ आर्याभिर्ब्राह्मे सिद्धान्ते उपर्युक्त दशभिरध्यायै र्यद् धूलिकर्म (गणित) तद्दोषैर्विनाऽस्तीति ।

अत्र चतुर्वेदाचार्यः 'यदि नामार्याणां त्रीणि शतानि पञ्चसप्ततियुतानि-अस्माभिर्व्याख्यातानि दशसु मध्यगत्याद्येष्वध्यायेषु परास्तिस्रोऽत्रार्या न पूर्यन्तेऽत्र शृङ्गोन्नत्यध्याये केचिद्विंशतिमार्याणां पठन्ति, तथा समागमे षड्विंशति तथा च संख्या पूर्यते । बलभद्रस्यायं पाठः 'आर्यात्रिशतीयुताष्टसप्तत्या' इति ॥

एतेन ब्रह्मसिद्धान्तोपरि बलभद्रस्यापि टीका वर्त्तत इत्यनुमीयते ।

अत्रोपलब्ध पुस्तकानुसारेण

	आर्या संख्याः
मध्यगतौ	= ६३
स्पष्टगतौ	= ६७ (योग साधन श्लोकं विहाय)
त्रिप्रश्ने	= ६६
चन्द्रग्रहणे	= २०
सूर्यग्रहणे	= २७
उदयास्ताधिकारे	= १३
चन्द्रशृङ्गोन्नतौ	= १८
चन्द्रच्छायाधिकारे	= ९
ग्रहयुत्यधिकारे	= २६ (अत्रैकः श्लोकः सुधाकरद्विवेदिरचितोऽस्ति)
भग्रहयुतौ	= ६६ (उपरिलिखितार्या पर्यन्तम्)

सर्वेषां योगः=३७५=आर्यायुतिः=उपरिलिखिताध्यायश्लोक संख्या+अध्यायोपसंहारश्लोकसंख्या, अतः सूर्यग्रहणाधिकारे उपसंहारश्लोके षड्विंशत्याः स्थाने नवविंशत्या, तथोदयास्ताधिकारोपसंहारे द्वादशभिरित्यत्र त्रयोदशवाचिपदमुचितम् । चतुर्वेदाचार्यलिखितानुसारेण ग्रहसमागमे २५ श्लोकाः । एवमत्र योगसाधनश्लोकं गृहीत्वा स्पष्टगतौ ६८ तदा सर्वयुतिः = ३७५ एवं चेत्तदा ग्रहयुत्युपसंहारे षड्विंशतिस्थाने पंचविंशति वाचिपदमुचितमिति सर्वे विवेचकैर्विवेचनीयम् ।

उदयास्ताधिकारे २५, स्पष्टाधिकार ६७ अस्याधिकारस्योपसंहारपर्यन्तं ७० गृहीत्वा यदि युतिः क्रियते तदा ३७८ समायातीति । पूर्वोक्ताऽऽर्या द्वयोक्त्या दशाध्यायात्मको ग्रहगणिताख्यखण्डेन विभक्तो ग्रन्थकर्त्रैवोपसंहृतोऽप्यस्ति, अत्र पाताधिकारो नास्ति स चोत्तरखण्डे स्पष्टगत्युत्तराध्याये निरूपित. । तत्स्थाने चन्द्रच्छायाधिकारोऽस्ति, सिद्धान्तशेखरे श्रीपतिने "मध्यस्पष्टगती प्रपंचबहुले त्रिप्रश्नसंज्ञस्ततश्चन्द्रार्कग्रहणे सपात उदयास्ताख्योऽथशृङ्गोन्नतिः । योगः खेचरयोरुडुग्रहयुतिस्त त्कालतन्त्रं मया कृत्स्नं शिष्यजनस्य कीर्त्तितमिदं सन्देह विच्छित्तये" ऽप्यनेन मध्यगत्यध्यायः, स्पष्टगत्यध्यायः, त्रिप्रश्नाध्यायः, चन्द्रग्रहणाध्यायः, सूर्यग्रहणाध्यायः, पाताध्यायः, ग्रहोदयास्ताध्यायः, चन्द्रशृङ्गोन्नत्यध्यायः । ग्रहयोगाध्यायः, भग्रहयोगाध्यायः" । त्रिदशभिरध्यायैः, कालतन्त्रं (पूर्वाचार्योक्तं ग्रहगणिततन्त्रम्) कथितमस्ति, यद्यप्यध्यायगणनया श्रीपत्युक्तमिदं कालतन्त्रं ग्रहगणितं वा द्वादशध्यायात्मकं तथापि 'मध्यस्पष्टगतौ' इत्याद्युक्त्या दशैवाध्यायनामानि लिखितानि, तेन ग्रहभगणाध्यायो मध्यमाध्यायान्तर्गतः । पर्वसम्भवाध्यायश्च चन्द्रसूर्यग्रहणाध्यायान्तर्गत एव सिद्धयति । श्रीपतिना चन्द्रच्छायाधिकारनिरूपितो विषयोऽपि चन्द्रशृङ्गोन्नत्यध्याये एव निरूपितः । अत एव चन्द्रशृङ्गोन्नत्यध्यायश्चन्द्राध्याय इति नाम्नैवोच्यते । एवमाचार्यो (ब्रह्मगुप्त) क्तवद्दशाध्यायविभक्तं प्रथमखण्डं सिद्धान्तशेखरस्य ग्रहगणिततन्त्रं कालतन्त्रं वा श्रीपतिना कथ्यते, लल्लाचार्येण शिष्यधीवृद्धिदतन्त्रस्याप्येकं खण्डं अष्टाभिरेवाध्यायै विभज्य "आदौ व्योमगतिस्ततः स्फुटगतिस्त्रिप्रश्नचन्द्रग्रहावादित्यग्रहपौर्णमासकरणं चन्द्रोदयः संयुतिः । एवं तन्त्रमिहाष्टधा स्थितमिदं यो वेति सम्यग्ग्रहं तं दैवज्ञमिति ब्रुवन्ति गणकाः शेषाः कुसांवत्सराः । एवमुपसंहृतम् । सूर्यसिद्धान्तकारेणापि "मध्यमाधिकारः । स्पष्टाधिकारः । त्रिप्रश्नाधिकारः चन्द्रग्रहणाधिकारः । सूर्यग्रहणाधिकारः । छेद्यकाधिकारः । ग्रहयुत्यधिकारः । नक्षत्रग्रहयुत्यधिकारः । उदयास्ताधिकारः । चन्द्रशृङ्गोन्नत्यधिकारः । पाताधिकारः ।" इत्येकादशभिरधिकारैः पूर्वार्धभागः सूर्यसिद्धान्तस्योपनिवद्धोऽस्तिः, अत्रच्छेद्यकाधिकारश्चन्द्रसूर्यग्रहणयोः परिलेखरूप एव तेन वस्तुतस्तात्त्विकदृष्ट्या विचारेणात्रापि दशभिरेवाधि-

कारैः पूर्वार्धभागोऽलंकृतोऽस्ति, भास्कराचार्येणाप्येकं खण्डमेवमेव समाप्य गोला-ध्याय नामकमपर खण्डं मङ्गलाचरण द्वारा समारब्धमिति ॥६५-६६॥

अब अध्यायों के नाम और ग्रन्थ सख्या को कहते हे

हि.भा.—मध्यगति (मध्यमाधिकार), स्पष्टगति (स्पष्टाधिकार) त्रिप्रश्नाधिकार, चन्द्रग्रहणाधिकार, सूर्यग्रहणाधिकार, उदयास्ताधिकार, चन्द्रशृङ्गोन्नत्यधिकार, चन्द्रच्छायाधि कार, ग्रहयुत्यधिकार, भग्रहयुत्यधिकार, इन दश अध्यायों में ब्राह्मसिद्धान्त में तीन सौ अठहतर ३७८ आर्याश्लोको से जो धूलिकर्म (गणित) है वह दोष रहित है अर्थात् समीचान है, यहा चतुर्वेदाचार्य कहते हैं कि मध्यगति (मध्यमाधिकार) आदि दश अध्यायो मे तीन सौ पचहत्तर आर्याओ की मैने जो व्याख्या की है उनमे अवशिष्ट तीन की पूर्ति नही होती है यहा कोई कोई शृङ्गोन्नत्यध्याय मे बीस आर्याओ को कहते है तथा समागम (ग्रहयुत्यधिकार) मे छब्बीस कहते हैं इस तरह सख्या पूरी हो जाती है । 'आर्यात्रिशती युताष्ट सप्तत्या' यह बलभद्र का पाठ है ।

इससे अनुमान किया जाता है कि ब्रह्म सिद्धान्त के ऊपर बलभद्र की भी टीका है ।

यहां प्राप्त पुस्तक के अनुसार—

मध्यगति में	=	६३ आर्या की संख्या
स्पष्टगतिमें	=	६७ (योग साधन श्लोक को छोड कर)
त्रिप्रश्न में	=	६६
चन्द्रग्रहण में	=	२०
सूर्यग्रहण में	=	२७
उदयास्ताधिकार में	=	१३
चन्द्रशृङ्गोन्नति में	=	१८
चन्द्रच्छायाधिकार मे	=	९
ग्रहयुत्यधिकार में	=	२६ (इस में १ श्लोक बिम्बकला पाठ प० सुधाकर द्विवेदी रचित को लेकर है)
भग्रहयुति में	=	६६ (इस अध्याय के ६६ वर्त्तमान आर्या पर्यन्त)
		३७५=आर्यायुति

ऊपर लिखित अध्याय श्लोक संख्या+अध्यायोपसंहार श्लोक संख्या=३७५, इस लिये सूर्यग्रहणाधिकार में उपसंहार श्लोक में छब्बीस के स्थान में सत्ताइस, तथा उदयास्ता-धिकार के उपसंहार में 'द्वादशभिः' यहां त्रयोदश (तेरह) वाचक पद उचित हैं, चतुर्वेदा-चार्य लिखितानुसार ग्रहसमागम (ग्रहयुत्यधिकार) में २५ श्लोक, तथा योगसाधन श्लोक

को लेकर स्पष्टगति में ६८ तब सबों के योग=३८५, यदि ऐसा है तब ग्रहयुत्यधिकार के उपसंहार में 'षड्विंशति=२६' स्थान में 'पंचविंशति=२५' वाचक पद उचित है इन बातों पर विवेचक लोग विचार करें। उदयास्ताधिकार में २५, स्पष्टाधिकार में ६७, इस अधिकार के उपसंहार पर्यन्त ७० लेकर यदि योग करते है तो ३७८ आते है। ६५-६६ इन दोनों आर्याओं से मालूम होता है कि दश अध्याय वाला ग्रहगणित नाम का यह पहला खण्ड है। इस में पाताधिकार नही है, वह उत्तर खण्ड (द्वितीय खण्ड) में स्पष्टगत्युत्तराध्याय में निरूपित है। उसके स्थान में प्रथम खण्ड में चन्द्रछायाधिकार है सिद्धान्त शेखर में श्रीपति ने "मध्य स्पष्टगती प्रपंचबहुले त्रिप्रश्नसंज्ञस्ततः" इत्यादि सं भाष्य मे लिखित श्लोक से मध्यगति अध्याय, स्पष्टगति अध्याय, त्रिप्रश्न अध्याय, चन्द्रग्रहण अध्याय, सूर्यग्रहण अध्याय, पात अध्याय, ग्रहोदयास्त अध्याय, चन्द्रशृङ्गोन्नति अध्याय, ग्रहयोग अध्याय. भग्रहयोग अध्याय, इन दशों अध्यायों से कालतन्त्र (पूर्वाचार्योक्त ग्रहगणित तन्त्र) को कहा हैं। यद्यपि अध्यायों की गणना से श्रीपति कथित यह कालतन्त्र वा ग्रहगणित बारह अध्याय वाला है तथापि "मध्य स्पष्टगती" इत्यादि उक्ति से दश अध्यायों के ही नाम लिखे है इसलिये ग्रहभगणाध्याय मध्यमाध्याय के अन्तर्गत तथा पर्व सम्भवाध्याय, चन्द्रग्रहणाध्याय और सूर्यग्रहणाध्याय के अन्तर्गत ही सिद्ध होता है, श्रीपति ने चन्द्राच्छायाधिकार में निरूपित विषयों को भी चन्द्रशृङ्गोन्नत्यध्याय ही में निरूपण किया है इसलिये चन्द्रशृङ्गोन्नत्यध्याय, चन्द्राध्याय के नाम ही से कहा गया है। इस तरह आचार्योक्त (ब्रह्मगुप्त) वत् दश अध्यायों में विभक्त (बटे हुए) प्रथम खण्ड को सिद्धान्त शेखर् के प्रथम खण्ड को ग्रहगणित तन्त्र वा कालतन्त्र श्रीपति कहते हैं। लल्लाचार्य अपने शिष्य धीवृद्धिदतन्त्र के एक खण्ड को आठ अध्यायों में विभक्त कर "आदौ व्योमगतिस्ततः स्फुटगतिस्त्रिप्रश्न-चन्द्रग्रहावादित्यग्रहपौर्णमासकरणं" इत्यादि सं. भाष्य में लिखित श्लोक से उपसंहार किया है। सूर्यसिद्धान्तकार ने भी "मध्यमाधिकार, स्पष्टाधिकार, त्रिप्रश्नाधिकार, चन्द्र ग्रहणाधिकार, सूर्यग्रहणाधिकार, छेद्यकाधिकार, नक्षत्र ग्रहयुत्यधिकार, उदयास्ताधिकार चन्द्रशृङ्गोन्नत्यधिकार, पाताधिकार, इन ग्यारह अधिकारों से सूर्य सिद्धान्त के पूर्वार्ध भाग को उपनिबद्ध किया है। इसमें छेद्यकाधिकार जो है सो चन्द्रग्रहण और सूर्यग्रहण के परिलेख रूप ही है, इसलिये तात्त्विक दृष्टि से बिचार करने से यहां भी दस ही अधिकारों से पूर्वार्धभाग अलंकृत है यह सिद्ध होता है, भास्कराचार्य ने भी एक खण्ड को इसी तरह समाप्त कर गोलाध्याय नाम के दूसरे खण्ड को मङ्गलाचरण द्वारा आरम्भ किया है इति ॥६५-६६॥

इदानीमिदं (गणितं) पिशुनाय न देयमित्याह।

गुरुणा न धूलिकर्म प्रतिकंचुककारिणे प्रदातव्यम्।
तस्य सुकृतप्रणाशः कुरुते प्रतिकञ्चुकं योऽस्य ॥६७॥

सु० भा०—गुरुणा महानुभावेन ज्योतिःशास्त्रविदा पुरुषेणेदं धूलिकर्म

गणितं प्रतिकंचुककारिणे पिशुनाय न प्रदातव्यम् । योऽस्य शास्त्रस्य प्रतिकचुक निन्दां कुरुते तस्य सुकृतप्रणाशो भवतीति ॥६७॥

वि. भा.—गुरुणा (ज्योतिःशास्त्रविदा महानुभावेन) इदं धूलिकर्म (गणित) प्रतिकचुककारिणे (पिशुनाय) न प्रदातव्यम् (न देयम्) योऽस्य शास्त्रस्य गणितस्य वा प्रतिकचुकं (निन्दां) कुरुते तस्य सुकृतप्रणाशः (सुकृतक्षय) भवतीति। सूर्यसिद्धान्तकारेणापि सूर्यसिद्धान्तपूर्वार्धान्ते पाताधिकारान्तेऽधिकारोपसहारे 'इत्येतत्परमं पुण्यं ज्योतिषां चरितं हितम् । रहस्य महदाख्यानमि' त्यनेन गणितस्य (ज्योतिः शास्त्रस्य) पुण्यजनकत्वं रहस्यत्व च कथितम् ॥६७॥

'अब इस धूलिकर्म (गणित) को पिशुन (चुगलखोर) के लिये नहीं देना चाहिये ।'

इसको कहते है ।

हि. भा.—गुरु (ज्योतिः शास्त्र विशारद महानुभाव) इस धूलिकर्म (गणित) को पिशुन (चुगलखोर) के लिये नहीं दे । जो इस शास्त्र (ज्योतिःशास्त्र) की निन्दा करता है उसका सुकृत (पुण्य आदि सुन्दर कार्य) नष्ट होता है, सूर्यसिद्धान्तकार भी सूर्य सिद्धान्त के पूर्वार्धभाग के अन्त मे पाताधिकार के उप सहार में 'इत्येतत्परमं पुण्यं ज्योतिषां चरित महत् । रहस्य महदाख्यातं' इस से इस ज्योतिः शास्त्र (गणित) का पुण्य जनकत्व और रहस्यत्व कहा है इति ॥६७॥

इदानीं स्वप्रशंसामाह ।

ग्रहमेलके यदुक्तं तत् स्थूलं स्पष्टमिह यदुक्तं तत् ।
ग्रहभमुनीन्दुच्छाया शृङ्गोन्नतिर्भग्रहाद्येषु ॥ ६८ ॥

सूर्यास्तमयादिष्टाद्रात्रिगता दृष्टभोदयास्तमयौ ।
जानाति न कश्चिदपि ब्राह्मोक्तादन्यतन्त्रज्ञः॥ ६९ ॥

सु० भा०—स्पष्टार्थमार्याद्वयम् ॥६८-६९॥

वि. भा.—ग्रहमेलके (ग्रहयुत्यधिकारे) यद् ग्रहशरादिसाधनमुक्तं तत्स्थूलम् । इह (भग्रहयुयुतौ) ग्रहनक्षत्रागस्त्यचन्द्रच्छायानयनशृङ्गोन्नतिसाधननक्षत्रग्रहयुत्यादिसाधनेषु यत्कथितमस्ति तत् स्पष्टम् (सूक्ष्मम्) सूर्यास्तमयात्कालादिष्टाद्रात्रिगताद्वा कश्चिदपि ब्रह्मोक्ततन्त्रादन्याचार्य (आर्यभटादि) रचित तन्त्रवेत्ता भोदयास्तमयौ (नक्षत्रस्योदयास्तकालौ) न जानात्यर्थाद् ब्रह्मोक्ततन्त्रज्ञ एव जानात्येतावताऽऽचार्यः (ब्रह्मगुप्तः) स्वोत्कर्षतां प्रकटयतीति ॥ ६८-६९ ॥

अब अपनी प्रशंसा को कहते है ।

हि. भा.—ग्रहयुत्यधिकार मे ग्रह के जो शर आदि के साधन कहे गये है वे स्थूल हैं, इस भग्रहयुत्यधिकार में ग्रह नक्षत्र अगस्त्य और चन्द्र, इन सवो के छायानयन, शृङ्गोन्नति साधन, नक्षत्र ग्रह की युति आदि साधनों में जो कहे गये है वे सूक्ष्म है, सूर्य के अस्तमय समय से वा इष्ट रात्रि गत काल से कोई भी ब्रह्मोक्त तत्र से अन्य तन्त्र (आर्यभटादिरचित तन्त्र) का वेत्ता (समझ ने वाला) नक्षत्र के उदय और अस्तमय को नहीं जानता है अर्थात् ब्रह्मोक्त तन्त्रज्ञ ही जानता है इससे आचार्य (ब्रह्मगुप्त) अपनी उत्कर्षता को प्रकाशित करते है इति ।।६८-६९।।

इदानीमधिकारोपसंहारमाह ।

भमुनिग्रहविक्षेपग्रहोदयास्तमयनाडिकाद्येषु ।
अध्यायो भग्रहयुतिरार्याणां सप्ततिर्दशमः ।।७०।।

सु० भा०—स्पष्टार्थम् ।।७०।।

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते ।
हृदि तं विनिधाय नूतनोऽयं रचितो भग्रहयोः सुधाकरेण ।।

इति श्रीकृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्तनूतनतिलके भग्रहयुत्यधिकारो दशमः ।।१०।।

वि. भा.—भानि (नक्षत्राणि) मुनिरगस्त्यः ग्रहा (भौमाद्याः) एतेषां विक्षेप (शर) साधनम् । ग्रहाणामुदयास्तमयघटचादिसाधनम् । एषु आर्याणां सप्ततिः—भग्रहयुतिर्नाम दशमोऽध्यायो गत इति ।।७०।।

इति श्री ब्राह्मस्फुट सिद्धान्ते भग्रहयुत्यधिकारो दशमः ।।१०।।

सम्पूर्णा पूर्वा दशाध्यायी

अब अधिकार के उपसंहार को कहते है ।

हि. भा.—नक्षत्र, मुनि (अगस्त्य), ग्रह (भौमादि) इन सबों के विक्षेप साधन, ग्रहों की उदय घटी और अस्तघटी आदि के साधनों में सत्तर आर्याओं से भग्रहयुति नाम का दशवां अध्याय समाप्त हुआ इति ।।६०।।

इति श्रीब्रह्मगुप्त विरचित ब्राह्मस्फुट सिद्धान्त में भग्रह युति नाम का दशम अधिकार समाप्त ।।१०।।

पूर्व दशाध्यायी सम्पूर्ण हुई, इति शुभमस्तु ।।

ब्राह्मस्फुटसिद्धान्तः

अथ तन्त्रपरीक्षाध्यायः

ब्राह्मस्फुटसिद्धान्तः

अथ तन्त्रपरीक्षाध्यायः

तत्र तावदन्येषां दोषान् वक्ष्यामीत्याह ।

ये ऽज्ञान पटलरुद्धदृशो ऽन्यं ब्राह्माद् वदन्ति सिद्धान्तम् ।
तेषां युगादिभेदे ये दोषास्तान् प्रवक्ष्यामि ॥ १ ॥

सु. भा.—अज्ञानपटलेनाज्ञानावरणेन रुद्धे दृशौ येषां ते। शेषं स्पष्टार्थम् ॥१॥

वि. भा.—ये अज्ञानपटलरुद्धदृशः (अज्ञानपटलेनाज्ञानाऽऽवरणेन रुद्धे दृशौ येषां ते) ब्राह्मात् (ब्राह्मसिद्धान्तात्) अन्यं (भिन्नं) सिद्धान्तं वदन्ति, तेषामज्ञानपटलरूद्धदृशां युगादिभेदे ये दोषाः सन्ति तानहं प्रवक्ष्यामीति ॥ १ ॥

अब तन्त्र परीक्षाध्याय आरम्भ किया जाता है ।

उसमें पहले अन्यों के दोषों को कहना है, उन्हीं को कहते हैं ।

हि. भा.—अज्ञानरूप पर्दे से रुकी हुई दृष्टि वाले लोग ब्राह्म सिद्धान्त से कुछ भिन्न बातें कहते है उन लोगो के युग आदि भेद में जो दोष है उनको मै कहता हूं इति ॥१॥

इदानीं संहिताकारमतं खण्डयति ।

युगमाहुः पञ्चाब्दं रविशशिनोः संहिताङ्गकारा यत् ।
अधिमासावमरात्रस्फुटतिथ्यज्ञानतस्तदसत् ॥ २ ॥

सु० भा०—संहिताङ्ककारा लगधादयः । तेषां मते अधिमासानामवमरात्राणामूनाहानां स्फुटतिथीनां च ज्ञानं न भवति। अतस्तदज्ञानतस्तन्मतमसत् । संप्रति यो ग्रन्थो लगधकृतो ज्योतिषवेदाङ्गनाम्ना प्रसिद्धस्तत्रैवं युगं पंचाब्दमित्यादि सर्वं स्थूलं विलिखितमस्ति । आचार्यमते तदेव संहिताकारमतं वराहमिहिरमते च तदेव पितामहमतम् । तत्र त्रिंशद्भिः सौरमासैरेकोऽधिमास इत्यादि सर्वं स्थूलं लिखितमस्ति तदर्थं पंचसिद्धान्तिका विलोक्या ॥ २ ॥

वि. भा.—संहिताङ्ककाराः (लगधादयः) अधिमासावमरात्रस्फुटतिथ्यज्ञानतः (अधिमासानां क्षयाहानांस्फुटतिथीनां चाज्ञानात्) पञ्चाब्द (पञ्चवर्षमित) युगं यत्प्राहुस्तदसत् (शोभनं न) अर्थाल्लगधमतेनाधिमासानां क्षयाहानां स्फुटतिथीनां ज्ञानं न भवत्यतस्तदज्ञानात्तन्मतं शोभनं न, तथा पञ्चाब्दं युगमपि तन्मतीयं शोभनं नास्ति, सम्प्रति 'ज्यौतिष वेदाङ्ग' नाम्ना प्रसिद्धो ग्रन्थो लगधकृतो दृग्गोचरी भूतो भवति तत्रैव युगं पञ्चाब्दमित्यादिसर्वं स्थूलं विलिखितमस्ति। आचार्यमतेन तदेव संहिताकारमतं वराहमिहिरमतेन तदेव पितामहमतम्। तत्र त्रिंशद्भिः सौरमासैरेको ऽधिमास इत्यादि सर्वं स्थूलं लिखितमस्ति। सूर्यसिद्धान्ते "तद्द्वादश सहस्राणि चतुर्युगमुदाहृतम्। सूर्याब्दसंख्यया द्वित्रिसागरैरयुताहतैः॥ सन्ध्यासन्ध्यांशसहितं विज्ञेयं तच्चतुर्युगम्। कृतादीनां व्यवस्थेयं धर्मपादव्यवस्थया" ऽनेन दिव्यवर्षाणां द्वादश सहस्राणि स्मृतिकारकथितं (चतुर्णां युगानां युगचरणानां कृतत्रेताद्वापरकलिसंज्ञानां समाहारः) महायुगं कथितमस्ति, सन्ध्यांसन्ध्यांशसहितं तच्चतुर्युगं (महायुग) दशसहस्रगुणितैर्द्वित्रिसागरैः ४३२०००० सौरवर्षैर्भवति। तत्रैवाग्रे कथ्यते यत् "युगस्य दशमो भागश्चतुस्त्रिद्व्येकसङ्गुणः। क्रमात्कृतयुगादीनां षष्ठांशः सन्ध्ययोः स्वकः" यथा दिव्यचतुर्युगमानस्य १२००० दशमांशः=१२००, चतुर्गुणितस्तदा कृतम्=१२००×४ =४८०० स एव (दशमांश) त्रिगुणितस्तदा त्रेता=१२००×३=३६००, एवं द्वापर=१२००×२=२४००, कलिः=१२०० इदं कृतादिमानं मनूक्ताद् भिन्नं कुतस्तदर्थं 'षष्ठांशः सन्ध्ययोः स्वकः' कथ्यते। यथा कृतमानम्=४८०० अस्य षष्ठांशः=८००=सन्ध्ययोर्मानम्। एतदर्धम्=४००=कृतयुगादौ सन्ध्या, कृतयुगान्तेऽपि सन्ध्या,=४०० एवं सन्ध्याभ्यां रहितं कृतयुगमानं ४८००−८००=४००० मनुस्मृत्युक्तमेव समागतम्। एवं सन्ध्याभ्यां रहितं सूर्यसिद्धान्तयुगमानं शुद्धं मनूक्तसमं युगमानं भवतीति। सूर्यसिद्धान्तादिज्यौतिषसिद्धान्तोक्तयुग वर्षेभ्यो मनुस्मृत्युक्त वर्षेभ्यश्च युगं पञ्चाब्दमिति संहिताकारोक्तयुगवर्षमानं भिन्नमस्त्यतस्तन्मतं न समीचीनम्। तथा 'चान्द्रोनसौरेणहृतात्तु चान्द्रादवाप्तसौरैर्दशनैर्दलाढ्यै ३२।१६' रित्यादि सिद्धान्तशिरोमणौ भास्करोक्तेन 'द्वात्रिंशद्भिर्गतैर्मासैर्दिनैः षोड़शभिस्तथा। घटिकानां चतुष्केन पतत्येकोऽधिमासकः' इति युक्तिसिद्धवचनेनान्यसिद्धान्तीयतत्पोषकवचनेभ्यश्च सिद्धमस्ति यत् ३२ सौरमासैः १६ दिनैश्चैकोऽधिमासपातो भवति, परन्तु लगधमतेन त्रिंशद्भिः सौरमासैरेकोऽधिमासो भवत्यतो युक्तिविरुद्धत्वात्तन्मतं न शोभनमिति विज्ञैर्विवेचनीयम्॥

अब संहिताकार के मत का खण्डन करते हैं।

हि. भा.—संहिताङ्ककार (लगध आदि) ने अधिमास, क्षयाह और स्फुटतिथियों के अज्ञान के कारण रवि और चन्द्र के सम्बन्ध से जो उनका साधन किया है सो ठीक नहीं है, तथा

पाच वर्ष का युग होता है यह जो कहा है सो भी ठीक नही है, इस समय लगधकृत ज्यौतिष-वेदाङ्ग नामक प्रसिद्ध ग्रन्थ देखने में आता है, उसी में पांच वर्ष का युग होता है इत्यादि सब विषय स्थूल लिखा हुआ है, आचार्य के मत से वही सहिताकार मत है तथा वराहमिहिर के मत से वही पितामह मत है। उस ग्रन्थ में तीस सौर मासों मे एक अधिमास होता है इत्यादि सब बाते लिखित हैं, सूर्य सिद्धान्त में "तद्द्वादश सहस्राणि चतुर्युगमुदाहृतम्" इत्यादि सं० भाष्य में लिखित श्लोक से स्मृतिकार कथित बारह हजार दिव्य वर्षो के चतुर्युग (चारो युगचरण कृत, त्रेता, द्वापर, कलि संज्ञकों के योग रूप महायुग) कथित है। सध्या और सन्ध्यांश सहित व चतुर्युग (महायुग) ४३२०००० सौर वर्षो का होता है उसी मे आगे कहते है कि "युगस्य दशमो भागश्चतुस्त्रिद्वयेक सङ्गुणः" इत्यादि स. भाष्य में लिखित श्लोक से यथा दिव्यचतुर्युग मान १२००० के दशम भाग १२०० चार से गुणने से कृत युग चरण =४८००, उसी दशमांश को तीन से गुणने से त्रेता युग चरण=१२००×३=३६००, उसी को दो से गुणने से द्वापर युगचरण=२४०० उसी को एक से गुणने से कलियुगचरण =१२००, ये कृतादियों के मान मनुस्मृति कथित मान से भिन्न क्यों है इसके लिये "षष्ठांश. सन्ध्ययोः स्वकः" कहते हैं, यथा कृतयुगचरण=४८०० इसका षष्ठांश ८००=यह दोनो सन्ध्याओं के मान है, इसका आधा=४००=कृतयुगादि में सन्ध्या, कृतयुगान्त मे भी सन्ध्या=४०० एव दोनों सन्ध्याओं से रहित कृतयुगमान=४८००—८००=४०००= मनुस्मृत्युक्तमान, इसी तरह दोनों सन्ध्याओं से रहित सूर्य सिद्धान्तीय युगमान शुद्ध मनुस्मृत्युक्त युगमान होता है, सूर्यसिद्धान्त आदि ज्यौतिष सिद्धान्त ग्रन्थोक्त युगवर्षो से भी "युग पञ्चाब्द" यह सहिताङ्गकारोक्त युगवर्ष मान भिन्न है इसलिये उनके मत ठीक नहीं है, तथा 'चान्द्रोनसौरेण हृतात्तु चान्द्रात्' इत्यादि सिद्धान्त शिरोमणि में भास्कराचार्योक्त से तथा 'द्वात्रिंशद्भिर्गतैर्मासैर्दिनैः षोडशभिस्तथा' इस युक्ति सिद्ध वचन से तथा उसके पोषक अन्य सिद्धान्तीय वचनों से सिद्ध है कि बत्तीस ३२ सौरमास तथा १६ सोलह दिनो में एक अधि-मासपात होता है परन्तु लगध के मत से तीस सौर मासों में एक अधिमास होता है इसलिये युक्ति विरुद्ध होने के कारण उनके मत ठीक नहीं हैं इसको विज्ञ लोग समझें इति ॥ २ ॥

इदानीं 'दो चन्दा दो सज्जा' इत्यादि जैनमतं खण्डयति ।

भानि चतुष्पञ्चाशत् द्वौ द्वा वर्केन्दवौ जिनोक्तं यत् ।
ध्रुवमत्स्यस्यावर्त्तो भवति यतोऽह्ना ततस्तदसत् ॥ ३ ॥

सु० भा०—स्पष्टार्थम् । 'किं गण्यं तव वैगुण्यं द्वैगुण्यं यो वृथाऽकृथाः' इत्यादि भास्करोक्तं तदीयगोलाध्यायभुवनकोशे एतदनुरूपमेव । तद्व्याख्ययाऽस्यापि व्याख्या स्फुटा ॥ ३ ॥

वि. भा.—यतः (यस्मात्कारणात्) अह्ना (एकेन दिनेन) ध्रुवमत्स्यस्या (ध्रुवतारासमीपस्थमत्स्याकारनक्षत्रस्य) ऽऽवर्त्तो (परिभ्रमणं) भवति, ततः

(तस्मात् कारणात्) चतुष्पञ्चाशत् संख्यकानि नक्षत्राणि (द्विगुणित नक्षत्र-संख्यातुल्यानि) रविचन्द्रौ द्वौ द्वाविति जिनोक्तं यत्तदसत् (न समीचीन मित्यर्थः) इति ॥ ३ ॥

अत्रोपपत्तिः

यदा रविर्भरणीस्थो भवति तदा सूर्यास्तकाले भरण्याः पुच्छतारा पूर्वतो-भवति, मुखतारा च पश्चिमतोऽर्थादस्तक्षितिजे भवत्यर्थान्मुखतारा स्थितो रविर्भवति, गोल भ्रमणेन गोलस्य यो भागः पश्चिम दिशि स पूर्वभागे गमिष्यति पूर्वभागश्च पश्चिमदिशि, तदा मुखतारास्थितस्यैव रवेरुदयो दृष्टिपथमायात्यतो जैनेन रविद्वयं चन्द्रद्वयं चतुष्पंचाशत्संख्यकं नक्षत्रं च यत् स्वीकृतं तन्निरर्थकं प्रतिभाति, एकेनैव रविणोदयास्तौ सिद्ध्यतः, जैनेन कथ्यते यदुदयकाले यो रविरस्ति सोऽस्तकाले न भवति, अत्र कथने किमपि कारणं न दृश्यते, चन्द्रद्वयकल्पने चतुश्पंचाशत्सख्यक-नक्षत्रकल्पनेऽपीदृशखण्डनमेव बोध्यम् । सिद्धान्तशिरोमणौ भास्कराचार्येणापि-"द्वौ द्वौ रवीन्दू भगणौ च तद्वदेकान्तरौ तावुदयं व्रजेता" मित्यनेन जैनमतं प्रतिपाद्य "किं गण्यं तव वैगुण्यं द्वचैगुण्यं यो वृथा ऽकृथाः । भार्केन्दूनां विलोक्यान्हा ध्र ुव मत्स्य परिभ्रमम्" त्यनेनाचार्योक्तानुरूपमेव खण्डनमभिहितमिति ॥३

अब 'दो चन्दा दो सुज्जा' इत्यादि जैनमत का खण्डन करते है ।

हि. भा. जिस कारण से एक दिन में ध्रुवतारा के समीप वर्ती मत्स्याकार (मछली के सदृश) तारा का परिभ्रमण होता है इस कारण से चौवन (द्विगुणित नक्षत्र संख्या) नक्षत्र, दो दो रवि और चन्द्र है यह जो जैनों ने कहा है सो ठीक नहीं है इति ॥ ३ ॥

उपपत्ति

जब रवि भरणी नक्षत्र में स्थित होते हैं तो सूर्यास्त काल में भरणी की पुच्छतारा पूर्व की ओर रहती है और मुखतारा पश्चिम की ओर (अस्तक्षितिज में) तब रवि पुच्छतारा में स्थित रहते है, गोलभ्रमण से गोल के पश्चिम तरफ का अश पूर्व तरफ जायगा और पूर्व की ओर का अश पश्चिम की ओर जायगा, तब तो मुखतारा स्थित रवि ही का उदय देखने में आता है, इसलिये दो सूर्य, दो चन्द्र, और चौवन नक्षत्र जो जैनों ने स्वीकार किया है वह निरर्थक मालूम होता है, एक ही रवि से उदय और अस्तादि होता है, जैन उदय काल के लिये एक रवि मानते हैं और अस्त काल के लिये दूसरा रवि, अर्थात् एक ही रवि के द्वारा दिन और रात्रि को नहीं मानते हैं । दो चन्द्र कल्पना में तथा चौवन नक्षत्र कल्पना में भी इसी तरह खण्डन समझना चाहिये । सिद्धान्त शिरोमणि में भास्कराचार्य ने "द्वौ द्वौ रवीन्दू भगणौ च तद्वदेकान्तरौ तावुदयं व्रजेताम्" इससे जैन मत का प्रतिपादन कर "किं गण्यं तव

वैगुण्य" इत्यादि सं. उपपत्ति मे लिखित श्लोक से आचार्योक्त खण्डन के अनुरूप ही खण्डन किया है इति ॥ ३ ॥

इदानीमार्यभटोक्तं युगं खण्डयति ।

आर्यभटो युगपादांस्त्रीन् यातानाह कलियुगादौ यत् ।
तस्य कृतान्तर्यस्मात् स्वयुगाद्यन्तौ न सत् तस्मात् ॥ ४ ॥

सु. भा.—आर्यभटः कलियुगादौ त्रीन् युगपादान् यातान् आह कथितवान् । यच्च प्रसिद्धं तद्ग्रन्थतः । (द्रष्टव्या मध्यमाधिकारे ऽष्टाविंशतिश्लोकस्य मदीया व्याख्या) यस्मात् कारणात् तन्मते तस्य स्वयुगाद्यन्तौ तदेकयुगस्यादिरन्यस्यान्त इति द्वौ कृतान्तः कृतयुगमध्ये भवतस्तस्मात् तद्युगं न सत् ।

अत्रोपपत्तिः । आर्यभटमते एक युगान्तादन्यस्यारम्भात् कलियुगादिपर्यन्तं त्रयो युगपादाः$=\frac{३\times४३२००००}{४}=$ ३२४०००० । आचार्यमते च, कृ+त्रे+द्वा $\frac{४३२००००\times९}{१०}=$३८८८००० द्वयोरन्तरे वर्षाणि=६४८००० एतानि चाचार्यमतेन संख्याधिकत्वात् कृतयुगमध्येऽत आर्यभटोक्तयुगाद्यन्तौ कृतयुगान्तः । इहाचार्येण स्वकृतयुगमध्ये आर्यभटोक्तौ युगाद्यन्तौ प्रतिपादितौ । तत्र यदि आचार्योक्तयुगादौ ग्रहाणां मेषमुखे स्थितिः स्यात् तदेदं खण्डनमुचितमन्यथा वाग्बलमेतदिति ज्योतिर्विदां स्फुटमेव ॥ ४ ॥

वि. भा.—आर्यभटः कलियुगादौ त्रीन् युगपादान् (युगचरणान्) यातान् (गतान्) आह (कथितवान्), यस्मात् कारणात् तस्य स्वयुगाद्यन्तौ (तदेकस्य युगस्यादिरन्यस्यान्त इति द्वौ) कृतान्तः (कृतयुग मध्ये) भवतः तस्मात् करणात् तद्युगं न सत् स्यादिति ॥ ४ ॥

अत्रोपपत्तिः

आर्यभटमतानुसारेणैकयुगान्तादन्यस्यारम्भात् कलियुगादिं यावत् त्रयो युगपादाः $=\frac{४३२००००\times३}{४}=$३२४००००, आर्यभटमतेनापि महायुगम्= ४३२००००, तथा$\frac{४३२००००}{४}=$एक युगपादः, तन्मतेन सर्वे युगपादाः समा एव सन्त्यतो युगपादस्त्रिभिर्गुणितस्तदा त्रयो युगपादा भवन्ति तेन $\frac{४३२००००\times३}{४}$

=तत्रो युगपादाः। आचार्यमतेनापि महायुगमानम्=४३२००००, कृतयुगे धर्म-चरणाः=४, त्रेतायां धर्मचरणाः=३, द्वापरे=२ कलौ=१, सर्वेषां योगो दश=१०, धर्मचरणा महायुगे भवन्त्यतोऽनुपाते 'यदि दशभिर्धर्मचरणैर्महायुगमानं लभ्यते तदा नवभिर्धर्मचरणैः किं, समागच्छन्ति कृत त्रेता द्वापर युग पादानां योगमानानि तत्स्वरूपम् $= \frac{४३२००००\times९}{१०} = \frac{३८८८००००}{१०} =$ ३८८८००० अन-योरन्तरेण ३८८८०००—३२४००००=६४८००० एतानि वर्षाणि चाचार्यमतेन संख्याधिकत्वात्कृतयुगमध्ये भवन्त्यत आर्यभटोक्तौ युगाद्यन्तौ कृतयुगान्त एव सिद्धयतः अत्राऽऽचार्येण स्वकृतयुगमध्ये आर्यभटोक्तौ युगाद्यन्तौ प्रतिपादितौ, तत्र यद्याचार्योक्तयुगादौ मेषादौ ग्रहाणामवस्थानं भवेत्तदेदं खण्डनं युक्तमन्यथा नहि, सूर्यसिद्धान्तेऽपि "युगस्य दशमो भागश्चतुस्त्रिद्व्येक संगुणः। क्रमात्कृतयुगादीनां" इत्यनेन कथितयुगचरणा आर्यभटोक्ता द्विसदृशा एव सन्ति, कथमार्यभटेन सर्वे युगपादाः समानाः कल्पिता इति त एव ज्ञातुं शक्ष्यन्तीति ॥ ४ ॥

अब आर्यभटोक्त युग का खण्डन करते है।

हि. भा.—आर्यभट ने कलियुगादि मे तीन युग चरणों को गत (बीता हुआ) कहा है। इस कारण से उनके एक युग का आदि अन्य युग का अन्त ये दोनों कृतयुग के मध्य मे होते है इस कारण से उनके युग ठीक नहीं है इति ॥ ४ ॥

उपपत्ति।

आर्यभट के मत से एक युगान्त से अर्थात् अन्य युग के आरम्भ मे कलियुगादि पर्यन्त तीनों युगचरण $= \frac{४३२००००\times३}{४} =$ ३२४००००, आर्यभट के मत मे भी महायुगमान =चतुर्युगमान=४३२००००, तथा एक युग चरण $= \frac{४३२००००}{४}$, उनके मत में सब युगपाद समान ही हैं, इसलिये युगपाद को तीन से गुणा करने से तीन युगपाद होते है। $\frac{४३२००००\times३}{४}$ =कलियुगादिपर्यन्त तीनों युगचरण, आचार्यमत में भी महायुग= ४३२०००० कृत युग में धर्म चरण=४, त्रेता में धर्मचरण=३, द्वापर में धर्मचरण=२, कलि में धर्मचरण=१ सबों के योग =४+३+२+१=१०=महायुग में धर्म चरण, तब अनुपात करते है यदि दस धर्म चरण में महायुगमान पाते है तो चार धर्म चरण में क्या इससे कृतयुग चरण मान आता है, इसी तरह त्रेता और द्वापर के धर्मपाद से अनुपात करने से उनके मान आते है जैसे $\frac{महायु\times३}{१०}$ =त्रेतायु, $\frac{महायु\times२}{१०}$ = द्वापर यु;

इन सबों का योग करने से कृतयु + त्रेतायु + द्वापरयु $= \frac{\text{मयु} \times ४}{१०} + \frac{\text{मयु} \times ३}{१०}$
$+ \frac{\text{मयु} \times २}{१०} = \frac{\text{मयु}\,(४+३+२)}{१०} = \frac{\text{मयु} \times ९}{१०} = \frac{४३२०००० \times ९}{१०} = \frac{३८८८००००}{१०}$
$=$ ३८८८०००, दोनों का अन्तर करने से ३८८८०००—३२४०००० $=$ ६४८००० इतने वर्ष आचार्य के मत से सख्याधिकत्व के कारण कृतयुग के मध्य मे होते है इसलिये आर्यभटोक्त युगादि और युगान्त कृतयुग के मध्य ही मे सिद्ध होता है। जहा आचार्य ने अपने कृतयुग के मध्य में आर्य भटोक्त युगादि और युगान्त को कहा है वहा यदि आचार्योक्त युगादि में मेषादि में ग्रहों की स्थिति हो तब यह खण्डन ठीक है अन्यथा नही। सूर्य सिद्धान्त में भी "युगस्य दशमो भागश्चतुस्त्रिद्वयेकसङ्गुणः" इत्यादि से कथित युगचरण आर्यभटोक्त से भिन्न ही है, आर्यभट ने क्यो सब युग चरणों को समान स्वीकार किया है इस विषय को वे ही जान सकते है इति ॥४॥

इदानीमार्यभटोक्तग्रन्थयोर्मतभेदं खण्डयति।

युगरविभगणाः रव्युघ्रिति यत् प्रोक्तं तत् तयोर्युगं स्पष्टम्।
त्रिशती रव्युदयानां तदन्तरं हेतुना केन ॥ ५ ॥

सु. भा.—आर्यभटेन ग्रन्थद्वयं रचितं। तत्रैकस्मिन् ग्रन्थे युगरविभगणाः रव्युधृ ४३२००००। सावनदिनानि=१५७७९१७५०० सृष्टिश्च लङ्कायां सूर्योदये इत्यभिहितम्। अन्यस्मिन् ग्रन्थे युगरविभगणास्तावन्त एव ४३२००००। सावनदिनानि=१५७७९१७८००। सृष्टिश्च लङ्कायामर्धरात्रे। तेनायमर्थः। आर्यभटेन 'युगरविभगणाः रव्युधृ' इति यत् तयोर्ग्रन्थयोरेकमेव स्पष्टं युगं प्रोक्तं तर्हि केन हेतुना रव्युदयानां त्रिशती तदन्तरं तयोर्ग्रन्थयोर्युगसावन दिनान्तरं यतो मतद्वयेन रविभगणसाम्येऽर्थाद्युगवर्षसाम्ये युगसावनदिनमध्येऽन्तरं त्रिशती कथमुत्पन्नमिति वदतोव्याघातदोष इति ॥ ५ ॥

वि. भा.—रव्युधृ=४३२००००, इति युगरविभगणा आर्यभटेन तयोर्ग्रन्थयोरेकमेव स्पष्टं युगं प्रोक्तं तर्हि केन हेतुना रव्युदयानां त्रिशती तदन्तरं (तयोर्ग्रन्थयो र्युगसावनदिनान्तरं) कथितमिति ॥५॥

अत्रोपपत्तिः

आर्यभटेन ग्रन्थद्वयं रचितम्। ग्रन्थद्वयेऽपि युगरविभगणाः=४३२०००० समाना एव सन्ति, एकस्मिन् ग्रन्थे युगसावनदिनानि=१५७७९१७५००, द्वितीयग्रन्थे च युगसावन दिनानि=१५७७९१७८००, ग्रन्थद्वयेऽपि सृष्टिर्लङ्कार्धरात्रेऽभिहितास्ति, ग्रन्थद्वयेऽपि युगरविभगणा ४३२०००० नां समत्वात्स्पष्टं युगमेकमेव

सिद्धं तदा ग्रन्थद्वयप्रोक्तयुगसावनदिनसंख्ययोर्मध्येऽन्तरं न भवितुमर्हति, परमत्र तयो (ग्रन्थद्वयकथितयुगसावनदिनसंख्ययोः) रन्तरं त्रिशत्या समं दृश्यते तेन सिद्धयति यदार्यभटमनसि युगसावनदिनानां निश्चितसंख्याविषये निश्चयो नाऽऽसीत् कथमन्यथैकस्मिन् युगे ग्रन्थद्वये भिन्न-भिन्न सावनदिनानां पाठस्तेन कृतोऽत आर्यभटमतं न समीचीनमिति ।। ५ ।।

अब आर्यभटरचित ग्रन्थद्वय में मतभेद का खण्डन करते है

हि. भा.—युगरविभगरण = ४३२०००० यहां आर्यभट ने दोनो ग्रन्थों मे स्पष्ट युग कहा है, तब किस कारण से उन दोनों ग्रन्थों में पठित युग सावन दिनो का अन्तर तीन सौ होता है इति ।।५।।

उपपत्ति ।

आर्यभट ने दो ग्रन्थ बनाये, दोनो ग्रन्थों में युगरविभगरण = ४३२०००० है, एक ग्रन्थ मे युग सावन दिन संख्या = १५७७९१७५०० है अन्य ग्रन्थ में युग सावन दिन सख्या = १५७७९१७८००, दोनों ग्रन्थों में सृष्टिकाल लङ्का का अर्धरात्र काल ही है, इससे यह सिद्ध होता है कि आर्यभट ने युगरविभगरण = ४३२०००० दोनो ग्रन्थों मे एक ही स्पष्ट रूप से कहा है तब एक युग के मध्य में रवि सावन दिन सख्याओं मे भेद नहीं होना चाहिये, परन्तु आर्यभट के मत से दोनों ग्रन्थो में पठित युग सावन दिन सख्याओं का अन्तर १५७७९१७८०० — १५७७९१७५०० = ३०० होता है, इससे सिद्ध होता है कि आर्यभट के मन में युग सावन दिनों की संख्या निश्चित नही थी, नही तो क्यों एक युग मे दोनों ग्रन्थों में भिन्न-भिन्न सावन दिन संख्याओं का पाठ करते, इसलिये आर्य भट का मत ठीक नही है इति ।।५।।

इदानीमार्यभटोक्तस्फुटयुगं खण्डयति ।

युगवर्षादीन् वदता चैत्र सितादेः समं प्रवृत्तान् यत् ।
तदसत् यतः स्फुटयुगं तत् स्थैर्यान्मन्दपातानाम् ।।६।।

सु. भा.—आर्यभटेन लध्वार्यभटीयतन्त्रे चैत्रसितादेः सकाशाद्युगपद्युगवर्षग्रहादीनां प्रवृत्तिर्लिखिता । चन्द्रमन्दोच्चपातौ विहायान्ये मन्दोच्चपाताश्च स्थिराः पठिता अतस्तन्मते युगादौ सर्वेषां मेषादौ स्थितिर्नेति स्फुटमिति । तेनायमर्थः । आर्यभटेन चैत्रसितादेः सकाशात् समं युगपत् प्रवृत्तात् युगवर्षादीन् वदता कथयता यत् स्फुटयुगमुक्तं तदसत् । यतो मन्दपातानां स्थैर्यात् तत् स्फुटयुगं कथमिति ।

तथा चाचार्यभटः ।

'युगवर्षमासदिवसाः समं प्रवृत्तास्तु चैत्रशुक्लादेः ।
कालोऽयमनाद्यन्तो ग्रहभैरनुमीयते क्षेत्रे । ।६ ।।'

वि. भा.—आर्यभटेन चैत्रसितादेः (चैत्रशुक्ल प्रतिपदादेः) सकाशात् समं (एककालावच्छेदेन-युगपद्वा) प्रवृत्तान् युगवर्षादीन् (युग-वर्षमासदिनादीन्) वदता (कथयता) यत् स्फुटयुग कथितं तदसत् (समीचीनं न), मन्दपातानां (मन्दोच्च पातानां) स्थैर्यात् (स्थिरत्वात्) तत् स्फुटयुग कथं भवेत्। आर्यभटेन लघ्वार्यभटीयतन्त्रे चैत्रशुक्लप्रतिपदादेर्युगपत् युगवर्षमासदिनग्रहादीनां सर्वेषां प्रवृत्तिर्लिखितास्ति, चन्द्रमन्दोच्चपातौ विहायान्ये मन्दोच्चपाताश्च स्थिराः पठितास्तदा तु तन्मते युगादौ मेषादौ सर्वेषां ग्रहादीनां स्थितिर्न सिद्धयत्यतस्तन्मतीयं स्फुटयुगं न शोभनम् इति ॥६॥

अत्रोपपत्तिः

क्रान्तिमण्डल ग्रहविमण्डलयोः सम्पातः पातः कथ्यते, स च वेधेन चलो विलोमगतिश्च लक्ष्यतेऽतो विलोमगत्या तेषां भगणाः सूर्यसिद्धान्त-सिद्धान्त शिरोमण्यादिप्रसिद्धसिद्धान्तग्रन्थेषु युगे पठिताः सन्ति-युगारम्भे (सृष्टयादौ) सर्वेषां ग्रहमन्दोच्चशीघ्रोच्चपातादीनामेकत्र (मेषादौ) स्थितिः समुचितास्ति, तेन तन्मतीययुगारम्भे सर्वेषां ग्रहादीनां युगपत्प्रवृत्तिसत्वात्तद्युग स्फुटयुगं समुचितमेव, किन्त्वार्य भटेन भौमादिग्रहाणां मन्दोच्चपाताः स्थिराः पठिताः सन्ति तदा युगादौ सर्वेषां ग्रहाणां तन्मन्दोच्चानां पातादीनामेकत्र (मेषादौ) स्थितेरसम्भवादार्यभटोक्तं स्फुटयुगं न समीचीनम् यद्यपि युगारम्भे (सृष्टयादिकाले) सिद्धान्तग्रन्थेषु मतभेदोऽस्ति सूर्य सिद्धान्तकारेण लङ्कार्धरात्रे सृष्टयादिः कथ्यते, अन्ये श्रीपतिभास्करप्रभृतयश्चैत्रशुक्लप्रतिपदादौ लङ्कासूर्योदयकाले सृष्टयादिं कथयन्ति, तथापि भास्कराचार्याद्याचार्याणां सिद्धान्तेषु मन्दोच्चपातानां भगणाः पठिताः सन्ति तेन तत्कथितयुगविषयेऽयं प्रश्न एव नोदेति, परमार्यभटेन भिन्न एव मार्ग आश्रितोऽतस्तन्मतखण्डनमाचार्येण क्रियते तत्समीचीनमेव। एतद्विषये चाऽऽर्यभटोक्तश्लोकः—

'युगवर्षमास दिवसाः समं प्रवृत्तास्तु चैत्रशुक्लादेः। कालोऽयमनाद्यन्तो ग्रहभैरनुमीयते क्षेत्रे' इति ॥६॥

अब आर्यभटोक्त स्फुटयुग का खण्डन करते है।

हि. भा.—चैत्र शुक्ल प्रतिपदादि से युगपत् (एक ही समय में) प्रवृत्त युग वर्ष मास दिन आदि को कहने वाले आर्यभट ने जो स्फुटयुग कहा हैं सो ठीक नही हैं, क्यों कि मन्दोच्चों और पातों को वे स्थिर मानते हैं तब वह (आर्यभटोक्त) स्फुटयुग कैसे हो सकता है, लघ्वार्य भटीय तन्त्र में आर्यभट चैत्र शुक्लप्रतिपदादि से एक ही समय में युगवर्ष मास आदि सबों की प्रवृत्ति लिखी है। चन्द्रमन्दोच्च और चन्द्रपात को छोड कर अन्य

मन्दोच्च और पात स्थिर पठित किया है, तब तो उनके मत मे युगादि में सव ग्रहादियों की स्थिति मेषादि मे सिद्ध नही होती है इसलिये उनके स्फुटयुग ठीक नही है इति ॥ ६ ॥

उपपत्ति

क्रान्तिमण्डल और ग्रह विमण्डल का सम्पात पात कहलाता है, वह वेध से चल है तथा विलोम गतिक (उलटा चलने वाला) लक्षित होता है, इसलिये विलोम गति से उन सबो के भगण 'सूर्यसिद्धान्त सिद्धान्तशिरोमणि आदि प्रसिद्ध सिद्धान्त ग्रन्थो मे युग मे पठित है, युगारम्भ (सृष्टयादि) मे ग्रह-मन्दोच्च-पात आदि सबो की स्थिति एक स्थान (मेषादि) में समुचित है, इसलिये उन सबों के युगारम्भ मे ग्रहादियों की प्रवृत्ति एक ही समय मे होने के कारण उनके युग ठीक है, लेकिन आर्यभट ने भौमादि ग्रहो के मन्दोच्चो और पातों को स्थिर पठित किया है तब युगादि मे सव ग्रहों की तथा मन्दोच्चो की और पात आदि की एक स्थान (मेषादि) में स्थिति नही हो सकती है इसलिये आर्यभटोक्त स्फुटयुग ठीक नही है, यद्यपि युगारम्भ (सृटयादिकाल) मे सिद्धान्त ग्रन्थो मे मतभेद है सूर्यसिद्धान्त-कार लङ्कार्धरात्र काल में सृष्टयादि मानते हैं। अन्य (श्रीपति भास्कर आदि) आचार्य चैत्र शुक्ल प्रतिपदादि मे लङ्का सूर्योदय काल में सृष्टयादि काल को कहते है, तथापि भास्कराचार्य आदि आचार्यो के सिद्धान्त ग्रन्थों मे मन्दोच्चो और पातो के भगण पठित हैं उन (मन्दोच्चों और पातो) को स्थिर नहीं दर्शाया गया है इसलिये उनके युग विषय मे यह प्रश्न ही नही उठता है, लेकिन आर्यभट ने तो एक भिन्न ही मार्ग का आश्रय ग्रहण किया है इसलिये उनके मत का खण्डन आचार्य ने किया है जो कि सर्वथा ठीक है, इस विषय मे आर्यभटोक्त श्लोक यह है—युगवर्षमासदिवसाः सम प्रवृत्तास्तु चैत्रशुक्लादेः इत्यादि स. उपपत्ति से लिखित श्लोक को देखिये' इति ॥ ६ ॥

इदानीं मन्दोच्चं न स्थिरमिति कथयति

ग्रहभुक्तेरूनायां मन्दोच्चं भवति शीघ्रमधिकायाम् ।
उच्चगतौ मन्दोच्चं न बिना भुक्त्येन्दुवर्ज्यमतः ॥ ७ ॥

सु. भा.—यत उच्चगतौ ग्रहभुक्तेरूनायां मन्दोच्चमधिकायां च शीघ्रं शीघ्रोच्चं भवति । अत आर्यभटमते इन्दुवर्ज्य मिन्दुमन्दोच्चं विहायान्येषां मन्दोच्चं भुक्त्या विना न सिध्यति तद्भगणानां पाठाभावादिति ॥ ७ ॥

वि. भा.—यतो ग्रहभुक्तेः (ग्रहगतितः) ऊनाया (अल्पायां) मुच्चगतौ मन्दोच्चं भवति, ग्रहगतितोऽधिकायामुच्चगतौ च शीघ्रोच्चं भवति, अत आर्यभटमते इन्दु-वर्ज्य (चन्द्रमन्दोच्चं विहाय) मन्दोच्चं (अन्येषां मन्दोच्चं) भुक्त्या विना (गत्या बिना) न सिध्यति तद्भगणानांपाठाभावात् । सूर्य सिद्धान्ते तु उच्चगतितो ग्रहगति-

(मध्यमग्रहगतिः) स्तथा शीघ्रोच्चगतितो मन्दस्पष्टग्रहगतिरल्पा कथिताऽस्ति, केन्द्र-परिभाषार्थं "ग्रहं संशोध्य मन्दोच्चात्तथा शीघ्राद्विशोध्य च" मिति तदुक्तपद्येन ज्ञायते, सिद्धान्ते शेखरे "खेचरो निजमृदूच्चवर्जितः खेचरेण च चलोच्चमूनितम्" सिद्धान्त शिरोमणौ "मृदूच्चेन हीनो ग्रहो मन्दकेन्द्रं चलोच्चं ग्रहोनं भवेच्छीघ्र-केन्द्रम्" । इत्यादि बहुषु सिद्धान्तग्रन्थेषु सूर्यसिद्धान्तोक्ताद्भिन्नमेवास्ति, ग्रहलाघव-करणे "मन्दोच्चं ग्रहवर्जितं निगदितं केन्द्रं तदाख्यं बुधै" रिति सूर्यसिद्धान्तोक्त-वदेवास्ति, कुजादिग्रहाणां मन्दोच्चानां स्थिरत्वकल्पनं कथमार्यभटेन कृतमिति त एव ज्ञातुं शक्ष्यन्ति, मन्ये मन्दोच्चानां गतिरतीवाल्पीयसी (अनिर्वाच्या) वर्त्तते परन्तु बहुभि (सहस्रवर्षैर्लक्षवर्षादिभिः) र्वर्षैः काचिदपि तद्गतिर्भवेत्तदा तु तज्जन्या त्रुटिर्भवेदेव, सिद्धान्ततत्त्वविवेके कमलाकरेण बहुभिर्वर्षैरविमन्दोच्चस्य सर्वेषु राशिषु चलनसम्भवात्सर्वेषु मासेषु क्षयमासो भवितुमर्हति तर्हि "क्षयः कार्त्तिका-दित्रये नान्यतः स्यादिति" भास्करेणाग्रहणपौषमाद्येष्वेव मासत्रयेषु य. क्षयमास सम्भवो लिखितः स न समीचीन इति भास्करमतं खण्डितम् तथा च तदुक्त-पद्यम् । "इदानीन्तनार्थं न शास्त्रं प्रवृत्तं न सत् कार्त्तिकादि त्रयोत्थं यदुक्तम्" इति ॥ ७ ॥

'अब मन्दोच्च स्थिर नहीं है' इसको कहते हैं ।

हि. भा.—जिस कारण से ग्रह गति (ग्रहमध्यगति) से अल्प उच्च गति में मन्दोच्च होता है तथा ग्रहगति से अधिक उच्च गति में शीघ्रोच्च होता है इसलिए आर्यभट के मत में चन्द्र मन्दोच्च को छोड़कर अन्य ग्रहों के मन्दोच्च गति बिना सिद्ध नही होते है क्योकि उन सबों के भगणों के पाठ नही हैं। सूर्य सिद्धान्त में उच्च गति से मध्यमग्रहगति तथा शीघ्रोच्च-गति से मन्द स्पष्ट गति को अल्प कहा गया है, केन्द्र परिभाषा के लिये "ग्रहं संशोध्य मन्दो-च्चात्तथा शीघ्राद्विशोध्य च" यह उनके इस पद्य से ज्ञात होता है । ग्रहलाघव करण में भी "मन्दोच्चं ग्रहवर्जितं निगदितं केन्द्रं तदाख्य बुधैः" यह सूर्य सिद्धान्तोक्तवत् ही है । किन्तु सिद्धान्तशेखर में "खेचरो निजमृदूच्चवर्जितः खेचरेण च चलोच्चमूनितम्' तथा सिद्धान्त शिरो-मणि में "मृदूच्चेन हीनो ग्रहो मन्दकेन्द्रं चलोच्चं ग्रहोनं भवेच्छीघ्रकेन्द्रम्" इत्यादि बहुत सिद्धान्त ग्रन्थों में सूर्य सिद्धान्तोक्त से भिन्न ही है, इससे मालूम होता है कि आचार्यो को यह निश्चय नही था कि ग्रह गति से उच्च गति अल्प है या अधिक है, नहीं तो भिन्न भिन्न सिद्धान्त ग्रन्थों में भिन्न भिन्न लेख नहीं रहता अस्तु । आर्यभट ने कुजादि ग्रहों के मन्दोच्चों को स्थिर क्यों माना, इस बात को वे ही जान सकते हैं। मानते हैं कि मन्दोच्चों की गति अत्यन्त अल्प है लेकिन बहुत वर्षों (लाख, कोटि) में उनकी गति कुछ भिन्न जरूर होगी तब तो तज्ज-नित त्रुटि होगी ही, सिद्धान्त तत्त्व विवेक में कमलाकर "बहुत वर्षो (लाख-कोटि) में प्रत्येक राशि में रवि मन्दोच्च के जाने से प्रत्येक मास में क्षयमास सम्भव हो सकता है तब "क्षयः कार्त्तिकादित्रये नान्यतः स्यात्" इससे भास्कराचार्य ने केवल अग्रहण, पौष और माघ इन

तीनों मासों में जो क्षय मास की सम्भावना लिखी है सो ठीक नही है। भास्कराचार्य ने रवि मन्दोच्च २ रा, १८ अ. मानकर उक्त बात कही है। परन्तु रवि मन्दोच्च बराबर मिथुन राशि में नही रहेगा इसलिए "इदानीन्तनार्थं न शास्त्र प्रवृत्त न मत् कार्त्तिकादित्रयोत्थ यदुक्त" इससे भास्करोक्त मत का खण्डन किया है इति ॥ ७ ॥

इदानी पाता न स्थिरा इति कथयति

आर्याष्टशते पाता भ्रमन्ति दशगीतिके स्थिराः पाताः ।
मुक्त्वेन्दुपातमपमण्डले भ्रमन्ति स्थिरा नातः ॥ ८ ॥

सु. भा.—आर्यभटीयतन्त्रे आर्या अष्टाधिकं शतमतस्तत् तन्त्रमार्याष्टशतमिति चोच्यते। तत्र दशभिरार्याभिर्भगणादिमानानि लिखितानि ता आर्या दशगीतिकमुच्यते। तत्र चन्द्रस्य पातभगणा एव पठिता नान्येषाम्। आर्याष्टशते गोलपादे ग्रहस्थानवर्णने च पाता भ्रमन्तीत्यभिहितम्। तेनायमर्थः। आर्य भटेनाऽऽर्याष्टशते पाता भ्रमति दशगीतिके चेन्दूपातं मुक्त्वा विहायान्ये स्थिराः पाताः सन्ति इति लिखितम्। गोलयुक्त्या च सर्वे पाता अपमण्डले क्रान्तिमण्डले भ्रमति अतस्ते स्थिरा नेति वदतो व्याघातदोषः। भौमादिमन्दपातानां वर्षशतेनापि गतिर्नोपलक्ष्यत इति स्वसमये आर्यभटेन स्थिराः पठिता इति वस्तुतो न किमपि दूषणमिहाचार्यस्याग्रह एव स्पष्टः ॥ ८ ॥

वि. भा.—आर्यभटीयतन्त्रे आर्या अष्टाधिकं शतमतस्तत् तन्त्रमार्याष्टशतमिति कथ्यते। तत्र भगणादिमानानि दशभिरार्याभिर्लिखितानि सन्ति तस्मात्ता आर्या दशगीतिकमिति कथ्यते। तत्र चन्द्रस्य पातभगणा एव पठिता नान्येषाम्। आर्याष्टशते गोलपादे ग्रहस्थानवर्णने पाता भ्रमन्तीत्यभिहितम्। एतेनायमर्थः प्रतिफलति आर्यभटेनाऽऽर्याष्टशते पाता भ्रमन्ति दशगीतिके च चन्द्रपातं मुक्त्वा (विहाय) ऽन्ये पाताः स्थिराः सन्ति इति लिखितम्। गोलयुक्त्या सर्वे पाता अपमण्डले (क्रान्तिवृत्ते) भ्रमन्त्यतस्ते स्थिरा नेति वदतो व्याघातदोषः। आर्याष्टशते पाता भ्रमन्ति, दशगीतिके च चन्द्रपातातिरिक्तपाताः स्थिराः सन्तीत्यार्यभटलेखेन ज्ञायते यत्पातभ्रमणसम्बन्धे आर्यभटस्य मनसि दाढ़र्य नासीत् 'चन्द्र पातारिक्तपाताः स्थिरा' इति यदार्यभटेन लिखितं तन्महदनुचितम्। यद्यार्यभटेन स्वसमये पातगतिर्नोपलब्धा तथापि त्वस्मिन् विषये गोलयुक्तिः किं कथयतीति विचारः कर्त्तव्य आसीत्, परं गोलयुक्तिविचारमकृत्वैव चन्द्रपातातिरिक्तपाताः स्थिराः सन्तीति लिखितं तन्नशोभनमिति विवेचका विवेचयन्त्विति ॥ ८ ॥

अब पात की अस्थिरता को कहते हैं।

हि. भा.—आर्य भटीयतन्त्र में एक सौ आर्या हैं इसलिए वह आर्याष्टशतं कहलाता है, उसमें भगणादिमान दश आर्याओं में लिखे गए हैं इसलिए वे आर्या 'दशगीतिक' कहे जाते हैं,

उनमें केवल चन्द्रपात भगण पठित है, अन्य (भौमादि) ग्रहों के पात भगण पठित नही है, आर्याष्टशत में गोलपाद में ग्रहस्थान वर्णन मे पात भ्रमण करते है ऐसा लिखा गया है, इससे यह अर्थ निकलता है कि आर्यभट ने "आर्याष्टशत में पात भ्रमण करते है और दशगीतिक में चन्द्रपात को छोडकर अन्य सब पात स्थिर हैं" लिखा है गोलयुक्त से सब पात क्रान्तिवृत्त में भ्रमण करते हैं इसलिए पात स्थिर नहीं है। 'आर्याष्टशत मे पात भ्रमण करते है तथा दशगीतिक में चन्द्रपातातिरिक्त पात स्थिर है' इस आर्यभट के लेखक से मालूम होता है कि पात भ्रमण के विषय मे आर्यभट के मन मे कुछ भी निश्चय नहीं था, चन्द्रपात से भिन्न पात स्थिर है यह जो आर्यभट ने लिखा है सो अत्यन्त अनुचित है, यद्यपि अपने समय में आर्यभट को पात गति उपलब्ध नही हुई हो तथापि इस विषय में गोलयुक्ति से विचार करना उचित था लेकिन गौलिक विचार न करके चन्द्रपात के भिन्न पात स्थिर है जो आर्यभट ने लिखे है बहुत अनुचित है इति ॥ ८ ॥

इदानीमार्यभटराहुं खण्डयति ।

आर्यभटो जानाति ग्रहाष्टगतिं यदुक्तवांस्तदसत् ।
राहुकृतं न ग्रहणं तत्पातो नाष्टमो राहुः ॥९॥

सु. भा.—आर्यभटो ग्रहाष्टगतिमष्टानां ग्रहाणां चलनं जानातीति कश्चिदार्यभट एव वा यदुक्तवान् तदसत् यतस्तन्मते राहुकृतं ग्रहणं परन्तु वस्तुतो राहुकृतं ग्रहणं न भवति । तत्पातश्चाष्टमो ग्रहो राहुर्न भवति । अर्थात् तद्गणितेन यश्चन्द्रपातः स दृष्टियोग्यो नेति । वाग्बलमेतत् । आर्यभटेन राहुकृतं ग्रहणं नोक्तं । तथा च तद्वाक्यम् । छादयति शशी सूर्यं शशिनं महती च भूछाया ।
(गोलपा. श्लो० २७) ॥ ९ ॥

वि. भा.—ग्रहाष्टगतिं (अष्टानां ग्रहाणां चलनं) आर्यभटो जानातीति कश्चिदार्यभट एव वा यदुक्तवान् तदसत् । यत आर्यभटमते राहुकृतं ग्रहणं भवति परन्तु यथार्थतो राहुकृतं ग्रहणं न भवति, तत्पातश्चाष्टमो ग्रहो राहुर्न भवति अर्थात्तद्गणितेन यश्चन्द्रपातः स दृष्टियोग्यो नेति, खण्डनमिदं निरर्थकं प्रतिभाति, आर्यभटेन राहुकृतं ग्रहणं न कथितम् तथा च तद्वाक्यम् 'छादयति शशी सूर्यं शशिनं महती च भूछाया (गोलपादे) २७ श्लो० आर्यभटेन यद्वस्तु नोक्तं तदपि स्वमनसि-धृत्वा ज्योतिर्विदां शिरोमणिनाऽऽचार्येण (ब्रह्मगुप्तेन) तन्मतं खण्ड्यते इति-महदाश्चर्यम् । आचार्येणेति विचारो न कृतो यत् पाठकास्तु (आर्यभटस्य किं मतमाचार्येण च किं खण्ड्यते इत्युभयोर्दर्शनेनैव) विचारं करिष्यन्ति, केवलं मल्लेखोपरि विश्वासं न करिष्यन्ति, तर्हि मन्मिथ्या कल्पनयालमिति ॥९॥

अब आर्यभटीय राहु का खण्डन करते हैं ।

हि. भा.—आठ ग्रहों के चलन को आर्यभट जानता है यह जो कहा गया है सो ठीक नही है, क्यो कि आर्यभट के मत मे राहुकृत ग्रहण है परन्तु वस्तुतः राहुकृतग्रहण नही होता है, उनके पात अष्टमग्रह राहु नही है अर्थात् उनके गणित से जो चन्द्रपात आता है वह दृष्टियोग्य नहीं है, यह खण्डन निरर्थक मालूम होता है । आर्यभट ने राहुकृत ग्रहण को नहीं कहा है उनके वाक्य हैं "छादयतिशशी सूर्य शशिनं महती च भूछाया, जिस बात को आर्यभट ने नहीं कहा है उसको भी अपने मन से महा पण्डित राज आचार्य (ब्रह्मगुप्त) आर्यभटोक्त कह कर खण्डन करते हैं यह बहुत आश्चर्य है, आचार्य ने यह विचार नहीं किया कि विवेचक लोग आर्यभट मत को और हमारे खण्डन को देख ही करके कुछ विचार करेंगे केवल मेरे लेख के ऊपर विश्वास नही करेंगे तब मेरी मिथ्या कल्पना से क्या लाभ इति ।।९।।

पुनरार्यभटमतं खण्डयति ।

न समा मनुयुगकल्पाः कल्पादिगतं कृतादियातं च ।
स्मृत्युक्तैरार्यभटो नातो जानाति मध्यगतिम् ।।१०।।

सु० भा०—आर्यभटोक्ता मनुयुगकल्पाः स्मृत्युक्तैर्मनुस्मृत्याद्युक्तैर्न समास्तथा तदुक्तं कल्पादिगतं कृतादियातं च स्मृत्युक्तेन न सममत आर्यभटो मध्यगतिं मध्यग्रहाणां चलनं न जानाति । इति सर्वं मध्यगत्यध्यायस्य ९, २८ श्लोकतः स्फुटम् ।। १० ।।

वि. भा.—मनुयुगकल्पा आर्यभटोक्ताः स्मृत्युक्तैः (मनुस्मृत्यादिकथितैः) समा न सन्ति, तथा तदुक्तं कल्पादिगतं कृतादियातं च स्मृत्युक्तेन न सममत आर्यभटो मध्यगतिं (मध्यग्रहाणां चलनं) न जानातीति । विषयोऽयं मध्यगत्यध्याये पूर्वप्रतिपादित एव, अत्र पुनस्तत्प्रतिपादनं पिष्टपेषणमात्रमेव, किमत्र तथ्यमिति प्रामाण्यवचनाधीनम् । कथमार्यभटेन स्मृतिप्रतिपादितमनुयुगादिमानेभ्यस्तन्मानानि भिन्नानि कथितानीति त एव ज्ञातुं शक्नुवन्तीति ।।१०।।

पुनः आर्यभट के मत का खण्डन करते हैं ।

हि. भा.—आर्यभटोक्त मनु, युग, कल्प ये स्मृति कथित मनु,युग, कल्प के बराबर नहीं है, तथा आर्यभटोक्त कल्पादिगत और कृत (सत्ययुग) आदि गतयुग चरण भी स्मृतिकथित के बराबर नहीं है इसलिये आर्यभट मध्य गति को नहीं जानते हैं । यह विषय पहले मध्यगत्यध्याय में आचार्य कह चुके हैं पुनः यहां उसका प्रतिपादन करना पिष्टपेषण मात्र है, इसमें क्या ठीक है यह बहुत प्रबल वचन प्रमाणाधीन है, आर्यभट ने स्मृति प्रतिपादित मनु, युग आदि मानों से भिन्न उनके मानों को कहा है इस बात को वे ही जान सकते हैं इति ।।१०।

इदानीमार्यभटोक्त कल्पादिवारस्य खण्डनं करोति ।

ओङ्कारो दिनवारो गुरुरौदयिकोऽस्य भवति कल्पादौ ।
न भवत्यर्को यस्मादोङ्कारो विस्तरस्तस्मात् ॥११॥

सु० भा०—आर्यभटेन स्वतन्त्रे 'गुरुदिवसात् भारतात् पूर्वं' मित्यनेन कल्पादौ गुरुवारः स्वीकृतः । तेनायमर्थः । यस्मादस्यार्यभटस्योङ्कारः स्वीकारः कल्पादावौदयिको दिनवारो गुरुर्भवति रविर्न भवति तस्मादस्योङ्कारः स्वीकारो विस्तर आधाररहितोऽर्थादप्रामाणिकः (स्तरः स्तरणमास्तरणम् । विगतः स्तरो यस्य स विस्तर इति) ।

आर्यभटमते द्वापरान्ते कल्पाद् गतयुगानि ४३२$\frac{3}{4}$ (मध्यमाधिकारे २८९ श्लोकटीका द्रष्टव्या)

एतानि युगसावनदिवसै—१५७७९१७५०० र्गुणानि जातः सावनाहर्गणः
$= 432\times 1577917500 + \frac{1577917500\times 3}{4} = 432\times 1577917500$
$+ 394479375\times 3$ । अयं सप्ततष्टो जातो द्वापरान्ते वारः$=5\times 5+3\times 3$
$=25+9=34=6$ । अयं सैकः कलियुगादौ वारः $7=0$ । अतो यदि गुरुवाराद्-गणनाऽऽरभ्यते तदा कलियुगादौ गतवारः ० । वर्तमानो गुरुरेव सिध्यत्यत आर्य-भटमतेन कल्पादौ गुरुवार आयाति ॥ ११ ॥

वि. भा.—स्वतन्त्रे 'गुरुदिवसात् भारतात् पूर्वं' मित्यनेन कल्पादावार्य-भटेन गुरुवारः स्वीकृतोऽस्ति । तेनायमर्थः-यस्मात् कारणात्-अस्य (आर्यभटस्य) ओङ्कारः (स्वीकारः) कल्पादावौदयिको दिनवारो गुरुर्भवति रविर्न भवति तस्मादस्य-ओङ्कारः स्वीकारो विस्तरः (आधाररहितोऽर्थादप्रामाणिकः) (स्तरः स्तरणमास्तरणम्) विगतः स्तरो यस्य स विस्तर इति ॥११॥

अत्रोपपत्तिः

आर्यभटमतेन कलियुगारम्भात् पूर्व वर्त्तमानकल्पे षड् ६ मनवो व्यतीता युगचरणत्रयं च, तथा तन्मते द्विसप्ततियुगैरेको मनुरतः कल्पादौ द्वापरान्ते कल्पाद् गतयुगानि $= 72\times 6+\frac{3}{4}=432\frac{3}{4}$, युगपठितसावनदिनैर्गुणनेन जातः सावनाहर्गणः$=432\times 1577917500+\frac{3\times 1577917500}{4}$, युग-पठित सावनदि.$=1577917500=432\times 1577917500+394479375\times 3$ अयं सप्तभिर्भक्तस्तदा द्वापरान्ते वारः$=5\times 5+3\times 3=25+9=34$ सप्तत-

ष्टिते शेषम् = ६ अयं सैकस्तदा कलियुगादौ वारः = ७, वा = ० अतो यदि गुरुवारा-द्वारगणना प्रारभ्यते तदा कलियुगादौ गतवार = ०, वर्त्तमानो वारो गुरुरेव सिध्यत्यत आर्यभटमतेन कल्पादौ गुरुवार आयाति [1]॥११॥

अब आर्यभटोक्त कल्पादिवार का खण्डन करते है ।

हि. भा.—अपने तन्त्र में 'गुरुदिवसात् भारतात्पूर्व' इस से कल्पादि में आर्यभट ने गुरुवार स्वीकार किया है, इसी कारण से कल्पादि में औदयिक दिनवार गुरु है, रवि नही यह जो आर्यभट ने स्वीकार किया है सो विस्तर है अर्थात् आधार रहित (अप्रामाणिक) है इति ।।११।।

उपपत्ति

आर्यभट के मत से कलियुगारम्भ से पूर्व वर्त्तमान कल्प मे छः मनु व्यतीत हुए है तथा तीन युगचरण व्यतीत है और उनके मत में बहत्तर ७२ युगों का एक मनु है इसलिये कल्पादि (द्वापरान्त) में कल्प से गतयुग $-७२ \times ६ + \frac{३}{४} = ४३२ \frac{३}{४}$, युगपठितसावन दिन = १५७७९१७५०० इस से गुणने से सावनाहर्गण हुआ । $४३२ \times १५७७९१७५०० + \frac{३ \times १५७७९१७५००}{४}$ इस को सात से भाग देने से द्वापरान्त में वार $= ५ \times ५ + ३ \times ३ = २५ + ९ = ३४$ सात से अधिक है, इसलिये सात से भाग देने से शेष = ६ इस में सैक करने से कलियुगादि में वार = ७, वा = ० इसलिये यदि गुरुवार से वार गणना प्रारम्भ करते हैं तब कलियुगादि में गतवार = ०, वर्त्तमान वार गुरुवार ही सिद्ध होता है अतः आर्यभट के मत से कल्पादि में गुरुवार ही आता है । परन्तु यहां मुझे यह कहना है कि आर्यभट भी तो वार गणना रवि, सोम, मंगल···इसी क्रम से करते है, रवि से वार गणना क्यों की जाती है इसका एक मात्र कारण यही है कि सृष्टयादि काल में रविवार था-तब फिर कल्पादि को गुरुवार में क्यों कहेगे, गुरु दिनान्त में द्वापर युग समाप्त हुआ अर्थात् कलियुगारम्भ हुआ, यहां शुक्रवार में सिद्धान्तकार लोग कलियुगारम्भ स्वीकार करते हैं इसलिये कलियुगादि से अभीष्ट रवि मण्डलान्त में जो गतकाल (कलिगत) है उससे पूर्ववत् ग्रहानयन होता है परन्तु यहां शुक्र से आरम्भकर वर्षाधिपति की गणना होती है ।

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(१) अत्रास्माक कथनमस्ति यदार्यभटोऽपि तु, रविः, सोमः, कुजः············ एतत्क्रमेणैव वारगणनां करोति, रवितो वारगणना कथं भवतीत्यत्रैकमात्रकारणमिदमेवास्ति यत् सृष्टयादिकाले रविवार एवाऽऽसीत् । तदा कल्पादौ गुरुवार आसीदिति तेन प्रकाण्ड-विदुषा कथं कथयिष्यते, गुरुदिनान्ते द्वापरयुगसमाप्तिरभवत्-कलियुगारम्भश्च शुक्रवारे ऽभवत् । मन्येऽत्रैव मत भेदोऽस्ति कलियुगारम्भ आर्यभटेन गुरुवारे कथ्यते, मद्विचारे त्विदमेवाऽऽयाति । गुरुवारे कल्पादिरभवदिति कैरपि स्वीकर्त्तुं न शक्यत इति ।

वाराधिपति की गणना भी शुक्र ही से होती है, आर्यभट शुक्रवार में कलियुगादि नहीं मानते हैं गुरुवार में मानते है, कल्पादि को गुरुवार में मानना तो नितान्त अनुचित है इस को तो कोई भी स्वीकार नही कर सकता है। आर्यभट भी वारगणना रवि से ही करते हैं इति ॥११॥

इदानीमार्यभटोक्तवारप्रवृत्तिं खण्डयति।

सूर्यादयश्चतुर्था दिनवारा यदुवाच तदसदार्यभटः।
लङ्कोदये यतोऽर्कस्यास्तमयं प्राह सिद्धपुरे ॥१२॥

सु. भा.—आर्यभटेन 'शीघ्रक्रमाच्चतुर्था भवन्ति सूर्यादयो दिनपाः।' इति

स्वतन्त्रे लिखितम्। च१, बु२, शु३, र४, कु५, गु६, श७। कक्षाक्रमेण ग्रहाणां संस्था। तत्र शीघ्रक्रमात् सूर्यादयो ग्रहाः र, चं, मं, बु, गु, शु, श। उपरिष्ठा ग्रहा मन्दगतयोऽधःस्थाः शीघ्रगतयो भवन्ति। ते च रवितः शीघ्रक्रमादधःस्थग्रहगणनया विपरीतगणनया रवेरनन्तरं शुक्रस्तदनन्तरं बुध इत्यादिगणनयेति स्फुटम्। अथ गोलपादे च तेनैवार्यभटेन 'उदयो यो लङ्कायां सोऽस्तमयः सवितुरेव सिद्धपुरे' इत्युक्तम्। तेनायमर्थः। सूर्यादयश्चतुर्था दिनवारा दिनपा भवन्तीति यदार्यभट उवाच तदसत्। यतः स एवं लङ्कोदये सिद्धपुरेऽर्कस्यास्तमयं प्राह। अर्थाद्यदि लङ्कोदये वारादिस्तर्हि सिद्धपुरेऽपि कथं न स एव वारादिरतो वारगणना स्थिरा न। अतस्तदुक्ताः सूर्यादयश्चतुर्था दिनपाः स्थिरा न समीचीनाः। आर्यभटेनैकदेशस्थितिवशेन दिनवारगणना प्रदर्शिताऽतोऽसद्दूषणमेतत् ॥ १२ ॥

वि. भा.—शीघ्रक्रमाच्चतुर्था भवन्ति सूर्यादयो दिनपाः, इत्यार्यभटोक्तम्। कक्षाक्रमेण ग्रहाणां स्थितिः=चन्द्रः, बुधः, शुक्रः, रविः, कुजः, गुरुः, शनिः। चन्द्रादुपरिष्ठा ग्रहाः क्रमशो मन्दगतयो भवन्ति, आर्यभटोक्तपद्येनाने 'शीघ्रक्रमाच्चतुर्था' नेत्यादि रविः, चन्द्रः, कुजः, बुधः, गुरुः, शुक्रः, शनिः, इति दिन पतयः। गोलपादे 'उदयो यो लङ्कायां सोऽस्तमयः सवितुरेव सिद्धपुरे' आर्यभटेनोक्तम्। तेनायमर्थः-सूर्योदयश्चतुर्था दिनवारा दिनपा भवन्तीति यदार्यभट उवाच तदसत्। यतः स एव लङ्कोदये सिद्धपुरेऽर्कस्यास्यास्तमयं प्राह; शीघ्रक्रमाच्चतुर्था इत्यादिना ऽऽर्यभटेन यद्दिनपतिज्ञानं कृतं तत्तु समीचीनमेव। संसारे सर्वत्रैव वारगणनक्रमो रवित एवास्ति, तज्ज्ञानप्रकार आर्यभटेन प्रदर्शितोऽस्ति। सूर्य सिद्धान्ते 'मन्दादधः क्रमेण स्युश्चतुर्था दिवसाधिपाः' अनेन दिनपतिज्ञानप्रकार एव कथ्यते। पूर्वलिखितप्रकारयोः (आचार्योक्तसूर्यसिद्धान्तोक्तयोः) केवलमेता-

वानेव भेदोऽस्ति यदाचार्येण रवित आरभ्य शीघ्रक्रमाच्चतुर्थश्चतुर्थो वारो दिनपति-र्भवतीति कथ्यते, सूर्यसिद्धान्तकारेण शनित आरभ्याऽधोऽधः क्रमेणार्थाच्छीघ्र-गतिक्रमेण चतुर्थश्चतुर्थो वारो दिनपतिः कथ्यते। तथा लङ्कोदयकाल एव सिद्धपुरेऽस्तकालो ऽतो यदि लङ्कोदये वारादिस्तदा सिद्धपुरेऽपि (सिद्धपुरीयास्त-कालेऽपि) स एव वारादिर्भवेदेव, तर्ह्यार्यभटोक्तौ को दोष आयातीति न ज्ञायते। "सूर्यादयश्चतुर्था दिनवारा दिनपा भवन्तीति यदार्यभट उवाच तदसत् यतः स एव लङ्कोदये सिद्धपुरेऽर्कस्यास्तमयं प्राह। अर्थाद्यदि लङ्कोदये वारादिस्तर्हि सिद्धपुरेऽपि कथं न स एव वारादिरतो वारगणना स्थिरा न, अतस्तदुक्ताः सूर्यादयश्चतुर्था दिनपाः स्थिरा न समीचीनाः" इति कथनं समीचीनं न प्रतिभाति, आर्यभटोक्त समीचीनमेवास्ति, आचार्यो व्यर्थमेव खण्डयतीति ॥१२॥

अब आर्यभटोक्त वार प्रवृत्ति का खण्डन करते है।

हि. भा. 'शीघ्रक्रमाच्चतुर्था भवन्ति सूर्यादयो दिनपाः' यह आर्यभटोक्त पद्य है, कक्षा क्रम से ग्रहों की स्थिति इस तरह है—चन्द्र, बुध, शुक्र, रवि, कुज, गुरु, शनि, चन्द्र से उपरिस्थित ग्रह क्रम से मन्द गति होते हैं। आर्यभटोक्त पद्य से रवि से शीघ्र क्रम से चौथे चौथे ग्रह दिनपति होते हैं अर्थात् रवि, चन्द्र, कुज, बुध, गुरु, शुक्र, शनि दिनपति हैं, गोलपाद में आर्यभटोक्ति है "उदयो यो लङ्कायां सोऽस्तमयः सवितुरेव सिद्धपुरे" इसलिये यह अर्थ है कि सूर्य आदि चौथे चौथे ग्रह दिनपति होते हैं यह जो आर्यभट कहते है सो ठीक नहीं है क्योंकि वे ही आर्यभट लङ्कोदय में सिद्धपुर में सूर्य के अस्तमय को कहते हैं, आर्यभट ने "शीघ्र क्रमाच्चतुर्था भवन्ति सूर्यादयो दिनपाः" इससे जो दिनपति का ज्ञान किया है सो ठीक ही है, संसार मे सब जगह रवि ही से वार गणना क्रम है अर्थात् रवि सोम, कुज, बुध············ यही क्रम है इस के ज्ञान के लिये आर्यभट ने प्रकार दिखलाया है। सूर्य सिद्धान्त में "मन्दादधः क्रमेण स्युश्चतुर्था दिवसाधिपाः" इस से दिनपतिज्ञान का प्रकार कहा है। दोनों (आचार्योक्त और सूर्य सिद्धान्तोक्त) प्रकारों में केवल इतना ही भेद है कि आचार्य रवि से शीघ्र क्रम से चौथे चौथे ग्रह को दिन पति कहते हैं और सूर्यसिद्धान्तकार शनि से अधोऽधः क्रम से अर्थात् शीघ्रगति क्रम में चौथे चौथे ग्रह को दिनपति कहते हैं. दोनों प्रकार समान ही हैं। तथा लङ्कोदय काल ही सिद्धपुरीय अस्तकाल है, इसलिये यदि लङ्कोदय में वारादि है तो वही सिद्धपुरीयास्त काल में भी होगा तब आर्यभटोक्ति मे क्या दोष आता है यह मैं नहीं कह सकता हूं, "सूर्य आदि चौथे दिनवार दिनपति होते हैं" यह जो आर्यभट ने कहा है सो ठीक नही हैं, क्यों कि वे ही आर्यभट लङ्कोदय काल में सिद्धपुर में अस्तमय कहते हैं अर्थात् यदि लङ्कोदय में वारादि है तो सिद्धपुर में भी वही वारादि क्यों नहीं होता, इसलिये वार गणना स्थिर नहीं हो सकती है अतः आर्यभटोक्त 'सूर्यादयश्चतुर्था दिनपाः' यह ठीक नहीं है यह कथन मुझे ठीक नहीं मालूम होता है, आर्यभटोक्त समीचीन ही है, आचार्य निरर्थक ही खण्डन करते हैं इति ॥१२॥

अथ पुनरार्यभटोक्तवारादि खण्डयति।

अधिकैः शतैश्चतुर्भिवर्षसहस्त्रैश्चतुर्दशभिरेकः।
युगयातैर्दिनवारान्तरमौदयिकार्ध रात्रिकयोः ॥१३॥

सु. भा.—आर्यभटेन ग्रन्थद्वयं रचितम्। एकस्मिन् युगसावनदिनानि १५७७९१७५००। लङ्कायामर्कोदये सृष्टिः। अन्यस्मिन् युगसावनदिनानि १५७७९१७८०० लङ्कायामर्धरात्रे सृष्टिः। उभयत्र युगवर्षसंख्या ४३२०००० एतावती तुल्यैव। अतो ग्रन्थद्वयतो वारगणनया युगवर्षैर्दिनशतत्रयान्तरं तथाऽनुपातेनैकदिन वारान्तरं च $\frac{४३२००००}{३००}$=१४४०० एतैर्युगयातवर्षैः। तेनायमर्थः। आर्यभटमतेनौदयिकार्ध-रात्रिकयोर्दिनवारमध्ये चतुर्दशभिर्वर्षसहस्रैश्चतुर्भिः शतैर्वर्षैरधिकैर्युगयातैर्दिनवारान्तरं दिनवारयोरेकमन्तरं पततीति वारगणना न स्थिरेति ॥ १३ ॥

वि० भा०—आर्यभटेन ग्रन्थद्वयं रचितम्। एकस्मिन् ग्रन्थे युगसावन-दिनानि=१५७७९१७५००, लङ्कायां रव्युदये सृष्टिः। अन्यस्मिन् ग्रन्थे युगसावन-दिनानि=१५७७९१७८००, लङ्कायामर्धरात्रे सृष्टिः। उभयत्र युगवर्षसंख्या= ४३२०००० समाना एव, युगपठितसावन दिनान्तरम्=३००, अतो ग्रन्थद्वयतो वार गणनया युगवर्षैर्दिनशतत्रयान्तरं भवति, तथानुपातेनैकदिनवारान्तरं च $\frac{४३२००००}{३००}$=१४४०० एतैर्युगगतवर्षैः। तेनायमर्थः—आर्यभटमतेनौदयिकार्धरा-त्रिकयोर्दिनवारमध्ये चतुर्दशभिर्वर्षसहस्रैश्चतुर्भिः शतैर्वर्षैरधिकैर्युगयातैर्दिनवार-योरेकमन्तरं पततीति वारगणना न स्थिरेति। सर्वप्रथममार्यभटस्यायं दोषो यत्तेनैकस्मिन् ग्रन्थे युगसावनदिनानि यानि लिखितानि तद्भिन्नान्यन्यस्मिन् ग्रन्थे कथं लिखितानि, तथैकत्र लङ्कार्कोदयकाले सृष्टिरन्यत्र लङ्कार्धरात्रे सृष्टिः कथं लिखिता, एकस्मिन्नेव विषये मतद्वयप्रतिपादनमेव तस्य दोषाधिक्यं व्यनक्ति अन्यद्वस्तु दूरे तिष्ठतु। अत्राचार्योक्तखण्डनमपि समीचीनमेवास्तीति विज्ञैर्ज्ञेय-मिति ॥१३॥

अब पुनः आर्यभटोक्त वारादि का खण्डन करते है।

हि. भा.—आर्यभट ने दो ग्रन्थों को बनाया, एक ग्रन्थ में युग सावन दिन संख्या =१५७७९१७५०० तथा लङ्का में रवि के उदयकाल में सृष्टिकाल लिखा है। दूसरे ग्रन्थ में युग सावन दिन सं.=१५७७९१७८०० तथा लङ्का के अर्धरात्र समय में सृष्टि काल लिखा हैं। दोनों ग्रन्थों में युगवर्ष संख्या=४३२०००० इतनी ही है, युग पठित सावन दिनों का अन्तर=१५७७९१७८००-१५७७९१७५००=३००, इसलिये दोनों ग्रन्थो से युगवर्षों में

अब आर्यभटीय राहु का खण्डन करते हैं।

हि. भा.—आठ ग्रहों के चलन को आर्यभट जानता है यह जो कहा गया है सो ठीक नहीं है, क्यों कि आर्यभट के मत में राहुकृत ग्रहण है परन्तु वस्तुतः राहुकृतग्रहण नहीं होता है, उनके पात अष्टमग्रह राहु नहीं है अर्थात् उनके गणित से जो चन्द्रपात आता है वह दृष्टियोग्य नहीं है, यह खण्डन निरर्थक मालूम होता है। आर्यभट ने राहुकृत ग्रहण को नहीं कहा है उनके वाक्य हैं "छादयतिशशी सूर्यं शशिनं महती च भूच्छाया, जिस बात को आर्यभट ने नहीं कहा है उसको भी अपने मन से महा पण्डित राज आचार्य (ब्रह्मगुप्त) आर्यभटोक्त कह कर खण्डन करते हैं यह बहुत आश्चर्य है, आचार्य ने यह विचार नहीं किया कि विवेचक लोग आर्यभट मत को और हमारे खण्डन को देख ही करके कुछ विचार करेंगे केवल मेरे लेख के ऊपर विश्वास नहीं करेंगे तब मेरी मिथ्या कल्पना से क्या लाभ इति॥९॥

पुनरार्यभटमतं खण्डयति।

न समा मनुयुगकल्पाः कल्पादिगतं कृतादियातं च।
स्मृत्युक्तैरार्यभटो नातो जानाति मध्यगतिम् ॥१०॥

सु० भा०—आर्यभटोक्ता मनुयुगकल्पाः स्मृत्युक्तैर्मनुस्मृत्याद्युक्तैर्न समास्तथा तदुक्तं कल्पादिगतं कृतादियातं च स्मृत्युक्तेन न सममत आर्यभटो मध्यगतिं मध्यग्रहाणां चलनं न जानाति। इति सर्वं मध्यगत्यध्यायस्य ९, २८ श्लोकतः स्फुटम् ॥ १० ॥

वि. भा.—मनुयुगकल्पा आर्यभटोक्ताः स्मृत्युक्तैः (मनुस्मृत्यादिकथितैः) समा न सन्ति, तथा तदुक्तं कल्पादिगतं कृतादियातं च स्मृत्युक्तेन न सममत आर्यभटो मध्यगतिं (मध्यग्रहाणां चलनं) न जानातीति। विषयोऽयं मध्यगत्यध्याये पूर्वप्रतिपादित एव, अत्र पुनस्तत्प्रतिपादनं पिष्टपेषणमात्रमेव, किमत्र तथ्यमिति प्रामाण्यवचनाधीनम्। कथमार्यभटेन स्मृतिप्रतिपादितमनुयुगादिमानेभ्यस्तन्मानानि भिन्नानि कथितानीति त एव ज्ञातुं शक्नुवन्तीति ॥१०॥

पुनः आर्यभट के मत का खण्डन करते हैं।

हि. भा.—आर्यभटोक्त मनु, युग, कल्प ये स्मृति कथित मनु, युग, कल्प के बराबर नहीं है, तथा आर्यभटोक्त कल्पादिगत और कृत (सत्ययुग) आदि गतयुग चरण भी स्मृतिकथित के बराबर नहीं है इसलिये आर्यभट मध्य गति को नहीं जानते हैं। यह विषय पहले मध्यगत्यध्याय में आचार्य कह चुके हैं पुनः यहां उसका प्रतिपादन करना पिष्टपेषण मात्र है, इसमें क्या ठीक है यह बहुत प्रबल वचन प्रमाणाधीन है, आर्यभट ने स्मृति प्रतिपादित मनु, युग आदि मानों से भिन्न उनके मानों को कहा है इस बात को वे ही जान सकते हैं इति ॥१०॥

इदानीमार्यभटोक्त कल्पादिवारस्य खण्डनं करोति।

ओङ्कारो दिनवारो गुरुरौदयिकोऽस्य भवति कल्पादौ।
न भवत्यर्को यस्मादोङ्कारो विस्तरस्तस्मात् ॥११॥

सु० भा०—आर्यभटेन स्वतन्त्रे 'गुरुदिवसात् भारतात् पूर्व' मित्यनेन कल्पादौ गुरुवारः स्वीकृतः। तेनायमर्थः। यस्मादस्यार्यभटस्योङ्कारः स्वीकारः कल्पादावौदयिको दिनवारो गुरुर्भवति रविर्न भवति तस्मादस्योङ्कारः स्वीकारो विस्तर आधाररहितोऽर्थादप्रामाणिकः (स्तरः स्तरणमास्तरणम्। विगतः स्तरो यस्य स विस्तर इति)।

आर्यभटमते द्वापरान्ते कल्पाद् गतयुगानि ४३२$\frac{३}{४}$ (मध्यमाधिकारे २८९ श्लोकटीका द्रष्टव्या)

एतानि युगसावनदिवसैः—१५७७९१७५०० र्गुणानि जातः सावनाहर्गणः

$$= ४३२ \times १५७७९१७५०० + \frac{१५७७९१७५०० \times ३}{४} = ४३२ \times १५७७९१७५००$$

$+ ३९४४७९३७५ \times ३$। अयं सप्ततष्टो जातो द्वापरान्ते वारः $= ५ \times ५ + ३ \times ३ = २५ + ९ = ३४ = ६$। अयं सैकः कलियुगादौ वारः ७ = ०। अतो यदि गुरुवाराद्-गणनाऽऽरभ्यते तदा कलियुगादौ गतवारः ०। वर्तमानो गुरुरेव सिध्यत्यत आर्य-भटमतेन कल्पादौ गुरुवार आयाति ॥ ११ ॥

वि. भा.—स्वतन्त्रे 'गुरुदिवसात् भारतात् पूर्व' मित्यनेन कल्पादावार्य-भटेन गुरुवारः स्वीकृतोऽस्ति। तेनायमर्थः—यस्मात् कारणात्-अस्य (आर्यभटस्य) ओङ्कारः (स्वीकारः) कल्पादावौदयिको दिनवारो गुरुर्भवति रविर्न भवति तस्मादस्य-ओङ्कारः स्वीकारो विस्तरः (आधाररहितोऽर्थादप्रामाणिकः) (स्तरः स्तरणमास्तरणम्) विगतः स्तरो यस्य स विस्तर इति ॥११॥

अत्रोपपत्तिः

आर्यभटमतेन कलियुगारम्भात् पूर्व वर्त्तमानकल्पे षड् ६ मनवो व्यतीता युगचरणत्रयं च, तथा तन्मते द्विसप्ततियुगैरेको मनुरतः कल्पादौ द्वापरान्ते कल्पाद् गतयुगानि $= ७२ \times ६ + \frac{३}{४} = ४३२ \frac{३}{४}$, युगपठितसावनदिनैर्गुणनेन

जातः सावनाहर्गणः $= ४३२ \times १५७७९१७५०० + \frac{३ \times १५७७९१७५००}{४}$, युग-

पठित सावनदि. $= १५७७९१७५०० = ४३२ \times १५७७९१७५०० + ३९४४७९३७५ \times ३$ अयं सप्तभिर्भक्तस्तदा द्वापरान्ते वारः $= ५ \times ५ + ३ \times ३ = २५ + ९ = ३४$ सप्तत-

ष्टिते शेषम्=६ अयं सैकस्तदा कलियुगादौ वारः=७, वा=० अतो यदि गुरुवारा-द्वारगणना प्रारभ्यते तदा कलियुगादौ गतवार=०, वर्त्तमानो वारो गुरुरेव सिध्यत्यत आर्यभटमतेन कल्पादौ गुरुवार आयाति [1]।।११।।

अब आर्यभटोक्त कल्पादिवार का खण्डन करते है।

हि. भा.—अपने तन्त्र में 'गुरुदिवसात् भारतात्पूर्व' इस से कल्पादि में आर्यभट ने गुरुवार स्वीकार किया है, इसी कारण से कल्पादि में औदयिक दिनवार गुरु है, रवि नहीं यह जो आर्यभट ने स्वीकार किया है सो विस्तर है अर्थात् आधार रहित (अप्रामाणिक) है इति।।११।।

उपपत्ति

आर्यभट के मत से कलियुगारम्भ से पूर्व वर्त्तमान कल्प मे छः मनु व्यतीत हुए है तथा तीन युगचरण व्यतीत है और उनके मत में बहत्तर ७२ युगो का एक मनु है इसलिये कल्पादि (द्वापरान्त) में कल्प से गतयुग $-७२ \times ६ + \frac{३}{४} = ४३२ \frac{३}{४}$, युगपठितसावन दिन=१५७७९१७५०० इस से गुणने से सावनाहर्गण हुआ। $४३२ \times १५७७९१७५०० + \frac{३ \times १५७७९१७५००}{४}$ इस को सात से भाग देने से द्वापरान्त में वार$=५ \times ५ + ३ \times ३ = २५ + ९ = ३४$ सात से अधिक है, इसलिये सात से भाग देने से शेष=६ इस में सैक करने से कलियुगादि में वार=७, वा=० इसलिये यदि गुरुवार से वार गणना प्रारम्भ करते है तब कलियुगादि में गतवार=०, वर्त्तमान वार गुरुवार ही सिद्ध होता है अतः आर्यभट के मत से कल्पादि में गुरुवार ही आता है। परन्तु यहां मुझे यह कहना है कि आर्यभट भी तो वार गणना रवि, सोम, मंगल···इसी क्रम से करते है, रवि से वार गणना क्यों की जाती है इसका एक मात्र कारण यही है कि सृष्ट्यादि काल में रविवार था-तब फिर कल्पादि को गुरुवार में क्यों कहेगे, गुरु दिनान्त में द्वापर युग समाप्त हुआ अर्थात् कलियुगारम्भ हुआ, यहां शुक्रवार में सिद्धान्तकार लोग कलियुगारम्भ स्वीकार करते हैं इसलिये कलियुगादि से अभीष्ट रवि मण्डलान्त में जो गतकाल (कलिगत) है उससे पूर्ववत् ग्रहानयन होता है परन्तु यहां शुक्र से आरम्भकर वर्षाधिपति की गणना होती है।

(१) अत्रास्माकं कथनमस्ति यदार्यभटोऽपि तु, रविः, सोमः, कुजः············ एतत्क्रमेणैव वारगणनां करोति, रवितो वारगणना कथं भवतीत्यत्रैकमात्रकारणमिदमेवास्ति यत् सृष्ट्यादिकाले रविवार एवाऽऽसीत्। तदा कल्पादौ गुरुवार आसीदिति तेन प्रकाण्ड-विदुषा कथं कथयिष्यते, गुरुदिनान्ते द्वापरयुगसमाप्तिरभवत्-कलियुगारम्भश्च शुक्रवारे ऽभवत्। मन्येऽत्रैव मत भेदोऽस्ति कलियुगारम्भ आर्यभटेन गुरुवारे कथ्यते, मद्विचारे त्वित्थ-मेवाऽऽयाति। गुरुवारे कल्पादिरभवदिति कैरपि स्वीकर्त्तुं न शक्यत इति।

वाराधिपति की गणना भी शुक्र ही से होती है, आर्यभट शुक्रवार में कलियुगादि नहीं मानते हैं गुरुवार में मानते है, कल्पादि को गुरुवार मे मानना तो नितान्त अनुचित है इस को तो कोई भी स्वीकार नही कर सकता है। आर्यभट भी वारगणना रवि से ही करते हैं इति ॥११॥

इदानीमार्यभटोक्तवारप्रवृत्तिं खण्डयति।

सूर्यादयश्चतुर्था दिनदारा यदुवाच तदसदार्यभटः।
लङ्कोदये यतोऽर्कस्यास्तमयं प्राह सिद्धपुरे ॥१२॥

सु. *भा.*—आर्यभटेन 'शीघ्रक्रमाच्चतुर्था भवन्ति सूर्यादयो दिनपाः।' इति स्वतन्त्रे लिखितम्। च[१], बु[२], शु[३], र[४], कु[५], गु[६], श[७]। कक्षाक्रमेण ग्रहाणां संस्था। तत्र शीघ्रक्रमात् सूर्यादयो ग्रहाः र, चं, मं, बु, गु, शु, श। उपरिष्ठा ग्रहा मन्दगतयोऽधःस्थाः शीघ्रगतयो भवन्ति। ते च रवितः शीघ्रक्रमादधःस्थग्रहगणनया विपरीतगणनया रवेरनन्तरं शुक्रस्तदनन्तरं बुध इत्यादिगणनयेति स्फुटम्। अथ गोलपादे च तेनैवार्यभटेन 'उदयो यो लङ्कायां सोऽस्तमयः सवितुरेव सिद्धपुरे' इत्युक्तम्। तेनायमर्थः। सूर्यादयश्चतुर्था दिनवारा दिनपा भवन्तीति यदार्यभट उवाच तदसत्। यतः स एव लङ्कोदये सिद्धपुरेऽर्कस्यास्तमयं प्राह। अर्थाद्यदि लङ्कोदये वारादिस्तर्हि सिद्धपुरेऽपि कथं न स एव वारादिरतो वारगणना स्थिरा न। अतस्तदुक्ताः सूर्यादयश्चतुर्था दिनपाः स्थिरा न समीचीनाः। आर्यभटेनैकदेशस्थितिवशेन दिनवारगणना प्रदर्शिताऽतोऽसद्दूषणमेतत् ॥ १२ ॥

वि. *भा.*—शीघ्रक्रमाच्चतुर्था भवन्ति सूर्यादयो दिनपाः, इत्यार्यभटोक्तम्। कक्षाक्रमेण ग्रहाणां स्थितिः=चन्द्रः, बुधः, शुक्रः, रविः, कुजः, गुरुः, शनिः। चन्द्रादुपरिष्ठा ग्रहाः क्रमशो मन्दगतयो भवन्ति, आर्यभटोक्तपद्येनाने 'शीघ्रक्रमाच्चतुर्था' नेत्यादि रविः, चन्द्रः, कुजः, बुधः, गुरुः, शुक्रः, शनिः, इति दिन पतयः। गोलपादे 'उदयो यो लङ्कायां सोऽस्तमयः सवितुरेव सिद्धपुरे' आर्यभटेनोक्तम्। तेनायमर्थः-सूर्योदयश्चतुर्था दिनवारा दिनपा भवन्तीति यदार्यभट उवाच तदसत्। यतः स एव लङ्कोदये सिद्धपुरेऽर्कस्यास्यास्तमयं प्राह; शीघ्रक्रमाच्चतुर्था इत्यादिना ऽऽर्यभटेन यद्दिनपतिज्ञानं कृतं तत्तु समीचीनमेव। संसारे सर्वत्रैव वारगणनक्रमो रवित एवास्ति, तज्ज्ञानप्रकार आर्यभटेन प्रदर्शितोऽस्ति। सूर्य सिद्धान्ते 'मन्दादधः क्रमेण स्युश्चतुर्था दिवसाधिपाः' अनेन दिनपतिज्ञानप्रकार एव कथ्यते। पूर्वलिखितप्रकारयोः (आचार्योक्तसूर्यसिद्धान्तोक्तयोः) केवलमेता-

वानेव भेदोऽस्ति यदाचार्येण रवित आरभ्य शीघ्रक्रमाच्चतुर्थश्चतुर्थो वारो दिनपतिर्भवतीति कथ्यते, सूर्यसिद्धान्तकारेण शनित आरभ्याऽधोऽधः क्रमेणार्थाच्छीघ्रगतिक्रमेण चतुर्थश्चतुर्थो वारो दिनपतिः कथ्यते। तथा लङ्कोदयकाल एव सिद्धपुरेऽस्तकालो ऽतो यदि लङ्कोदये वारादिस्तदा सिद्धपुरेऽपि (सिद्धपुरीयास्तकालेऽपि) स एव वारादिर्भवेदेव, तर्ह्यार्यभटोक्तौ को दोष आयातीति न ज्ञायते। "सूर्यादयश्चतुर्था दिनवारा दिनपा भवन्तीति यदार्यभट उवाच तदसत् यतः स एव लङ्कोदये सिद्धपुरेऽर्कस्यास्तमयं प्राह। अर्थाद्यदि लङ्कोदये वारादिस्तर्हि सिद्धपुरेऽपि कथं न स एव वारादिरतो वारगणना स्थिरा न, अतस्तदुक्ताः सूर्यादयश्चतुर्था दिनपाः स्थिरा न समीचीनाः" इति कथनं समीचीनं न प्रतिभाति, आर्यभटोक्तं समीचीनमेवास्ति, आचार्यो व्यर्थमेव खण्डयतीति ॥१२॥

अब आर्यभटोक्त वार प्रवृत्ति का खण्डन करते हैं।

हि. भा. 'शीघ्रक्रमाच्चतुर्था भवन्ति सूर्यदयो दिनपाः' यह आर्यभटोक्त पद्य है, कक्षा क्रम से ग्रहों की स्थिति इस तरह है—चन्द्र, बुध, शुक्र, रवि, कुज, गुरु, शनि, चन्द्र से उपरिस्थित ग्रह क्रम से मन्द गति होते हैं। आर्यभटोक्त पद्य से रवि से शीघ्र क्रम से चौथे चौथे ग्रह दिनपति होते है अर्थात् रवि, चन्द्र, कुज, बुध, गुरु, शुक्र, शनि दिनपति हैं, गोलपाद में आर्यभटोक्ति है "उदयो यो लङ्कायां सोऽस्तमयः सवितुरेव सिद्धपुरे" इसलिये यह अर्थ है कि सूर्य आदि चौथे चौथे ग्रह दिनपति होते हैं यह जो आर्यभट कहते है सो ठीक नहीं है क्योंकि वे ही आर्यभट लङ्कोदय में सिद्धपुर में सूर्य के अस्तमय को कहते हैं, आर्यभट ने "शीघ्र क्रमाच्चतुर्था भवन्ति सूर्यादयो दिनपाः" इससे जो दिनपति का ज्ञान किया है सो ठीक ही है, ससार में सब जगह रवि ही से वार गणना क्रम है अर्थात् रवि सोम, कुज, बुध············ यही क्रम है इस के ज्ञान के लिये आर्यभट ने प्रकार दिखलाया है। सूर्य सिद्धान्त में "मन्दादधः क्रमेण स्युश्चतुर्था दिवसाधिपाः" इस से दिनपतिज्ञान का प्रकार कहा है। दोनों (आचार्योक्त और सूर्य सिद्धान्तोक्त) प्रकारों में केवल इतना ही भेद है कि आचार्य रवि से शीघ्र क्रम से चौथे चौथे ग्रह को दिन पति कहते हैं और सूर्यसिद्धान्तकार शनि से अधोऽधः क्रम से अर्थात् शीघ्रगति क्रम में चौथे चौथे ग्रह को दिनपति कहते हैं, दोनों प्रकार समान ही हैं। तथा लङ्कोदय काल ही सिद्धपुरीय अस्तकाल है, इसलिये यदि लङ्कोदय में वारादि है तो वही सिद्धपुरीयास्त काल में भी होगा तब आर्यभटोक्ति मे क्या दोष आता है यह मैं नहीं कह सकता हूं, "सूर्य आदि चौथे दिनवार दिनपति होते है" यह जो आर्यभट ने कहा है सो ठीक नही हैं, क्यों कि वे ही आर्यभट लङ्कोदय काल में सिद्धपुर में अस्तमय कहते हैं अर्थात् यदि लङ्कोदय में वारादि है तो सिद्धपुर में भी वही वारादि क्यों नहीं होता, इसलिये वार गणना स्थिर नहीं हो सकती है अतः आर्यभटोक्त 'सूर्यादयश्चतुर्था दिनपाः' यह ठीक नहीं है यह कथन मुझे ठीक नहीं मालूम होता है, आर्यभटोक्त समीचीन ही है, आचार्य निरर्थक ही खण्डन करते हैं इति ॥१२॥

अथ पुनरार्यभटोक्तवारादिं खण्डयति।

अधिकैः शतैश्चतुर्भिवर्षसहस्रैश्चतुर्दशभिरेकः।
युगयातैर्दिनवारान्तरमौदयिकार्धरात्रिकयोः ॥१३॥

सु. भा.—आर्यभटेन ग्रन्थद्वयं रचितम्। एकस्मिन् युगसावनदिनानि १५७७९१७५००। लङ्कायामर्कोदये सृष्टिः। अन्यस्मिन् युगसावनदिनानि १५७७९१७८०० लङ्कायामर्धरात्रे सृष्टिः। उभयत्र युगवर्षसंख्या ४३२०००० एतावती तुल्यैव। अतो ग्रन्थद्वयतो वारगणनया युगवर्षैर्दिनशतत्रयान्तरं तथाऽनुपातेनैकदिन वारान्तरं च $\frac{४३२००००}{३००}$=१४४०० एतैर्युगयातवर्षैः। तेनायमर्थः। आर्यभटमतेनौदयिकार्ध-रात्रिकयोर्दिनवारमध्ये चतुर्दशभिर्वर्षसहस्रैश्चतुर्भिः शतैर्वर्षैरधिकैर्युगयातैर्दिनवा-रान्तरं दिनवारयोरेकमन्तरं पततीति वारगणना न स्थिरेति ॥ १३ ॥

वि० भा०—आर्यभटेन ग्रन्थद्वयं रचितम्। एकस्मिन् ग्रन्थे युगसावन-दिनानि=१५७७९१७५००, लङ्कायां रव्युदये सृष्टिः। अन्यस्मिन् ग्रन्थे युगसावन-दिनानि=१५७७९१७८००, लङ्कायामर्धरात्रे सृष्टिः। उभयत्र युगवर्षसंख्या= ४३२०००० समाना एव, युगपठितसावन दिनान्तरम्=३००, अतो ग्रन्थद्वयतो वार गणनया युगवर्षैर्दिनशतत्रयान्तरं भवति, तथानुपातेनैकदिनवारान्तरं च $\frac{४३२००००}{३००}$=१४४०० एतैर्युगगतवर्षैः। तेनायमर्थः—आर्यभटमतेनौदयिकार्धरा-त्रिकयोर्दिनवारमध्ये चतुर्दशभिर्वर्षसहस्रैश्चतुर्भिः शतैर्वर्षैरधिकैर्युगयातैर्दिनवार-योरेकमन्तरं पततीति वारगणना न स्थिरेति। सर्वप्रथममार्यभटस्यायं दोषो यत्तेनैकस्मिन् ग्रन्थे युगसावनदिनानि यानि लिखितानि तद्भिन्नान्यन्यस्मिन् ग्रन्थे कथं लिखितानि, तथैकत्र लङ्कार्कोदयकाले सृष्टिरन्यत्र लङ्कार्धरात्रे सृष्टिः कथं लिखिता, एकस्मिन्नेव विषये मतद्वयप्रतिपादनमेव तस्य दोषाधिक्यं व्यनक्ति अन्यद्वस्तु दूरे तिष्ठतु। अत्राचार्योक्तखण्डनमपि समीचीनमेवास्तीति विज्ञैर्ज्ञेय-मिति ॥१३॥

अब पुनः आर्यभटोक्त वारादि का खण्डन करते है।

हि. भा.—आर्यभट ने दो ग्रन्थों को बनाया, एक ग्रन्थ में युग सावन दिन संख्या =१५७७९१७५०० तथा लङ्का में रवि के उदयकाल में सृष्टिकाल लिखा है। दूसरे ग्रन्थ में युग सावन दिन सं.=१५७७९१७८०० तथा लङ्का के अर्धरात्र समय में सृष्टि काल लिखा हैं। दोनों ग्रन्थों में युगवर्ष संख्या=४३२०००० इतनी ही है, युग पठित सावन दिनों का अन्तर=१५७७९१७८००-१५७७९१७५००=३००, इसलिये दोनों ग्रन्थो से युगवर्षों में

वार गणना से तीन सौ ३०० दिन का अन्तर पडता है, तथा अनुपात से एकदिन वारान्तर $\frac{४३२००००}{३००}$ = १४४०० इतने युग गत वर्षों मे होते है, इसलिये ऐसा अर्थ कीजिये कि आर्यभट के मत से औदयिक दिनवार और अर्धरात्रिक दिनवार के मध्य मे चौदह हजार चार सौ युगगत वर्षों में दोनो दिनवारों का अन्तर एक होता है इसलिये आर्यभटोक्त वारगणना स्थिर नही है सिद्ध हुआ। सब से मुख्य दोष आर्यभट मत में यह है कि उन्हो ने एक ग्रन्थ मे युग सावन दिन जो लिखे है उससे भिन्न दूसरे गन्थ में लिखा; एक ही विषय मे दो तरह के मत होना यही आर्यभट का सब से प्रधान दोष है, और बाते अलग रही। यहा आचार्योक्त खण्डन युक्तियुक्त है इसको विज्ञ लोग समझे इति ॥१३॥

इदानीमार्यभटोक्त ग्रहौ खण्डयति।

औदयिकाद्दिनभुक्तेस्तुर्यांशेनार्धरात्रिको भवत्यूनः।
कतरं स्फुटं न निश्चितमनयोः स्फुटमेकमपि नातः ॥ १४ ॥

सु. भा.—आर्यभटस्य प्रथमग्रन्थेनौदयिको ग्रहो य आगच्छति तस्माद् द्वितीयग्रन्थागत आर्धरात्रिको ग्रहो दिनगति चतुर्थांशेनोनो भवति, अर्थाद् द्वयोर्ग्रहयोरन्तरे ग्रहगतिचतुर्थांशकला भवन्ति। यतोऽनयोः कतरं स्फुटं वास्तवमित्यार्यभटेन न निश्चितमतस्तन्मते नैकमपि न स्फुटमिति ॥ १४ ॥

वि. भा.—औदयिकात् (आर्यभटस्य प्रथम ग्रन्थेन समागतात्) ग्रहात्-आर्धरात्रिको (द्वितीयग्रन्थागतः) ग्रहो दिनभुक्तेस्तुर्यांशेन (दिनगतिचतुर्थांशेन) ऊनो भवत्यर्थाद् द्वयोर्ग्रहयोरन्तरे ग्रहगतिचतुर्थांशकला भवन्ति। यतोनयोर्मध्ये कतरं स्फुटं (वास्तवं) इत्यार्यभटेन न निश्चितमतस्तन्मतेनैकमपि न स्फुटमस्तीति। ग्रन्थद्वये प्रतिपादितयो (लङ्कार्कोदयिकार्धरात्रिकयोः) ग्रंहयोः कः स्फुट एतत्प्रश्नस्यैवाऽऽवश्यकता नासीद्यद्यार्यभटेनोभयत्रैकस्यैव ग्रहस्योल्लेखः कृतो भवेत्। आर्यभटेनग्रन्थद्वये भिन्नं भिन्नं (लङ्कार्कोदयिकमार्धरात्रिकं च) ग्रहद्वयं प्रतिपाद्य स्वस्याल्पज्ञत्वं प्रकटीकृतमिति, यस्यमूलमशुद्धं तत्सम्बन्धेऽनेके दोषा आयान्त्येवात्राऽऽचार्यखण्डनं युक्तिसङ्गतमेवेति ॥ १४ ॥

अव आर्यभटोक्त ग्रहद्वय का खण्डन करते हैं।

हि. भा.—आर्यभट के प्रथमग्रन्थ से जो औदयिक ग्रह आते हैं उससे द्वितीय ग्रन्थागत आर्धरात्रिक ग्रहदिनगति के चतुर्थांश तुल्य ऊन (अल्प) होते हैं अर्थात् दोनों ग्रहों के अन्तर में ग्रहगति चतुर्थांशकला होती है। इन दोनों ग्रहों में कौन स्फुट (वास्तव) है यह बात आर्यभट ने निश्चित की है इसलिये उनके मत से एक भी ग्रह स्फुट नहीं है। दोनों ग्रन्थों में कथित लङ्कार्कौदयिक ग्रह और लङ्कार्ध रात्रिक ग्रह में कौन स्फुट है इस प्रश्न की आवश्य-

कता ही नहीं थी यदि आर्यभट ने दोनों ग्रन्थों में एक ही ग्रह का उल्लेख किया होता। आर्यभट ने दोनों ग्रन्थों में भिन्न भिन्न (औदयिक और आर्धरात्रिक) ग्रहों का प्रतिपादन कर अपनी अल्पज्ञता ही को प्रकाशित किया है। जिस विषय का मूल अशुद्ध रहता है उसके विषय मे अनेक दोष आते ही है यहां आचार्य जो खण्डन करते है सो युक्ति सङ्गत ही है इति ॥ १४ ॥

इदानीमार्यभटोक्तभूव्यासमानं खण्डयति।

षोडशगवियोजनपरिधिं प्रतिभूव्यासं पुलावदता।
आत्मज्ञानं ख्यापितमनिश्चयस्तनिकृतकन्यात् ॥ १५ ॥

(नृषि-योजन भूपरिधिं प्रतिभूव्यासं पुर्नञिला वदता।
आत्मज्ञानं ख्यापितमनिश्चयस्तत्कृतव्यासः ॥ १५ ॥)

(इति कोष्ठकान्तर्गतः सुधाकरद्विवेदिशोधितः पाठः साधुः)

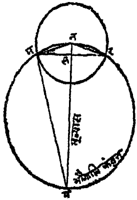
सु. भा.—आर्यभटेन 'घहस्तो ना' चतुर्हस्तः पुरुष इत्युक्तम् तथा नृषि-योजनं नरप्रमाणानां षि-अष्टसहस्रं योजनमुक्तम्। तैर्योजनैर्यो भूपरिधिरस्ति त प्रति भूव्यासश्च ञिला ञि सहस्रं ला पञ्चाशत् पञ्चाशदधिकसहस्रयोजनानि भूव्यासस्तेनार्यभटेनोक्तः स च न समीचीनः। आचार्ययोजनमानमार्यभटयोजन-मानं त्वेकमेव परन्तु भूव्यासमाने भेदोऽत आचार्यस्य 'आर्यभटेन पुनर्भूव्यासं ञिला वदताऽऽत्मज्ञानमात्रमेव ख्यापितं प्रसिद्धीकृतं वस्तुतस्तत्कृते भूव्यासो-ऽनिश्चयोऽस्ति न समीचीन' इति खण्डनम्। वाग्बलमेतद्युक्तचप्रतिपादनादिति।

तथाचार्यभटः।

'नृषि योजनं ञिला भूव्यास' इति (गीतिकापा० ५२लो०)
द्यहस्तोना (गीतिका पा० ६ श्लो०) ॥ १५ ॥

वि. भा.—'घहस्तोना' चतुर्हस्तः पुरुष इत्यार्यभटोक्तम्। नृषि योजनं (नर-प्रमाणानां षि-अष्टसहस्रं) योजनं उक्तम्। तैर्योजनैर्यो भूपरिधिरस्ति तं प्रति भूव्यासश्च ञिला (ञि 'सहस्रं', ला 'पञ्चाशत्' अर्थात् पञ्चाशदधिकसहस्रयोज-नानि) तेनो (आर्यभटेन) क्तः स च न समीचीनः। द्वयो (आचार्याऽऽर्यभटयोः) र्योजनमानमेकमेव किन्तु भूव्यासमानेऽन्तरमस्त्यत आचार्यस्य 'आर्यभटेन पुनर्भू-व्यासं ञिला (१०५० योजनानि) वदताऽऽत्मज्ञानमात्रमेव ख्यापितं (प्रसिद्धी कृतं) वस्तुतस्तत्कृते भूव्यासोऽनिश्चयोऽस्ति (न समोचीनः) आचार्येणात्र न कापि युक्तिः प्रदर्शिताऽत आचार्योक्तमिदं खण्डनं कथमादरणीयं भवेत्। वस्तुतो भूव्यासज्ञानं वेधाधीनम्। वेधेन यस्य यन्मितो भूव्यास उपलब्धस्तन्मितो लिखितः। भूव्यास

ज्ञानार्थमेकः प्रकारो मया लिख्यते, भौगोलिकं किमप्येकं वृत्तं ग्रहीतव्यम् । तद्वृत्त-परिधौ कुत्रापीष्टकर्कटस्यै (कर्कटकस्याग्रयोरन्तरं मापनेन विदितमस्ति) कमग्रं-स्थापयित्वा द्वितायाग्रस्य भ्रमणेनैकं लघुवृत्त लेख्यम् । यथा



न=कर्कटस्यैकमग्रम् । द्वितीयाग्रस्य भ्रमणेन जात लघु-वृत्तम् । नम=कर्कटकाग्रद्वयान्तर विदित मस्ति,

नमचापम्=नरचापम् अतः नम पूर्णज्या = नर पूणज्या

नम, नर, मर रेखाभिरुत्पन्नं त्रिभुज समद्विबाहुकम् । न बिन्दुतो मरपूर्णज्योपरिकृतो लम्बो भौगोलिकवृत्तकेन्द्रे (भूकेन्द्रे) गतो भवेत्तदा यन=भूव्यासः यम रेखा कार्या, $<$यमन=९०

नम चापं विदितमस्ति तेन तज्ज्यो (मस) त्क्रमज्या (सन) पूर्णज्या (नम) अपि विदिता भवेयुस्तदा यमस, मसन त्रिभुजयोः साजात्यात्

$$\frac{\text{मस} \times \text{मस}}{\text{नस}} = \text{यस} = \frac{\text{मस}^2}{\text{नस}}$$

अत्र नस, मस विदिते स्तस्तेन यक्ष रेखा विदिता जाता,

अतः यस+नस=नय=भूव्यासः, एवं भूव्यासस्य ज्ञानं जानम् । गणित-करणेन नयमानं मन्मितमागच्छेत्तदेव वास्तव भूव्यासमान भवितुमर्हति । 'नृषि योजन ञिला भूव्यास' इति गीतिकायाः ५ श्लोके तथा 'घहस्तोना' गीतिकायाः ६ श्लोके आर्यभटोक्तमिति ॥१५॥

अब आर्यभटोक्त भूव्यासमान का खण्डन करते हैं ।

हि. भा.—'घ हस्तोना' अर्थात् चार हाथ के पुरुष होते हैं यह आर्यभटोक्त है, आठ हजार पुरुष प्रमाण का एक योजन होता है, उन योजनों से जो भूपरिधि है उसका व्यास (भूव्यास) १०५० एक हजार पचास योजन आर्यभट ने कहा है सो ठीक नहीं है । आचार्य और आर्यभट के योजनमान एक ही हैं लेकिन भूव्यास मान में भेद है, आचार्य कहते हैं कि आर्यभट ने भूव्यास मान '१०५० योजन' को कहते हुए आत्मज्ञानमात्र को प्रसिद्ध किया है वस्तुतः उनके मत में भूव्यास अनिश्चित (असमीचीन) है, आचार्य ने यहां कोई युक्ति नहीं दिखलाई है इसलिये यह खण्डन कैसे आदरणीय हो सकता है । वस्तुतः भूव्यास का ज्ञान वेध के अधीन है, वेध से जिनको जितना भूव्यास उपलब्ध हुआ है उतना अपने-अपने ग्रन्थ में आचार्यों ने लिखा है । भूव्यास ज्ञान के लिये यहां एक प्रकार हम दिखलाते हैं । भौगोलिक कोई एक वृत्त लीजिये । उस वृत्त की परिधि में इष्ट कर्कट (कर्कट के दोनों अग्रों के अन्तर मापन के द्वारा विदित है) के एक अग्र को रख कर दूसरे अग्र को घुमाने से एक लघुवृत्त लिखिये । यहां सं. व्याख्या में लिखित क्षेत्र को देखिये । न=कर्कट का एक अग्र, द्वितीय अग्र

ो घुमाने से एक लघुवृत्त हुआ जो क्षेत्र में देखने मे आता है। नम=कर्कट के दोनों अग्रों ; अन्तर, विदित है, नम चाप=नरचाप इसलिये नम पूर्णज्या=नर पूर्णज्या नम, नर, र रेखाओ से उत्पन्न त्रिभुज सम द्विबाहुक है, न बिन्दु से मर पूर्णज्या के ऊपर लम्ब करने । वह लम्बरेखा भौगोलिकवृत्तकेन्द्र (भूकेन्द्र) गत होती है (रे. ग. ३ अ युक्ति से), तब न=भूव्यास यम रेखा लीजिये। ∠यमन=९० (रे. ग. ३ अध्याय), नम चाप विदित ; इसलिये उसकी ज्या=मस,उत्क्रमज्या=सन, पूर्णज्या=मर ये सत विदित होगी। ब यमस, मसन दोनों त्रिभुजो में सजातीय होने के कारण अनुपात करते हैं $\frac{\text{मस} \times \text{मस}}{\text{नस}} = \text{यस} = \frac{\text{मस}^2}{\text{नस}}$ यहां नस, मस विदित है इसलिये यस रेखा भी विदित हो ई। अतः यस+नस=नय=भूव्यास, इस तरह भूव्यास का ज्ञान हो गया, गणित करने से नय' का मान जितना आता है उतने ही वास्तव भू व्यास मान होंगे।

'नृषि योजन ञिला भूव्यासः' गीतिका के ५ श्लो०, अर्थात् आठ हजार पुरुष प्रमाण का एक योजन होता है उन योजनों से १०५०=भूव्यास, तथा 'घ हस्तोना' गीतिका का ६ छठा श्लो. अर्थात् चार हाथ का पुरुष होता है यह आर्यभटोक्त हैं इति ॥१५॥

इदानीं भूव्यासस्य प्राधान्यं वर्णयति।

भूव्यासस्याज्ञानाद् व्यर्थं देशान्तरं तदज्ञानात् ।
स्फुटतिथ्यन्ताज्ञानं तिथिनाशाद् ग्रहणयोर्नाशः ॥१६॥

सु. भा.—भूव्यासस्याज्ञानाद् देशान्तरं व्यर्थमशुद्धं भवति। तदज्ञानाद्देशान्तराज्ञानात् स्फुटतिथ्यन्तस्याज्ञानम्। तिथिनाशाद् ग्रहणयोर्नाश इति प्रसिद्धमेव ॥ १६ ॥

वि. भा.—भूव्यासस्याज्ञानात् देशान्तरं व्यर्थ (अशुद्धं) भवति, तदज्ञानात् (देशान्तराज्ञानात्) स्फुटतिथ्यन्तस्याज्ञानम् तिथिनाशाद् ग्रहणयोर्नाश इति ॥१६॥

अत्रोपपत्तिः।

भूकेन्द्रान्नाड़ीवृत्तस्य प्रति बिन्दौ रेखा नेयास्ता भूबिम्बे यत्र लग्नास्तदा कृतिर्वृत्ताकारा भवति तदेव वृत्त स्फुटभूपरिधिः। स्वपृष्ठस्थानाद् ध्रुवयष्टच्युपरि यो लम्बस्तदेव स्फुटभूपरिधिव्यासार्धम्। भूकेन्द्रात्स्वपृष्ठस्थानं यावद् भूव्यासार्ध कर्णः। स्फुटभूव्यासार्ध कोटिः। भूकेन्द्रात्कोटिमूलं यावद् भुजः। अत्र त्रिभुजे भूकेन्द्रलग्नकोणो लम्बांशास्ततोऽनुपातो यदि त्रिज्यया भूव्यासार्धं लभ्यते तदा लम्बज्यया किं लब्धं स्फुटभूपरिधिव्यासार्धम् $= \frac{\text{लंज्या. भूव्या}\frac{1}{2}}{\text{त्रि}}$ ततो भूव्यासार्धेन भूपरिधिर्लभ्यते तदा स्फुटभूपरिधिव्यासार्धेन किं समागतः स्फुटभूपरिधिः-

$= \frac{\text{भूप} \times \text{स्फुभूप}}{\text{भूव्या} \frac{1}{2}} = \frac{\text{भूप} \times \text{लंज्या} \times \text{भूव्या} \frac{1}{2}}{\text{त्रि. भूव्या} \frac{1}{2}} = \frac{\text{भूप. लंज्या}}{\text{त्रि}}$, स्वस्फुटभूपरिधि-लंङ्कायाम्योत्तरे यत्र लगति तस्मात् स्वपृष्ठस्थानपर्यन्त स्फुटभूपरिधौ यद्योजनात्मकं चापं तदेव योजनात्मकं देशान्तरम् । स्फुटभूपरिधिज्ञान भूव्यासाधीनमस्ति, यदि भूव्यासमानमशुद्धं तदा स्फुटभूपरिधिमानमप्यशुद्धं भवेत् । स्फुटभूपरिधेरधोनं देशान्तरम्, तथास्फुटभूपरिधियोजनैर्यदि षष्टिघटिका लभ्यन्ते तदा देशान्तरयोजनैः कियत्य इति लब्धं घटिकादितिथिषु ऋण धनं वा कार्यं तदा स्पष्टातिथिर्भवति, एवमेव क्रियाकरणेन स्पष्टदर्शान्तस्य पूर्णान्तस्य च ज्ञानं भवति, यदि देशान्तरमशुद्धं तदा दर्शान्तपूर्णान्तयोरप्यशुद्धत्वाद्रविचन्द्रग्रहणयोरप्यशुद्धत्वं भवेदतो भूव्यासस्य शुद्धस्याज्ञानाद् बह्व्य आपत्तय आगच्छन्ति, आचार्येण कथ्यते यदार्यभटोक्तभूव्यासो न समीचीनोऽस्ति, तदसमीचीनत्वे तूपरि प्रदर्शिता आपत्तयः समाग च्छन्ति, भूव्याससम्बन्धे बहूनामाचार्याणां बहूनि संमतानि सन्ति । यथा 'भूपरिधिः खखखशरा' इत्याचार्योक्तभूपरिधिः । सिद्धान्तशेखरे 'योजनैः खखखवाण संमितैर्भूमिगोलपरिधिः प्रकीर्तितः । तस्य योजनमया च विस्तृतिर्भूभुजङ्गविषयामृतांशवः' अनेन श्रीपतिराचार्य सदृश एव भूपरिधिरुक्तः । सूर्यसिद्धान्ते 'तद्वर्गतो दशगुणात् पदं भूपरिधिर्भवेत्' अनेन तस्य भूव्यासस्य वर्गाद् दशगुणात् पदं (वर्गमूलं) भूपरिधिर्भवेदिति सूर्यसिद्धान्तकारेण कथितः । सुधावर्षिण्यां सूर्य सिद्धान्तटीकायां म. म. सुधाकर द्विवेद्विना "तद्वर्गतोऽदश गुणादि" त्यत्र न दशेत्यदश किञ्चिन्न्यूना दशतैर्गुणाद् भूव्यासवर्गात्पदं भूपरिधिः, एव लिखितः । दशगुणक एव समीचीन इति कमलाकरेण सौरवासनायां सिद्धान्ततत्वविवेके च सर्वं युक्तिशून्यं प्रलपितम् । रङ्गनाथेन स्वगूढार्थप्रकाशे दशगुणकः स्थूल उक्तः सौरभाष्ये नृसिहेनापि दश गुणक एव स्वीकृतः । लल्लभास्करादिमतेष्वपि भूपरिधोर्विभिन्नत्वं समुपलभ्यते । वस्तुतो व्यासात्परिध्यानयनं परिधेर्व्यासानयनं वा सूक्ष्मं कथमपि भवत्येव नहि । भूव्यासज्ञाने वेध एव शरणमिति ॥१६॥

अब भूव्यास की प्रधानता को कहते है ।

हि॰ भा॰—भूव्यास के अज्ञान (यथार्थज्ञान) से देशान्तर अशुद्ध होता है, देशान्तर के अज्ञान (शुद्ध देशान्तर के नहीं ज्ञान) से स्फुट तिथ्यन्त का ज्ञान नहीं होता है, तिथिनाश (स्फुट तिथ्यन्त के नहीं ज्ञान) से चन्द्रग्रहण और सूर्यग्रहण का नाश होता है अर्थात् वास्तव ज्ञान नहीं होता है इति ॥१६॥

उपपत्ति

भूकेन्द्र से नाड़ीवृत्त के प्रतिबिम्ब में रेखायें लाना, वे भू बिम्ब में जहां-जहां लगती हैं उनकी आकृति वृत्ताकार होती हैं वही वृत्त स्फुट भू परिधि है, स्वपृष्ठस्थान से ध्रुवयष्टि के ऊपर जो लम्ब रेखा होती है वह स्फुट भू परिधि व्यासार्ध है, भूकेन्द्र से स्वपृष्ठ स्थान पर्यन्त

भूव्यासार्ध कर्ण, स्फुट भूव्यासार्ध कोटि, भूकेन्द्र से कोटिमूल पर्यन्त भुज, इस त्रिभुज में भूकेन्द्र लग्न कोणलम्बांश है तब अनुपात करते है यदि त्रिज्या में भूव्यासार्ध पाते हैं तो लम्बज्या में इससे स्फुट भूपरिव्यासार्ध आता है, $\frac{\text{लंज्या. भूव्या}\frac{1}{2}}{\text{त्रि}}$ = स्फुट भूपरिधिव्यासार्ध, पुनः अनुपात करते हैं यदि भूव्यासार्ध से भूपरिधि पाते हैं तो स्फुटभूपरिधि व्यासार्ध में क्या इससे स्फुट-भूपरिधिमान आता है $\frac{\text{भूपरिधि. स्फुट भूपरिधिव्या}\frac{1}{2}}{\text{भूव्या}\frac{1}{2}}$ = स्फुट भूपरिधि = $\frac{\text{भूप. लज्या. भूव्या}\frac{1}{2}}{\text{त्रि. भूव्या}\frac{1}{2}}$ = $\frac{\text{भूप. लंज्या}}{\text{त्रि}}$, स्व स्फुट भूपरिधि लङ्कायाम्योत्तर वृत्त मे जहां लगती है वहां से स्वपृष्ठ स्थान पर्यन्त उस स्फुट भूपरिधि में जो योजनात्मक चाप है वही योजनात्मक देशान्तर है, स्फुट भूपरिधिज्ञान भूव्यासाधीन है, यदि भूव्यास का मान अशुद्ध होगा तब स्फुट भूपरिधि मान भी अशुद्ध होगा, देशान्तर स्फुटपरिधि के अधीन है, तथा यदि स्फुट भूपरिधि योजन में साठ घटी पाते हैं तो देशान्तर योजन में क्या इससे लब्ध घटिकादि देशान्तर को तिथि घटी में ग्रहवत् ऋण वा धन करना चाहिये। तब स्फुट तिथि होती है, इसी तरह क्रिया करने से स्पष्ट दर्शान्ति और स्पष्ट पूर्णान्ति का ज्ञान होता है, यदि देशान्तर अशुद्ध रहेगा तब दर्शान्ति और पूर्णान्ति के भी अशुद्ध रहने के कारण सूर्य ग्रहण और चन्द्रग्रहण भी अशुद्ध ही होगा इसलिये शुद्धभूव्यास का ज्ञान न होने से अनेक आपत्तियां आती है। आचार्य कहते है कि आर्यभटोक्त भूव्यास ठीक नहीं है, उसके ठीक न रहने से उपर्युक्त अनेक आपत्तियां आती हैं, भूव्यास के विषय में भिन्न-भिन्न आचार्यों का भिन्न-भिन्न मत है, जैसे आचार्य के मत से भूपरिधि=५००० सिद्धान्त शेखर में श्रीपति भी भूपरिधि योजन=५००० और भूव्यास योजन=१५८१, सिद्धान्त शिरोमणि में भास्कराचार्य ने भूपरिधियोजन=४९६७ तथा भूव्यास=१५८१$\frac{\text{१}}{\text{२४}}$ कहा है, सूर्य सिद्धान्त में भूव्यासयोजन=१६००, एवं लल्ल आदि आचार्य ने भी भूव्यास और भूपरिधि के विषय में भिन्न भिन्न मान कहा है। वस्तुतः व्यास से परिधि का आनयन या परिधि से व्यास का सूक्ष्म आनयन हो ही नही सकता है। भूव्यास के ज्ञान में वेध ही शरण है। आचार्यों को वेध से जितना भूव्यास उपलब्ध हुआ अपने अपने ग्रन्थ में लिख दिया है इति ॥१६॥

इदानीमार्यभटोक्तभूभ्रमणं खण्डयति।

प्राणेनैति कलां भूर्यदि तर्हि कुतो व्रजेत् कमध्वानम्।
आवर्त्तनमुर्व्याश्चेन्न पतन्ति समुच्छ्रयाः कस्मात् ॥१७॥

सु. भा.—आर्यभटेन भूश्चला भगणाः स्थिरा इति कल्पितम्। यथाऽन्येऽहोरात्रासुभिर्भभ्रमादेकं भदिनं मन्यन्ते तथाऽऽर्यभटोऽहोरात्रासुभिः स्वाक्षोपरि भूभ्रमणं मन्यते। तेनायमर्थः। यदि भूः प्राणेनैकेनासुना एकां कलामेति गच्छति तर्हि नरः कुतः कस्मात् स्थानात् कमध्वानं कं मार्गं व्रजेत्। अर्थात् मानवाः

श्येनादयः पक्षिणश्च पृथिव्याः प्राग्भ्रमणेन स्वस्थानतोऽन्यत्र गताः पुनः स्वस्थानं न प्राप्नुयुस्तथोर्व्या भूमेर्यद्यध ऊर्ध्वमावर्त्तन भ्रमण भवेत् तर्हि समुच्छ्र्याः प्रासाद-भूधरादयः कस्मान्न पतन्ति। अतो भूमेः प्राग्भ्रमण नेत्याचार्याशयः। भूवायु-सहिताया भूमेः प्राग्भ्रमणं भवतीत्यज्ञात्वाऽऽचार्येणेद खण्डितमतोऽसद्दूपणमेतत्।

तथाचार्यभटः।

अनुलोमगतिर्नौरथः पश्यत्यचलं विलोमग यद्वत्।
अचलानि भानि तद्वत् समपश्चिमगानि लङ्कायाम्।

अत्रार्यभटाभिप्रायमबुद्ध्वैव परमेश्वरेण स्वटीकायामन्यथा व्याख्यातं तत् सुधीभिर्नादरणीयमिति। यदि परमेश्वरव्याख्या समोचीना स्यात् तर्हि ब्रह्मगुप्त खण्डनस्यावसरो नैव भवेत् 'प्राणेनैति कलां भ'मिति तत्प्रकल्पितः पाठोऽपि नार्य-भटसंमत इति सुधीभिर्भृश विचिन्त्यम् ॥ १७ ॥

वि. भा.—आर्यभटेन भूश्चला भगणाः स्थिरा इति कल्पितम्। यथाऽन्येऽहो-रात्रासुभिर्भभ्रमादेकं भदिन मन्यन्ते तथैवार्यभटो ऽहोरात्रासुभिः स्वाक्षोपरि भूभ्रमणं मन्यते। तेनायमर्थः-यदि भूः प्राणेन (एकेनासुना) एकां कलामेति (गच्छति) तर्हि नरः कुतः (कस्मात् स्थानात्) कमध्वानं (कं मार्गं) व्रजेत्। अर्थात् मनुष्याः पक्षिणश्च पृथिव्याः पूर्वाभिमुखभ्रमणेन स्वस्थानतोऽन्यत्रगताः पुनः स्वस्थानं न प्राप्नुयुः। तथा उर्व्याः (भूमेः) यद्यध ऊर्ध्वं वा आवर्त्तनं (भ्रमणं) भवेत्तदा समुच्छ्रयाः (प्रासादपर्वतादयः) कस्मात्कारणात् न पतन्ति, अतो भूमेः पूर्वाभिमुखं भ्रमणं न भवतीत्याचार्याभिप्रायः। सूर्यसिद्धान्तकारेण "मध्ये समन्तादण्डस्य भूगोलो व्योम्नि तिष्ठति। बिभ्राणः परमां शक्तिं ब्रह्मणो धारणा-त्मिकाम्" ऽनेन भुवः स्थिरत्वमेवोक्तम्। लल्लभास्करप्रभृतय आचार्या भुवः स्थिरत्वमेवोक्तवन्तः। आकाशे ये किल ग्रहादिपिण्डास्ते सर्वे सततं भ्रमन्त्येव तर्हि प्राचीनैरस्मज्ज्यौतिषसिद्धान्तकारैः कथं भुवः स्थिरत्वं प्रतिपादितम्, तत्रेदं कारणं यद्यस्य गोलस्य पृष्ठे द्रष्टा तिष्ठति तं गोलमचलं मन्यतेऽन्ये च गोलास्त-द्दशतो भ्रमन्त इव भान्त्यत आचार्यैर्भूगोलपृष्ठवास्यभिप्रायेण 'आकाशे निराधारे ब्रह्मणो धारणात्मिकां शक्तिं धारयन् भूगोलस्तिष्टति" त्युक्तम्। भूवायु-सहिताया भूमेः प्राग्भ्रमणं भवतीत्यज्ञात्वा ऽऽचार्येणार्यभटोक्तभूभ्रमणं खण्ड्यते. वस्तुत आचार्यखण्डनमिदं न समोचीन मिति विज्ञैर्विविच्य ज्ञेयम् ॥१७॥

अब आर्यभटोक्त भूभ्रमण का खण्डन करते हैं।

हि. भा.—आर्यभट पृथ्वी को चल और भगणों (नक्षत्रों) को स्थिर मानते हैं। जैसे अन्य आचार्य लोग अहोरात्रासु में नक्षत्र भ्रमण से भदिन (नाक्षत्र दिन) को मानते

हैं वैसे आर्यभट अहोरात्रासु में अपने अक्ष के ऊपर भूभ्रमण (पृथ्वी के चलन) को मानते हैं। तब श्लोक का यह अर्थ होता है कि यदि भू (पृथ्वी) एक असु में एक कला चलती है तो मनुष्य किस स्थान से किस मार्ग में जाता है अर्थात् मनुष्य और पक्षी गण पृथ्वी के पूर्वाभिमुख भ्रमण से अपने स्थान से अन्यत्र गये हुए पुनः अपने स्थान को नहीं प्राप्त करेंगे अर्थात् अपने स्थान में नहीं आयेंगे। तथा यदि पृथ्वी का भ्रमण नीचे या ऊपर होता है तो कोठा पर्वत क्यों नहीं गिरते है—इसलिये पृथ्वी का पूर्वाभिमुख भ्रमण नहीं होता है यह आचार्य का अभिप्राय है। सूर्य सिद्धान्तकार ने "मध्ये समन्तादण्डस्य भूगोलो व्योम्नि तिष्ठति" इत्यादि सं. भाष्य मे लिखित श्लोक से पृथ्वी का स्थिरत्व ही कहा है, लल्लाचार्य-भास्कराचार्य आदि सब आचार्यों ने पृथ्वी का स्थिरत्व ही कहा है। आकाश मे जितने ग्रहादि पिण्ड हैं वे सब सतत भ्रमण करते ही है तब हमारे प्राचीन ज्यौतिषाचार्यो ने क्यों पृथ्वी को स्थिर माना है क्योंकि पृथ्वी पिण्ड भी तो आकाश ही में है, इस में यह कारण है कि जिस गोल के पृष्ठ के ऊपर द्रष्टा रहते है वे उसगोल को अचल (स्थिर) मानते हैं, अन्य गोल उसके वश से भ्रमण करते हुए मालूम पडते हैं इसलिये प्राचीनाचार्यो ने भूपृष्ठ वासी लोगों के अभिप्राय से 'आकाश में निराधार और ब्रह्म की धारणात्मक शक्ति को धारण किये हुए भूगोल है' कहा है, भू वायु से युक्त पृथ्वी का पूर्वाभिमुख भ्रमण होता है इस बात को न समझ कर आचार्य आर्यभटोक्त भूभ्रमण का खण्डन करते हैं। वस्तुतः आचार्य का यह खण्डन बिलकुल असङ्गत है इसको विज्ञ लोग विचार कर समझें इति ॥१७॥

इदानीमार्यभटोक्तमन्दपरिधिं खण्डयति।

औदयिको यः परिधिर्विषमेऽन्योऽन्यः समे भुजस्य गुणः।
तदसद्विषमान्तफलं यतो न युग्मादि फल तुल्यम् ॥ १८ ॥

सु. भा.—आर्यभटेन भौमादीनां परिधयो विषमपदेऽन्ये समे चान्ये पठिताः। ततः समपदीयकेन्द्रभुजज्या समपदीयमन्दपरिधिगुणा भांशहृता फलचापं मन्दकलाः। एवं विषमपदीयकेन्द्रभुजज्या विषमपदीयमन्दपरिधिगुणा भांशहृता फलचापं मन्दकलाः। तेनायमर्थः। आर्यभटेन विषमेऽन्यः समे पदे चान्यो य औदयिको मन्दपरिधिर्भुजस्य मन्दकेन्द्रभुजज्याया गुणः पठितस्तदसदस्ति। यतः सन्धिस्थाने ओजान्ते युग्मादौ च विषमपदीयपरिधिना यद्विषमान्ते फलं तदेव तदन्येन समपदीयपरिधिना युग्मादौ यत्फलं तेन न तुल्यम्। असद्दूषणमेतत्। आर्यभटेन पदयोः परिधिपाठभेदादवान्तरेऽनुपाततः परिधिर्ग्राह्य इति सूचितम्। एवमिष्टकालिकमन्दपरिधिवशान्न फलभेदः।

तथा चार्यभटः—

ङार्धानि मन्दवृत्तं शशिनः छ ग छ घ ढ छ झ यथोक्तेभ्यः। झ गड़ गल कल

दृड तथा शनिगुरुकुजभृगुबुधोच्चशीघ्रेभ्यः । मन्दात् ङ खदजडा वक्रिणां द्वितीये पदे चतुर्थे च । जा ण क्ल छ्ल झ्नोच्चाच्छीघ्रात् गियिङश कुवायुकक्षाऽन्त्या ॥

झार्धानि सार्वैश्चतुर्भिरपर्वर्तितानि वृत्तानि ज्ञेयानि । यथोक्तेभ्यः सूर्यबुधशुक्रकुजगुरुशनिभ्यः ।

वक्रिणां बुधशुक्रकुजगुरुशनीनाम् ।
चन्द्रस्य मन्द परिधिः=७ । सूर्यस्य ३ ।
अन्येषां प्रथमतृतीयपदयोः । बु० ७ । शु० ४ । कु० १४ । गु० ७ । श० ९
द्वितीयचतुर्थपदयोः । बु० ५ । शु० २ । कु० १० । गु० ८ । श० १३
एवं शन्यादीनां शीघ्र परिधयः ।
प्रथमतृतीयपदयोः श० ९ । गु० १६ । कु० ५३ । शु० ५९ । बु० ३१
द्वितीयचतुर्थपदयोः । श० ८ । गु० १५ । कु० ५१ । शु० ५७ । बु० २९
इह संख्यासङ्केतार्थं गणकतरङ्गिणी द्रष्टव्या ॥ १८ ॥

वि. भा.—आर्यभटेन विषमपदे समपदेच कुजादिग्रहाणां मन्दपरिधयो भिन्ना भिन्नाः पठितास्ततः 'स्वेनाहते परिधिना भुजकोटिजीवे भांशैरि' त्यादिना समपदीयकेन्द्रज्या समपदीय मन्दपरिधिगुणा भांशैर्भक्ता फलचाप मन्दफलकला भवन्ति । एवं विषमपदीयकेन्द्रज्या विषमपदीयमन्दपरिधिगुणा भांशैर्भक्ता फलचाप मन्दफलकला भवन्ति । तेनायमर्थः —आर्यभटेन विषमे पदेऽन्यः समे पदे चान्यो य औदयिको मन्दपरिधिर्भुजस्य (मन्दकेन्द्रभुजज्यायाः) गुणः पठितस्तदसदस्ति । यतः सन्धिस्थाने (विषमपदान्ते समपदादौ च) विषम पदीयपरिधिना विषमान्ते यत्फलं भवति तत्तुल्य मेवसमपदीयपरिधिना समपदादौ फलं न भवति । परन्तु तयोः फलयोस्तुल्यत्वमेव भवितुमर्हति, तस्मादार्यभटोक्त मन्द परिधिर्न समीचीन इत्याचार्यः कथयति । पदयोः परिधिपाठभेदादवान्तरेऽनुपाततः परिधिरानेय इत्यार्यभटेन सूचितम् । एवमिष्टकालिक मन्दपरिधिवशान्न फलभेदः अत्राऽर्यभटोक्तवाक्यानि ।

झार्धानि मन्दवृत्तं शशिनः छ ग छ घ ढ छ झ यथोक्तेभ्यः ।
झगडग्लक्लदृड तथा शनि गुरु कुज भृगुबुधोच्चशीघ्रेभ्यः ॥
मन्दात् ङ ख द ज डा वक्रिणां द्वितीये पदे चतुर्थे च ।
जा ण क्ल छ्ल झ्नोच्चाच्छीघ्रात् गियिङश कुवायु कक्षाऽन्त्या ॥

झार्धानि सार्थैश्चतुर्भिरपवर्त्तितानि वृत्तानि ज्ञेयानि, यथोक्तेभ्यः (सूर्यबुधशुक्रकुजगुरुशनिभ्यः), वक्रिणाम् (बुधशुक्रकुजगुरुशनीनाम्), चन्द्रस्य मन्द-

परिधिः=७, सूर्यस्य मन्दपरिधिः=३ अन्येषां ग्रहाणां प्रथम तृतीय पदयोर्मन्द-परिधयः-बुधस्य=७, शुक्रस्य=४, कुजस्य=१४, गुरोः=७, शनेः=९ तथा द्वितीयचतुर्थपदयोर्मन्दपरिधयः- बुधस्य=५, शुक्रस्य=२, कुजस्य=१०, गुरोः=८, शनेः=१३ एवं शन्यादीनां शीघ्रपरिधयः प्रथमतृतीयपदयोः- शनेः=९, गुरोः=१६, कुजस्य=५३, शुक्रस्य=५९, बुधस्य=३१ द्वित्तीयचतुर्थपदयोश्च शनेः=८, गुरोः=१५, कुजस्य=५१, शुक्रस्य=५७, बुधस्य= २९ अत्र संख्या सकेतज्ञानार्थ म. म. सुधाकरद्विवेदिरचितगणकतरङ्गिणी द्रष्टव्येति । अत्राऽऽचार्येणार्यभटोक्तपठितविषमपदीयसमपदीययोर्मन्दपरिधिभागयोः खण्डनं यत्कृतं तन्न युक्तमित्युपरिलिखित भाष्यतः स्फुटमिति ।

अत्रोपपत्तिः ।

विष्णुधर्मोत्तरपुराणान्तर्गतस्य ब्रह्मसिद्धान्तस्य स्फुटकर्त्रा ब्रह्मगुप्तेन (आचार्येण) रविचन्द्रयोर्भिन्नान् भिन्नान् मन्दपरिध्यंशान् वेधेनोपलभ्य पठिताः। प्रागुन्मण्डलस्थे रवौ रवेर्धनफले तन्मन्दपरिध्यंशाद्याः=१३°।२०′, मध्यान्हे तन्मन्द-परिध्यंशाद्याः=१३°।४०′, पश्चिमोन्मण्डलस्थे रवौ तन्मन्द परिध्यंशाद्याः=१४°।० ऋणफले प्रागुन्मण्डलस्थे रवौ मन्दपरिध्यंशाद्याः=१४°।०, मध्यान्हे मन्दपरिध्यं-शाद्याः=१३°।४०′, पश्चिमोन्मण्डलस्थे रवौ तन्मन्द परिध्यंशाद्याः=१३°।२०′

चन्द्रस्य धनफले प्रागुन्मण्डलस्थे चन्द्रे तन्मन्दपरिध्यंशाद्याः					=३०°।४४′
,,		मध्यान्हे	,,	,,	=३१°।३६′
,,		पश्चिमोन्मण्डलस्थे	,,	,,	=३०°।४४′
चन्द्रस्य ऋण फले प्रागुन्मण्डलस्थे चन्द्रे तन्मन्दपरिध्यंशाद्याः					=३०°।४४′
,,	,,	मध्यान्हे	,,	,,	=३१°।३६′
	,,	पश्चिमोन्मण्डलस्थे	,,	,,	=३२°।२८′

कुजादिग्रहाणां मन्दपरिध्यंशाः क्रमेण ७०, ३८, ३३, शुक्रस्य समपदान्ते =११, विषम पदान्ते=९, शनेः=३० आचार्य मतेन सूर्यस्य धने ऋणे च मन्द-फले विंशतिकलाभिर्हीनाश्चतुर्दशांशा तन्मध्याह्नपरिधिर्भवति, प्रागुन्मण्डलस्थे रवौ विंशतिकलाभिः सहितो हीनश्च मध्याह्नपरिधिः परिधिर्भवति, पश्चिमो-न्मण्डलस्थे रवौ च विंशतिकलाभिर्हीनः सहितश्च मध्यान्हपरिधिः परिधिर्भवति। चन्द्रस्य ऋणे धने च फले चतुर्विंशतिकलाभिर्हीना द्वात्रिंशदशामध्याह्न परिधि-र्भवति। प्रागुन्मण्डलस्थे चन्द्रे द्विपञ्चाशत्कलाभिर्हीनो मध्याह्नपरिधिः परिधि-र्भवति पश्चादुन्मण्डलस्थे चन्द्रे द्विपञ्चाशत्कलाभिर्हीनोऽधिकश्च मध्यान्हपरिधिः परिधिर्भवति। आचार्योक्त वाक्यम् ।

सूर्यस्यमनु द्वितयं त्र्यंशोनं दिनदले नतस्य प्राक् ।
तिथिघटिकाभिस्त्र्यंशाविकोनमूनाधिकं पश्चात् ॥
द्युदले जिनलिप्तोनं दशतद्वितयं द्विशरकलोन प्राक् ।
पश्चाद्युतोनमिन्दोः सूर्यस्य ऋणे धने परिधिः ॥

लघ्वार्यभटैः सर्वेषां ग्रहाणां मन्दान्त्यफलज्यां नत्परिधीश्च वेधेनाऽऽनीय सार्धचतुर्भिरपवर्त्य पठिताः । पूर्व भाष्ये 'ङार्धानि मन्दवृत्तं शशिन' इत्यादिना ग्रहाणां ये मन्दपरिध्यंशाः पूर्व लिखिताः सन्ति ते सार्धचतुर्भिरपवर्त्तिताएव, तेन ते अपवर्त्तित परिध्यंशाः सार्धचतुर्भिर्गुणितास्तदा वास्तवाः परिध्यंशा भवन्ति, यथा रवेः=१३° । ३०′, चन्द्रस्य=३१° । ३०′, कुजस्य=६३०, बुधस्य=३१° । ३०′ गुरोः=३१° । ३०′, शुक्रस्य=१८°, शनेः=४०° । ३०′, आर्यभटाऽऽचार्यपठित परिध्योः किञ्चिदन्तरं भवतीति प्रत्यक्षदर्शनेनैव स्फुटम् । सूर्यसिद्धान्त मतानुसारेण समपदान्ते रविमन्दपरिध्यंशाः=१४°, चन्द्रस्य=३२°, विषम पदन्ते रविमन्द परिध्यंशाः=१३° । ४०′, चन्द्रस्य—३१° । ४०′ कुजादि ग्रहाणां सम पदान्ते मन्द परिधयः क्रमेण ७५°, ३०°, ३३°, १२°, ४९°, विषम पदान्ते च क्रमेण तेषां मन्द-परिध्यंशाः=७२°, २८°, ३२°, ११°, ४८° तथा च तद्वाक्यम् ।

"रवेर्मन्द परिध्यंशा मनवः शीतगोरदाः ।
युग्मान्ते विषमान्ते च नखलिप्तोनितास्तयोः ॥
युग्मान्तेऽर्थाद्रयः खाग्निसुराः सूर्या नवार्णवाः ।
ओजेद्वचगा वसुयमा रदारुद्रा गजाब्धयः ॥"

लल्लाचार्यस्त्वार्यभटमतानुसारेणैव परिध्यंशा लिखिताः । भास्कराचार्येण शनैश्चरातिरिक्तानां ग्रहाणां परिधय आचार्योक्तानुसारेणैव लिखिताः सन्ति, मन्दान्त्यफलज्यामानं सर्वदा न स्थिरमतः स्वस्वसमयोपलब्धान्त्यफलज्या मानवशेनाऽऽचार्यैभिन्ना भिन्नाः परिध्यंशाः पठिताः । आचार्येण दुराग्रहवशात आर्यभटोक्त-विषमपदीयसमपदीयपठितपरिध्यंशयोः खण्डनं कृतमिति सुधीभिर्ज्ञेयम् ॥ १८ ॥

अब आर्यभटोक्त मन्दपरिधि का खण्डन करते हैं ।

हि॰ भा.—आर्यभट ने विषम पद में और सम पद में कुजादि ग्रहों का मन्द परिध्यंश भिन्न भिन्न पठित किया है तब 'स्वेनाहते परिधिना भुज कोटि जीवे भांशैः' इत्यादि से समपदीय केन्द्रज्या को समपदीय मन्दपरिधि से गुणा कर भांश ३६० से भाग देने से जो लब्ध हो उसका चाप मन्द फलकला होती है, एवं विषमपदीय केन्द्रज्या को विषमपदीय मन्द-परिधि से गुणा कर भाश ३६० से भाग देने से जो लब्ध हो उसका चाप मन्द फल कला होती है, अब इससे श्लोक का अर्थ ऐसा होता है कि आर्यभट ने विषम पद में अन्य और समपद में अन्य जो औदयिक मन्द परिधि मन्द केन्द्र भुजज्या का गुणक पठित किया है सो ठीक

नहीं है, क्योंकि सन्धिस्थान (विषम पदान्त और समपदादि) में विषम पदीय परिधि से जो फल होता है तत्तुल्य ही समपदीय परिधि से समपदादि में फल नही होता है। लेकिन उन दोनों फलों का तुल्य होना उचित है। इसीलिए आर्यभटोक्त मन्दपरिध्यश ठीक नही है यह आचार्य कहते है। दोनों पदो में परिधि पाठभेद से अवान्तर में अनुपात से परिध्यानयन करना चाहिए यह बात आर्यभट ने सूचित कर दी है। एव इष्ट कालिक मन्द परिधि वश से फल में भेद नहीं होता है। यहां आर्यभटोक्त वाक्य है "झार्धानि मन्दवृत्त शशिन:" इत्यादि स० भाष्य में लिखित पद्यों को देखिये। यहां झार्ध से साढे चार ९/२ से अपवर्त्तित परिधि समझनी चाहिये। यथोक्त 'सूर्य, बुध, शुक्र, कुज, गुरु, शनि' से, वक्री 'बुध, शुक्र, कुज, गुरु, शनि' ग्रहों के चन्द्र की अपवर्तित मन्द परिधि=७°, सूर्य की अपवर्त्तित मन्द परिधि=३°, अन्य ग्रहों की प्रथम और तृतीय पद में अपवर्त्तित मन्द परिधि=बुध की=७, शुक्र की=४, कुज की=१४, गुरु की=७, शनि की=९ तथा द्वितीय और चतुर्थ पद मे मन्द परिधि=बुध की=५, शुक्र की=२, कुज की=१०, गुरु की=८, शनि की=१३ एव शनि आदि ग्रहों की प्रथम पद में और तृतीय पद में शीघ्र परिधि=शनि की=९, गुरु की=१६, कुज की=५३, शुक्र की=५९, बुध की=३१, द्वितीय पद मे तथा चतुर्थ पद मे शनि की=८, गुरु की=१५, कुज की=५१, शुक्र की=५७, बुध की=२९

यहां आर्यभटोक्त पद्यो की सख्या सङ्केत ज्ञान के लिये म. म. सुधाकर द्विवेदिरचित गणकतरङ्गिणी को देखिये। यहां आचार्य आर्यभटोक्त पठित विषमपदीय और समपदीय मन्द परिध्यंश का खण्डन जो किये हैं सो ठीक नही हैं यह ऊपर लिखित भाष्य से स्पष्ट है।

उपपत्ति।

विष्णुधर्मोत्तर पुराणान्तर्गत ब्रह्मसिद्धान्त के स्फुट कर्त्ता आचार्य (ब्रह्मगुप्त) ने रवि और चन्द्र के वेध से भिन्न भिन्न मन्द परिध्यश को उपलब्ध कर पठित किया है, पूर्व उन्मण्डल स्थित रवि के रहने से रवि के धनफल मे उनके मन्द परिध्यंशादि=१३°।२०', मध्याह्न में उनके मन्द परिध्यंशादि=१३°।४०', पश्चिम उन्मण्डलस्थित रवि मे उनके मन्द-परिध्यशादि=१४°।०, ऋणफल में पूर्व उन्मण्डल स्थित रविमें मन्द परिध्यशादि=१४°।०, मध्याह्न में मन्द परिध्यंशादि=१३°।४०', पश्चिम उन्मण्डलस्थ रवि में मन्दपरिध्यंशादि =१३°।२०', चन्द्र के धनफल में पूर्व उन्मण्डलस्थ चन्द्र मे चन्द्रमन्दपरिध्यशादि=३०°।४४'

" " मध्याह्न में " =३१°।३६'

" " पश्चिम उन्मण्डलस्थ " " =३०°।४४'

चन्द्र के ऋण फल में पूर्व उन्मण्डलस्थ चन्द्रमें चन्द्रमन्द परिध्यंशादि		=३०°।४४′
,, ,, मध्याह्न में ,, ,,		=३१°।३६′
,, ,, पश्चिम उन्मण्डलस्थ चन्द्र में ,,		=३२°।२८′

कुजादि ग्रहों के क्रम से मन्द परिध्यंश=७०, ३८।३३ शुक्र के सम पदान्त में =११, विषम पदान्त मे=९, शनि के=३० आचार्य के मत से सूर्य के धनफल में वा ऋणफल मे चौदह अंश में बीस कला को घटाने से उनके मध्याह्न परिध्यंश होते हैं। पूर्व उन्मण्डल स्थित रवि में मध्याह्न मन्द परिध्यंश में बीसकला को जोडने और घटाने से परिध्यंश होते हैं। पश्चिम उन्मण्डल में रवि के रहने से मध्याह्न परिध्यंश में बीस कला को घटाने से और जोडने से परिध्यंश होते हैं। चन्द्र के ऋण फल में और धन फल मे बत्तीस अंश में चौवीश कला को घटाने से मध्याह्न परिध्यंश होते हैं। पूर्व उन्मण्डल में चन्द्र के रहने से मध्याह्न परिधि में बावन कला को घटाने से परिध्यंश होते है। पश्चिम उन्मण्डल मे चन्द्र के रहने से मध्याह्न परिधि में बावन कला को घटाने से और जोडने से परिध्यंश होते हे। यहा आचार्योक्त वाक्य यह है "सूर्यस्य मनुद्विलिप्त्यंशोन दिनदले नतश्च प्राक्। नियि घटिकाभि." इत्यादि स० उपपत्ति में लिखित पद्यो को देखिये। लघ्वार्यभट ने सब ग्रहो की मन्दान्त्य फलज्या और मन्दपरिध्यंश को वेध से लाकर साढे चार से अपवर्त्तित कर पठित किया। पहले 'भार्धानि मन्द वृत्तं" इत्यादि से ग्रहो के जो मन्द परिध्यंश लिखे गये है वे साढे चार से अपवर्त्तित परिध्यंश ही हैं। इसलिये उन अपवर्त्तित मन्द परिध्यंश को साढे चार से गुणा कर देने से आचार्योक्त वास्तव परिध्यंश होते हैं। जैसे रवि के=१३°।३०′, चन्द्र के=३१°।३०′ कुज के=६३०, बुध के=३१°।३०′, गुरु के=३१°।३०′, शुक्र के=१८°, शनि के=४०°।३०′, आर्यभटोक्त पठित परिध्यंश में और आचार्योक्त पठित परिध्यंश थोडा ही अन्तर पड़ता है। सूर्य सिद्धान्तमतानुसार समपदान्त में रवि मन्द परिध्यंश=१४°, चन्द्र के=३२°, विषमपदान्त में रविमं परिध्यंश=१३°।४०′, चन्द्र के=३१°।४०′, कुजादि ग्रहों के क्रम से समपदान्त में मन्दपरिध्यंश=७५°, ३०°, ३३°, १२°, ४९°, विषम पदान्त मे क्रम से उनके मन्द परिध्यंश=७२°, २८°, ३२°, ११°, ४८°, उनके वाक्य ये हैं।

'रवेर्मन्द परिध्यंशा मनवः शीतगो रदाः' इत्यादि स० उपपत्ति मे लिखित पद्यों को देखिये।

आर्यभटमतानुसार ही लल्लाचार्य ने परिध्यंश लिखे हैं। भास्कराचार्य ने शनैश्चर को छोड़कर अन्य ग्रहों के परिध्यंश आचार्योक्तानुसार ही लिखे है, मन्दान्त्यफलज्या का मान सदा स्थिर नहीं रहता है इसीलिये अपने अपने समय में उपलब्ध अन्त्यफलज्या वश से आचार्य लोगों ने भिन्न भिन्न मन्दपरिध्यंश पठित किया, आचार्य ने दुराग्रह वश आर्यभटोक्त विषमपदीय और समपदीय पठित परिध्यंश का खण्डन किया है इति ॥ १८ ॥

इदानीमार्यभटोक्त शीघ्रपरिधीन् खण्डयति ।

विषमेऽन्योऽन्यो युग्मे परिधिर्गुणकः क्रमोत्क्रमज्यानाम् ।
चक्रार्धे फलनाशो न भवति यस्मादसत् तदपि ॥१९॥

सु. भा.—एवं शीघ्रपरिधिभेदात् स्पष्टाधिकारस्य १५ सूत्रानुसारेण विषमपदेऽन्यः समपदे चान्यः परिधिः क्रमोत्क्रमज्यानां गुणो भवति। एवं चक्रार्धे युग्मपदान्ते विषमपदादौ च सन्धित्वात् परिधिद्वयग्रहणे यस्मात् फलनाशो न भवति तस्मादार्यभटोक्तं तच्छीघ्रपरिधिमानं चासदिति। मन्दपरिधिखण्डनवदिदं खण्डनमप्यसत् ॥ १९ ॥

वि. भा.—एवं शीघ्रपरिधिभेदात् स्पष्टाधिकारस्य १५ सूत्रानुसारेण विषमपदेऽन्यः युग्मे (समपदे) चान्यः परिधिः क्रमोत्क्रमज्यानां गुणको भवति । एवं चक्रार्धे समपदान्ते विषमपदादौ च सन्धित्वात् परिधिद्व ग्रहणे यस्मात् कारणात् फलनाशो न भवति तस्मादार्यभटोक्तं तच्छीघ्रपरिधिमान चासदिति ॥१९॥

अत्रोपपत्तिः ।

स्पष्टाधिकारस्य १५ सूत्रोपपत्तौ प्रदर्शितमस्ति यत् प्रथमपदे $\frac{\text{गतांश क्रमज्या} \times \text{परिधि}}{\text{भांश}}$ = भुजफलम्, पदान्ते परमं भुजफलम् । तृतीयपदे $\frac{\text{क्रमज्या} \times \text{परिधि}}{\text{भांश}}$ = भुजफलम्, पदान्ते परमं भुजफलम् द्वितीयपदे परमं भुजफलम् $- \frac{\text{उत्क्रमज्या} \times \text{परिधि}}{\text{भांश}}$ पदान्ते शून्यं भुजफलम् । चतुर्थपदे च परम भुज फलम् $- \frac{\text{उत्क्रमज्या} \times \text{परिधि}}{\text{भांश}}$ = भुजफलम् । यद्यपि समपदान्ते विषमपदादौ च सन्धित्वात्परिधिद्वय ग्रहणे फलनाशो न भवति तावता न काचिद्धानिर्यत आर्यभटेन परिधिपाठभेदादवान्तरेऽनुपाततः परिधिर्ग्राह्य इति सूचितम्, तस्मादाचार्योक्तं खण्डनमिदं न समीचीनमिति विज्ञैर्ज्ञेयम् ॥१९॥

अब आर्यभटोक्त शीघ्रपरिधि का खण्डन करते हैं ।

हि. भा.—शीघ्रपरिधि भेद से स्पष्टाधिकार के १५वें सूत्र के अनुसार विषमपद में और समपद में भिन्न-भिन्न परिधि भुजांश की क्रमज्या और उत्क्रमज्या की गुणक होती है, एवं चक्रार्ध (छ. राशि) मे अर्थात् सम पदान्त में विषम पदादि में भी सन्धि होने के कारण से जिस हेतु परिधिद्वय ग्रहण करने से फल का नाश (फलाभाव) नहीं होता है उसी प्रकार आर्यभटोक्त शीघ्र परिधिमान असत् है इति ॥१९॥

उपपत्ति ।

स्पष्टाधिकार के १५वें सूत्र की उपपत्ति मे दिखलाया गया है कि प्रथम पद मे $\frac{\text{गतांश क्रमज्या} \times \text{परिधि}}{\text{भांश}}$ = भुजफल । पदान्त में परम भुज फल होता है, तृतीयपद मे $\frac{\text{क्रमज्या} \times \text{परिधि}}{\text{भांश}}$ = भुजफल, पदान्त में परम भुजफल होता है, द्वितीय पद मे परमभुजफल $- \frac{\text{उत्क्रमज्या} \times \text{परिधि}}{\text{भांश}}$ = भुजफल, पदान्त में भुजफल शून्य होता है। चतुर्थपद मे परम भुजफल $- \frac{\text{उत्क्रमज्या} \times \text{परिधि}}{\text{भांश}}$ = भुजफल, यद्यपि समपदान्त मे विषम पदादि में भी दोनो पदों की सन्धि होने के कारण परिधिद्वय (सम पद और विषम पद मे पठित परिधि) ग्रहण करने से फलनाश (फलाभाव) नहीं होता है, उससे कुछ हानि नहीं है क्योकि परिधि पाठ भेद से अवान्तर में अनुपात से परिधि का ग्रहण करना चाहिये ऐसा ने आर्यभट सूचित किया हुआ है इसलिये आचार्योक्त खण्डन ठीक नही हे इति ॥१६॥

इदानीमार्यभटमतेनानुपातेन यदि परिधिः स्फुटः क्रियते
तदापि न समीचीन इति खण्डयति ।

व्यासार्धहृतो बाहुः परिधिविशेषाहतः फलोनयुतः ।
प्रथमोऽधिकोनको यत् तदसत् पदयोः परिधिपाठात् ॥२०॥

सु. भा.—बाहुभुजज्या परिधिविशेषाहतः परिध्यन्तरहतो व्यासार्धेन त्रिज्यया हृतः । प्रथमः परिधिर्यदि द्वितीयादधिकोनकस्तदा क्रमेण प्रथमः परिधिः फलोनयुतः स्फुटः परिधर्भवेदिति यत् स्पष्टपरिध्यानयनं प्रसिद्धं तदप्यार्यभटमतेनासद्भवति । कस्मात् । पदयोः परिधि पाठात् । अर्थात्तन्मते पदयोः परिधिद्वयम् । तत्र कुत्रचित् प्रथमः समपदीयः कुत्रचिच्च विषमपदीयः परिधिर्भवति । अतः संस्कारविधिर्व्यभिचरति । वाग्बलमेतत् । प्रथमान्यभेदेऽपि तात्कालिक संस्कारस्य समीचीनत्वादिति सुधीभिर्भृशं विचिन्त्यम् ॥ २० ॥

वि. भा.—बाहुः (इष्टदोर्ज्या) परिधिविशेषाहतः (विषमसमपरिध्यन्तरगुणः) व्यासार्ध हृतः (त्रिज्या भक्तः) प्रथमः परिधिर्यदि द्वितीयादधिकोनकस्तदा यथाक्रमं प्रथमः परिधिः फलोनयुतः कार्यस्तदा स्फुटः परिधिर्भवेदिति यत्प्रसिद्धं स्फुटपरिध्यानयनं तदप्यार्यभटमतेन पदयोः परिधिपाठभेदादसद् भवति ॥२०॥

अत्रोपपत्तिः ।

यदि त्रिज्यातुल्यया केन्द्रदोर्ज्यया विषमसमपदान्तपरिध्योरन्तरं लभ्यते तदेष्टकेन्द्रदोर्ज्यया किं फलं विषमपदान्तपरिधितः समपदान्तपरिधेश्चयापचय-वशाद्धनर्णं कार्यं तदा स्फुटः परिधिर्भवति सूर्यसिद्धान्तेऽपी 'ओज युग्मान्तरगुणा भुजज्या त्रिज्ययोद्धृता । युग्मवृत्ते धनर्णं स्यादोजादूनाधिके स्फुटम्' त्यनेन तदेव कथ्यते, सिद्धान्तशेखरेऽप्येतदनुरूपमेव, आर्यभटमतेन पदयोः परिधिद्वयमस्ति, तत्र कुत्रचित् प्रथमः समपदीयः कुत्रचिच्च विषमपदीयः परिधिर्भवति, तदा संस्कारविधौ दोष आगच्छति । एतत् खण्डनमपि न समीचीनम् । प्रथमान्यभेदेऽपि तात्कालिक संस्कारस्य समीचीनत्वादिति ॥२०॥

अब आर्यभट मत में "अनुपात से यदि परिधि-स्फुट की जाती है तो भी वह समीचीन नहीं होती है" इसका यह खण्डन करते है ।

हि. भा. इष्टदोर्ज्या को विषम परिधि और समपरिधि के अन्तर से गुणा कर त्रिज्या से भाग देने से जो फल हो उसको प्रथम परिधि यदि द्वितीय परिधि से अधिक और ऊन (अल्प) हो तो क्रम से प्रथम परिधि में ऊन और युत करना तब स्फुट परिधि होती है । यह जो प्रसिद्ध स्फुट परिध्यानयन है वह भी आर्यभट मत से दोनों पदों में परिधि पाठ भेद से समीचीन नहीं होता है, इति ॥२०॥

उपपत्ति ।

यदि त्रिज्या तुल्य केन्द्रदोर्ज्या में विषम सम पदान्तीय परिध्यन्तर पाते है तो इष्ट केन्द्र दोर्ज्या में क्या इस से जो फल आता है उस को द्वितीय परिधि से प्रथम परिधि के ऊन और अधिक रहने से क्रम से प्रथम परिधि में युत और ऊन करने से स्फुट परिधि होती है, यह जो प्रसिद्ध स्फुट परिध्यानयन है वह भी आर्यभट मत से समीचीन नहीं होता है क्योंकि उन के मत में दोनों पदो मे दो तरह की परिधि है, वहां कहीं पर प्रथम-समपदीय परिधि होती है और कही पर विषम पदीय परिधि होती है इसलिये संस्कार विधि व्यभिचरित होती है, यह आचार्योक्त खण्डन ठीक नही है क्योकि प्रथम और अन्य के भेद मे भी तात्कालिक सस्कार समीचीन ही होता है इति ॥२०॥

इदानीं पुनआर्यभटोक्तपरिधीन् खण्डयति ।

विषमसमयोर्यदि द्वौ परिधी किं सूर्य चन्द्रयोर्नोक्तौ ।
घटते च कथं चिदियं स्फुट क्रियौदयिक तन्त्रोक्ता ॥२१॥

सु. भा.--यदि तन्मते विषमसमयोः पदयोर्भेदाद् द्वौ परिधी अपेक्षितौ तदा गोलयुक्तिसाम्यात् तेन सूर्य चन्द्रयोर्द्वौ द्वौ परिधी किं नोक्तौ ।

अत आर्यभटीयौदयिक तन्त्रोक्तेयं स्फुटक्रिया कथंचिच्च घुणाक्षरन्यायेन कदाचित् घटत इत्यर्थः। यस्मिन् तन्त्रे सूर्योदये ग्रहसाधनं तदौदयिक तन्त्रम्। सूर्यचन्द्रयोर्न द्वौ द्वौ परिधी अन्येषां च द्वौ द्वौ इत्यनेन न काचिद्धानिः फलवासना-विचित्रत्वादत इदमपि वाग्बलमिति ॥ २१ ॥

वि. भा.—यदि विषमसमयोः पदयोर्भेदादायभटमते द्वौ परिधी अपेक्षितौ तदा तेन सूर्यचन्द्रयोर्द्वौ द्वौ परिधी किं नोक्तौ, अत आर्यभटीयौदयिकतन्त्रोक्तेयं स्फुटक्रिया घुणाक्षरन्यायेन कथचित् घटते। यस्मिन् तन्त्रे सूर्योदये ग्रहसाधन तदौदयिकतन्त्रम्। सूर्यचन्द्रयोर्न द्वौ द्वौ परिधी[1] अन्येषां ग्रहाणां च द्वौ द्वौ

(१) ग्रह स्पष्टीकरणे बहवस्तादृशा विषयाः सन्ति येषां गोले सत्ता नोपलभ्यते यथा सूर्यचन्द्रयोः केवलमेक मन्दोच्चमस्ति, अन्येषां ग्रहाणां च मन्दोच्च शीघ्रोच्चं चास्ति, तथा मान्द कर्मैकमर्केन्द्वोर्भौमादीनामथोच्यते। शैघ्र्य मान्द पुनर्मान्द शैघ्र्य च त्वार्यनुक्रमात्। मध्ये शीघ्रफलस्यार्ध मान्दमर्धफलं तथा। मध्यग्रहे मन्दफल सकल शैघ्र्यमेव च,। दलीकृताभ्या प्रथमं फलाभ्यां ततोऽखिलाभ्यामसकृत्कुजस्तु। स्फुटौ रवीन्दू मृदुनैव वेत्ति शीघ्राख्य तुङ्गस्य तयोरभावात्। इतिक्रमेण सूर्यसिद्धान्तोक्तभास्कराचार्योक्त वाक्यानि सन्ति, अन्येषां बहूनामे तत्सदृशान्येव वाक्यानि सन्ति, गोले फलद्वय (मन्दफल शीघ्रफल च) मेवोपलभ्यते यत्संस्का रेण मध्यमग्रहः स्फुटतां याति, मन्दफलार्ध शीघ्रफलार्ध च कथ संस्क्रियते इति वक्तुं न शक्यते तत्र परम्परागतमागम एव प्रमाण न हि तत्र काचिद्युक्तिः। नतकर्मविषयेऽप्येवमेवा-ऽऽगम प्रमाणम् , एवमनेके विषयाः सन्ति। यद्विषये आचार्या आगम प्रमाणमेव लिखितवन्त इति।

(२) ग्रहस्पष्टीकरण में बहुत ऐसे विषय है जिनकी सत्ता गोल मे नहीं उपलब्ध होती है, जैसे रवि और चन्द्र के केवल एक ही मन्दोच्च है, क्यों ? शीघ्रोच्च नहीं है, इसका उत्तर यही है कि इसी तरह उपलब्ध या आगम प्रमाण है, अन्य ग्रहों के लिये मन्दोच्च और शीघ्रोच्च दोनों हैं, यहां भी आगम प्रमाण ही कारण है। सूर्य सिद्धान्त म लिखते है 'मान्द कर्मैकमर्केन्द्वोर्भौमादीनामथोच्यते' से 'सकल शैघ्र्यमेव च' तक तथा भास्करोक्त वचन हैं 'दलीकृताभ्यां प्रथम फलाभ्यां ततोऽखिलाभ्यामसकृत् कुजस्तु' अन्य बहुत आचार्यो के ऐसे ही वाक्य है, गोल मे केवल दो फल (मन्दफल और शीघ्रफल) उपलब्ध होते है मध्यग्रह में जिन के संस्कार करने से स्पष्ट ग्रह होते हैं। मध्यम रवि और मध्यम चन्द्र में एक ही मन्दफल संस्कार करने से स्पष्ट रवि और स्पष्ट चन्द्र होते है। कुजादि ग्रहो के स्पष्टी करण के लिये मन्द फलार्ध और शीघ्रफलार्ध का भी संस्कार किया जाता है। क्यों किया जाता है, इसको नही कह सकते है इसके लिये केवल आगम प्रमाण ही कह सकते हैं, युक्ति नहीं कुछ कह सकते है। नत कर्म संस्कार क्यो करना चाहिये वह भी केवल रवि और चन्द्र ही के लिये, यहां भी आगम प्रमाण ही को कारण कह सकते है, एव अनेक विषय है जिन के विषय में आचार्य लोग आगम प्रमाण प्रमाण ही के लिये लिखे हैं।

२. देखो पृष्ठ ६८८ का फुटनोट (२)।

परिधी इत्येतावता न काऽपि हानिः फलवासनाया विचित्रत्वात्, एतत्खण्डनम प्याचार्योक्तं न समीचीनमिति ।।२१।।

अब पुनः आर्यभटोक्त परिधि का खण्डन करते हैं ।

हि. भा.—यदि विषमपद और समपद के भेद से आर्यभट के मत में दो परिधि अपेक्षित है तो वे सूर्य और चन्द्र के लिये दो दो परिधि क्यो नहीं कहते हैं । इसलिये आर्यभटीय औदयिक तन्त्र में कही हुई यह स्फुट क्रिया घुणाक्षरन्याय (घुन द्वारा लकड़ी को काटने से कभी कभी अक्षर का रूप बन जाता है, लेकिन घुन जानबूझ कर लकडी को अक्षराकार नहीं काटती है) से कदाचित् घटती है, जिस तन्त्र में सूर्योदय कालिक ग्रह साधन होता है वह औदयिक तन्त्र कहलाता है । सूर्य और चन्द्र के लिये दो दो परिधि नहीं कही गई हैं और अन्य ग्रहों की दो दो परिधि कही गई है इससे आर्यभट के मत में कुछ भी हानि नही है क्योंकि फल की वासना (उपपत्ति) विचित्र है, आचार्योक्त यह खण्डन भी ठीक नहीं है इति ।।२१।।

इदानीं रव्यग्रावशेन रवेः सममण्डलप्रवेशं खण्डयति ।

उत्तर गोलेऽग्रायां विषुवज्ज्यातो यदुक्तमूनायाम् ।
समण्डलगस्तदसत् क्रान्तिज्यायां यतो भवति ।।२२।।

सु. भा.—आर्यभटेन स्वगोलपादे 'उत्तरगोले यदाऽग्रा विषुवज्ज्यातो अक्षज्यात ऊना भवति तदैव रवेः सममण्डल प्रवेशः' इत्यभिहितं परन्तु गोलयुत्तया तु सौम्यापमज्याऽक्षज्योना तदा रवेः सममण्डलप्रवेशो भवत्यतो विषुवज्ज्यात उत्तरगोलेऽग्रायामूनायां रवेः सममण्डलप्रवेशो भवतीति यदुक्तमार्यभटेन तदसद्यतः क्रान्तिज्यायां विषुवज्ज्यातो न्यूनायामर्कस्य सममण्डल प्रवेशोभवति। आर्यभट वाक्यं च-

परमापक्रमजीवामिष्टज्यार्धाहतां ततो विभजेत् ।
ज्यालम्बकेन लब्धाऽर्काग्रा पूर्वा परे क्षितिजे ।।

सा विषुवज्ज्योना चेद्विषुवदुदग्लम्बकेन संगुणिता विषुवज्ज्यया विभक्तो लब्धः पूर्वापरे शंकुः । गोलपा दे श्लो० ।।३०-३१।।

वि. भा. - उत्तरगोले यदाऽग्रा विषुवज्ज्यात (अक्षज्यातः) ऊना (अल्पा) भवति तदैव रवेः सममण्डलप्रवेशो भवतीत्यार्यभटेन स्वगोलपादे कथितम् । परं गोल युत्तयोत्तरा क्रान्तिज्या यदा ऽक्षज्यातोल्पा भवति तदा रवेः सममण्डल प्रवेशो भवत्यतो विषुवज्यात ऊनायां (अल्पायां) अग्रायामुत्तरगोले रवेः सम-

मण्डल प्रवेशो भवतीति यदुक्तमार्यभटेन तदसत् । यतो विषुवज्ज्यात (अक्षज्यातः) ऊनायां क्रान्तिज्यायां रवेः सममण्डल प्रवेशो भवतीति ॥२२॥

अत्रोपपत्तिः ।

यदोत्तरा क्रान्तिः स्वाक्षांशेभ्यो न्यूना तदा रवेरहोरात्रवृत्तस्य पूर्वापरवृत्तस्य च क्षितिजादुपरि सयोगाद्रवेः सममण्डलप्रवेशो भवितुमर्हति, दक्षिणक्रान्तौ रवेरहोरात्रवृत्तस्य पूर्वापरवृत्तस्य च क्षितिजाधः सयोगात् स्वाक्षाधिकायामुत्तरक्रान्तौ च खस्वस्तिकादुत्तरदिशि रव्यहोरात्रवृत्तस्य याम्योत्तरवृत्तस्य च सम्पातादहोरात्रवृत्तस्य पूर्वापरवृत्तस्य च संयोगाभावात् सममण्डलप्रवेशो न भवेदिति गोलदर्शनेन स्फुटम् । आर्यभटेनोत्तरगोलेऽक्षज्यातो ऽल्पायामग्रायां रवेः सममण्डलप्रवेशो भवतीति यदुक्तं तन्निर्युक्तिकम् । आर्यभटोक्त वाक्य च—

परमापक्रम जीवामिष्टज्यार्धाहतां ततो विभजेत् ।
ज्यालम्बकेन लब्धाऽर्काग्रा पूर्वापरे क्षितिजे ॥
सा विषुवज्ज्योना चेद्विषुवदुदग्लम्बकेन संगुणिता ।
विषुवज्ज्यया विभक्ता लब्धः पूर्वापरे शकुः ॥
(गोलपादे श्लो० ३०-३१) ॥२२॥

अब रवि की अग्रावश से आर्यभटोक्त रवि के सममण्डल प्रवेश का खण्डन करते है ।

हि. भा.—उत्तरगोल में जब अग्रा अक्षज्या से अल्प होती है तब ही रवि का सममण्डल प्रवेश होता है यह अपने गोलपाद में आर्यभट कहते हैं । लेकिन गोलयुक्ति मे जब उत्तर क्रान्तिज्या अक्षज्या से अल्प होती है तब रवि का सममण्डलप्रवेश होना है, इसलिये अक्षज्या से अल्प अग्रा में उत्तर गोल मे रवि का सममण्डलप्रवेश होता है यह जो आर्यभट ने कहा है सो ठीक नहीं है । क्योंकि अक्षज्या से अल्प क्रान्तिज्या में उत्तर गोल में रवि का सममण्डल प्रवेश होता है इति ॥२२॥

उपपत्ति ।

जब उत्तराक्रान्ति अक्षांश से अल्प होती है तो रवि के अहोरात्रवृत्त और पूर्वापरवृत्त का योग क्षितिज से ऊपर होने के कारण रवि का सममण्डलप्रवेश होता है । दक्षिण क्रान्ति में रवि के अहोरात्रवृत्त और पूर्वापरवृत्त का योग क्षितिज से अधोभाग में होता है, अक्षांशाधिक उत्तर क्रान्ति में खस्वस्तिक से उत्तर तरफ रवि के अहोरात्रवृत्त और याम्योत्तरवृत्त के सम्पात से अहोरात्रवृत्त और पूर्वापरवृत्त के योगाभाव के कारण सममण्डलप्रवेश नहीं होता है यह गोल देखने से स्फुट है । उत्तर गोल में अक्षज्या से अल्प अग्रा में

सममण्डल प्रवेश होता है यह जो आर्यभट ने कहा है सो निर्युक्तिक है। आर्यभटोक्त वाक्य यह है 'परमापक्रमजीवाम्भिष्टज्यार्धाहतां ततो विभजेत्' इत्यादि सं. उपपत्ति में लिखित श्लोकों को देखिये ॥२२॥

इदानीमार्यभटोक्त लम्बनावनत्यानयनं खण्डयति।

व्यासार्धेन विभक्ता दृग्नतिजीवा चतुर्गुणा लब्धम्।
लम्बननाडयः पञ्चदश गुणितया त्रिज्यया भक्ता ॥२३॥

दृक्क्षेपज्या भुक्त्यन्तराहता लब्धमवनति र्भवति।
स्फुटयोजनकर्णाभ्यां भूव्यासेन च विना स्पष्टे ॥२४॥

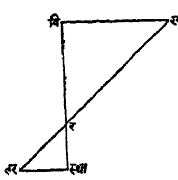
आर्यभटेनास्मिन् सति लघुनि किमर्थं महत् कृतं कर्म।
गणिताज्ञानाज्जाडयं विजानता यदि ततः सुतराम् ॥२५॥

सु. भा.—यदि रविकर्णेन त्रिज्या तदा भूव्यासार्धेन किं जातं रविपरमलम्बनम्। एवं चन्द्रयोजनकर्णभूव्यासार्धाभ्यां चन्द्रपरमलम्बनमार्यभटेनानीतं तत इष्टलम्बनं नतिश्चानीता। एवं योजनकर्णभूव्यासार्धग्रहणेन क्रियागौरवमतः खण्डयति यद्दृग्नतिजीवा चतुर्गुणा व्यासार्धेन त्रिज्यया विभक्ता लब्धं लम्बननाडयः स्युः। दृक्क्षेपज्या च रविचन्द्रभुक्त्यन्तरहता पञ्चदशगुणया त्रिज्यया हृता लब्धमवनति र्भवति। एवं ते स्पष्टे लम्बनावनती स्फुटयोजनकर्णाभ्यां विना भूव्यासेन च विना सिद्धे भवतः। एतादृशे ऽस्मिन् लघुनि साधने सत्यपि योजनकर्णवशेनार्यभटेन किमर्थं महत् कर्म कृतम्। यदि गणिताज्ञानात् कृतं तर्हि तस्य जाडयमेव। यदि मदुक्तप्रकारं विजानता कृतं तर्हि ततोऽपि सुतरामतिशयेन तस्य जाडयं यतो लघुकर्म ज्ञात्वापि किमर्थं गौरवं कर्म लिखितमिति। इहाचार्योक्तलम्बनानयनोपपत्तिः 'त्रिभोनलग्नस्य रवेश्च शङ्क्वोर्वा दृग्ज्ययोर्वर्गवियोगमूल' मित्यादि भास्करविधिना स्फुटा ॥२३-२५॥

वि. भा.—दृग्नतिजीवा चतुर्गुणा व्यासार्धेन (त्रिज्यया) विभक्ता लब्धं लम्बननाडयः स्युः। दृक्क्षेपज्या भुक्त्यन्तराहता (रविचन्द्रगत्यन्तरगुणिता) पञ्चदश गुणितया त्रिज्यया भक्ता लब्धमवनतिर्भवति। एवं ते स्पष्टे लम्बनावनती स्फुटयोजनकर्णाभ्यां विना, भूव्यासेन च विना सिद्धे भवतः। अस्मिन् लघुनि साधने सत्यपि, आर्यभटेन योजन कर्णवशेन किमर्थं महत्कर्मकृतम्। यदि गणिताज्ञानात्, कृतं तदा तस्य तज्जाडयमेव, यदि मत्कथितप्रकारं विजानता कृतं तदा ततोऽपि सुतराम् (अतिशयेन) तस्य जाडयं, लघुकर्म ज्ञात्वापि किमर्थं गौरव कर्म लिखितमिति ॥२३-२५॥

अत्रोपपत्तिः ।

क्रान्तिवृत्ते यत्र रविस्तदुपरि दृग्वृत्तं कार्यं तस्मिन् दृग्वृत्ते यत्र रविर्लम्बितस्तदुपरिगतं कदम्बप्रोतवृत्तं कार्यं, तत् क्रान्तिवृत्ते यत्रलग्नं तस्माल्लम्बितरविं यावत्कदम्बप्रोतवृत्ते रविनतिः । रविलम्बितरव्योरन्तरं दृग्वृत्ते दृग्लम्बनम् । लम्बितरविस्थानात् (लम्बितरव्युपरिगतकदम्बप्रोतवृत्तक्रान्तिवृत्तयोः सम्पातात्) रविं यावत्क्रान्तिवृत्ते स्पष्टलम्बनम् । इति नतिस्पष्टलम्बनदृग्लम्बनभुजत्रयैः (भुजकोटिकर्णैः) रुत्पन्नमेकं चापीयजात्य त्रिभुजम् । तथा रवितः खस्वस्तिकं यावद्रविनतांशाः कर्णः । खस्वस्तिकाद्वित्रिभं यावत् दृक्क्षेपवृत्ते वित्रिभनतांशा भुजः । वित्रिभरव्योरन्तरं क्रान्तिवृत्ते कोटिः । एतैरवयवत्रयैरुत्पन्नं द्वितीयं चापीयजात्यत्रिभुजम् । द्वितीयचापीयजात्यत्रिभुजज्याक्षेत्रे $\sqrt{\text{रदृग्ज्या}^2 - \text{दृक्क्षपज्या}^2}$ = वित्रिभशंकु । व्यासार्धपरिणतदृग्नतिज्या स्वल्पान्तरादियमेव त्रिज्या व्यासार्धीया ऽऽचार्येण स्वीकृता, तत उक्तचापीयजात्यत्रिभुजयो र्ज्याक्षेत्र साजात्यादनुपातो यदि रविदृग्ज्यया दृग्नतिज्या लभ्यते तदा दृग्लम्बनज्या किं समागच्छति स्पष्टलम्बनज्या तत्स्वरूपम्



$= \frac{\text{दृग्नतिज्या} \times \text{दृलंज्या}}{\text{दृग्ज्या}}$ वि = वित्रिभलग्नम् । ख = खस्वस्तिकम् । र = क्रान्तिवृत्ते रविः = गर्भीयरविः । लंर = लम्बितरविः । स्था = लम्बितरविस्थानम् । रख = रविनतांशाः ।

खवि = दृक्क्षेपचापम् । रवि = वित्रिभरव्यन्तरम् = दृग्नतिचापम् । रलं = रदृग्लम्बनम् । लंस्था = रविनतिः । स्थार = रविस्पष्टलं । अथ यत्र पृष्ठीयदृग्ज्या परमा भवत्यर्थात् त्रिज्या तुल्या तत्रैव दृग्लम्बनस्य परमत्वं भवत्यतोऽनुपातः क्रियते यदि त्रिज्यातुल्यया पृष्ठीयदृग्ज्यया परमं दृग्लम्बनं लभ्यते तदेष्टपृष्ठीयदृग्ज्यया किं लब्धमिष्टदृग्लम्बनम् = $\frac{\text{परमलं} \times \text{पृदृग्ज्या}}{\text{त्रि.}}$, अत्र स्वल्पान्तरात् दृलंज्या = दृलं, परमलंज्या = परमलं = ४ घटी, तदा स्पष्टलम्बनज्या स्वरूपे उत्थापनेन $\frac{\text{दृग्नतिज्या} \times \text{पलं} \times \text{पृदृग्ज्या}}{\text{त्रि. दृग्ज्या}}$ = स्पष्टलम्बनज्या = स्पष्टलम्बन, ततः[1]

$\frac{\text{दृग्नतिज्या} \times ४}{\text{त्रि.}}$ स्वल्पान्तरात् दृग्ज्या = पृदृग्ज्या एतावता 'व्यासार्धेन विभक्ता दृग्नतिजीवा चतुर्गुणा लब्धम् । लम्बन नाड्य इत्युपपन्नम्' अत्र या त्रुटयस्ता उपपत्ति-

(१) यदि रविचन्द्रगत्यन्तरकलाभिः षष्टिघटिकालभ्यन्ते तदा स्पष्टलम्बनकलाभिः किं समागच्छति स्पष्टलम्बन घटी = $\frac{\text{पलं} \times ६० \times \text{दृग्नतिज्या}}{\text{त्रि.} \times \text{गअं}} = \frac{४ \times \text{दृग्नतिज्या}}{\text{त्रि.}}$.

दर्शनेनैव स्पष्टाः, सिद्धान्तशिरोमणौ भास्कराचार्येणापि "त्रिभोनलग्नस्य रवेश्च शङ्क्वोर्वा दृग्ज्ययोर्वर्गवियोगमूल" मित्यादिनाऽऽचार्योक्तानुरूपमेवोक्तम् । अथ स्फुटनत्यानयनार्थं विचार्यते । लंख = रपृष्ठीयनतांशाः = रख + रलं = रविनतांश + दृलम्बन, अथ रखवि, रलंस्था चापीयजात्यत्रिभुजयोर्ज्याक्षेत्रसाजात्यात् $\frac{\text{दृक्क्षे} \times \text{दृलंज्या}}{\text{दृग्ज्या.}}$

= नतिज्या, परन्तु $\frac{\text{पलंज्या. पृदृज्या}}{\text{त्रि.}}$ = दृलंज्या तत उत्थापनेन $\frac{\text{दृक्क्षे. पलंज्या. पृदृज्या}}{\text{दृग्ज्या. त्रि.}}$

= नतिज्या, अत्र स्वल्पान्तरात् ज्याचापयोरभेदात् नतिज्या = नति तथा च दृग्ज्या = पृदृग्ज्या, पलंज्या = पलं, ततः $\frac{\text{दृक्क्षे. पलं}}{\text{त्रि.}}$ = नतिः । गतेः पञ्चदशांशः परमलम्बनं भवति, $\frac{\text{रविग}}{१५}$ = रपलं, $\frac{\text{चंग}}{१५}$ = चंपलं ततो रविनतिः = $\frac{\text{दृक्क्षेप. रग,}}{\text{त्रि. १५}}$

एवं चन्द्रनतिः = $\frac{\text{दृक्क्षे. चंग}}{\text{त्रि. १५}}$ द्वयोरन्तरेण स्फुटा नतिः = $\frac{\text{दृक्क्षे. रवि चन्द्रगत्यन्तर}}{\text{त्रि. १५}}$

एतावता "दृक्क्षेपज्या भुक्तचन्तराहता पञ्चदश गुणितया त्रिज्यया भक्ता लब्धमवनति" रित्याचार्योक्तमुपपन्नम् । सूर्य सिद्धान्तकारेण "दृक्क्षेपः शीततिग्मांश्वोर्मध्य भुक्तचन्तराहतः । तिथिघ्नत्रिज्यया भक्तो लब्धं सावनतिर्भवे" दित्यादिनाऽऽचार्योक्तानुरूपमेव कथ्यते । अत्र कर्णभूव्यासयोः किमपि प्रयोजनं नास्ति तह्यार्यभटेन 'रविकर्णेन चन्द्रकर्णेन वा तत्पृष्ठीय दृग्ज्या लभ्यते तदा भूव्यासार्धेन किमिति लब्धे रविचन्द्रयोर्दृग्लम्बनज्याप्रमाणे' एतद्वशेन स्पष्टलम्बनस्पष्टनत्योरानयनं किमर्थं कृतं, मदुक्तानयनेन लघुकर्मणैव तत्सिद्धिर्भवति, तत्र महतः कर्मणः काऽऽवश्यकता, एतावता ज्ञायते यदार्यभटेन यन्महत्कर्म कृतं तत्तद्गणिताज्ञानात् । अत्राचार्योक्तसाधने किं लघुकर्म, आर्यभटोक्तसाधने किं महत्कर्मास्तीति मन्मनसि नागच्छति, आचार्योक्तखण्डनमिदं मह्यं न रोचते इति विवेचका भृशं विवेचयन्त्विति ॥२३-२५॥

अब आर्यभटोक्त स्फुट लम्बन और स्फुटनत्यानयन का खण्डन करते हैं ।

हि. भा.—दृग्नतिज्या को चार से गुणा कर त्रिज्या से भाग देने से लब्ध लम्बन घटी होती है, दृक्क्षेपज्या को रवि और चन्द्र के गत्यन्तर से गुणा कर पन्द्रह गुणित त्रिज्या से भाग देने से लब्ध स्फुटनति होती है, इस तरह यह स्पष्ट लम्बन और स्पष्ट नति स्फुट योजनकर्णों के बिना और भूव्यास के बिना सिद्ध होती है । इस लघु साधन के रहने पर भी आर्यभट ने योजन कर्ण वश से क्यों महत् कर्म किया । यदि गणित के नहीं जानने के कारण किया तो यह उनकी मूर्खता है, यदि हम से कहे हुए प्रकार को जानते हुये किया तो यह उस से भी बड़ी मूर्खता है । लघुकर्म को जानकर भी क्यों गौरव कर्म लिखा इति ॥२३-२५॥

उपपत्ति ।

क्रान्तिवृत्त में जहां रवि है उनके ऊपर दृग्वृत्त कर देना, उस दृग्वृत्त में रवि जहां पर लम्बित होते है उनके ऊपर कदम्ब प्रोतवृत्त कर देना, वह क्रान्तिवृत्त मे जहा पर लगता है वह लम्बित रवि स्थान है। लम्बित रविस्थान से लम्बित रवि पर्यन्त कदम्ब प्रोतवृत्त में रविनतिभुज, रवि और लम्बित रवि के अन्तर दृग्वृत्त मे दृग्लम्बन कर्ण, तथा लम्बित रवि-स्थान से (लम्बितरव्युपरिगत कदम्बप्रोतवृत्त और क्रान्तिवृत्त के सम्पात से) रविपर्यन्त क्रान्तिवृत्त में स्पष्ट लम्बनकोटि, इन तीनो भुजकोटिकर्णो मे उत्पन्न एक चापीय जात्य त्रिभुज है, तथा रवि से खस्वस्तिक पर्यन्त रविनतांश कर्ण, खस्वस्तिक से वित्रिभ लग्न पर्यन्त दृक्क्षेप वृत्त में दृक्क्षेप चाप भुज, क्रान्तिवृत्त मे रवि और वित्रिभ लग्न के अन्तर कोटि, इन तीनों से उत्पन्न द्वितीय चापीय जात्य त्रिभुज है, इस त्रिभुज के ज्याक्षेत्र मे $\sqrt{\text{रदृग्ज्या}^2 - \text{दृक्क्षेपज्या}^2}$ = वित्रिभशङ्कु व्यासार्ध परिणत दृग्नतिज्या, स्वल्पान्तर से इसी को त्रिज्या व्यासार्धीय आचार्य ने मान लिया है, तब पूर्व कथित चापीय जात्य त्रिभुज द्वय के ज्याक्षेत्र के सजातीय होने से अनुपात करते है, यदि रवि दृग्ज्या मे दृग्नतिज्या पाते हैं तो दृग्लम्बनज्या में तथा इस मे स्पष्ट लम्बनज्या आती है, $\frac{\text{दृग्नतिज्या. दृलज्या}}{\text{रदृग्ज्या}}$ = रविस्पलज्या ।

यहां सं. उपपत्ति में लिखित क्षेत्र को देखिये । वि = वित्रिभ लग्न । ख = खस्वस्तिक, र = क्रान्तिवृत्त में रवि = गर्भीय रवि, लर = लम्बित रवि, स्था = लम्बित रविस्थान, रख = रविनतांश, खवि = दृक्क्षेपचाप, विर = रविवित्रिभान्तर = दृग्नतिचाप, रलं = रवि दृग्लम्बन । लंस्था = रविनति, स्थार = रविस्पलम्बन, पृष्ठीयदृग्ज्या जहां पर परम होती है अर्थात् त्रिज्या के बराबर होती है वहीं पर दृग्लम्बन का परमत्व होता है इसलिये अनुपात करते है, यदि त्रिज्या तुल्य पृष्ठीय दृग्ज्या में परम दृग्लम्बनज्या पाते है तो इष्ट पृष्ठीय दृग्ज्या मे क्या इससे इष्ट दृग्लम्बनज्या आती है $\frac{\text{पलज्या. पृदृग्ज्या}}{\text{त्रि.}}$ = दृलंज्या, यहा स्वल्पान्तर मे दृलंज्या = दृलं, पलंज्या = पलं, तब रवि स्पष्ट लम्बनज्या स्वरूप में उत्थापन देने से $\frac{\text{दृग्नतिज्या} \times \text{पलं.} \times \text{पृदृग्ज्या}}{\text{त्रि रदृग्ज्या}}$ = स्पलंज्या = स्पलं, यहाँ स्वल्पान्तर मे रदृग्ज्या = पृदृज्या तब $\frac{\text{दृग्नतिज्या} \times \text{पल}}{\text{त्रि.}}$ = स्पलं, अब अनुपात करते है कि यदि रवि और चन्द्र के गत्यन्तर कला में साठ घटी पाते है तो स्पष्ट लम्बन कला में क्या इससे स्पष्ट लम्बन घटी आती है, $\frac{६० \times \text{स्पल}}{\text{गत्यन्तरक}}$

$$= \frac{६० \times \text{दृग्नतिज्या} \times \text{पल}}{\text{त्रि. गत्यन्तर}} = \frac{\text{दृग्नतिज्या} \times ४}{\text{त्रि.}} = \text{स्पलंघ} \text{ । यत: } \frac{६० \times \text{पलं}}{\text{गत्यन्तरक}} = ४ \text{ घटी, इससे}$$

"व्यासार्धेन विभक्ता दृग्नतिजीवा चतुर्गुणा लब्धम् । लम्बन नाड्य" यह उपपन्न हुआ । यहां जो त्रुटियां हैं उपपत्ति देखने ही से स्पष्ट हैं । सिद्धान्तशिरोमणि में भास्कराचार्य ने भी

"त्रिभोनलग्नस्य रवेश्चशक्नोरि" त्यादि से आचार्योक्त के अनुरूप ही कहा है। स्फुटनत्यानयन के लिये विचार करते है। लख = पृष्ठीयनतांश = रख + रलं = रविनतांश + दृग्लम्बन, रखवि, रलंस्था दोनों चापीयजात्य त्रिभुज के ज्याक्षेत्र सजातीय है इसलिये अनुपात करते हैं। $\frac{\text{दृक्क्षेज्या. दृलंज्या}}{\text{दृग्ज्या}}$ = नतिज्या, परन्तु $\frac{\text{पलंज्या. पृदृज्या.}}{\text{त्रि.}}$ = दृलज्या, इससे उत्थापन देने से $\frac{\text{दृक्क्षेज्या. पलंज्या. पृदृज्या}}{\text{दृज्या. त्रि.}}$ = नतिज्या, यहां स्वल्पान्तर से ज्या और चाप में अभेद मानने से नतिज्या = नति, तथा दृज्या = पृदृज्या, पलंज्या = पलं, तब $\frac{\text{दृक्क्षेज्या. पलं}}{\text{त्रि.}}$ = नति, परन्तु गतिकाल का पञ्च दशांश परम लम्बन होता है, $\frac{\text{रग}}{१५}$ = रपल $\frac{\text{चग}}{१५}$ = चंपल इसलिये $\frac{\text{दृक्क्षेपज्या. रग}}{\text{त्रि. १५}}$ = रविनति, तथा $\frac{\text{दृक्क्षेज्या. चग}}{\text{त्रि. १५}}$ = चन्द्रनति, दोनों के अन्तर करने से स्फुटनति = $\frac{\text{दृक्क्षेज्या. रविचन्द्रगत्यन्तर}}{\text{त्रि १५}}$, इससे "पञ्चदश गुणितया त्रिज्यया विभक्ताः। दृक्क्षेपज्या भुक्तचन्तराहता लब्धमवनतिर्भवेत्" यह आचार्योक्त उपपन्न हुआ। सूर्यसिद्धान्त कार ने "दृक्क्षेपः शीततिग्मांश्वोर्मध्यभुक्तचन्तराहतः" इत्यादि से आचार्योक्त के सदृश ही कहा है। यहां कर्ण और भूव्यासार्ध का कुछ भी प्रयोजन नही है, तब आर्यभट 'रविकर्ण में या चन्द्रकर्ण में यदि उनकी पृष्ठीय दृग्ज्या पाते है तो भूव्यासार्ध मे क्या इससे रविदृग्लम्बनज्या और चन्द्रदृग्लम्बनज्या आती है' इसके वश से स्पष्ट लम्बन और स्पष्ट नति के साधन क्यों किये। हमारे आनयन से लघुकर्म ही से उनकी सिद्धि होती है। तब वहां महत् कर्म की क्या आवश्यकता है, इससे मालूम होता है कि आचार्यभट ने गणित के अज्ञान के कारण महत् कर्म किया है। यह आचार्य खण्डन करते है। आचार्योक्त साधन में क्या लघु कर्म है और आर्यभटोक्त साधन मे क्या कर्म गौरव है यह हम नही कह सकते हैं। आचार्योक्त यह खण्डन मुझे ठीक नही मालूम होता है इसको विवेचक लोग विचार कर समझें इति ॥२३-२५॥

इदानीमार्यभटोक्तलम्बनं खण्डयति।

लम्बनमृणधनमुक्तं पूर्वापरयोस्तिथौ दिनार्धस्य।
युक्तोऽभावो यदि भवति तद्दृणधनयोस्तिथौ कतरत् ॥२६॥

सु. भा.—आर्यभटेन पूर्वापरकपालयोर्यथाक्रमं तिथौ लम्बनमृणं धनं चोक्तम्। तदुक्तं स्यात् यद्यदि दिनार्धस्य लम्बनस्याभावो भवेत् परन्तु दिनार्धे लम्बनं भवति तत् तिथौ ऋणधनयोर्मध्ये कतरद्युक्तं तन्मते। आर्यभटेन दृक्क्षेप

मण्डलवशतः पूर्वापरकपालयोर्लम्बनमुक्तमत इदं दूषणं न सत् ।

तथा च चतुर्वेदाचार्यः—

'स्याद्दूषणमेतद्यद्यार्यभटो वक्ष्येत् ।

तद्वाक्यं च ।

दृक्क्षेपमण्डलमपि प्राग्लग्नं स्यात् त्रिराश्यूनम् । दृक्क्षेपमण्डलं चानेन वाक्येन वित्रिभलग्नं भवति । तत्र चापमण्डलस्यात्युच्चता युज्यते यतः सर्वदाऽप-मण्डलार्धमेव दृश्यतेऽतस्तत्र तस्य लम्बनक्षयस्तस्मादार्यभटस्य नायं दोषः । भास्करादीनामेव भवतु तैर्न बुद्धस्तदभिप्राय इति' । एतेन ब्रह्मसिद्धान्तोपरि भास्करादीनां प्राचीनानां ज्योतिर्विदां च टीकेति स्फुट भवति ॥२६॥

वि. भा.—पूर्वापरयोः कपालयोर्यथाक्रममार्यभटेन तिथौ लम्बनमृणं धन चोक्तम् । इति तत्पक्षोयुक्तः स्याद्यदि दिनार्धस्य (मध्यान्हकालीनस्य) लम्बनस्या भावो भवेत् । परन्तु दिनार्धे लम्बनं भवति, तदा तत् तिथौ ऋणधनयोर्मध्ये कतरद्युक्तं तन्मते इत्याचार्य आर्यभटमतं खण्डयतीति ॥२६॥

अत्रोपपत्तिः ।

आर्यभटेन दृक्क्षेपवृत्तवशतः पूर्वापरकपालयोर्लम्बनमुक्तमत इदं खण्डनं न युक्तिसङ्गतम् । तथा च चतुर्वेदाचार्यः— 'स्याद्दूषणमेतद्यद्यार्यभटो वक्ष्येत् । तद्वाक्यं च-दृक्क्षेपमण्डलमपि प्राग्लग्नं स्यात् त्रिराश्यूनम्' अनेन वाक्येन दृक्क्षेप-मण्डलं वित्रिभलग्नं भवति । तत्र चापम मण्डलस्यात्युच्चता युज्यते यतः सर्वदाऽपम-मण्डलार्धमेव दृश्यतेऽतस्तत्र तस्य लम्बनक्षयस्तस्मादार्यभटस्य नायं दोषः । भास्करादीनामेव भवतु तैर्न बुद्धस्तदभिप्राय इति' एतेन ब्रह्मसिद्धान्तोपरि भास्करादीनां प्राचीनानां ज्यौतिषिकाणां च टीकेति स्फुटं भवनीति ॥२६॥

अब आर्यभटोक्त लम्बन का खण्डन करते हैं ।

हि. भा.—आर्यभट ने 'पूर्वकपाल में और पश्चिम कपाल में क्रम से तिथि में लम्बन को ऋण करना और धन करना' कहा है । यह उनका मत युक्त हो सकता है यदि दिनार्ध काल में लम्बन का अभाव हो, (लेकिन दिनार्ध में लम्बन होता है) तब तिथि में ऋण और धन लम्बन में कौन लम्बन आर्यभट के मत में ठीक है यह आर्यभट मत का खण्डन आचार्य करते हैं इति ॥२६॥

उपपत्ति ।

आर्यभट ने दृक्क्षेप वृत्त वश से पूर्व कपाल में और पश्चिम कपाल में लम्बन कहा है इसलिये आचार्योक्त खण्डन ठीक नहीं है । यहां आर्यभट कहते हैं 'स्याद्दूषणमेतद्यद्यार्यभटो

वक्ष्येत्' अर्थात् यदि आर्यभट भाष्य में लिखित बात को कहते हो तब आचार्योक्त दूषण (दोष) ठीक ही है, उनके वाक्य हैं 'दृक्क्षेपमण्डलमपि प्राग्लग्नं स्यात् त्रिराश्यूनम्' इस वाक्य से दृक्क्षेप मण्डल वित्रिभ लग्न है, वहा क्रान्ति मण्डल की अतिशयेन उच्चतायुक्त है क्यों कि सदा क्रान्तिवृत्त का आधा ही भाग दृश्य होता है, इसलिये वहां लम्बन का क्षय (अभाव) होता है, इसलिये आचार्योक्त दोष आर्यभट के मत में नहीं होता है, भास्कर आदि आचार्यों के मत ही मत में दोष है क्यों कि वे लोग आचार्य के अभिप्राय को नहीं समझे। इस से सिद्ध होता है कि ब्रह्म सिद्धान्त के ऊपर भास्कर आदि प्राचीन ज्योतिषियों की टीका है इति ॥२६॥

इदानीमार्यभटोक्तलम्बननत्योः क्षेत्र संस्थानं खण्डयति

दृक्क्षेपज्या बाहु र्दृग्ज्याकर्णोऽनयोः कृतिविशेषात् ।
मूलं दृग्नतिजीवा संस्थानमयुक्तमेतदपि ॥ २७ ॥

सु० भा०—दृक्क्षेप एव ज्या दृक्क्षेपज्या वित्रिभनतांशज्या भुजः। रविदृग्ज्या कर्णः। अनयोः कृतिविशेषात् कृत्यन्तरात् मूलं दृग्नतिजीवा भवति। भास्करादीनामार्यभटानुयायिनां मतेन भुजकोटिकर्णानां संस्थानमयुक्तमस्ति । एतदपि चिन्त्यम्। अर्थात् तेषां मतेन स्थानविशेषे दृग्नतिदृक्क्षेपज्ये व्यभिचरत इति। तद्यथा । यत्र षट्षष्टिरक्षांशास्तत्र मिथुनान्तस्थेऽर्के तेषामुदयज्याऽर्थादग्रा व्यासार्धतुल्या । अर्कोदयकाले तेषां मध्यज्याऽर्थाद्दशमलग्ननतांशज्या च व्यासार्ध तुल्या भवन्त्यपममण्डलस्य क्षितिजानुकारत्वात्। ततो 'मध्यज्योदयजीवा संवर्गे व्यासदल हृते 'इत्यादि तदीय विधिना फलं वित्रिभदशमान्तरज्या त्रिज्यातुल्य भवति। तन्मध्यज्ययोर्वर्गान्तरमूलं तन्मते दृक्क्षेपः शून्यसमोऽत आर्यभटपक्षे तदा ऽवनतेरभावः परन्तु गोलयुक्त्या तदा परमावनतिर्भवति । अतस्तदीयो दृक्क्षेपो ऽस्मिन् स्थाने व्यभिचरति। अथ तत्रस्थ एव रवौ तन्मते दृक्क्षेपः शून्य समो रविदृग्ज्या च त्रिज्या समा । अतस्तयोर्वर्गान्तरपदं दृग्नतिजीवा त्रिज्या समा जाता तद्वशतः परमलम्बनं घटी चतुष्टयमार्यभटपक्षत उत्पद्यते। गोलयुक्त्या च क्रान्तिवृत्तस्य क्षितिजानुकाराद् दृङ्मण्डलगत्या परमं लम्बितोऽपि चन्द्रः स्थानीयलम्बितकदम्बप्रोतयोरैक्यात् तत्र स्फुटलम्बनाभावः। एवमार्यभटपक्षतः संस्थानमयुक्त मिति सद्दूषणम्। चतुर्वेदाचार्येणापीदमेवोदाहरणं प्रदर्शितम् ॥२७॥

वि. भा.—दृक्क्षेपज्या (दृक्क्षेप एव ज्या) वित्रिभनतांशज्या, बाहुः (भुजः) दृग्ज्या (रविनतांशज्या) कर्णः अनयोः कृतिविशेषात् (वर्गान्तरात्) मूलं दृग्नतिजीवा कोटि भवति, आर्यभटानुयायिनां भास्करादीनां मतेनेति भुजकोटिकर्णानां

संस्थानं (स्थितिः) अयुक्तमस्तीत्येतदपि विचारणीयमर्थात्तेषां मतेन स्थल विशेषे दृग्नतिदृक्क्षेपज्ये व्यभिचरत इति ॥२७॥

अत्रोपपत्तिः

षट्षष्टि ६६ भागाक्षांशे देशे मिथुनान्तस्थिते रवौ तदुदयज्याऽर्थादग्रा त्रिज्या समा, रव्युदयकाले तेषां मध्यज्याऽर्थाद्दशमलग्ननतांशज्याऽपि त्रिज्या-समा भवति (क्रान्तिवृत्तस्य क्षिनिजानुकारत्वात्) 'मध्यज्योदयजीवासवर्गे व्यास-दलहृते' इत्यादि तदीयविधिना फलं वित्रिभदशमलग्नान्तरज्या भवति, तन्मध्यज्ययोर्वर्गान्तर मूलं दृक्क्षेपः शून्यसमोऽतस्तदा ऽऽर्यभटपक्षेऽत्रनतेरभावः परं तदा गोलोपरि प्रत्यक्षमेव परमावनतिर्दृश्यते ऽतस्तदीयो दृक्क्षेपोऽस्मिन् स्थाने व्यभिचरति। अथ तत्रस्थ एव रवौ तन्मतेदृक्क्षेपः शून्यसमः। रविदृग्ज्या च त्रिज्यासमा, तयोर्वर्गान्तरमूलं दृग्नतिज्या त्रिज्या समा जाता तद्वशतः परम-लम्बनं घटी चतुष्टयमार्यभटपक्षत उत्पद्यते, परन्तु गोलयुक्त्या क्रान्तिवृत्तस्य क्षितिजानुकारत्वाद दृग्वृत्तगत्या परमं लम्बितोऽपि चन्द्रः स्थानीय लम्बितकदम्ब-प्रोतवृत्तयोरेकत्वात्तत्र स्फुटलम्बनाभावः। एवमार्यभटपक्षतः संस्थानमयुक्तमिति खण्डनं समीचीनं चतुर्वेदाचार्येणापीदमेवोदाहरणं प्रदर्शितम्। चापीयजात्य त्रिभुजे कर्णचाप भुजचापज्ययोर्वर्गान्तरे मूलं कोटिचापज्या न भवति, किन्तु भुजकोटिव्यासार्धवृत्ते परिणतं भवतीत्येतस्य ज्ञानं तेषां नाऽऽसीदित्येव सर्वं प्रथमं महद्दूषणं तन्मते इति ॥२७॥

अब आर्यभटोक्त लम्बन और नति के क्षेत्र संस्थान (क्षेत्र स्थिति) का खण्डन करते हैं।

हि. भा.—दृक्क्षेपज्या अर्थात् वित्रिभ लग्न नतांशज्या भुज, रविनतांशज्या (रविदृग्ज्या) कर्ण, और इन दोनों का वर्गान्तरमूल दृग्नतिजीवा कोटि होती है। आर्यभट के अनुयायी भास्कर आदि आचार्यों के मत से यह भुज-कोटि कर्णों का संस्थान (स्थिति) अयुक्त हैं यह भी विचारणीय है अर्थात् उनके मत से स्थान विशेष में दृग्नतिज्या और दृक्क्षेपज्या व्यभिचरित होती है इति ॥२७॥

उपपत्ति

जिस देश में छियासठ ६६ अक्षांश है वहां मिथुनान्त में रवि के रहने से उनकी (आर्यभटानुयायियों की) उदयज्या (अग्रा) त्रिज्या के बराबर होती है। रवि के उदय काल में उनकी मध्यज्या (दशमलग्न नतांशज्या) भी त्रिज्या के बराबर होती है (क्यों कि क्रान्तिवृत्त क्षितिज वृत्तानुकार है) इसलिये 'मध्यज्योदय जीवा संवर्गे व्यास दलहृते' इत्यादि उनकी विधि से फल वित्रिभ लग्न और दशमलग्न की अन्तरज्या होती है, उसका और

मध्यज्या का वर्गान्तर मूल दृक्क्षेप शून्य के बराबर होता है इसलिये आर्यभट के पक्ष में वहां पर अवनति का अभाव हुआ, लेकिन वहां गोल युक्ति से प्रत्यक्ष ही परम अवनति देखी जाती है, इसलिये इस स्थान में उनके दृक्क्षेप का व्यभिचार होता है, पूर्वोक्त स्थान ही में रवि के रहने से उनके मत में दृक्क्षेप शून्य के बरावर है, रबि की दृग्ज्या त्रिज्या के बराबर है, इसलिये दोनों का वर्गान्तर मूल दृग्नतिज्या त्रिज्या के बराबर हुआ, उस के वश से आर्यभट के पक्ष मे परमलम्बन चार घटी के बराबर होजा है, परन्तु गोल युक्ति से वहां क्षितिजानुकार क्रान्तिवृत्त के होने से दृग्वृत्त गति से चन्द्र के परम लम्वित रहने पर भी स्थानीय लम्बित कदम्ब प्रोतवृत्तों की एकता के कारण वहां स्फुट लम्बनाभाव होता है, इस तरह आर्यभट पक्ष से क्षेत्र सस्थान अयुक्त है यह आचार्योक्त खण्डन समीचीन है। चतुर्वेदाचार्य ने भी इसी उदाहरण को दिखलाया है। चापीय जात्य त्रिभुज में कर्णचापज्या और भुज चापज्या का वर्गान्तर मूल कोटि चापज्या नहीं होती है किन्तु भुजचाप कोटि व्यासार्धवृत्त में परिणत होती हैं इस का ज्ञान उन सबों को नही था उनके पक्ष में यही सब से मुख्य दोष हैं और दोष तो ऊपर दिखलाया ही गया है इति ॥२७॥

इदानीं लम्बनावनत्योरानयनं यैर्दशज्यया कृतं तन्मतं खण्डयति ।

लम्बनघटिका लिप्ता दशज्ययाऽर्केन्दुदृग्नतिकलानाम् ।
यस्मान्न समास्तस्माद्दशज्यया लम्बनं स्थूलम् ॥२८॥

सु० भा.—पुलिशादिभिर्दशज्यया या लम्बनघटिका कला उत्पादितास्ता आचार्यसाधितानामर्केन्दुदृग्नतिकलानाम् (अर्केन्द्वोर्दृग्नती ये ताभ्यां याः पृथक् पृथक् कला लम्बनकलास्तासां) यस्मान्न समास्तस्माद् दशज्यया लम्बनं स्थूलं भवति। २७ श्लोके यथा क्षेत्रसंस्थानमयुक्तं प्रदर्शितं तथाऽत्र पृथक् पृथक् रविचन्द्रयोर्लम्बनक्षेत्रे अयुक्ते। तद्वशतः स्फुटलम्बनं स्थूलमिति। सूर्यग्रहणाधिकारस्य प्रथमश्लोकव्याख्यायां पञ्चज्या दशज्या चास्माभिः प्रदर्शिताः वस्तुतो लम्बनमशुद्धमेवायाति तर्हि इहाचार्येण स्थूलग्रहणं किमर्थं कृतमित्यत्र ३२श्लोक टीकायां चतुर्वेदाचार्यः। 'अत्र स्थूलग्रहणं महापुरुषतया कृतमन्यथा वासनाविरोधाल्लम्बनावनती एव तैर्न ज्ञाते ॥२८॥

वि. भा.—लम्बनघटिका लिप्ता दशज्यया पुलिशादिभिराचार्यैर्याः कथितास्ता यस्मात् कारणादाचार्यसाधितानामर्केन्दु दृग्नतिकलानाम् (रविचन्द्रयोर्ये दृग्नती ताभ्यां पृथक् पृथक् याः कला लम्बनकलास्तासां) समा न भवन्ति तस्मात्कारणाद्दशज्यया लम्बनं स्थूलं भवतीति ॥२८॥

अत्रोपपत्तिः

पूर्वं २७ श्लोके क्षेत्रसंस्थानं यथाऽयुक्तं प्रदर्शितं तथाऽत्र रविचन्द्रयोः

पृथक् पृथक् लम्बनक्षेत्रे अप्ययुक्ते भवतस्तद्वशतः साधितं स्फुटलम्बनमपि स्थूलं भवति। वस्तुतो लम्बनमशुद्धमेव समागच्छति तर्ह्याचार्येणात्र स्थूलग्रहणोपादानं किमर्थं कृतमिति त एव ज्ञातुं शक्ष्यन्ति, उदयज्या=अग्रा, मध्यज्या=दशमलग्न-नतांशज्या, रविशंकुः, दृग्गतिः=वित्रिभशंकुः। दृक्क्षेपः=वित्रिभनतांशज्या, इति पञ्चज्याः सन्ति, पौलिश तन्त्रेचन्द्रस्यापि पृथक् पञ्चज्याः साधिता इति दशज्याः स्युरिति ॥२८॥

अब लम्बन और अवनति के आनयन जिन आचार्यों ने दशज्या से किये हैं उनके मत का खण्डन करते हैं।

हि. भा.—जो लम्बन घटीकला पुलिश आदि आचार्यों से दशज्या से कही गई है वे जिस कारण से आचार्य साधित रवि और चन्द्र की दृग्गति से (पृथक् पृथक् जो लम्बन कला होती है) उनके बराबर नहीं होती है उसी कारण दशज्या से साधित लम्बन स्थूल होता है इति ॥ २८ ॥

उपपत्ति ।

पहले २७ वें श्लोक में जिस तरह क्षेत्र संस्थान अयुक्त दिखलाया गया है उसी तरह यहां रवि और चन्द्र के पृथक् पृथक् लम्बन क्षेत्र भी अयुक्त होते हैं उन के वश मे साधित स्फुट लम्बन भी स्थूल होते है वस्तुतः लम्बन अशुद्ध ही आता है तब यहां आचार्य ने क्यों स्थूल ग्रहण का उपादान किया है। इस बात को वे ही कह सकते है उदयज्या=अग्रा, मध्यज्या=दशमलग्ननतांशज्या, रविशंकु, दृग्गति=वित्रिभशंकु, दृक्क्षेप=वित्रिभ नतांशज्या, ये पञ्चज्या है, पौलिश तन्त्र में चन्द्र की भी पृथक् पञ्चज्या साधित हैं, यही दशज्या हैं इति ॥२८॥

इदानीं स्फुटं दृक्क्षेप संस्थानं कथयति ।

वित्रिभलग्ने दृक्क्षेपमण्डलं तदपमण्डल युतौ ज्या ।
मध्या दृक्क्षेपज्या नार्यभटोक्ताऽनया तुल्या ॥२९॥

सु. भा.—वित्रिभलग्ने यद्दृक् क्षेपमण्डलं दृङ्मण्डलं तस्यापमण्डलस्य च या युतिस्तस्यां युतौ मध्या या ज्याऽर्थात् खस्वस्तिकाद्युतिपर्यन्तं दृक्क्षेप मण्डले ये भागास्तेषां ज्या दृक्क्षेपज्या (दृक्क्षेप एव ज्या) अनया तुल्याऽऽर्यभटोक्ता न भवति ॥२९॥

वि. भा.—वित्रिभलग्ने यद्दृक्क्षेपमण्डलं तदपमण्डलं (दृग्वृत्तं) तस्यापमण्डलस्य (क्रान्तिवृत्तस्य) च या युतिस्तस्यां (युतौ) या मध्याज्या (खस्वस्तिकाद्युति

पर्यन्तं दृक्क्षेपवृत्ते यः (शास्तेषां ज्या) दृक्क्षेपज्या भवति, अनया (दृक्क्षेपज्यया) तुल्याऽऽर्यभटोक्ता (दृक्क्षेपज्या) न भवतीति ॥२९॥

अत्रोपपत्तिः ।

खस्वस्तिकाद्वित्रिभलग्नपर्यन्तं दृक्क्षेपवृत्ते दृक्क्षेपचापम् । एतस्य ज्या दृक्क्षेपज्या, आर्यभटेन मध्यज्या (दशमलग्ननतांशज्या) वित्रिभदशमलग्नान्तरज्ययोर्वर्गान्तरमूलं दृक्क्षेपज्यामानं कथ्यते वस्तुतो मध्यज्या वित्रिभदशमान्तरज्ययोर्वर्गान्तरमूल वित्रिभदशमान्तरकोटिव्यासार्धे परिणतं भवति (चापीय जात्यत्रिभुजज्याक्षेत्रविधानेन) एतत् त्रिज्या व्यासार्धे परिणामनेन वास्तवं दृक्क्षेपज्यामानं भवितुमर्हति, आचार्य कथनमत्रातीवयुक्तियुक्तमिति सुधीभिर्बोध्यमिति ॥ २९ ॥

अब स्फुट दृक्क्षेप की स्थिति को कहते है।

हि. भा.—वित्रिभलग्न में जो दृक्क्षेपवृत्त (वित्रिभदृग्वृत्त) होता है उस की और क्रान्तिवृत्त की युति (योग) में जो मध्याज्या अर्थात् खस्वस्तिक से युति बिन्दु पर्यन्त दृक्क्षेपवृत्तीय चापज्या दृक्क्षेपज्या है इसके बराबर आर्यभटोक्त दृक्क्षेपज्या नहीं होती है इसीलिये आर्यभटोक्त दृक्क्षेपज्या असत् है इति ॥ २९ ॥

उपपत्ति ।

खस्वस्तिक से वित्रिभलग्नपर्यन्त दृक्क्षेप वृत्त में दृक्क्षेप चाप है इसकी ज्या दृक्क्षेपज्या है आर्यभट मध्यज्या (दशमलग्ननतांशज्या) और वित्रिभ दशमलग्न की अन्तरज्या के वर्गान्तर मूल को दृक्क्षेपज्या कहते है, वस्तुतः मध्यज्या और दशमवित्रिभलग्नान्तरज्या का वर्गान्तर मूल वित्रिभ दशमान्तर कोटि व्यासार्धवृत्त में परिणत दृक्क्षेपज्या होती है। (चापीय जात्य त्रिभुज के ज्याक्षेत्र विधान से) इस को त्रिज्या व्यासार्ध में परिणत करने से वास्तव दृक्क्षेपज्या होगी, यहां आचार्य जो खण्डन करते है सो अतीव युक्तियुक्त है इति ॥२९॥

इदानीं दृक्क्षेपा शुद्धिवशतोऽन्यत्खण्डयति ।

दृक्क्षेपज्याऽतोऽसत् तन्नाशादवनतेर्नाशः ।
अवनतिनाशात् ग्रासस्योनाधिकता रविग्रहणे ॥३०॥

सु. भा.—अतः पूर्वप्रतिपादित संस्थानत आर्यभटीया दृक्क्षेपज्या ऽसज्जाता । तन्नाशाद् दृक्क्षेपाशुद्धेरवनतेर्नाशस्तस्या गणनायास्तदधीनत्वात् । अवनति-

नाशात् (स्फुटशरनाशस्ततो) रविग्रहणे ग्रासस्योनाधिकता भवतीति स्फुटम् ॥३०॥

वि. भा.—अतः (पूर्वप्रतिपादितयुक्तितः) आर्यभटोक्ता दृक्क्षेपज्याऽसत् (असमीचीना) जाता, तन्नाशात् (दृक्क्षेपाशुद्धे .) अवनतेर्नाशः (अवनतिसाधनस्य दृक्क्षेपाधीनत्वात्) अवनतिनाशात् स्फुटशरनाशः (यतः सूर्यग्रहे नतिसस्कृत. शरः स्फुटशरो भवति) तस्माद्रविग्रहणे ग्रासस्योनाधिकता (स्फुटशरोनमानैक्यार्धस्य ग्रासत्वात्) भवतीति खण्डनमिदमाचार्योक्तमतीव शोभनमिति विज्ञैः परीक्षणीयम् ॥३०॥

अब दृक्क्षेपज्या की अशुद्धि से अन्य खण्डन करते है ।

हि. भा.—पूर्व प्रतिपादित संस्थान से आर्यभटोक्त दृक्क्षेपज्या असत् (असमीचीन) हुई, दृक्क्षेप की अशुद्धि से अवनति अशुद्ध होती है (क्यो कि दृक्क्षेप ही के वश से अवनति का साधन होता है) अवनति की अशुद्धि से स्फुटशर अशुद्ध होता है (क्यों कि सूर्य ग्रहण में नतिसंस्कृत शर स्फुटशर होता है) इसीलिये सूर्य ग्रहण में ग्रास की अल्पता और अधिकता (क्योंकि मानैक्यार्ध में स्फुट शर को घटाने से शेष ग्रास होता है) होती है, यह खण्डन बहुत ठीक है इसको विज्ञ लोग विचार कर देखे इति ॥३०॥

इदानीं श्रीषेणविष्णुचन्द्रकृतं सूर्यग्रहणं खण्डयति ।

पञ्चज्यया यतोऽर्कग्रहणं श्रीषेणविष्णुचन्द्रकृतम् ।
आर्यटोक्तान्यनयोरर्कग्रहदूषणानि ततः ॥३१॥

सु. भा.—यतः श्रीषेण विष्णुचन्द्रकृतमर्कग्रहणं चाऽऽर्यभटोक्तवत् पञ्चज्ययैव । ततस्तस्मादार्यभटोक्तान्यर्कग्रहदूषणान्यनयोः श्रीषेण विष्णुचन्द्रयोरपि देयानि ॥३१॥

वि. भा.—यतः (यस्मात्कारणात्) श्रीषेणविष्णुचन्द्रकृतमर्कग्रहणमार्यभटोक्तवत् पञ्चज्ययैवास्ति, ततः (तस्मात्कारणात्) अनयो (श्रीषेणविष्णुचन्द्रयोः) रप्यार्यभटोक्तान्यर्कग्रहदूषणानि वाच्यानीति ॥३१॥

अब श्रीषेण और विष्णुचन्द्रकृत सूर्यग्रहण का खण्डन करते हैं ।

हि. भा.—जिस कारण से श्रीषेण और विष्णुचन्द्रकृत सूर्यग्रहण आर्यभटोक्त की तरह पञ्चज्या ही से है, इसलिये आर्यभटोक्त सूर्यग्रहण में जितने दोष हैं वे इन दोनों में भी कहने चाहिये इति ॥३१॥

इदानीमेवं सिद्धं निर्गलितार्थमाह ।

एवं विचार्यमाणे पञ्चज्यालम्बनं महास्थूलम् ।
स्थूलाऽवनतिश्च तथा दशज्यया लम्बनावनती ॥३२॥

सु० भा०—एवं पूर्वोक्तदूषणे विचार्यमाणे पञ्चज्यालम्बनं पञ्चज्यया लम्बनं महास्थूलं जातमवनतिश्च स्थूला जाता। तथा दशज्ययाऽप्येवमेव लम्बनावनती महास्थूले ॥३२॥

वि. भा.—एवं पूर्वोक्तदोषकदम्बके विचार्यमाणे पञ्चज्यया लम्बनमतीव स्थूलं जातम्, अवनतिश्च स्थूला जाता, दशज्यया लम्बनावती तथैवातीव स्थूले जाते इति ॥३२॥

अब पूर्वोक्त दूषणों से जो निर्गलितार्थ (निचोड बातें) निकला है उसे कहते हैं।

हि. भा.—इस तरह पूर्वोक्त दोषों को विचार करने से सिद्ध होता है कि पञ्चज्या से साधित लम्बन बहुत स्थूल होता है, अवनति भी बहुत स्थूल होती है, दशज्या से भी साधित लम्बन और अवनति इसी तरह बहुत स्थूल होती है इति ॥ ३२ ॥

इदानीं स्वसिद्धान्तमाह ।

नाड़ीचतुष्कविधिना सर्वत्र समो यतस्ततः स्थूलः ।
मानार्थं कर्म महद् कृतमार्यभटेन लघुनि सति ॥३३॥

सु. भा.—यतो यदुक्तेन नाडीचतुष्क विधिना लम्बनानयनप्रकारः सर्वत्र समः समानोऽर्थात् कुत्रचिन्न व्यभिचरति ततस्तस्मात् कारणादन्योक्तः प्रकारः स्थूलो ज्ञेयः। तथा मदुक्ते साधने लघुनि सति आर्यभटेन लम्बनमानार्थं महत् कर्म कृतम् तन्नादरणीयं सिद्धान्तप्रपञ्चकुशलैरिति ॥ ३३ ॥

वि. भा.—यतः (यस्मात् कारणात्) नाड़ीचतुष्कविधिना (व्यासार्धेन विभक्ता दृग्नतिजीवा चतुर्गुणा लब्धमित्याचार्योक्तलम्बनघटचानयनेन) सर्वत्र समोऽर्थाल्लम्बनानयनप्रकारः सर्वत्रैकरूप एव न कुत्रापि व्यभिचरति ततः (तस्मात् कारणात्) स्थूलो (अन्योक्त प्रकारः स्थूलः) ज्ञेयः। मदुक्ते साधने लघुनि सति मानार्थं (लम्बनमानार्थं) आर्यभटेन महत्कर्म कृतं तन्न शोभनमतो विद्वद्भिस्तन्नादरणीयमिति यद्यप्याचार्येण 'व्यासार्धेन विभक्ता दृग्नतिजीवा चतुर्गुणा लब्धमि' त्यादिना स्वमतेन लम्बनावनत्योः साधनं प्रतिपाद्याऽर्यभटोक्त-

तत्साधनस्य खण्डनं प्रतिपादितमस्ति, तथाप्यत्र तत्प्रतिपादनेन पिष्टपेषणमात्रमेव प्रदर्श्यते नात्र किमपि वैशिष्टचमिति ।। ३३ ।।

अब आचार्य अपने सिद्धान्त को कहते है ।

हि. भा.—जिस कारण से नाडी चतुष्कविधि से अर्थात् "व्यासार्धेन विभक्ता दृग्नतिजीवा चतुर्गुणा लब्धम्" इत्यादि से सब स्थानों मे लम्बनानयन प्रकार समान ही होता है, कहीं पर भी व्यभिचरित नही होता है, इसी कारण से अन्योक्त प्रकार स्थूल समझना चाहिये । हमारे लघु साधन रहने पर लम्बन मान के लिये आर्यभट ने जो महत्कर्म किया सो ठीक नहीं है इसलिये ज्योतिः सिद्धान्तज्ञ लोग इसका आदर न करे । यद्यपि आचार्य "व्यासार्धेन विभक्ता दृग्नतिजीवा इत्यादि से" अपने मत से लम्बन और अवनति के साधन प्रकार कह कर आर्यभटोक्त लम्बन और अवनति साधन प्रकार का खण्डन दिखला चुके है । तथापि यहां उन्ही विषयो का प्रतिपादन कर केवल पिष्ट पेषण मात्र ही दिखलाते हैं उसमें कुछ विशिष्टता नहीं है इति ।।३३।।

इदानीमार्यभटोक्तमक्षजदृक्कर्म खण्डयति ।

विक्षेपगुणाऽक्षज्या लम्बकभक्ताग्रहे धनमृणं यत् ।
उक्तमुदयास्तमययोर्न प्रतिघटिकं यतस्तदसत् ।।३४।।

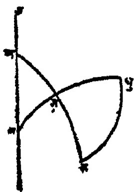
सु. भा.—आर्यभटेनार्कासन्नभावेन यौ ग्रहाणामुदयास्तमयौ तयो 'रक्षज्या विक्षेपगुणा लम्बकेन लम्बज्यया भक्ता' इत्यक्षजं दृक्कर्म यद्ग्रहे धनमृणं वोक्तं तद्यतः प्रतिघटिकमर्थात् प्रवहवशेन नित्योदयास्तयोः प्रतिवेलं नोक्तमतस्तदानयनमसदेकदेशीयत्वादिति ।

अत्र चतुर्वेदाचार्यः ।

असद्दूषण मेतत् सामान्येन तन्त्रोक्तत्वादिति ।।३४।।

वि. भा.—आर्यभटेनार्कासिन्नभावेन ग्रहाणां यावुदयास्तौ भवतस्तयोः "अक्षज्या शरगुणा लम्बज्यया भक्ता' इत्यक्षजं दृक्कर्म यद्ग्रहे धनमृणंवोक्त तद्यतः प्रतिघटिकमर्थात् प्रवहवशेन नित्योदयास्तयोः प्रतिक्षणं नोक्तमतस्तदानयनमसदेकदेशीयत्वादिति ।।३४।।

अत्रोपपत्तिः ।



ध्रु = ध्रुवः । स = समस्थानम् । ग्र = ग्रहबिम्बम्, ध्रुग्रन = ग्रहबिम्बोपरिध्रुवप्रोतवृत्तम् । सग्रम = ग्रहबिम्बोपरि समप्रोतवृत्तम् । जमन = क्रान्तिवृत्त खण्डम् । ग्रन = ध्रुवप्रोतवृत्तीयः शरः । $<$ मनग्र = न ग्रहस्यायनवलनकोटिः । न = आयनदृक्कर्मसंस्कृतग्रहस्थानम् । नम = अक्ष दृक्कर्म, $<$ नग्रम = ग्रहस्याक्षजं वलनम् । अत्र शरस्या-

ल्पत्वात् नग्र=मग्र=ग्रहस्य कदम्बप्रोतवृत्तीयशरः=शर, तदा नग्रम चापीय त्रिभुजे कोणानुपातेन $\frac{\text{शरज्या.अक्षजवनलज्या.}}{\text{आयनवलनकोज्या}}$ =अक्षजदृक्कर्मकलाज्या परन्तु $\frac{\text{त्रि. पद्यु}}{\text{द्यु}}$ =आयनवलन कोज्या, अत उत्थापनेन $\frac{\text{शरज्या. अक्षजवज्या. द्यु}}{\text{त्रि पद्यु.}}$ =अक्षजदृक्कर्मकज्या क्षितिजस्थे ग्रहे 'क्षितिजेऽक्षज्यया तुल्यमक्षजं वलनमि' त्यनेन अक्षजवलनज्या= अक्षज्या, तत उत्थापनेन $\frac{\text{शरज्या. अक्षज्या. द्यु}}{\text{त्रि. पद्यु}} = \frac{\text{शरज्या. अक्षज्या. द्यु. लंज्या}}{\text{त्रि. पद्यु. लंज्या}} =$ अक्षजदृक्कर्मज्या। अत्र स्वल्पान्तरात् शरज्या=शर तथा लंज्या=पद्यु, त्रि=द्यु तदा $\frac{\text{शर. अक्षज्या}}{\text{लंज्या}}$ =आक्षदृक्कर्मकलाज्या=आक्षदृक्कर्मकला, एतावता 'विक्षेप गुणाऽक्षज्या लम्बकभक्ते' त्युपपन्नम्। अत्र चतुर्वेदाचार्यः। असद्दूषणमेतत् सामान्येन तन्त्रोक्तत्वादिति ॥३४॥

अब आर्यभटोक्त अक्षज दृक्कर्म का खण्डन करते हैं।

हि. भा.—आर्यभट ने 'रवि के आसन्नभाव से ग्रहों के जो उदय और अस्त होते हैं उन दोनों कालो में 'विक्षेप गुणाऽक्षज्या लम्बक भक्ता' इस से समागत अक्षजदृक्कर्मकला को ग्रह में धन वा ऋण जो कहा है वह प्रवह वश से नित्योदयास्त में प्रति क्षण नहीं कहा गया है इसलिये उनके आनयन असत् (असमीचीन) है, क्यों कि उनकी उक्ति एक देशीय है इति ॥ ३४ ॥

उपपत्ति

यहां संस्कृतोपपत्ति में लिखित क्षेत्र को देखिये। ध्रु=ध्रुव। स=समस्थान, ग्र= ग्रहविम्ब। ध्रुग्रन=ग्रहविम्बोपरिगत ध्रुवप्रोतवृत्त, सग्रम=ग्रहविम्बोपरिगत समप्रोतवृत्त। जमन=क्रान्तिवृत्तखण्ड। ग्रन—ध्रुव प्रोतवृत्तीयशर। <मनग्र=न ग्रह की आयन वलन कोटि, न=आयन दृक्कर्म संस्कृत ग्रह स्थान, नम=अक्षज दृक्कर्म, <नग्रम=ग्रह के अक्षजवलन, यहां शर की अल्पता के कारण स्वल्पान्तर से नग्र=मग्र=ग्रह के कदम्ब प्रोतवृत्तीय शर=शर, नग्रम चापीय त्रिभुज में कोणानुपात से $\frac{\text{शरज्या.अक्षजवलनज्या.}}{\text{आयनवकोटिज्या}}$ =अक्षज दृक्कर्म-कलाज्या, परन्तु $\frac{\text{त्रि. पद्यु}}{\text{द्यु}}$ =आयनवलनकोज्या उत्थापन देने से $\frac{\text{शरज्या अक्षजवलनज्या द्यु}}{\text{त्रि. पद्यु}}$ =अक्षजदृक्कर्मलाज्या, क्षितिज में ग्रह के रहने से 'क्षितिजेऽक्षज्यया तुल्यमक्षजं वलनं' इससे अक्षजवलनज्या=अक्षज्या, उत्थापन देने से $\frac{\text{शरज्या.अक्षज्या.द्यु}}{\text{त्रि. पद्यु}} = \frac{\text{शरज्या. अक्षज्या. द्यु. लंज्या}}{\text{त्रि. पद्यु. लंज्या}}$

अक्षज दृक्कर्मकज्या, यहां स्वल्पान्तर से शरज्या=शर, लंज्या=पद्यु, त्रि=द्यु तब $\frac{\text{शर. अक्षज्या}}{\text{लंज्या.}}$ =अक्षजदृक्कर्मज्या=अक्षज दृक्कर्मकला इससे 'विक्षेपगुणाऽक्षज्या लम्बकभक्ता' यह उपपन्न हुआ। यहां चतुर्वेदाचार्य कहते है 'असद्दूषणमेतत् सामान्येन तन्त्रोक्तत्वात्' अर्थात् यह दूषण (आचार्य जो दोष दिखाते है) ठीक नही है क्यो कि आर्यभटीयतन्त्र मे सामान्य रूप से कहा गया है इति ।।३४।।

इदानीमार्यभटोक्तमायनं दृक्कर्म खण्डयति ।

त्रिज्याकृतिभक्ता विक्षेपापक्रमगुणोत्क्रमज्येन्दोः ।
अयनान्ते यद्दृणधनं तत् तस्यादौ ततोऽसत् तत् ।।३५।।

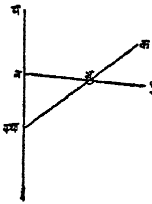
सु. भा.—इन्दोश्चन्द्रस्योत्क्रमज्या विक्षेपापक्रमगुणा विक्षेपेण शरेण गुणाऽपक्रमेण परमापमज्यया च गुणा ततस्त्रिज्याकृतिभक्ता फलमायनदृक्कर्मकलेति यदुक्ता मार्यभटेन तत् ततस्तस्मात् कारणान्न सत् । कस्मात् । यतो ऽयनान्ते गोलसन्धौ यद्दृणधनं फलमुत्पद्यते तत् तस्य मते आदावयनादावेवोत्पद्यते ऽतस्तदसदित्यर्थः । गोलयुक्त्या खेटकोटिग्रहणं समुचितं तत्रार्यभटेन खेटभुजग्रहणं कृतं तेनायनादौ ग्रहे कोटिः शून्यमिता भुजः परमो नवतिसमः । गोलयुक्त्या तत्रायन वलनाभावादायनं दृक्कर्म शून्यमार्यभटमतेन च तत्र भुजस्य परमत्वात् तत् फलमुत्पद्यते यच्च गोलयुक्त्या गोलसन्धौ परमायनवलनत्वादुत्पद्यत इति । अतस्तदसत् ।

अत्र चतुर्वेदाचार्यः । सद्दूषणमेतद्यत आर्यभटीयं वाक्यमेतदत्रार्थे—

विक्षेपापक्रमगुणमुत्क्रमणं विस्तरार्धं कृतिभक्तं । अत्र भटदीपिकायां परमेश्वरः । 'सायनचन्द्रस्योत्क्रमण कोट्या उत्क्रमज्येत्यर्थः' एवं चेत् तदाऽऽचार्यखण्डनं न समीचीनम् । इदं कर्म क्रमज्यया कर्तव्यमार्यभटादिभिरुत्क्रमज्यया यत् कृतं तत्र तथ्यमिति भास्करखण्डनं वस्तुतो गोलयुक्तियुक्तं वास्तवमिति स्फुटं चापक्षेत्रकुशलानाम् ।। ३५ ।।

वि. भा.—इन्दोः (चन्द्रस्य) उत्क्रमज्या (भुजोत्क्रमज्या) विक्षेपापक्रमगुणा (विक्षेपेण शरेण, अपक्रमेण परम क्रान्तिज्यया च गुणा) त्रिज्याकृति (त्रिज्यावर्ग) भक्ता लब्धमायनदृक्कर्मकलेति यदुक्तमार्यभटेन तत् ततः (तस्मात् कारणात्) असत् यतः (यस्मात्कारणात्) अयनान्ते (गोलसन्धौ) यद्दृणधनं फलमुत्पद्यते तत्तस्यमते आदावयन सन्धावेवोत्पद्यतेऽतस्तदसदिति ।।३५।।

अत्रोपपत्तिः ।



ध्रु=ध्रुवः । क=कदम्बम् । ग्र=ग्रह बिम्बकेन्द्रम् । पनस्था=क्रान्ति वृत्त खण्डम् । ग्रहबिम्बकेन्द्रोपरिगतं कदम्ब प्रोतवृत्तं क्रान्ति वृत्ते यत्र लग्नं तत्र ग्रहस्थानम्=स्था, ग्रहबिम्बकेन्द्रोपरि ध्रुव-प्रोतवृत्तं क्रान्तिवृत्ते यत्र लग्नं स एवायनदृक्कर्मसंस्कृतग्रहः=न नस्था=आयनं दृक्कर्म, ग्रस्था=कदम्बप्रोतवृत्तेशरः=मध्यशरः $<$स्थाग्रन=ग्रहायनवलनांशाः । $<$स्थानग्र=आयन दृक्कर्म संस्कृत ग्रहस्यायन वलनकोटिः । शरस्याल्पत्वात् स्वल्पान्तरात् ग्रस्था=ग्रन, तेन $<$स्थानग्र=$<$न स्थाग्र=९० तदा ग्रस्थान त्रिभुजेऽनुपातेन $\frac{\text{शरज्या. आयनवलनज्या}}{\text{त्रि}}$ = आयन दृक्कर्मकलाज्या, परमार्यभटमतेन $\frac{\text{चन्द्रभुजोत्क्रमज्या. जिज्या}}{\text{त्रि}}$=आयनवलनज्या, अत उत्थापनेन $\frac{\text{शरज्या. चन्द्रभुजोत्क्रमज्या.जिज्या}}{\text{त्रि. त्रि}}=\frac{\text{शरज्या. चन्द्रभुजोत्क्रमज्या.जिज्या}}{\text{त्रि}^2}$ =आयनदृक्कर्मकलाज्या, अल्प स्वान्तरात् शरज्या=शर, तथा आयनदृक्कर्मक-लाज्या=आयनदृक्कर्मकला, ततः $\frac{\text{शर. चन्द्रभुजोत्क्रमज्या. जिज्या}}{\text{त्रि}^2}$ =आयनदृक्कर्म-कला, एतावता 'त्रिज्याकृतिभक्ता विक्षेपापक्रम गुणोत्क्रमज्येन्दोरि' त्युपपद्यते । अत्र चन्द्रभुजोत्क्रमज्यास्थाने चन्द्रभुजकोटिज्याग्रहणं समुचितमस्ति, अयनादौ (अयनसन्धौ) चन्द्रे चन्द्रभुजकोटिः=०, चन्द्रभुजः=९० तत्राऽयनवलनाभावा-दायनदृक्कर्मणोऽप्यभावो भवेत्, परमार्यभटमतेन तत्र चन्द्रभुजस्य परमत्वा-त्तदुत्क्रमज्यावशत आयनदृक्कर्मोत्पद्यते, यच्च गोलसन्धौ परमायनवलनत्वा-दुत्पद्यतेऽतस्तन्मतं न सदिति । अत्र चतुर्वेदाचार्यः 'सद्दूषणमेतद्यत आर्यभटीयं वाक्यमेतदत्रार्थे-विक्षेपापक्रमगुणमुत्क्रमणं विस्तरार्धकृतिभक्तम्' इदं कर्म क्रमज्यया साधितं वास्तवं भवति, आर्यभटादिभिरुत्क्रमज्यया यत्साधितं तन्न समीचीनम् । उत्क्रमज्यया साधितं वलनं दृक्कर्म च न समीचीनमेतदर्थं शिद्धान्तशिरोमणौ भास्कराचार्येण युक्तियुक्तं सर्वमभिहितम् । अत्र भटदीपिकायां परमेश्वरः । 'सायन चन्द्रस्योत्क्रमणं कोटचा उत्क्रमज्येत्यर्थं' । एवं चेत्तदाऽऽचार्य खण्डनं न समीचीनमिति ॥३५॥

अब आर्यभटोक्त आयन दृक्कर्म का खण्डन करते हैं ।

हि. भा.—चन्द्र भुजोत्क्रमज्या को शर से और परम क्रान्तिज्या से गुणा कर त्रिज्या वर्ग से भागदेने से फल आयनदृक्कर्म कला होती है यह जो आर्यभट ने कहा है सो ठीक नहीं है, क्यों कि अयनान्त (गोलसन्धि) में जो ऋण फल और धन फल उत्पन्न होता है वह

उन के मत में अयनादि (अयन सन्धि) ही में उत्पन्न होता है इसलिये उनका मत ठीक नहीं है इति ॥३५॥

उपपत्ति।

यहां सं. उपपत्ति में लिखित क्षेत्र को देखिये। ध्रु = ध्रुव। क = कदम्ब, ग्र = ग्रह-बिम्बकेन्द्र, पनस्था = क्रान्ति वृत्त खण्ड, ग्रह बिम्बोपरिगत कदम्बप्रोतवृत्त क्रान्तिवृत्त में जहां लगता है वहां ग्रहस्थान = स्था, है ग्रह बिम्ब केन्द्रोपरिगत ध्रुवप्रोतवृत्त क्रान्तिवृत्त में जहां लगता है वही अायन दृक्कर्म संस्कृत ग्रह = न, है। नस्था = आयनदृक्कर्मकला, ग्रस्था = कदम्ब प्रोतवृत्त में शर = मध्यम शर, < स्थाग्रन = ग्रह के आयनवलनांश < स्थानग्र = आयनदृक्कर्म संस्कृत ग्रह की आयनवलन कोटि, शर की अल्पता के कारण स्वल्पान्तर से ग्रस्था = ग्रन इसलिये < स्थानग्र = < नस्थाग्र = ९०, तब ग्रस्थान त्रिभुज में अनुपात से $\frac{\text{शरज्या. आयनवलनज्या}}{\text{त्रि}}$ = आयन दृक्कर्मकलाज्या, आर्यभट के मत से $\frac{\text{चन्द्रभुजोत्क्रमज्या. जिज्या}}{\text{त्रि}}$ = आयनवज्या, अतः उत्थापन देने से $\frac{\text{शरज्या. चन्द्रभुजोत्क्रमज्या. जिज्या}}{\text{त्रि. त्रि}}$ = $\frac{\text{शरज्या. चन्द्रभुजोत्क्रमज्या. जिज्या}}{\text{त्रि}^2}$ = आयनदृक्कर्मज्या। यहां स्वल्पान्तर से शरज्या = शर, तथा आयन दृक्कर्मकलाज्या = आयनदृक्कर्मकला, अतः $\frac{\text{शर चन्द्रभुजोत्क्रमज्या. जिज्या}}{\text{त्रि}^2}$ = आयनदृक्कर्मकला, इस से 'त्रिज्या कृतिभक्ता विक्षेपापक्रमगुणोत्क्रमज्येन्दोः' यह उपपन्न हुआ। यहां चन्द्रभुजोत्क्रमज्यास्थान में चन्द्रभुज कोटिज्या का ग्रहण करना समुचित है, अयनादि (अयन सन्धि) में चन्द्र के रहने से चन्द्रभुज कोटि = ०, चन्द्रभुज = ९०, वहां आयनवलन के अभाव से आयनदृक्कर्म का भी अभाव होता है, लेकिन वहां आर्यभट के मत से चन्द्रभुज के परमत्व से आयन दृक्कर्म होता है. जो गोल सन्धि में आयन वलन के परमत्व से उत्पन्न होता है इसलिये उनके मत ठीक नहीं है। यहां चतुर्वेदाचार्य कहते हैं 'सद्दूषणमेतद्यत आर्यभटीय वाक्यमेतदत्रार्थे' अर्थात् आचार्योक्त यह दोष ठीक है क्यों कि इस विषय में आर्यभट के बचन ठीक हैं 'विक्षेपापक्रमगुणमुत्क्रमणं विस्तरार्धकृतिभक्तम्' अर्थात् 'त्रिज्याकृति भक्ता विक्षेपापक्रमगुणोत्क्रमज्येन्दोः' आचार्योक्त इस पद्य का जो अर्थ है वही आर्यभटोक्त वचन का अर्थ है, क्रमज्या से साधित आयनदृक्कर्मकला वास्तव होती है, आर्यभट आदि ने आचार्य उत्क्रमज्या से जो इसका साधन किया है सो ठीक नहीं है, उत्क्रमज्या से साधित वलन और दृक्कर्म ठीक नहीं है इसके लिये सिद्धान्तशिरोमणि में भास्कराचार्य ने युक्ति युक्त सब बातें कही हैं, इति ॥३५॥

इदानीं दृक्कर्माज्ञानाद्ये दोषा आयान्ति तानाह।

दृक्कर्माविज्ञानात् कालाविज्ञानमकथितत्वाच्च।
कालाज्ञानात् शङ्कोरज्ञानं कोटिनाशोऽतः ॥३६॥

शशिशङ्कोः प्राच्यपरा कोटिः कोटिभुजकृतियुतेर्मूलम् ।
तिर्यक् कर्णो न भवति यतोऽर्कचन्द्रान्तरं कर्णः ॥३७॥
कोटिश्रवणाज्ञानात् शशिनः शृङ्गोन्नतिर्विसंवदति ।
उदयास्तयोर्दिनकृतः प्रतिघटिकमतीव चाज्ञानात् ॥ ३८ ॥

सु. भा.—दृक्कर्माविज्ञानादकथितत्वात् कालसाधनानयनस्याकथितत्वाच्च कालाविज्ञानं कालाज्ञानात् शङ्कोरज्ञानमतः शङ्कोरज्ञानात् कोटिनाशः। ततश्चन्द्र-शृंगोन्नतौ या शङ्कोः प्राच्यपरा कोटिः साधिता तस्या नाशो भुजस्यापि नाशः । ततः कोटिभुजकृतियुतेर्मूलं तिर्यक् कर्णोऽपि न भवति । यतो रविचन्द्रान्तरं रविचन्द्र-बिम्बान्तरसूत्रमेव कर्णस्तस्य नाशे महान् विरोधः । एवं कोटिश्रवणाज्ञानाद् दिनकृतः सूर्यस्योदयादस्ताद्वा चन्द्रस्य प्रवहवशेन प्रतिघटिकं प्रतिवेलमुदयास्तयो-श्चातीवाज्ञानात् शशिनश्चन्द्रस्य शृङ्गोन्नतिर्विसंवदति विसंवादमायाति न घटत इत्यर्थः ॥३६-३८॥

वि. भा.—दृक्कर्माविज्ञानादकथित्वात् कालसाधनस्याकथितत्वाच्च कालावि-ज्ञानं, कालाज्ञानात् शङ्कोरज्ञानं, अतः शङ्कोरज्ञानात् कोटिनाशः, ततश्चन्द्रशृङ्गोन्नतौ या शङ्कोः प्राच्यपरा (पूर्वापरा) कोटः साधिता तस्था नाशः । भुजस्यापि नाशः । ततः कोटिभुजकृतियुते (कोटिभुजयोवर्गयोगस्य) मूलं तिर्यक् कर्णोऽपि न भवति, यतोऽर्कचन्द्रान्तरं (रविचन्द्रबिम्बान्तरसूत्रमेव) कर्णस्तस्य नाशे सति महान् विरोधो भवति, एवं कोटिकर्णाज्ञानात् दिनकृतः (सूर्यस्य) उदयादस्ताद्वा चन्द्रस्य प्रवहवशेन प्रतिघटिकं (प्रतिवेलं) उदयास्तयोश्चातीवा ज्ञानात् शशिनः (चन्द्रस्य) शृङ्गोन्नतिर्विसंवदति विसंवादमायति न घटत इत्यर्थः) इति ॥३६-३८॥

अब दृक्कर्म के अज्ञान से (वास्तविक ज्ञान न रहने से) जा दोष आते हैं उन्हें कहते हैं।

हि. भा.—दृक्कर्मक ज्ञान न रहने से काल साधन के न कहने के कारण काल ज्ञान नही होता है। काल के अज्ञान से शंकु का ज्ञान नही होता है, शंकु के अज्ञान से कोटि का ज्ञान नहीं होता, तब चन्द्रशृङ्गोन्नति में शकु से जो पूर्वापर कोटि का ज्ञान होता है वह नही हो सकता, भुज का भी ज्ञान नही होगा, तब भुज और कोटि के वर्ग योग का मूल तिर्यक् कर्ण का भी ज्ञान नहीं होगा, इस तरह कोटि और कर्ण के अज्ञान से सूर्य के उदय से वा अस्त से चन्द्र के प्रवहवश से प्रतिक्षण उदय और अस्त के अतीव अज्ञान से चन्द्र की शृङ्गोन्नति नही घटती है अर्थात् जिस समय में चन्द्र शृङ्गोन्नति देखनी चाहिये वह देखने में नहीं आती है इति ॥३६-३८॥

इदानीं शृङ्गोन्नतावार्यभटोक्तं शुक्लं खण्डयति ।

अर्केन्द्वन्तरघटिका व्यस्तज्या चन्द्रमानगुणिता यत् ।
व्यास विभक्ताच्छुक्लं यतो न दृक्तुल्यमसदस्मात् ॥३९॥

सु. भा.—अर्केन्द्वन्तरघटिकातो ये ऽन्तरांशा रविचन्द्रयोस्तेषां व्यस्तज्यो-त्क्रमज्या चन्द्रबिम्बमानगुणिता व्यासेन द्विगुणत्रिज्यया विभक्ता शुक्लं भवतीत्या-र्यभटोक्तं यतो दृक् तुल्यं सर्वदा नास्मात् तच्छुक्लमसत् ।

आचार्येणेदमानयनं दिनशृङ्गोन्नत्यर्थं शृंगोन्नत्यध्याये प्रदर्शितमार्यभटेन सर्वकालिकशृंगोन्नत्यर्थं तदुक्तमतोऽसदिति ।

अत्र चतुर्वेदाचार्यः ।

'चन्द्रान्तरस्थितघटिकानां प्रागानीतानामुत्क्रमेण या ज्या सार्केन्द्वन्तर-घटिकाव्यस्तज्योच्यते रविचन्द्रान्तरस्थानां कालांशानामुत्क्रमज्येत्यर्थः । युज्यते रविचन्द्रान्तरस्थानां भागानामपमण्डलभोगेनोत्क्रमजीवया शुक्लानयनम् । असद्दू-षणमेतत् । यत आर्यभटीयोऽयमर्थो नास्ति । शृङ्गोन्नतौ च तेनैतावदेव सूचितम् ।

भूग्रहभानां गोलार्धानि स्वच्छायया विवर्णानि ।
अर्धानि यथासारं सूर्याभिमुखानि दीप्यन्ते ।।

इत्यवस्थिते यथा गोलवासनाया शृङ्गोन्नतिर्न विरुद्धयते तथा व्याख्यातुं युज्यत इति ।

मन्मते चेहाचार्य आर्यभटानुयायिनां भास्करादीनां शुक्लं खण्डयति ।
शिष्यधीवृद्धिदे तथैव लल्लोक्तान्नयनोल्लेखादिति ।। ३९ ।।

वि. भा.—अर्केन्द्वन्तरघटिकातो (रविचन्द्रान्तरघटीतः) येऽन्तरांशा (रविचन्द्रयोः) स्तेषां व्यस्तज्या (रविचन्द्रान्तराशोत्क्रमज्या) चन्द्रमानगुणिता (चन्द्रबिम्बव्यास गुणिता) व्यासेन (द्विगुण त्रिज्यया) विभक्ता तदा आर्यभटोक्तं शुक्लं भवति, यतः (यस्मात्कारणात्) तत्सर्वदा दृक्तुल्यं न भवत्यस्मात्कारणा-त्तदसदिति ।।३९।।

अत्रोपपत्तिः ।

रवि चन्द्रयोरन्तराभावे शुक्लाभावः । परमेऽन्तरे (षड्राशितुल्ये) पूर्ण चन्द्रबिम्बतुल्यं शुक्लं तथा राशित्रयतुल्येऽन्तरे बिम्बार्धतुल्यं शुक्लमिति च भास्कराचार्यतः प्राचीनैः सर्वैरप्याचार्यैः स्वीकृतम् तदिहान्तरांशोत्क्रमज्यया शुक्लवृद्धेः प्रत्यक्षतो दर्शनात् द्विगुणत्रिज्यातुल्यया रविचन्द्रान्तरोत्क्रमज्यया चन्द्रबिम्बतुल्यं शुक्लं लभ्यते तदेष्ट रविचन्द्रान्तरोत्क्रमज्यया किं समागच्छत्यार्य-भटीयं सर्वकालिकशृङ्गोन्नत्युपयोगि शुक्लम् । आचार्येण शृङ्गोन्नत्यध्याये यच्छुक्लाङ्गुलानयनं कृतं तद्दिनशृङ्गोन्नत्यर्थमत आचार्योक्तविरुद्धत्वादार्यभटो-

क्त न सदित्याचार्यः कथयति । अत्र चतुर्वेदाचार्यः- रविचन्द्रान्तरस्थितघटिकानां प्रागानीतानामुत्क्रमेण या ज्या सार्केन्द्वन्तर घटिका व्यस्तज्योच्यते । रविचन्द्रान्तर-संस्थानां कालांशानामुत्क्रमज्येत्यर्थः । युज्यते रविचन्द्रान्तरास्थानां भागानामपम-ण्डल भोगेनोत्क्रमजीवया शुक्लानयनम् । असद्दूषणमेतत् । यत आर्यभटीयोऽयमर्थो नास्ति । शृङ्गोन्नतौ च तेनैतावदेव सूचितम् । भूग्रहभानां गोलार्धानि स्वच्छायया विवर्णानि । अर्धानि यथासारं सूर्याभिमुखानि दीप्यन्ते । इत्यवस्थिते यथा गोलवासनया शृङ्गोन्नतिर्न विरुद्धयते तथा व्याख्यातुं युज्यत इति' ।

प्राय आर्यभटानुयायिनां शुक्लं खण्डयत्याचार्यः ।
शिष्यधीवृद्धिदे तथैव लल्लोक्तानयनं दर्शनादिति ।।३९।।

अब शृङ्गोन्नति में आर्यभटोक्त शुक्ल का खण्डन करते हैं ।

हि. भा.—रवि और चन्द्र की अन्तर घटी से रवि और चन्द्र का जो अन्तरांश होता है उस की उत्क्रमज्या (रविचन्द्रान्तरांशोत्क्रमज्या) को चन्द्रबिम्बव्यास से गुणा कर व्यास (द्विगुणित त्रिज्या) से भाग देने से आर्यभटोक्त शुक्ल होता है, जिस कारण से वह सर्वदा दृक्तुल्य नहीं होता है इस कारण से वह असत् (असमीचीन) है इति ।।३९।।

उपपत्ति

रवि और चन्द्र के अन्तराभाव रहने से शुक्लाभाव होता है, परम अन्तर (६ राशि तुल्य अन्तर) में पूर्ण (चन्द्रबिम्ब तुल्य) शुक्ल होता है, तथा तीन राशि तुल्य अन्तर में बिम्बार्धतुल्य शुक्ल होता है ये बाते भास्कराचार्य से प्राचीन सब आचार्यो ने स्वीकार की है । यहाँ अन्तरांशोत्क्रमज्या से प्रत्यक्ष शुक्लवृद्धि के देखने से अनुपात करते है द्विगुणित त्रिज्यातुल्य रवि चन्द्रान्तरांशोत्क्रमज्या में चन्द्र बिम्ब तुल्य शुक्ल पाते हैं तो इष्ट रवि चन्द्र-न्तरांशोत्क्रमज्या में क्या इससे आर्यभटीय सर्वकालिक शृङ्गोन्नति के लिये उपयुक्त शुक्ल आता है । आचार्य ने शृङ्गोन्नति अध्याय में जो शुक्लानयन किया है वह दिन में शृङ्गोन्नति के लिये है, इसलिये आचार्योक्त से आर्यभटोक्त के विरुद्ध होने के कारण वह ठीक नहीं है यह बात आचार्य कहते है । यहां चतुर्वेदाचार्य कहते है 'रविचन्द्रान्तरस्थितघटिकानां प्रागानीतानां' इत्यादि सं. उपपत्ति में लिखित गद्य को देखिये अर्थात् पूर्वानीत रवि और चन्द्र की अन्तर घटी की जो उत्क्रमज्या है वह रविचन्द्रान्तर घटी की व्यस्तज्या कहलाती है, अर्थात् रवि और चन्द्र के अन्तर स्थित कालांशज्या है, तथा क्रान्तिमण्डल भोग से रवि चन्द्रान्तरांश उत्क्रमज्या मे शुक्लानयन समुचित है, आचार्योक्त यह खण्डन ठीक नहीं है, क्यों कि यह अर्थ आर्यभटीय नहीं है, शृङ्गोन्नति में आर्यभट ने इतना ही सूचित किया है कि 'भूग्रहभानां गोलार्धानि स्वच्छायया विवर्णानि' इत्यादि सं. उपपत्ति में लिखित पद्य को देखिये । प्रायः आचार्य आर्यभटानुयायियों (भास्करादियों) के शुक्ल का खण्डन करते हैं क्यों कि शिष्यधीवृद्धिद में वैसा ही लल्लोक्तानयन देखने में आता है इति ।।३९।।

इदानीमार्यभटसाधितचन्द्रदिनगतशेषौ खण्डयति ।

प्राक् प्रागुदिताभ्यधिकः पश्चादुदितोनकोऽपरे व्यस्तः ।
कालो यश्छायार्थं तदसत् स्फुटभुक्तिगमनात् प्राक् ॥४०॥

सु. भा.—प्राक् प्राक्क्षितिजे प्रागुदिताभ्यधिकः कार्यः । पश्चादुदितोनकः कार्यः । अर्थात् प्राक्क्षितिजे यदि चन्द्रः प्रागुदितस्तदा सोऽधिकेन तात्कालिकलग्नेन समः कार्यः । चन्द्रभोग्यकालस्य लग्नभुक्तकालस्य मध्योदयानां च योगः कार्य इत्यर्थः । एवं यदीष्टलग्नानन्तरं चन्द्रोदयस्तदा लग्नभोग्यकालस्य चन्द्रभुक्तकालस्य मध्योदयानां च योगः कार्यः । अपरे प्रत्यक्क्षितिजे तु पूर्वोक्ततो व्यस्तस्तदा चन्द्रस्य गतो वा शेषः कालः स्यादिति । एवमार्यभटेन छायार्थ यः कालः साधितस्तन्मानमसज्ज्ञेयं प्राक्स्फुट भुक्तिगमनात् । अर्थाद्यदि चन्द्रो नक्षत्रवत् स्थिरस्तदाऽऽर्यभटकर्मणा लग्नात् कालसाधनवत् कालो भवेत् परन्तु स्फुटभुक्त्या चन्द्रः प्राग्गच्छति अतोऽसकृत्कर्मणा तात्कालिकचन्द्रोदयास्तलग्नवशेन स्फुटकालसाधनं युक्तमत आर्यभटोक्तं सकृत्कालसाधनं न सदिति ।

अत्र चतुर्वेदाचार्यः—

'अयमप्यर्थस्तत्र (आर्यभटतन्त्रे) नास्ति तस्मादसद्दूषणमेतत् स्यात् ।
तद्व्याख्यातॄणां यद्भवति तद्भवतु का नः क्षतिः' ॥४०॥

वि. भा.—प्राक् (पूर्वे क्षितिजे) प्रागुदिताभ्यधिकः कार्यः पश्चादुदितोनकः कार्योऽर्थाद्यदि चन्द्रः पूर्वक्षितिजे प्रागुदितस्तदा सोऽधिकेन तात्कालिक लग्नेन समः कार्यो ऽर्थाच्चन्द्रभोग्यकाललग्नभुक्तकालमध्योदयानां योगः कार्यः । यदीष्टलग्नानन्तरं चन्द्रोदयस्तदा लग्नभोग्यकालचन्द्रभुक्तकालमध्योदयानां योगः कार्यः । अपरे (पश्चिमक्षितिजे) व्यस्तः (पूर्वोक्ततो विपरीतः) तदा चन्द्रस्य गतः शेषो वा कालः स्यात् । एवमार्यभटेन छायार्थं यः कालः साधितस्तन्मानमसद्बोध्यं प्राक् स्फुटभुक्तिगमनात् । अर्थाद्यदि चन्द्रो नक्षत्रवत् स्थिरस्तदाऽऽर्यभटोक्त कर्मणा लग्नात्कालसाधनवत् कालो भवेत् । परन्तु चन्द्रः स्फुटगत्या पूर्वदिशि गच्छति, अतस्तात्कालिकचन्द्रोदयास्तलग्नवशेनाऽसकृत्कर्मणा स्फुटकालसाधनं समुचितं तत आर्यभटोक्तं सकृत्कर्मणा कालसाधनं न समीचीनमिति । अत्र चतुर्वेदाचार्यः ।

'अयमप्यर्थस्तत्र (आर्यभटतन्त्रे) नास्ति तस्मादसद्दूषणमेतत् स्यात् तद्व्याख्यातॄणां यद्भवति तद् भवतु का नः क्षतिः' । आर्यभट तन्त्रे यस्य विषयस्योल्लेखो नास्ति तमपि स्वकपोलकल्पितं कृत्वा ऽऽचार्यस्तं खण्डयतीति महदाश्चर्यम् ॥४०॥

अब आर्यभट से साधित चन्द्रदिनगत और चन्द्रदिनशेष का खण्डन करते है ।

हि. भा.—यदि चन्द्र प्राक् क्षितिज में प्राक् उदित हो तो चन्द्र को अधिक तात्कालिक लग्न के साथ सम करना यदि चन्द्र पश्चात् उदित हो तो चन्द्र को अल्पतात्कालिक लग्न के साथ सम करना अर्थात् चन्द्र के भोग्यकाल, लग्न के भुक्तकाल तथा चन्द्र और लग्न के मध्यवर्त्ती राश्युदयासुओं का योग करना, यदि इष्ट लग्न के अनन्तर चन्द्रोदय हो तो लग्न के भोग्य काल, चन्द्र के भुक्त काल तथा चन्द्रलग्नान्तर्गत राश्युदयासुओं का योग करना चाहिये. पश्चिम क्षितिज मे पूर्वोक्त से विलोम होता है तब चन्द्र का गत वा शेष काल होता है । एवं छाया के लिये आर्यभट ने जो काल साधन किया है उस का मान ठीक नही समझना चाहिये । स्फुटगति से चन्द्र के पूर्व दिशा में जाने के कारण अर्थात् यदि चन्द्र नक्षत्र की तरह स्थिर हो तब आर्यभटीय कर्म से लग्न से काल साधन की तरह काल होता है । लेकिन चन्द्र तो अपनी स्फुट गति से पूर्व दिशा में जाते है इसलिये तात्कालिक चन्द्रोदयास्त लग्नवश से असकृत्कर्म से स्फुट कालसाधन युक्त है अतः सकृत् प्रकार से आर्यभटोक्त काल साधन असत् (असमीचीन) है, यहां चतुर्वेदाचार्य कहते हैं- 'अयमप्यर्थस्तत्र (आर्यभटतन्त्रे) नास्ति' इत्यादि सं. उपपत्ति में लिखित गद्य को देखिये अर्थात् यह अर्थ भी आर्यभटतन्त्र में ।

इदानीं दिनगतघटिकाद्यज्ञाने ये दोषास्तानाह ।

उदितानुदितास्तमितावशेषकालान्न वेत्ति यः स कथम् ।
आर्यभटज्ञः शशिनश्छाया शृङ्गोन्नती वेत्ति ॥ ४१ ॥

सु. भा.— आर्यभटज्ञ आर्यभटतन्त्रज्ञो वाऽऽर्यभट एव ज्ञः पण्डित इत्यार्यभटज्ञः । शेषं स्पष्टार्थम् ॥४१॥

वि. भा.—य आर्यभटज्ञः (आर्यभटतन्त्रवेत्ता) इतावशेषकालात् (गतकालाच्छेषकालाच्च) शशिनः (चन्द्रस्य) उदितानुदितास्तं न जानाति, स चन्द्रस्य छायाशृङ्गोन्नती कथं वेत्ति कथमपि न वेत्तीत्यर्थः—अत्रैतदुक्तं भवति पूर्वकपाले प्रश्ने प्रश्नकालिकविघटिकासु प्रागुदिते चन्द्रे अन्तरजा घटिका योज्याः । पश्चादुदिते चन्द्रे (इष्टलग्नानन्तरमुदिते चन्द्रे) अन्तरजा घटिकाः प्रश्नकालिकघटिकासु हीनाः कार्याः । पश्चिमकपाले तु विपर्ययोऽर्थात्प्रागुदिते चन्द्रे हीनाः पश्चादुदिते योज्यास्तदा चन्द्रच्छायार्थं गतः शेषो वा कालः स्यात् । अनया रीत्या चन्द्रच्छायार्थ गतशेषकालानयनमार्यभटोक्तमस्ति, यत्खण्डनमाचार्येणात्रैवा (तन्त्रपरीक्षाध्याये) ध्याये "प्राक् प्रागुदिताभ्यधिकः पश्चादुदितोनकोऽपरे व्यस्तः । कालोयश्छायार्थं तदसत् स्फुटभुक्ति गमनात् प्राक्" ऽनेन कृतम् । गतशेष नाड़िकाभिरेव चन्द्रस्य स्पष्टशंकुज्ञानं भवति यद्वशेन चन्द्रशृङ्गोन्नतेर्ज्ञानं भवति-आर्यभटोक्तं गतशेषकालानयनं न समीचीनमस्त्यतस्तद्वशेन साधिते चन्द्रच्छायाशृङ्गोन्नती अपि न समीचीने भवितुमर्हत इत्येवाऽचार्यकथनस्याभिप्राय इति ॥४१॥

अब दिनगत घटी आदि का ज्ञान न रहने से जो दोष होते है उन्हे कहते हैं ।

हि. भा.—जो आर्यभट तन्त्र के पण्डित-गत काल मे और शेष काल से उदित चन्द्र और अनुदित चन्द्र चन्द्रास्त को नही जानते है वे चन्द्र की छाया और चन्द्रशृङ्गोन्नति को कैसे समझ सकते है अर्थात् किसी तरह नही समझ सकते है– यहाँ ऐसा कहा जाता है पूर्व कपाल में प्रश्न होने से पूर्वोदित चन्द्र मे प्रश्न कालिक घटी में अन्तर घटी को जोड देना चाहिये, 'पश्चादुदित चन्द्र में (इष्टलग्नानन्तर उदित चन्द्र मे) अन्तर घटी को प्रश्नकालिक घटी मे से हीन करना चाहिये, पश्चिमकपाल में विपरीत होता है अर्थात् पूर्वोदित चन्द्र में प्रश्नकालिक घटी में से अन्तर घटी को हीन करना चाहिये, पश्चात् उदित चन्द्र मे प्रश्नकालिक घटी में अन्तर घटी को जोड़ना चाहिये तब चन्द्र की छाया के लिये गतकाल वा शेपकाल होता है, इस रीति से चन्द्रच्छाया साधनार्थ गतकाल और शेषकाल का साधन आर्यभट ने अपने सिद्धान्त में किया है, जिसका खण्डन इसी तन्त्र परीक्षाध्याय मे "प्राक् प्रागुदिताभ्यधिकः" इत्यादि संस्कृत विज्ञान भाष्य में लिखित श्लोक से आचार्य ने किया है, गत घटी और शेषघटी से ही चन्द्र का स्पष्टशंकु साधन होता है, स्पष्टशंकु वश ही से चन्द्र की शृङ्गोन्नति का ज्ञान होता है, आर्यभट कथित गत कालानयन और शेष कालानयन ठीक नही है इसलिये उसके द्वारा साधित चन्द्रच्छाया और चन्द्रशृङ्गोन्नति भी ठीक नही हो सकती है यही आचार्य के कथन का अभिप्राय है इति ॥४१॥

इदानीमार्यभटं दूषयति ।

स्वयमेव नाम यत् कृतमार्यभटेन स्फुटं स्वगणितस्य ।
सिद्धं तदस्फुटत्वं ग्रहणादीनां विसंवादात् ॥ ४२ ॥
जानात्येकमपि यतो नार्यभटो गणितकालगोलानाम् ।
न मया प्रोक्तानि ततः पृथक्-पृथक् दूषणान्येषाम् ॥ ४३ ॥
आर्यभटदूषणानां संख्या वक्तुं न शक्यते यस्मात् ।
तस्मादयमुद्देशो बुद्धिमताऽन्यानि योज्यानि ॥ ४४ ॥

सु. भा.—आर्यभटेन स्वयमेव स्वगणितस्य नाम स्फुटमिति यत्कृतं ग्रहणादीनां विसंवादात् तदस्फुटत्वं सिद्धम् । अर्थात् पूर्वदर्शितग्रहणादिदोषेण यद्गणितस्यास्फुटत्वं सिद्धमतस्तेन व्यर्थमेव स्वगणितस्य स्फुटं नामकरणं कृतमिति ।

यतो गणितकालगोलानां मध्ये आर्यभट एकमपि न जानाति ततस्तस्मादेषां गणितकालगोलानां पृथक् पृथग्दूषणानि मया न प्रोक्तानि । अर्थात् तद्गणितपादे तत्कालपादे तद्गोलपादे च दूषणबाहुल्यमस्ति किं तदुल्लेखेन ।

यस्मादार्यभटदूषणानां मया संख्या वक्तुं न शक्यते तस्मादयं पूर्वप्रति-

पादितो दोषोच्चय उद्देश उदाहरणरूप एव ज्ञेयः । तदुदाहरणबलेन बुद्धिमता ऽन्यानि दूषणानि योज्यानि । इति सर्वमाचार्यस्यानर्गलवाक्यम् ।

अत एव चतुर्वेदाचाय : ।

'स्पष्टार्थमिदमार्यात्रयम् । राजाज्ञेयम्' । अर्थादीदृशानर्गलवाक्यप्रतिपादने नाचार्यो निर्भयो राजाज्ञया प्रतीयते ऽन्यथा विदुषामीदृशं वाक्य' दण्डार्हमिति ४२-४४॥

वि. भा.—आर्यभटेन स्वयमेव स्वगणितस्य नाम स्फुटं यत्कृतं ग्रहणादीनां विसंवा'दात्कारणात्तस्यास्फुटत्वं सिद्धम् । अर्थात्पूर्वप्रदर्शितग्रहणादिदोषकदम्बकेन तद्गणितस्यास्फुटं नामकरणं तेन व्यर्थमेव कृतम्, यतः (यस्मात् कारणात्) गणितकालगोलानां मध्ये एकमपि आर्यभटो न जानाति, ततः (तस्मात् कारणात्) एषां (गणित-कालगोलानां) पृथक्-पृथक् दूषणानि मया न प्रोक्तानि (कथितानि), अर्थात् तद्गणितपाद-कालपाद गोलपादेषु च दोष बाहुल्यार्त्कि तदुल्लेखेन । यस्मात् कारणात् मयाऽऽर्यभटदूषणानां संख्या वक्तुं न शक्यते तस्मात् कारणादयं पूर्व प्रदर्शितो दोषसमूह उद्देश (उदाहरणरूप एव) ज्ञेयः । तद्बलेन बुद्धिमता ऽन्यानि दूषणानि योज्यानि, आचार्यस्येति सर्व वाक्यमनुचितम् । अतएव चतुर्वेदाचार्य :— स्पष्टार्थमिदमार्यात्रयम् । राजाज्ञेयम्' अर्थादीदृशानुचित वाक्यप्रदिपादनेनाचार्यो निर्भयो राजाज्ञया प्रतीयतेऽन्यथा पण्डितानामीदृश मनर्गलवाक्य' दण्डार्हमिति ॥ ४२-४४ ॥

अब आर्यभट के दोषों को कहते हैं ।

हि. भा.—आर्यभट ने अपने ही अपने गणित के नाम से जो स्फुट किया है अर्थात् स्फुट गणित नाम जो रखा है, ग्रहण आदि के विसंवाद' के कारण उसकी अस्फुटता सिद्ध हुई अर्थात् पूर्वकथित दोषसमूह से उनके गणित का अस्फुटत्व सिद्ध होता है इसलिये आर्यभट ने व्यर्थ ही अपने गणित का नाम करण 'स्फुट' किया । जिस कारण से आर्यभट गणित-काल और गोल इनमें एक को भी नहीं जानते है इस कारण से इन गणित-काल और गोल, के पृथक्-पृथक् (अलग-अलग) दोषो को हम नही कहते है । अर्थात् उनके गणित पाद में कालपाद मे और गोल पाद में दोषों की अधिकता से उनके उल्लेख करने से क्या लाभ । जिस कारण मे हम आर्यभट के दोषों की सख्या कहने में असमर्थ है इस हेतु से यह पूर्वकथित दोष समूह उदाहरण रूप ही समझना चाहिये । उनके वल से बुद्धिमान् लोग अन्य दोपो की भी योजना करेगे । आचार्य के यह सब वाक्य अन्तर्गत है इसलिये चतुर्वेदाचार्य कहते हैं । 'स्पष्टार्थमिद मार्यात्रियं राजाज्ञेयम्' इन तीनों आर्याश्लोक के अर्थ स्पष्ट है, यह राजा की आज्ञा है, अर्थात्

(१) दृग्विरोधात् । (२) दृष्टि विरोध से

इस तरह के अनर्गल वाक्य के प्रति पादन से आचार्य राजा की आज्ञा से निर्भय प्रतीत होते हैं नहीं तो पण्डितों के इस तरह अनर्गल वाक्य दराडार्ह (दण्ड योग्य) है इति ।। ४२-४४ ।।

इदानी विशेषमाह ।

कालान्तरेण दोषा येऽन्यैः प्रोक्ता न ते मयाऽभिहिताः ।
किं ते दूष्येष्वथ दूषकेषु कोशोऽत्र येयः स्यात् ।। ४५ ।।

सु. भा.—अन्यैरार्यभटानुयायिभिर्भास्करादिभिरार्यभटतन्त्रे कालान्तरेण गत्यादिषु ये दोषाः प्रोक्तास्ते चात्र मया नाभिहिताः । दुष्येषु दुष्टजनेषु । अथ दूषकेषु च ते तव प्रतिकोशः किमत्र येयो लभ्यः स्यात् । आर्यभटपक्षवादिने 'ते' प्रयोगः कृत आचार्येण । यदि दूष्यदूषकाणां गणना क्रियते तर्हि मम किं लभ्यो भवेदिति हेतोर्मया ते दोषा न लिखिता इति ।

अत्र चतुर्वेदाचार्यः ।
स्पष्टार्थेयं निष्प्रयोजना च ।।४५।।

वि. भा.—अन्यैः (आर्य भटानुयायिभिर्भास्कराद्यैः) आर्यभटतन्त्रे कालान्तरेण गत्यादिषु ये दोषाः प्रोक्ता (कथिताः) स्तेऽत्र मया नाभिहिताः (न कथिताः) । दूष्येषु (दुष्टजनेषु), अथ दूषकेषु ते (तव) प्रति कोशोऽत्र किं येयः (लभ्यः) स्यात् आर्यभट पक्षपातिने 'ते' प्रयोग आचार्येण कृतः । यदि दूष्यदूषकाणां गणना क्रियेत तदा मम किं लभ्यो भवेदिति हेतोस्ते दोषा मया न लिखिता इति ।। अत्र-चतुर्वेदाचार्य :—'स्पष्टार्थेयं निष्प्रयोजना च' ।। ४५ ।।

अब विशेष कहते हैं ।

हि. भा.—आर्यभटतन्त्र में अन्यों (आर्य भटानुयायी भास्करादियों) से कालान्तर में गति आदि में जो दोष कहे गये हैं वे (दोष) यहां हमने नहीं कहे हैं । दूष्य (दुष्टजन) और दूषक आपके प्रति कोश करने से यहां मुझे क्या लाभ है अर्थात् दूष्य और दूषकों की गणना करने से मुझे क्या लाभ है इसी कारण से वे दोष हमसे नही लिखे गये हैं इति । यहां चतुर्वेदाचार्य कहते हैं 'स्पष्टार्थेयं निष्प्रयोजना च' अर्थात् यह आर्या स्पष्टार्थ है और विना प्रयोजन के है ।। ४५ ।।

इदानीं श्रीषेणादीनां दोषान् कथयति ।

श्रीषेणविष्णुचन्द्रप्रद्युम्नार्यभटलाटसिंहानाम् ।
ग्रहणादि विसंवादात् प्रतिदिवसं द्विगुणमज्ञत्वम् ।। ४६ ।।

सु. भा.—श्रीषेण-विष्णुचन्द्रप्रद्युम्न-आर्यभट-लाटसिंहानां प्रतिदिवसं प्रतिदिनमज्ञत्वं जाड्यं द्विगुणं द्विगुणोत्तरं वर्धते। कस्मात्। ग्रहणादिविसंवादात् ग्रहणादिषु दृग्विरोधात् ॥४६॥

वि. भा.—ग्रहणादि विसंवादात् (ग्रहणादीनां दृग्विरोधात्) श्रीषेण-विष्णु-चन्द्र-प्रद्युम्न-आर्यभट-लाटसिंहानां प्रतिदिवसं (प्रतिदिनं) अज्ञत्वं (मूर्खत्वं) द्विगुणं (द्विगुणोत्तरं) वर्धत इति ॥ ४६ ॥

अब श्रीषेण आदि आचार्यों के दोषों को कहते हैं।

हि. भा.—ग्रहण आदि विषयों में दृष्टि विरोध से श्रीषेण-विष्णुचन्द्र-प्रद्युम्न-आर्यभट-लाट सिंह इन सबों की मूर्खता प्रत्येक दिन द्विगुणित बढती है अर्थात् इन आचार्यों के गणित द्वारा साधित ग्रहण आदि की स्थिति जो होती है वे उसी रूप में दृष्टि द्वारा देखने में नहीं आती है इसलिये इन सबों की जड़ता प्रतिदिन द्विगुणित बढ़ती जाती है इति ॥ ४६ ॥

इदानीं दोषे विशेषमाह।

युक्त्याऽऽर्यभटोक्तानि प्रत्येकं दूषणानि योज्यानि ।
श्रीषेणप्रभृतीनां कानिचिदन्यानि वक्ष्यामि ॥ ४७ ॥

सु. भा.—आर्यभटोक्तानि प्रत्येकं दूषणानि युक्त्या श्रीषेण प्रभृतीनामपि योज्यानि तेषामपि तथोक्तत्वात्। अथ तेषां कानिचिदन्यानि विशिष्टानि दूष-णानि चाहं वक्ष्यामीति ॥४६॥

वि. भा.—आर्यभटोक्तानि (आर्यभटप्रतिपादितानि) प्रत्येकं दूषणानि (दोषकदम्बकानि) युक्त्या श्रीषेणप्रभृतीनामपि योज्यानि तथैव तेषामप्युक्तत्वात्। तेषां कानिचिदन्यानि विशिष्टानि दोष कदम्बकानि चाहं वक्ष्यामीति ॥ ४७ ॥

अब दोष में विशेष कहते है।

हि. भा.—आर्यभट से प्रतिपादित प्रत्येक दोष युक्ति से श्रीषेण आदि आचार्यों के लिये भी कहना चाहिये क्योंकि उन लोगों ने भी आर्य भटोक्त के सदृश ही कहा है, अतः उन लोगों (श्रीषेण आदि आचार्यों) के कुछ विशिष्ट दोषों को मैं कहता हूं इति ॥ ४७ ॥

इदानीं तेषां दोषा नाह।

लाटात् सूर्यशशाङ्कौ मध्याविन्दूच्च चन्द्र पातौ च ।
कुजबुधशीघ्रबृहस्पतिसितशीघ्र शनैश्चरान् मध्यान् ॥ ४८ ॥

इस तरह के अनर्गल वाक्य के प्रति पादन से आचार्य राजा की आज्ञा से निर्भय प्रतीत होते हैं नहीं तो पण्डितों के इस तरह अनर्गल वाक्य दण्डार्ह (दण्ड योग्य) है इति ।। ४२-४४ ।।

इदानीं विशेषमाह ।

कालान्तरेण दोषा येऽन्यैः प्रोक्ता न ते मयाऽभिहिताः ।
किं ते दूष्येष्वथ दूषकेषु कोशोऽत्र येयः स्यात् ।। ४५ ।।

सु. भा.—अन्यैरार्यभटानुयायिभिर्भास्करादिभिरार्यभटतन्त्रे कालान्तरेण गत्यादिषु ये दोषाः प्रोक्तास्ते चात्र मया नाभिहिताः । दुष्येषु दुष्टजनेषु । अथ दूषकेषु च ते तव प्रतिकोशः किमत्र येयो लभ्यः स्यात् । आर्यभटपक्षवादिने 'ते' प्रयोगः कृत आचार्येण । यदि दूष्यदूषकाणां गणना क्रियते तर्हि मम किं लभ्यो भवेदिति हेतोर्मया ते दोषा न लिखिता इति ।

अत्र चतुर्वेदाचार्यः ।

स्पष्टार्थेयं निष्प्रयोजना च ।।४५।।

वि. भा.—अन्यैः (आर्य भटानुयायिभिर्भास्कराद्यैः) आर्यभटतन्त्रे कालान्तरेण गत्यादिषु ये दोषाः प्रोक्ता (कथिताः) स्तेऽत्र मया नाभिहिताः (न कथिताः) । दूष्येषु (दुष्टजनेषु), अथ दूषकेषु ते (तव) प्रति कोशोऽत्र किं येयः (लभ्यः) स्यात् आर्यभट पक्षपातिने 'ते' प्रयोग आचार्येण कृतः । यदि दूष्यदूषकाणां गणना क्रियेत तदा मम किं लभ्यो भवेदिति हेतोस्ते दोषा मया न लिखिता इति ।। अत्र-चतुर्वेदाचार्य :—'स्पष्टार्थेयं निष्प्रयोजना च' ।। ४५ ।।

अब विशेष कहते हैं ।

हि. भा.—आर्यभटतन्त्र में अन्यों (आर्य भटानुयायी भास्करादियों) से कालान्तर में गति आदि में जो दोष कहे गये हैं वे (दोष) यहां हमने नही कहे हैं। दूष्य (दुष्टजन) और दूषक आपके प्रति कोश करने से यहां मुझे क्या लाभ है अर्थात् दूष्य और दूषकों की गणना करने से मुझे क्या लाभ है इसी कारण से वे दोष हमसे नहीं लिखे गये हैं इति । यहां चतुर्वेदाचार्य कहते हैं 'स्पष्टार्थेयं निष्प्रयोजना च' अर्थात् यह आर्या स्पष्टार्थ है और विना प्रयोजन के है ।। ४५ ।।

इदानीं श्रीषेणादीनां दोषान् कथयति ।

श्रीषेणविष्णुचन्द्रप्रद्युम्नार्यभटलाटसिंहानाम् ।
ग्रहणादि विसंवादात् प्रतिदिवसं द्विगुणमज्ञत्वम् ।। ४६ ।।

सु. भा.—श्रीषेण-विष्णुचन्द्रप्रद्युम्न-आर्यभट-लाटसिंहानां प्रतिदिवसं प्रतिदिनमज्ञत्वं जाड्यं द्विगुणं द्विगुणोत्तरं वर्धते। कस्मात्। ग्रहणादिविसंवादात् ग्रहणादिषु दृग्विरोधात् ॥४६॥

वि. भा.—ग्रहणादि विसंवादात् (ग्रहणादीनां दृग्विरोधात्) श्रीषेण-विष्णु-चन्द्र-प्रद्युम्न-आर्यभट-लाटसिंहानां प्रतिदिवसं (प्रतिदिनं) अज्ञत्वं (मूर्खत्वं) द्विगुणं (द्विगुणोत्तर) वर्धत इति ॥ ४६ ॥

अब श्रीषेण आदि आचार्यों के दोषों को कहते हैं।

हि. भा.—ग्रहण आदि विषयों मे दृष्टि विरोध से श्रीषेण-विष्णुचन्द्र-प्रद्युम्न-आर्यभट-लाट सिंह इन सबों की मूर्खता प्रत्येक दिन द्विगुणित बढ़ती है अर्थात् इन आचार्यों के गणित द्वारा साधित ग्रहण आदि की स्थिति जो होती है वे उसी रूप में दृष्टि द्वारा देखने में नहीं आती है इसलिये इन सबों की जड़ता प्रतिदिन द्विगुणित बढ़ती जाती है इति ॥ ४६ ॥

इदानीं दोषे विशेषमाह।

युक्त्याऽऽर्यभटोक्तानि प्रत्येकं दूषणानि योज्यानि।
श्रीषेणप्रभृतीनां कानिचिदन्यानि वक्ष्यामि ॥ ४७ ॥

सु. भा.—आर्यभटोक्तानि प्रत्येकं दूषणानि युक्त्या श्रीषेण प्रभृतीनामपि योज्यानि तेषामपि तथोक्तत्वात्। अथ तेषां कानिचिदन्यानि विशिष्टानि दूषणानि चाहं वक्ष्यामीति ॥४६॥

वि. भा.—आर्यभटोक्तानि (आर्यभटप्रतिपादितानि) प्रत्येकं दूषणानि (दोषकदम्बकानि) युक्त्या श्रीषेणप्रभृतीनामपि योज्यानि तथैव तेषामप्युक्तत्वात्। तेषां कानिचिदन्यानि विशिष्टानि दोष कदम्बकानि चाहं वक्ष्यामीति ॥ ४७ ॥

अब दोष में विशेष कहते है।

हि. भा.—आर्यभट से प्रतिपादित प्रत्येक दोष युक्ति से श्रीषेण आदि आचार्यों के लिये भी कहना चाहिये क्योंकि उन लोगों ने भी आर्य भटोक्त के सदृश ही कहा है, अतः उन लोगों (श्रीषेण आदि आचार्यों) के कुछ विशिष्ट दोषों को मै कहता हूं इति ॥ ४७ ॥

इदानीं तेषां दोषा नाह।

लाटात् सूर्यशशाङ्कौ मध्याविन्दूच्च चन्द्र पातौ च।
कुजबुधशीघ्रबृहस्पतिसितशीघ्र शनैश्चरान् मध्यान् ॥ ४८ ॥

युगयातवर्षभगणान् वासिष्ठाद्विजयनन्दिकृतपादात् ।
मन्दोच्चपरिधिपातस्पष्टीकरणाद्यमार्यभटात् ।। ४९ ।।
श्रीषेणेन गृहीत्वा रक्षोच्चय रोमकः कृतः कन्था ।
एतानेव गृहीत्वा वासिष्ठो विष्णुचन्द्रेण ।। ५० ।।
अनयोर्न कदाचिदपि ग्रहणादिषु भवति दृष्टिगणितैक्यम् ।
यद्भवति तद्घुणाक्षर मतो ऽस्फुटाभ्यां किमेताभ्याम् ।। ५१ ।।

सु. भा.—श्रीषेणार्यकृतो रोमक सिद्धान्तो यश्च वासिष्टो विष्णुचन्द्रेण तयोर्दूषणमाहार्याचतुष्टयेनेति" चतुर्वेदाचार्योक्तिः । तेनायमर्थः । श्रीषेणेन लाटात् लाटदेवकृतात् सिद्धान्तात् सूर्यचन्द्रौ चन्द्रोच्चमन्दपातौ च गृहीत्वा कुजादीनां मध्यान् युगयातवर्ष भगणान् वासिष्ठाद्वसिष्ठसिद्धान्ताद्विजयनन्दिकृतपादात् विजयनन्दकृतात् पादकरणादधमकरणाच्च गृहीत्वा मन्दोच्चपरिधिपात स्पष्टीकरणाद्यं चार्यभटात् गृहीत्वा रक्षोच्चयरोमको भस्मसमूहरुपो रोमकः कन्थाकृतः । तत्र भस्मरुपाणि सर्वाणि वस्तून्यपवित्राणि । अत एव रोमकः कन्थाकारो यत्र मालिन्यानां भस्मादीनामेवोच्चयः । एतानेव सर्वान् गृहीत्वा विष्णुचन्द्रेण वासिष्ठो वसिष्ठसिद्धान्तः कृतः । अनयोर्ग्रहणादिषु कदाचिदपि दृष्टिगणितैक्यं न भवति । कदाचिद्दृग्गणितैक्यं भवति तद् घुणाक्षरं घुणाक्षरन्यायेन भवति न तद्गणितकर्मणा । अत एताभ्यामस्फटाभ्यां रोमक वासिष्ठाभ्यां किमिति ।

अत्र चतुर्वेदाचार्यः ।

"स्पष्टार्थमार्या चतुष्टयम् । कुलशोभेयमाचार्यस्य । अर्थात् यादृशी वाणी ('कन्था' घुणाक्षरमित्यादि) आचार्येणानुचितोक्तेह तयाऽवगम्यते आचार्य कुलनीचता । यतः पण्डित कुलोत्पन्नानां नेदृशी वाणी भवतीति ।।४८-५१।।

वि. भा.—श्रीषेणेन लाटात् (लाटदेवकृतात् सिद्धान्तात्) मध्यौ सूर्यशशाङ्कौ (रविचन्द्रौ) इन्दूच्चचन्द्रपातौ (चन्द्रोच्च चन्द्रपातौ) च गृहीत्वा वासिष्ठात् (वसिष्ठसिद्धान्तात्) विजयनन्दिकृतपादाच्च (विजयनन्दि कृतात् पादकरणादधमकरणाच्च) मध्यान् कुजबुधशीघ्रबृहस्पतिसितशीघ्रशनैश्चरान् गृहीत्वा, आर्यभटात् मन्दोच्चपरिधिपातस्पष्टीकरणाद्यं गृहीत्वा रक्षोच्चयरोमकः (भस्मसमूहरूपो रोमकः) कन्था कृतः (तत्र रोमके सर्वाणि वस्तूनि भस्मरूपाण्यपवित्राणि सन्ति, अत एव रोमकः कन्थाकारो यत्र भस्मा दीनां मालिन्यानामेव समूहः) एतानेव सर्वान् गृहीत्वा विष्णु चन्द्रेण वासिष्ठः (वसिष्ठसिद्धान्तः) कृतः । अनयोः (रोमक वसिष्ठसिद्धान्तयोः) ग्रहणादिषु कदाचिदपि दृष्टिगणितैक्यं न भवति । कदाचित् यद्दृष्टिगणितैक्यं भवति तद्घुणाक्षरं (घुणाक्षर न्यायेन) भवति, तद्गणित-

क्रियया नहि, अत एताभ्यां (रोमक-वासिष्ठ-सिद्धान्ताभ्याम्) किम् । अत्र चतुर्वेदाचार्य :—

'स्पष्टार्थमार्याचतुष्टयम् । कुलशोभेयमाचार्यस्य' । अर्थात् यादृशी वाणी ('कन्था' घुणाक्षर मित्यादि) आचार्येणानुचितोक्ता तयाऽऽचार्यस्य कुलनीचताऽवगम्यते यत उच्च कुलोत्पन्नानां नैतादृशी वाणी भवतीति ।। ४८-५१ ।।

अब उन सबों (श्रीषेण आदि आचार्यो) के दोषों को कहते है ।

वि. भा.—श्रीषेण लाटदेवकृत सिद्धान्त मे मध्यम रवि और चन्द्र को तथा चन्द्रमन्दोच्च और चन्द्रपात को लेकर, वासिष्ट (वसिष्ठ सिद्धान्त) ने तथा विजयनन्दिकृत प्रथम करण से मध्यम कुज, बुधशीघ्रोच्च, गुरु, शुक्रशीघ्रोच्च, और शनैश्चर को लेकर तथा मन्दोच्च परिधिपात स्पष्टीकरण आदि को आर्यभटतन्त्र से लेकर भस्मसमूहरूप रोमक (रोमक सिद्धान्त) को कन्था बनाये (उसमें सब चीजे भस्म के सदृश अपवित्र है इसलिये रोमक कन्थाकार है जिसमे भस्म आदि मलिन चीजो ही का समूह है ।) इन्ही सबों को लेकर विष्णुचन्द्र ने वासिष्ठ (वसिष्ठ सिद्धान्त) बनाया था । इन दोनों (रोमक सिद्धान्त और वसिष्ठ सिद्धान्त) के ग्रहणादियों में कभी भी दृग्गणितैक्य नहीं होता है । कदाचित् दृग्गणितैक्य होना है तो घुणाक्षरन्याय से, उनकी गणित क्रिया मे नही इसलिये इन दोनो (रोमक और वसिष्ठ) से क्या लाभ, कुछ भी नही । यहाँ चतुर्वेदाचार्य कहते हैं—संस्कृत भाष्य में देखिये, अर्थात् चारों आर्यायों के अर्थ स्पष्ट हैं, यह आचार्य की कुल शोभा है, अर्थात् कन्था, घुणाक्षर इत्यादि आचार्य की अनुचित उक्ति से उनकी कुल नीचता समझी जाती है क्योंकि उच्च कुलोत्पन्न लोगों की वाणी इस तरह की नही होती है इति ।। ४८-५१ ।।

इदानीमार्यभटस्यान्यं दोषमाह ।

नीचोच्चवृत्तमध्यस्य गोलवाह्येन नाम कृतमुच्चम् ।
तत्स्थो न भवत्युच्चो यतस्ततो वेत्ति नोच्चमपि ।। ५२ ।।

सु. भा.—गोलवाह्येनार्यभटेन नीचोच्चवृत्तमध्यस्य नीचोच्चवृत्तकेन्द्रस्य नामोच्चं कृतम् । परन्तु यतस्तत्स्थ उच्चो न भवति स च भुवो दूरे तिष्ठति । तत आर्यभट उच्चमपि न वेत्तीति स्फुटम् ।

अत्र चतुर्वेदाचार्यः—'वाग्बलमेतत्' ।।५२।।

वि. भा.—गोलवाह्येना (गोलानभिज्ञेन) ऽऽर्यभटेन नीचोच्चवृत्तमध्यस्य (नीचोच्चवृत्त केन्द्रस्य) नामोच्चं कृतम् । यतः (यस्मात् कारणात्) तत्स्थः (नीचोच्चवृत्तकेन्द्रस्थितः) उच्चो न भवति, 'यः स्यात् प्रदेशः प्रतिमण्डलस्य दूरे भुवस्तस्य कृतोच्च संज्ञा' इत्युक्तेः स च (उच्चः) भुवो दूरे तिष्ठति, ततः (तस्मात्

कारणात्) आर्यभट उच्चमपि न वेत्ती (जानाति) ति। अत्र चतुर्वेदाचार्य :— 'वाग्बलमेतत्'। 'कक्षास्थ मध्यग्रहचिन्हतोऽथ वृत्तं लिखेदन्त्यफलज्यया तत्। नीचोच्चवृत्तमि' ति भास्करोक्त्या वस्तुतो नीचोच्चवृत्तस्य केन्द्रमुच्च न भवितुमर्हति, यथाऽऽचार्येण कथ्यतेतथैव यद्यार्यभटोक्त भवेत्तदा त्वाचार्योक्तखण्डन समीचीनं नान्यथेति ॥ ५२ ॥

अब आर्य भट के अन्य दोष को कहते है।

हि. भा.— गोल को न जानने वाले आर्यभटने नीचोच्चवृत्त के केन्द्र का नाम उच्च रक्खा है। जिस कारण से नीचोच्चवृत्त केन्द्रस्थित उच्च नही होता है, वह (उच्च) पृथिवी (भूकेन्द्र) से बहुत दूर पर स्थित है इस कारण से आर्य भट उच्च को भी नही जानते है। यहां चतुर्वेदाचार्य कहते है 'वाग्बलमेतत्' अर्थात् यह आचार्य की कमजोरी है। कक्षावृत्त स्थित मध्यम ग्रह को केन्द्र मानकर अन्त्य फलज्या व्यासार्ध से जो वृत्त होता है वही नीचोच्च वृत्तसंज्ञक है वस्तुतः इसका केन्द्र उच्च नही है, आचार्य कथनानुसार ही यदि आर्यभटोक्त हो तब तो आचार्योक्त खण्डन ठीक ही है, अन्यथा नही इति ॥ ५२ ॥

इदानीं स्थिरपातमन्दोच्चान् खण्डयति।

अन्या विक्षेपकला मन्दान्यत्वात्फलाधिकाः स्पष्टाः।
यस्मान्महायुगादौ न राहुमन्दाः स्फुटास्तस्मात् ॥ ५३ ॥

सु० भा०—यस्मात् पातानां स्थिरत्वान्महा युगादावप्यन्या विक्षेपकलाः सिध्यन्ति सपातमन्दस्पष्टभुजभावात्। एवं फलाधिकाः स्पष्टाश्चान्ये सिध्यन्ति मन्दान्यत्वात् तस्मात् तदुक्ता राहुमन्दा न स्फुटाः। महायुगादौ सर्वे मेषमुखे भवन्ति तत्र शराभावोऽपि युक्तः। पातानां सत्त्वे तत्र ग्रहशर उत्पद्यते। एवं मन्दोच्चानां भावे मन्दफलमुत्पद्यते यद्वशाद्भौमादीनां न मेषमुखे स्थितिरिति तद्राहुमन्दा न समीचीना इति ॥५३॥

वि. भा.—यस्मात्कारणात् राहूणां (पतानां) स्थिरत्वात् (संचलना भावात्) महायुगादावपि विक्षेपकलाः (शरकलाः) अन्याः (भिन्नाः) भवितुमर्हन्ति, सपातमन्दस्पष्टग्रहभुजांशसत्वात् परं तत्र (महायुगादौ) ग्रहादीनां मेषादौ स्थितत्वाच्छराभावः समुचितः। पातसत्त्वे तु ग्रहशरा उत्पद्यन्ते, एवं मन्दोच्चसत्त्वे मन्द फलोत्पत्तेस्तदधिकाः स्पष्टग्रहा भिन्नाः सिध्यन्ति, एतेन ग्रहाणां (मङ्गलादीनां) महायुगादौ मेषादौ स्थितेरभावः सिध्यति, तस्मात्कारणात्तदुक्तस्थिरराहुमन्दा

न स्फुटा अर्थाद् ग्रहपातानां मन्दोच्चानां च स्थिरत्वकल्पने ग्रहशराणां मन्दफलानाञ्च समुत्पत्तिर्भवति, तेन महायुगादौ, मङ्गलादि ग्रहाणां मेषादौ स्थितेरभावः सिध्यति, परं महायुगादौ ग्रहा दीनां मेषादौ स्थितिर्भवत्येवातः पातानां मन्दोच्चानां च स्थिरत्वकल्पनं न युक्तमिति ॥ ५३ ॥

अब स्थिर पात और स्थिर मन्दोच्च का खण्डन करते हैं ।

हि. भा.—जिस कारण से पातो की स्थिरता मे महायुगादि में भी ग्रहो की शरकला सिद्ध होती है तथा ग्रहमन्दोच्चों की स्थिरता से मन्दफलो की उत्पत्ति होती है इसलिये स्पष्ट ग्रह भी भिन्न सिद्ध होते है जो उचित नही है इसलिये श्रीषेणादि आचार्योक्त स्थिरपात और स्थिर मन्दोच्च ठीक नही है अर्थात् महायुगादि में ग्रहादिको की स्थिति मेषादि में अवश्य रहनी है, परन्तु ग्रहपातों की स्थिरत्व कल्पना से तथा ग्रहमन्दोच्चों की स्थिरत्व कल्पना से ग्रहादियों की स्थिति मेषादि में सिद्ध नही होती है अतः उन आचार्यो (श्रीषेणादि) का स्थिरपात और स्थिर मन्दोच्च ठीक नही है ॥ ५३ ॥

इदानी विष्णुचन्द्रादीनामयनचलनं दूषयति ।

परमाल्पा मिथुनान्ते द्यु रात्रि नाड्यो ऽर्कगति वशाद्दतवः ।
नायनयुगमयनवशात् स्थिरमयनद्वितयमपि तस्मात् ॥ ५४ ॥

सु. भा.—अस्मदादीनां परमाल्पा द्युरात्रिनाड्यो दिवसाधिकवशाद्या रात्रिस्तस्या नाड्यो मिथुनान्ते मिथुनान्तस्थे रवावेव भवन्ति । अर्कवशान्निरयणार्कवशादृतवश्च भवन्ति । अतोऽयन वशान्नायनयुगमर्थाद्यथा ग्रहचलनाद् ग्रहयुग मेषान्मीनान्तपर्यन्तं भवति तथा ऽयनचलनवशादयनयुगं नोत्पद्यते तस्मादयनद्वितयमपि स्थिरमिति विष्णुचन्द्रेणायनयुगमुक्तं तथा च तद्वाक्यम् । 'तस्य चात्र युगं रुद्रकृतनन्दाष्टकेन्दवः १८९४११ । अयनस्य युगं प्रोक्तं ब्रह्मार्कादिमत पुरा' इति मुञ्जालमते चायनयुगभगणाः १९९६६९ ।

अत्र चतुर्वेदाचार्य :—

'असद्दूषणमेतद्यस्मात् संप्रत्येव मिथुनान्ते न रात्रिदिनयोः परमापचयोपचयौ' ॥५४॥

वि. भा.—मिथुनान्ते रवौ परमाल्प द्युरात्रिनाड्यो दिनाधिकवशाद्रात्रिस्तथा नाड्यो भवन्ति । अर्कगतिवशादृतवश्च भवन्ति, अतो ऽयनवशादयनयुगं न भवत्यर्थाद्ग्रहचलनवशाद्यथा ग्रहयुगं (ग्रहभगणमानं) मेषादितो मीनान्तं

भवति तथाऽयनचलनवशादयनयुगं न भवति, तस्मात्कारणादयनद्वितयमपि स्थिरम् । अर्थान्मिथुनान्तस्थे रवौ परम क्रान्तिवशात् $\frac{\text{पभा} \times \text{परम क्रांज्या}}{१२}$ =परमकुज्या, ततः $\frac{\text{परमकुज्या} \times \text{त्रि}}{\text{परमाल्पद्यु}}$ =परम चरज्या, ततश्चापम्=परमचरम्, अतः १५+परमचर=परमदिनार्धम्, द्विगुणीकरणेन परमदिनम् । परमदिनमानवशादस्मात्परमाल्पा रात्रिर्भवति, मुञ्जालेनैव प्रथममयन चलनोपलब्धिस्तत्संस्कारश्चोक्तः सिद्धान्तशिरोमणौ भास्कराचार्येण 'तत्पक्षे तद्भगणाः कल्पे गोऽङ्गर्त्तुनन्दगो चन्द्राः' नेन मुञ्जालमतीयायनयुगभगणाः १९९६६९ कथिताः । विष्णुचन्द्रेणायनयुगं कथितं तथा च तद्वाक्यम्—तस्यचात्र युगं रुद्रकृतनन्दाष्टकेन्दवः १८९४११ । अयनस्य युगं प्रोक्तं ब्रह्मार्कादिमतं पुरा ॥

अत्र चतुर्वेदाचार्य :—असद्रूपणमेतद्यस्मात् सम्प्रत्येव मिथुनान्ते न रात्रि-दिनयोः परमापचयोपचयौ । सिद्धान्तशेखरे ऽयनचलनभागाननुक्त्वाऽपि ध्रुवमानसे करणे "युगाब्ध्यब्ध्यूनिते शाके पष्टि भक्तेऽयनांशकाः । अयनांशाः सदादेयाः क्रान्तौ लग्ने चरागमे" एवमयनांशानयनं तत्संस्कारञ्चाभिहितवान् श्रीपतिः । 'लघुभास्करीय' वृहद्भास्करीय' मित्याख्ययोर्ज्योतिषसिद्धान्तग्रन्थयोर्निर्माता भास्करः सम्प्रति प्रसिद्धभास्कराचार्यादतिप्राचीन आर्यभटसामयिक आसीत्, एतेन भास्करेणायनचलनचर्चा न कृता, अयनांशानयनं सूर्यसिद्धान्तकार-गणेशदैवज्ञादीनां भिन्न-भिन्नमस्तीति सूर्यसिद्धान्त - ग्रहलाघवादिग्रन्थावलोकनात्स्फुटं भवतीति ॥ ५४ ॥

हि. भा.—मिथुनान्त में रवि के रहने पर दिन मान के अधिकवश से रात्रि और नाडी परमाल्प होती है, रवि की गति के कारण ऋतुएं होती हैं, इसलिये अयन वश से अयन युग नहीं होता है, अर्थात् जैसे ग्रहचलनबश से ग्रहयुगमेषादि से मीनान्त पर्यन्त होता है उसी तरह अयन चलन वश से अयन युग नहीं होता है इसलिये दोनों का अयन स्थिर सिद्ध होता है, अर्थात् मिथुनान्त में रवि के रहने से परम क्रान्तिवश से $\frac{\text{पभा. परम क्रांज्या}}{१२}$ =परम कुज्या,

$\therefore \frac{\text{परमकुज्या. त्रि}}{\text{परमाल्पद्यु}}$ =परमचरज्या चाप करने से परमचर हुआ, तब १५ घटी+परम चर घटी = परम दिनार्धघटी, दूना करने से परम दिन घटी हुई, इस परम दिनमानवश से परमाल्प रात्रि घटी होती है, सब से पहले मुञ्जालाचार्य को अयन चलन की उपलब्धि हुई, उसकी संस्कार विधि भी उन्होंने ही सब से पहले कही हैं, सिद्धान्त शिरोमणि में भास्कराचार्य ने मुञ्जालोक्त अयन युगभगण १९९६६९ कहा हैं। विष्णुचन्द्र ने अयन युग कहा है, उनके

वाक्य हैं "तस्य चात्र युगं रुद्र कृत नन्दाष्टकेन्दवः १८६४११, अयनस्य युगं प्रोक्तं ब्रह्मार्कादिमत पुरा" यहाँ चतुर्वेदाचार्य कहते हैं कि यह ब्रहमगुप्त कृत खण्डन ठीक नही है क्योंकि इसी समय मिथुनान्त में रात्रि और दिन का परम अपचय और उपचय नही होता है, सिद्धान्त शेखर में अयन चलन भाग को नहीं कह कर भी 'ध्रुव मानस' करण ग्रन्थ में अयनांशानयन और उसकी संस्कार विधि को श्रीपति ने कहा है। 'लघु भास्करीयम्' 'वृहद्भास्करीयम्' इन दोनों ज्यौतिष सिद्धान्त ग्रन्थो के रचयिता भास्कर इस समय के प्रसिद्ध सिद्धान्त शिरोमणि के रचयिता भस्कराचार्य से अति प्राचीन, आर्य भट के समकालीन थे, इन्होंने अयन चलन की चर्चा नही की है, सूर्य सिद्धान्त-ग्रहलाघव आदि ग्रन्थों के देखने से अयनाशानयन स्पष्ट होता है ॥ ५४ ॥

इदानीं महायुगलक्षणं श्रीषेणादिकथितयुगखण्डनं चाह।

यद्युगवधिर्महायुगमुक्तं श्रीषेणविष्णुचन्द्राद्यैः।
तत्स्थूलं दृग्लिप्ता महायुगादौ ग्रहेषु यतः ॥ ५५ ॥

सु. भा.—येषां सर्वेषां ग्रहभगणानां पातमन्दोच्चशीघ्रोच्चानां युगवधिरर्थात् सर्वेषां मेषादिप्रवृत्तेः पुनर्यावता कालेन मेषादिप्रवेशस्तदेव महायुगमुच्यत इति। श्रीषेणविष्णुचन्द्राद्यैर्यद् युगमुक्तं तत् स्थूलं यतस्तन्मतेन महायुगादौ ग्रहेषु दृग्लिप्ताः शरकलाः मेषादितरत्र क्रान्तिवृत्तस्थानकलाश्चोत्पद्यन्ते। अर्थात् तन्मतेन यदि मन्वादिप्रणीते स्मृतिसंमते महायुगादौ ग्रहगणना क्रियते तदा भौमादीनां न मेषमुखे स्थितिरित्याचार्याभिप्रायः। वस्तुतः श्रीषेण प्रणीते रोमके 'युगमन्वन्तरकल्पाः' इत्याचार्योक्तमध्यमाधिकारवचनेन न महायुगादिचर्चेति। अतोऽत्र महायुगवचनेनाचार्योक्तमहायुगग्रहणमिति स्फुटम् ॥५५॥

वि. भा.—यत् (यस्मात्कारणात्) पात मन्दोच्चशीघ्रोच्चानां ग्रहभगणाना युगवधिरर्थान्मेषादिप्रविष्टानां तेषां यावता कालेन पुनर्मेषादौ प्रवेशस्तावान् कालो महायुगं कथ्यते। श्रीषेण विष्णुचन्द्राद्यैर्यद्युगं कथितं तत्स्थूलं यतस्तन्मतेन महायुगादौ ग्रहेषु दृग्लिप्ताः (शरकलाः) मेषादितोऽन्यत्रोत्पद्यन्ते अर्थात्तन्मतेन मन्वादिरचितस्मृतिग्रन्थसम्मते महायुगादौ यदि ग्रहगणना क्रियते तदा मेषादौ मंगलादिग्रहाणां स्थितिर्न सिध्यति, श्रीषेणरचिते रोमके न महायुगादिचर्चा कुत्राप्यस्ति तेन महायुगशब्देनाचार्योक्तमहायुगग्रहणं कार्यमिति। यदः मेषादौ सर्वेषा ग्रहाणां पातमन्दोच्चशीघ्रोच्चानां स्थितिर्भवति तस्यैव नाम महायुगादिरिय स्थितिः श्रीषेणकथितमहायुगादो न भवत्यतस्तन्मतेमहायुगादिर्न समीचीन इत्याचार्योक्तखण्डनंयुक्ति युक्तमिति ॥ ५५ ॥

हि. भा.—जिस कारण से ग्रहभगणों तथा पात मन्दोच्च-शीघ्रोच्चों की मेषादि स्थिति मे जितने काल में फिर मेषादि में स्थिति होती है वही काल महा युग कहलाता है, श्रीषेण-विष्णुचन्द्र आदि आचार्यों ने जो युग कहा है वह स्थूल है, क्योंकि उनके मत से महायुगादि में मेषादि से अन्यत्र (भिन्न स्थान में) उत्पन्न होता है, अर्थात् उनके मत से मनु आदि स्मृति-कार रचित स्मृतिग्रन्थ सम्मत महायुगादि में यदि ग्रहगणना करते है तो मेषादि में मङ्गलादि ग्रहों की स्थिति सिद्ध नही होती है, श्रीषेण रचित रोमक में कहीं पर महायुगादि की चर्चा नहीं है, इसलिये महायुग शब्द से यहा आचार्य कथित महायुग लेना चाहिये, जब सब ग्रहों की तथा पात मन्दोच्च शीघ्रोच्चों की स्थिति मेषादि में होती हैं तो उसी का नाम महायुगादि है, श्रीषेण कथित महायुगादि में यह स्थिति नही होती है इसलिये उनके मत से महायुगादि ठीक नही है, आचार्योक्त यह खण्डन ठीक है ।। ५५ ।।

इदानीं पुनरपि तद्युगमेव निराकरोति ।

कदिनादौ स्मृतिषूक्तं ग्रहभोत्पत्तिर्दिनक्षये प्रलयः ।
तान्यतिबहूनि यस्मात् महायुगेऽतोऽप्रसिद्धमिदम् ।। ५६ ।।

सु. भा.—कदिनादौ ब्रह्मदिनादौ ग्रहनक्षत्रोत्पत्तिर्दिनक्षये ब्रह्मदिनावसाने च ग्रहभानां प्रलय इति स्मृतिषूक्तमस्ति । एव ब्रह्मदिनसमे महायुगे यस्मात् तानि श्रीषेणाद्युक्तानि युगानि अतिबहूनि भवन्ति अत इदं तदुक्तमप्रसिद्धं न कुत्रापि स्मृत्यादौ तच्चर्चा । अतोऽनेक युगग्रहणेन गौरवकर्मणा किमिति । वाग्बलमेतत् । यतोऽनेकयुगग्रहणेनापि ग्रहगणनायां न काचिद्धानिस्तत्स्थभगणग्रहणादिति स्फुटं गणित विदामिति ।। ५६ ।।

वि. भा.—कदिनादौ (ब्रह्मदिनादौ) ग्रहभोत्पत्तिः (ग्रहनक्षत्रसृष्टिः), दिनक्षये (ब्रह्मदिनान्ते) ग्रहाणां नक्षत्राणां च प्रलयः (नाशः) स्मृतिषु (स्मृतिग्रन्थेषु) कथितमस्ति, सिद्धान्तशेखरे श्रीपतिनाऽप्येवमुक्तं यथा—ज्योतिर्ग्रहाणां विधिवास-रादौ सृष्टिर्लयस्तद्दिवसावसाने । सिद्धान्तशिरोमणौ भास्कराचार्येण 'यतः सृष्टिरेषां दिनादौ दिनान्ते लयस्तेषु सत्स्वेव तच्चार चिन्ता' ऽप्यनेन ब्रह्मदिनादावेव ग्रहादि-सृष्टिः कथ्यते, परं सूर्यसिद्धान्तकारेण कथ्यते यत् 'ब्रह्मदिनादितः शतगुणितवेद-सप्तवेददिव्याब्देषु ब्रह्मा सृष्टिं रचयित्वाऽऽकाशे नियोजितवान् । ब्रह्मगुप्त-श्रीपति-भास्कराचार्य कथितसृष्ट्यादिकालनिराकरणार्थं सूर्यसिद्धान्तकारमतमण्डनार्थं च कमलाकरेण सिद्धान्ततत्त्वविवेके बहुप्रपञ्चितं नहि नामभेदेन वस्तुभेदः । कल्प-सम्बन्धिभगणादीनां सृष्टिसम्बन्धिभगणादीनां चाभेदात् । यदि धर्मकृत्यानुष्ठाने सूर्यसिद्धान्तकारमतस्यैव प्राधान्यं तदा कमलाकरोक्तमवश्यं सर्वजनमान्यमेव ।

यस्मात् कारणात् महायुगे (ब्रह्मदिन समे) तानि (श्रीषेणाद्युक्तानि) युगानि-अतिबहूनि भवन्ति, अतः (अस्मात् कारणात्) इदं तत्कथितं युगमप्रसिद्धमर्थात्कुत्रापि मान्यग्रन्थेषु तच्चर्चा नास्ति, अनेकयुगग्रहणेन कर्मगौरवमेव भवति तावता न किमपि फलम् । अनेकयुगग्रहणेनापि ग्रहगणनायां न कापि क्षतिर्भवति तत्स्थितभगणग्रहणादत आचार्य कथितमिदं दुराग्रहपूर्णमेव कथितुं शक्यते नात्र किमपि याथार्थ्यमिति ॥ ५६ ॥

अब पुनः श्रीपेणादिकथित युग का खण्डन करते हैं ।

हि. भा.—ब्रह्म दिनादि में ग्रहों और नक्षत्रों की सृष्टि होती है, ब्रह्म दिनान्त में उनका नाश होता है ये बाते स्मृति ग्रन्थ में कही गयी है, सिद्धान्त शेखर में श्रीपति भी 'ज्योतिर्ग्रहाणां विधिवासरादौ' इत्यादि विज्ञान भाष्य मे लिखित पद्यसे, सिद्धान्त शिरोमणि मे भास्कराचार्य ने भी 'यतः सृष्टिरेषां दिनादौ दिनान्ते' इत्यादि विज्ञानभाष्य में लिखित पद्य से स्मृतिग्रन्थ मे कथित बात ही कही है । लेकिन सूर्य सिद्धान्तकार ने ब्रह्मदिनादि में ग्रहादियों की सृष्टि नही कही है, वे कहते है कि ब्रह्मदिनादि ४७४०० इतने दिव्य वर्ष व्यतीत होने पर ब्रह्मा सृष्टि को रचकर आकाश में नियोजित किया । ब्रह्मगुप्त-श्रीपति-भास्कराचार्य कथित सृष्ट्यादि काल के निराकरण के लिये और सूर्य सिद्धान्तकार के मत के समर्थन के लिये सिद्धान्त तत्त्व विवेक मे कमलाकर ने बहुत बाते कही है, लेकिन नाम भेद से वस्तु भेद नहीं होता है, क्योंकि कल्पसम्बन्धी भगणादियो मे और सृष्टि सम्बन्धी भगणादियों में कोई भेद नहीं है, यदि धर्मअनुष्ठान आदि कार्यों में सूर्यसिद्धान्तकार मत ही को प्रधानता दी जाय तब तो कमलाकर का कथन अवश्य ही सबों के लिये मान्य होगा, जिस कारण से ब्रह्मदिन के बराबर महायुग में श्रीषेण आदि कथित युग बहुत होते है इस हेतु से उनका कथित युग अप्रसिद्ध है अर्थात् स्मृति ग्रन्थो मे कही पर उसकी चर्चा नहीं है, अनेक युगों के ग्रहण करने मे कर्म गौरव ही होता है और कुछ फल नही होता है, लेकिन यह आचार्य कथित बात ठीक नही है, क्योंकि अनेक युग ग्रहण करने से भी ग्रहगणना में कुछ हानि नही होती है ॥ ५६ ॥

इदानीं पादकरणानि दूपयति ।

प्रतिदिवसविसंवादाद् ग्रहतिथिकरणार्क्षदिवसमासानाम् ।
ग्रहणग्रहयोगादिषु पादं पादेन कः स्पृशति ॥ ५७ ॥
अङ्कचिति विजयनन्दि प्रद्युम्नादीनि पादकरणानि ।
यस्मात् तस्मात्तेषां न दूषणान्यत्र लिखितानि ॥ ५८ ॥

सु. भा.—ग्रहतिथिकरणऋक्ष-दिवस-मासानां तथा ग्रहणयोगादिषु च प्रतिदिवसविसंवादात् प्रत्यहं दृग्विरोधात् पादं करणाधमं कः पादेनापि स्पृशति ।

अर्थाद्यथाऽङ्गेषु अधोवर्त्तित्वात् पादोऽधमस्तथा दृग्गणितयोरसाम्यात् पादमधमं यत् करणं तत् पादेनापि स्पर्शानर्ह 'प्रक्षालनाद्धि पङ्कस्य दूरादस्पर्शनं वरम्'— इति न्यायात् । तस्मान्मलमयस्य खण्डनेन वाणीमालिन्यमात्रमेव । 'पादं पादेन न स्पृशेत्'— इति स्मृत्यादिषु तत्स्पर्शनिषेधाच्चेति ।

यस्मादङ्कचिति-विजयनन्दिप्रद्युम्नादीनि अर्थादितैर्निर्मितानि करणानि सर्वाणि पादकरणानि करणाधमानि तस्मात्' पादं पादेन कः स्पृशति'—इति न्यायात् मया तेषां दूषणान्यत्र न लिखितानीति ।

अत्र चतुर्वेदाचार्य :—

'यत्रार्यभटादयो दूष्यन्ते तत्र पादेनापि पादकरणानि कः स्पृशति । का तेषु गणनेत्यर्थः' ।

ग्रहतिथिकरणर्क्षदिवसमासानामित्यत्र योगपदाभावात् स्पष्टीकरणाध्याये योगसाधनं नाचार्यस्येति स्पष्टं प्रतीयते ॥ ५७-५८ ॥

वि. भा.—ग्रहतिथिकरण नक्षत्र दिवस मासानां तथा ग्रहणग्रहयोगादिषु प्रतिदिवस विसंवादात् प्रतिदिनं दृग्विरोधात् पादं (करणाधमं) पादेन कः स्पृशति, अर्थाद् दृग्गणितयोर्वैषम्यात् पादं (अधमं) यत्करणं तत्पादेनापि स्पर्श-योग्यं नास्ति 'प्रक्षालनाद्धि पङ्कस्य दूरादस्पर्शनं वरमित्युक्तेः' पादं पादेन न स्पृशेदिति स्मृतिग्रन्थेषु तत्स्पर्शनिषेधाच्च, तेन दूषितस्य विषयस्य खण्डनकरणेन केवलं वाग्मालिन्यमेव भवितुमर्हति, यस्मात् अङ्कचिति विजयनन्दिप्रद्युम्नादि निर्मितानि पादकरणानि (करणाधमानि) सति तस्मात् कारणात् तेषां दूषणानि मयाऽन्यत्र न लिखितानि ।

अत्र चतुर्वेदाचार्य :—यत्रार्य भटादयो दूष्यन्ते तत्र पादेनापि पादकरणानि कः स्पृशति का तत्र गणनेत्यर्थः । ग्रहतिथिकरणार्क्षदिवसमासानामित्यत्र योग-पदाभावात् स्पष्टीकरणाध्याये योगसाधनं नाचार्यस्येति स्पष्टं प्रतीयते ॥५७-५८॥

अब पाद करणों (करणाधम) का खण्डन करते हैं ।

हि. भा.—ग्रह-तिथि-करण-नक्षत्र दिन मासों में तथा ग्रहण-ग्रहयोगादि (ग्रहयुत्यादि) यों में प्रतिदिन दृग्विरोध के कारण अधम करण को पाद से कौन स्पर्श करता है अर्थात् वेध और गणित में असमानता से अधम जो करण है वह पाद से भी स्पर्श करने के योग्य नहीं है, पाद को पाद से स्पर्श नही करना चाहिये ऐसा स्मृति ग्रन्थों में उसके लिये निषेध वचन है, इसलिये दूषित विषय का खण्डन करने से केवल वाणी (बोली) की मलिनता ही होती है, अङ्कचिति-विजयनन्दि-प्रद्युम्न आदि आचार्यों द्वारा बनाये हुये करण ग्रन्थ अधम हैं इसलिये उन सबों के दोष हमने अन्यत्र नहीं लिखे हैं ॥ ५७-५८ ॥

इदानीं दूषणान्युपसंहरति

इति बहुधा विवदन्ते ग्रहार्थिनः साग्रहा इव प्रसभम् ।
ब्राह्मस्फुटसिद्धान्ते रवीन्दुभूयोगमज्ञात्वा ॥ ५६ ॥

सु. भा.—एवं ब्राह्मस्फुटसिद्धान्ते आचार्य कृते ऽस्मिन् सिद्धान्ते यो रविः । इन्दुः । भूः भूपरिमाणम् । योगो ग्रहयुत्याद्यधिकारः । तत् सर्वमज्ञात्वा ग्रहार्थिनो ज्योतिर्विदः प्रसभं हठात् साग्रहा आग्रहिण इव बहुधा विवदन्ते विवादं कुर्वन्ति दृग्गणितैक्ययोरसाम्यादिति आचार्यस्यात्मप्रशंसैव ।

अत्र चतुर्वेदाचार्य :—
'एतद्वाक्यमाचार्यस्येति' ॥ ५९ ॥

वि. भा.—ब्राह्मस्फुटसिद्धान्ते (आचार्यरचितेऽस्मिन् सिद्धान्तग्रन्थे) रविः (सूर्यबिम्बादि प्रमाणम्) इन्दुः (चन्द्रबिम्बादि प्रमाणम्) भूः (पृथिव्याः प्रमाणम्) योगः (ग्रहयुतिः) एतत्सर्वमज्ञात्वा (अविज्ञाय) ग्रहार्थिनः (ग्रहसम्बन्धि विषययाजका ज्योतिर्विदः) इति (एवं) प्रसभ (हठात्) साग्रहा इव (आग्रहिण इव) बहुधा विवाद कुर्वन्ति, दृग्गणितयोर्वैषम्यादेतावता ऽऽचार्येण स्वप्रशंसा क्रियते, अत्र चतुर्वेदाचार्य—:'एतद्वाक्यमाचार्यस्येति' ॥ ५९ ॥

अब दोषों के उपसंहार करते है ।

हि. भा.—आचार्य (ब्रह्मगुप्त) कृत इस सिद्धान्त ग्रन्थ में सूर्य बिम्बादि प्रमाण-चन्द्र बिम्बादि प्रमाण - पृथिवी परिमाण और ग्रहयुति इन सबों को नहीं जानकर ज्योतिषी लोग इस तरह हठ से आग्रही की तरह बहुत विवाद करते है क्योंकि वेध और गणित में असमानता रहती है, इससे आचार्य अपनी प्रशंसा करते है ॥ ५६ ॥

इदानीमिति कर्त्तव्यतामाह ।

तन्त्रभ्रंशे प्रतिदिनमेवं विज्ञाय धीमता यत्नः ।
कार्यस्तस्मिन् यस्मिन् दृग्गणितैक्यं सदा भवति ॥ ६० ॥

सु. भा.—तन्त्रभ्रंशे सति तदीयतन्त्रगणनया दृग्विरोधे सति एवं पूर्वोक्तं प्रतिदिनं स्पष्टीकरणाद्यं वेधादिना विज्ञाय तस्मिन् तन्त्रे बीजादिना तथा यत्नः कार्यो यथा दृग्गणितैक्यं भवति । एवं यस्मिन् तन्त्रे सदा दृग्गणितैक्यं भवति तदेव तन्त्रमादरणीयमिति ।

अत्र चतुर्वेदाचार्य :—
'मध्यस्थमवलम्ब्य स्वार्थं कुरुत इत्यर्थः' ॥ ६० ॥

वि. भा.—तन्त्र भ्रंशे दृग्विरोधे सति प्रतिदिनमेवं पूर्वकथित स्फुटीकरणादिकं वेधादिना ज्ञात्वा तस्मिन् तन्त्रे बुद्धिमता बीज कर्मादि संस्कारेण तथा यत्नः कार्यो यथा तत्र सदा दृग्गणितैक्यं भवति। एवं करणेन यस्मिन् तन्त्रे दृग्गणितयोः साम्यं भवेत्तदेव तन्त्रं सर्वजनमान्यं भवेत् ॥ ६० ॥

अब कर्त्तव्यता को कहते हैं।

हि. भा.—तन्त्र के पतन में उसकी तन्त्र गणना से दृग्विरोध होने पर प्रत्येक दिन पूर्वोक्त स्पष्टीकरणादि को वेधादि के द्वारा समझकर उस तन्त्र में बीज कर्मादि संस्कार से वैसा यत्न करना चाहिये जिससे उसमें बराबर वेध और गणित में एकता हो, इस तरह जिस तन्त्र में दृग्गणितैक्य होता है वही तन्त्र आदरणीय होता है ॥ ६० ॥

इदानीं स्व सिद्धान्तमेवादरणीयं प्रतिपादयति—

चन्द्ररविग्रहणेन्दुच्छायादिषु सर्वदा यतो ब्राह्मे।
दृग्गणितैक्यं भवति स्फुटसिद्धान्तस्ततो ब्राह्मः ॥ ६१ ॥

सु. भा.—यतो ब्राह्मे ब्रह्मसिद्धान्ते मद्रचिते ऽस्मिन् तन्त्रे चन्द्र रविग्रहणेन्दुच्छायादिषु सर्वदा दृग्गणितैक्यं भवति ततस्तस्मादयं ब्राह्मो मदीय एव स्फुटसिद्धान्त आदरणीय इति ॥ ६१ ॥

वि. भा.—यतः (यस्मात्कारणात्) ब्राह्मे (मदीय ब्राह्मस्फुटसिद्धान्ते) चन्द्रग्रहण-सूर्यग्रहण-चन्द्रच्छायादिषु सर्वदा दृग्गणितैक्यं भवति, ततः (तस्मान् कारणात्) ब्राह्मः (मदीयः) स्फुट सिद्धान्तः समादरणीयः ॥ ६१ ॥

अव अपने सिद्धांन्त को ही आदरणीय कहते हैं।

हि. भा.—क्योंकि हमारे सिद्धान्त ग्रन्थ में चन्द्रग्रहण-सूर्यग्रहण-चन्द्रच्छायादियों में सर्वदा दृग्गणितैक्य होता है इसलिये हमारा ही स्फुट सिद्धान्त आदरणीय हैं इति ॥ ६१ ॥

इदानीं गोलज्ञप्रशसामाह

गोलज्ञो जानात्येषां सर्वो दूषणानि कथितानि।
आर्यभटाद्युक्तानां तन्त्राणां दूषणाध्याये ॥ ६२ ॥

सु. भा.—सर्वो गोलज्ञ इह दूषणाध्याये एषामार्यभटाद्युक्तानां तन्त्राणां कथितानि दूषणानि जानाति मूर्खश्च प्राचीनतन्त्रदूषणेन मामुपहसन्तो निन्दयिष्यन्तीत्येवाचार्याशयः।

अत्र चतुर्वेदाचार्य :—

'गोलज्ञः सर्वेषामेव सर्वाणि दूषणानि वेत्तीत्यर्थः' ॥ ६२ ॥

वि. भा.—सर्वो गोलज्ञः (गोलवेत्ता) आर्यभटकथितानामेषां तन्त्राणां कथितानि दूषणान्यत्र दूषणाध्याये जानाति मूर्खाश्च प्राचीन तन्त्राणां दोषकथनेन मां हसन्तो निन्दां करिष्यन्तीत्याचार्यस्याभिप्रायः ।

अत्र चतुर्वेदाचार्यः—'गोलज्ञः सर्वेषामेव सर्वाणि दूषणानि वेत्ति' इत्यर्थः ॥६२

अब गोलवेत्ता की प्रशंसा करते है।

हि. भा.—सब गोलवेत्ता इस दूषणाध्याय में आर्यभट से कथित इन तन्त्रों के दोषों को जानते हैं, अर्थात् हमारे द्वारा प्राचीन तन्त्रों के दोषोद्घाटन करने से मूर्ख लोग हंसते हुए हमारी निन्दा करेंगे यह आचार्य के कहने का अभिप्राय है इति ॥ ६२ ॥

इदानीमुपसंहारमाह ।

इति कथिततन्त्रगणकान् पठितैरपि दूषणैः करोत्यज्ञान् ।
तन्त्रपरीक्षार्याणां त्रिषष्टिरेकादशो ऽध्यायः ॥ ६३ ॥

सु. भा.—इत्येवमयमार्याणां त्रिषष्टिस्तन्त्रपरीक्षानामैकादशोऽध्यायः पठितैर्दूषणैरपि कथिततन्त्रगणकान् आर्यभट-श्रीषेण विष्णुचन्द्रानुयायिनोऽज्ञान् मूर्खान् करोति । खण्डनमाकर्ण्य ते विवर्णवदना मूर्खा इव भवन्तीत्यर्थ ॥ ६३ ॥

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते ।
हृदि तं विनिधाय नूतनोऽयं रचितो दूषण के सुधाकरेण ॥

इति श्रीकृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्तनूतनतिलके तन्त्रपरीक्षाध्यायो नामैकादशोध्यायः ॥ ११ ॥

वि. भा.—इति (एवं) आर्याणां (आर्याछन्दसां) त्रिषष्टिस्तन्त्र परीक्षानामैकादशोऽध्यायः कथितदूषणैरपि कथिततन्त्रगणकान् (आर्यभट श्रीषेण-विष्णुचन्द्रानुयायिनो गणकान्) मूर्खान् करोति । खण्डनं श्रुत्वा ते मूर्खा इव भवन्तीति ॥ ६३ ॥

इति श्री ब्राह्मस्फुटसिद्धान्ते दूषणाध्यायो नामैकादशो ऽध्यायः ॥ ११ ॥

अब उपसंहार को कहते हैं ।

हि. भा.—इस तरह तिरसठ आर्याछन्दों का तन्त्र परीक्षा नामक ग्यारहवां अध्याय पूर्वकथित दोषों से कथित तन्त्र के ज्यौतिषियों (आर्यभट-श्रीषेण-विष्णुचन्द्र आदि गणकों) को मूर्ख करता है अर्थात् दूषणाध्याय पूर्वकथित दोषों के द्वारा आर्यभट-श्रीषेण विष्णुचन्द्र आदि आचार्यों को मूर्ख बनाना है ।। ६३ ।।

इति ब्राह्मस्फुटसिद्धान्त में दूषणाध्याय नामक ग्यारहवां अध्याय समाप्त हुआ ।। ११ ।।

ब्राह्मस्फुटसिद्धान्तः

अथ गणिताध्यायः

ब्राह्मस्फुटसिद्धान्तः

अथ गणिताध्यायः

अथ गणिताध्यायो व्याख्यायते । तत्रादौ तत्प्रशंसामाह ।

परिकर्म विंशतिं सङ्कलिताद्यां पृथग्विजानाति ।
अष्टौ च व्यवहारान् छायान्तान् भवति गणकः सः ।। १ ।।

सु. भा.—सङ्कलितायां परिकर्मविंशतिं छाया व्यवहारान्तानष्टौ व्यवहारांश्च पृथक् पृथग्विजानाति स गणको गोलश्रवणाधिकारी भवति । अतस्तद्वर्णनमावश्यकम् । सङ्कलितम् । व्यवकलितम् । प्रत्युत्पन्नो गुणनम् । भागहारः । वर्गः वर्गमूलम् । घनः घनमूलम् । पञ्चजातयः । त्रैराशिकम् । व्यस्तत्रैराशिकम् । पञ्चराशिकम् । सप्तराशिकम् । नवराशिकम् । एकादशराशिकम् । भाण्डप्रतिभाण्ड चेति कर्मविंशतिः । व्यवहाराश्च मिश्रकः । श्रेढी । क्षेत्रम् । खातम् चितिः । क्राकचिकः । राशिः। छाया चेत्यष्टौ ॥१॥

वि. भा.—यः सङ्कलिताद्यां (संङ्कलित पूर्वकाम्) परिकर्मविंशतिं (सङ्कलित-व्यवकलिते, गुणन-भजन-वर्ग-वर्गमूल-घनमूलानि भागप्रभागभागानुबन्धादयः पञ्चजातयः, त्रैराशिकम्-व्यस्त त्रैराशिकम् । पञ्चराशिकम् । सप्तराशिकम् नवराशिकम् । एकादश राशिकम् । भाण्डप्रतिभाण्डकं चेति) अष्टौ च छायान्तान् व्यवहारान् (मिश्रव्यवहारः, श्रेढीव्यवहारः, क्षेत्रव्यवहारः, खातव्यवहारः, चितिव्यवहारः, क्राकचिक व्यवहारः, राशिव्यवहारः, छायाव्यहारश्चेति) पृथक् पृथग्विजानाति स गणको (गणितगोलादिवेत्ता) भवतीति । सिद्धान्तशेखरे श्रीपतिना-"जानाति विंशतिमिमां परिकर्मणां यश्छायाष्टमीर्व्यवहृतीरपि मिश्रिताद्याम् । व्यक्तं स वेत्ति गणितं गणितप्रवीणगोष्ठीषु वैष भजते गणकाग्रणीत्वम्" ऽनेन यद्यपि ब्रह्मगुप्तोक्तमेव व्यक्तगणिताभिधेयं श्लोकान्तरेण कथितम् । परमत्र ब्रह्मगुप्त-श्रीपति कथितयोर्व्यक्तगणिताध्याययोर्विंशत्यां परिकर्मसु विषयवर्णने भेदोऽस्ति तद्विंशतिपरिकर्मणां नामानि बहुधा भिन्नानि सन्ति, अष्टसु मिश्रादिव्यवहारेष्वपि बहुधैव भिन्नत्वं च, तत्तत्सामयिकगणितेष्वावश्यकत्व-

मनावश्यकत्वं वेति ज्ञात्वा तत्कृतं किमिति गणितज्ञैर्ज्ञातव्यम् । द्वितीयार्यभटरचिते महासिद्धान्ते पाटीगणितप्रश्ना यथा—

सङ्कलितं व्यवकलितं गुणनं भागं कृतिं घनं त्वनयोः ।
मूले भिन्नाभिन्नाङ्कानां शीघ्रं सखे कथय ॥ १ ॥

विद्वन् ! सवर्णनं वद रूपाग्राणां तथांशकाग्राणाम् ।
सदृशच्छेदविधानं प्रभागवल्ल्योः सवर्णनं च कथम् ॥ २ ॥

वद भागभागकविधिं नानाजात्युद्भवानि च फलानि ।
अनुपातान्मिश्राणां वित्तौघानां पृथक्करणम् ॥ ३ ॥

काञ्चनवर्णोत्पत्तिं रससंयोगोद्भवान् विभेदांश्च ।
श्रेढीगणितं वक्त्रादीनां ज्ञानं गुणोतरं चैव ॥ ४ ॥

भुजकोटचो वंद कर्णं कर्णात्कोटिं भुजं यद्वा ।
कोटचादिद्वययोगे विवरे दृष्टेऽथवा पृथङ्माने ॥ ५ ॥

त्रिभुजचतुर्भुजवर्त्तुलमर्दलका दण्डकमलरूपाणाम् ।
क्षेत्राणां वद गणितं लम्बं लम्बाच्छ्रुतिं श्रुते लम्बम् ॥ ६ ॥

वापीसमखातानां विषमाणां वा वदाशु गणितं किम् ।
कूपानां च घनाख्यं पाषाणफलं त्वनेकदृषदां च ॥ ७ ॥

संख्या चितीष्टकानामित्युच्छ्रायस्तरूणां च ।
कर्मकराणां देयं वद यदि गणितं विजानासि ॥ ८ ॥

मार्गैर्द्वित्रिचतुर्भिर्भेदो दीर्घैः फलं ब्रूहि ।
खदिराम्रसरलजम्बूशाल्मलिकाबीजकादीनाम् ॥ ९ ॥

समभूभित्त्याश्रयगतस्य राशेश्च खारिकामानम् ।
द्युगतं नरभाज्ञानाद् द्युगताद्भां वा वदाशु गणितज्ञ ॥ १० ॥

प्राय उपर्युक्तानां प्रश्नानामेवोत्तराणि दातुं प्राचीनैः पाटी गणिताध्यायो विरचित इति तत्तत्पाटी गणिताध्यायावलोकनेन प्रतीयते। भास्कराचार्येणापि लीलावतीनामके स्वपाटीगणितग्रन्थे प्राय एतावतामेव प्राचीनोक्त प्रश्नानामुत्तराणि विधातुं विधयो वर्णिता इति ॥ १ ॥

हि. भा.—अब व्यक्त गणिताध्याय की व्याख्या करते हैं, उसमें पहले उसकी प्रशंसा कहते हैं, जो व्यक्ति संङ्कलित आदि बीस परिकर्म (सङ्कलित-व्यवकलित, गुणन, भजन, वर्ग, वर्गमूल, घन, घनमूल, पञ्चजाति, त्रैराशिक, व्यस्तत्रैराशिक, पञ्चराशिक, सप्तराशिक, नवराशिक, ग्यारहराशिक, भाण्ड प्रतिभाण्ड (बदला बदली) तथा आठ व्यवहारों

(मिश्र व्यवहार, श्रेढी व्यवहार, क्षेत्रव्यवहार, खात व्यवहार, चिति व्यवहार, क्रकच व्यवहार. राशि व्यवहार, छायाव्यवहार) को अलग अलग जानते है वे गणक (ज्यौतिषशास्त्र के ज्ञाता) है, सिद्धान्त शेखर मे 'जानाति विंशतिमिमा' इत्यादि संस्कृत विज्ञान भाष्य में लिखित श्लोक से, ब्रह्मगुप्तकथित व्यक्तगणित को ही श्लोकान्तर से श्रीपति कहते हैं तथापि ब्रह्मगुप्तकथित और श्रीपति कथित व्यक्तगणिताध्याय के बीस परिकर्मों के विषय वर्णन मे भेद है। और उन बीसो परिकर्मो के नाम भी बहुत भिन्न है। आठो मिश्र व्यवहारादियो में भी बहुधा भिन्नत्व है ही, क्या उन उन सामयिक गणितो मे आवश्यकत्व वा अनावश्यकत्व को जानकर वैसा किया गया है इन बातो का विद्वान् लोग विचार करे। द्वितीयार्यभटरचित महासिद्धान्तग्रन्थ मे अधोलिखित पाटी गणित प्रश्न है। जो 'सङ्कलित व्यवकलित गुणन भाग कृति घन त्वनयोः' इत्यादि संस्कृत विज्ञान भाष्य मे लिखित दस श्लोको से वर्णित है. प्रायः ऊपर कथित प्रश्नों के ही उत्तर के लिये प्राचीनाचार्यो ने पाटी गणिताध्याय की रचना की, ये बाते उनके पाटीगणिताध्याय को देखने से मालूम होती है, भास्कराचार्य ने भी अपने लीलावती नामक पाटीगणितग्रन्थ में प्रायः इन्ही प्राचीनोक्त प्रश्नों के उत्तर के लिये विधियों का वर्णन किया है इति ॥ १ ॥

इदानी भिन्न सङ्कलित व्यवकलितयोः करणसूत्रमाह।

विपरीतच्छेदगुणा राश्योश्छेदांशकाः समच्छेदाः।
सङ्कलितेंऽशा योज्या व्यवकलितेऽशान्तरं कार्यम् ॥ २ ॥

सु. भा.—राश्योश्छेदांशका विपरीतच्छेदगुणा मिथश्छेदगुणा एव समच्छेदास्तुल्यहरा भवन्ति। शेषं स्पष्टार्थम्। 'अन्योन्यहाराभिहतौ हरांशौ राश्योः समच्छेदविधानमेवम्' इत्यादि भास्करोक्तमेतदनुरूपमेव।

अत्र चतुर्वेदाचार्योक्तमुदाहरणम्।
सत्रिभागं तथा सार्धं रूपं षड्भागसंयुतम्।
एकीकृतं भवेत्किं स्वं रूपत्रयसमन्वितम् ॥

न्यासः

१	१	१	
१	१	१	$\frac{३}{१}$ यथोक्तकरणेन जातौ राशिः ॥७॥
३	२	६	

अत्र चतुर्वेदाचार्यः। 'यच्च स्कन्दसेनाचार्येण श्रेढीन्यायेन सङ्कलितं प्रदर्शितं तत्सङ्कलनं क्षेत्र प्रदर्शनाय'। इत्यनेन स्कन्दसेनोऽपि कश्चित्प्राचीनो गणक इत्यवगम्यते ॥२॥

वि. भा.—द्वयो राश्योश्छेदांशका विपरीतच्छेदगुणा (परस्पर हर गुणाः) स्तदा समच्छेदाः (तुल्यहराः) भवन्ति, तुल्य हरेजातेऽंशयोगः कार्यः, व्यवकलितेऽंशान्तरं कार्यम्। भिन्नाङ्कानां योग वियोगार्थ समच्छेदी करणं सर्वै रेवाचार्यैः कथ्यते। सिद्धान्तशेखरे "परस्परच्छेदहतौ हरांशौ योगाय राश्योः सदृशच्छिदौ स्तः। योगो वियोगश्च समच्छिदां हि" ऽनेन श्रीपतिना तदेव कथ्यते। लीलावत्या "अन्योन्य हाराभिहतौ हरांशौ राश्योः समच्छेदविधानमेवम्" मनेन भास्करेणापि तदेव कथ्यते।

अत्र चतुर्वेदाचार्योक्तमुदाहरणम्।

सत्रिभागं तथा सार्धं रूपं षड्भागसंयुतम्।
एकीकृतं भवेत्किं स्वं रूपत्रयसमन्वितम्॥

न्यासः $१\frac{१}{३}+१\frac{१}{२}+१\frac{१}{६}=\frac{४}{३}+\frac{३}{२}+\frac{७}{६}$ विपरीतच्छेदगुणा इत्यादिना
$\frac{८}{६}+\frac{९}{६}+\frac{७}{६}=\frac{२४}{६}=४$ अत्र रूपत्रयसमन्वितमित्यनेन योगफलम्
$=४+३=७=$ राशिः।

अत्रोपपत्तिः।

$\frac{अ}{क}, \frac{ग}{घ}$ अनयोर्योगान्तरं कर्त्तव्यमस्ति, तदा कल्प्यते $\frac{अ}{क}=ल$। $\frac{ग}{घ}=व$

$अ=क \times ल$ $\quad$ $ग=व \times घ$ अत्र पक्षौ क गुणितौ तदा
अत्र पक्षौ घ गुणितौ तदा, $\quad$ $ग \times क=व \times घ \times क$
$अ \times घ=क \times ल \times घ$

$\therefore$ $अ \times घ \pm ग \times क=क \times ल \times घ \pm व \times घ \times क$ पक्षौ $क \times घ$ भक्तौ तदा
$\frac{अ \times घ}{क \times घ} \pm \frac{ग \times क}{क \times घ}=ल \pm व$ एतेनाऽचार्योक्तमुपपन्नमिति॥ २॥

अब भिन्नाङ्क के सङ्कलित (योग) और व्यवकलित (अन्तर) के लिये कहते हैं।

हि॰ भा.—दो भिन्न राशियों के हर और अंश को परस्पर हर से गुणने से दोनों राशियों में समच्छेदत्व होता है। समच्छेदत्व होने पर ही उन दोनों का अंशयोग करने से सङ्कलित होता है, और अंश का अन्तर करने से व्यवकलित होता है। भिन्नाङ्कों के योग और अन्तर के लिए समच्छेदी करण (समान हर करना) सब आचार्य कहते हैं। सिद्धान्त शेखर में 'परस्परच्छेदहतौ हरांशौ॥' इत्यादि संस्कृत विज्ञान भाष्य में लिखित पद्य से श्री पति उसी विषय को कहते हैं। लीलावती में 'अन्योन्य हाराभिहतौ' इत्यादि से भास्कराचार्य भी उसी बात को कहते हैं॥

यहाँ विज्ञान भाष्य मे लिखित चतुर्वेदाचार्योक्त उदाहरण के अनुसार न्यास करने मे $१+\frac{१}{३}+१\frac{१}{२}+१\frac{१}{६}=\frac{४}{३}+\frac{३}{२}+\frac{७}{६}$ आचार्योक्त 'विपरीतच्छेदगुणा इत्यादि मे $\frac{८}{६}+\frac{९}{६}+\frac{७}{६}$ $=\frac{२४}{६}=४$, 'रूपत्रय समन्वित' इसमें $४+३=७=$योगफल$=$राशि।

उपपत्ति

$\frac{अ}{क}, \frac{ग}{घ}$ इन दोनो राशियो का योग और अन्तर करना है। तब कल्पना करते हैं

$\frac{अ}{क}=ल$। और, $\frac{ग}{घ}=व$,

$\therefore अ=ल\times क$ $\qquad$ $ग=व\times घ$

यहां दोनों पक्षों को घ से गुणने से, $\qquad$ दोनो पक्षों को क मे गुणा करने पर

$अ\times घ=ल\times क\times घ$। $\qquad$ $ग\times क=व\times घ\times क$

अतः $अ.घ\pm ग.क=ल.क.घ\pm व.घ.क$ दोनो पक्षों को क. घ. भाग देने से

$$\frac{अ.घ}{क.घ}\pm\frac{ग.क}{क.घ}=ल\pm व$$

इससे आचार्योक्त उपपन्न हुआ ॥२॥

इदानीं प्रत्युत्पन्ने करणसूत्रम्।

रूपाणिच्छेदगुणान्यंशयुतानि द्वयोर्बहूनां वा।
प्रत्युत्पन्नो भवतिच्छेदवधेनोद्धृतोंऽशवधः ॥ ३ ॥

सु० भा०—रूपाणि छेदगुणानि अंशयुतानि कार्याणि। एवं द्वयोर्वा बहूनां भिन्नानां सवर्णनं भवति। सवर्णनानन्तरं भिन्नयोर्वा बहूनां भिन्नानामंशानां वधश्छेदानां वधेनोद्धृतः' फलं प्रत्युत्पन्नो गुणनफलं भवति। 'छेदघ्नरूपेषु लवा धनर्णम्'— इत्यादि तथा 'लवा लवघ्नाश्च हरा हरघ्नाः' इत्यादि 'अंशाहतिश्छेदवधेन भक्ता' इत्यादि च सर्व भास्करोक्तमेतदनुरूपमेव।

अत्र चतुर्वेदाचार्योक्तोद्देशकः—

दशसार्धा भुजो यत्र कोटिः षड्भागसप्ततिः।
तत्रायते फलं किं स्यात् क्षेत्रे शीघ्रं निगद्यताम् ॥

न्यासः। भु $\frac{२१}{२}$। को $\frac{३५}{३}$ उक्तवज्जातः प्रत्युत्पन्नः $१२२\frac{१}{२}$। अन्योद्देशक.।

मरिचानां पलं षड्भिर्यदि सार्धैः पणैर्भवेत्।
पलषड्विंशतेर्मूल्यं सङ्कर्षाय वद स्फुटम् ॥

वि. भा.—द्वयो राश्योर्वाबहूनां राशीनां रूपाणि छेदगुणानि अंशयुतानि कार्याणि, ततोंऽशवधश्छेदवधेन भक्तस्तदा लब्धं प्रत्युत्पन्नो गुणनफलं भवति। अत्र चतुर्वेदाचार्योक्तमुदाहरणम्। दश सार्धाभुजो यत्र कोटिः षड्भागसप्ततिः। तत्रायते फलं किं स्यात् क्षेत्रे शीघ्रं निगद्यताम्। न्यासः-भुजः$=१०\frac{१}{२}=\frac{२१}{२}$। कोटिः $=\frac{७०}{६}=\frac{३५}{३}$

तदा रूपाणिच्छेदगुणानीत्यादिना तथायते तद्भुजकोटिघात इत्यादिना वाऽयतक्षेत्रफलम्$=$भु$\times$को $=\frac{२१}{२}\times\frac{३५}{३}=\frac{७}{२}\times ३५=\frac{२४५}{२}=१२२\frac{१}{२}=$ प्रत्युत्पन्नः। लीलावत्यां 'छेदघ्नरूपेषु लवाधनर्णमित्यादि' अंशाहतिश्छेदवधेन भक्ता' इत्यादि 'लवालवघ्नाश्च हराहरघ्ना' इत्यादि भास्करोक्तानि सर्वाण्याचार्योक्त-सदृशान्येव सन्ति, आयतक्षेत्रस्य फलं किं भवतीत्यस्यात्राज्ञानादायतक्षेत्रसम्बन्धेन यदुदाहरणं चतुर्वेदाचार्येण दत्तं तदस्मभ्यं न रोचते इति विद्वद्भिर्विवेचनीयम् ॥३॥

अत्रोपपत्तिः।

$\frac{अ}{क}=$ गुण्यः $=$ ल । $\frac{ग}{घ}=$ गुणकः $=$ व

$\therefore$ अ $=$ क $\times$ ल । ग $=$ व $\times$ घ

ततः अ $\times$ ग $=$ क $\times$ ल $\times$ व $\times$ घ

पक्षौ क $\times$ घ भक्तौ तदा

$\frac{अ\times ग}{क\times घ}=$ ल $\times$ व $=$ गुण्य $\times$ गुणक $=$ गुणनफल

एतेन 'छेदवधेनोद्धृतोंऽशवध इत्याचार्योक्तं, अंशाहतिश्छेदवधेन भक्ता' त्यादि भास्करोक्तं चोपपन्नं भवतीति ॥३॥

अब प्रत्युत्पन्न (भिन्नाङ्क गुणनफल) के लिये कहते हैं।

हि. भा.—दो राशियों के अथवा बहुत राशियों के रूप को हर से गुणाकर अंश जोड़ना तब अंशों के गुणनफल को हर के गुणनफल से भाग देने से फल प्रत्युत्पन्न (भिन्नाङ्क गुणनफल) होता है। यहां चतुर्वेदाचार्योक्त उदाहरण के अनुसार न्यास करने से भुज$=१०\frac{१}{२}$, कोटि$=\frac{७०}{६}=\frac{३५}{३}$

'रूपाणिच्छेदगुणानि' इत्यादि आचार्योक्त से आयत क्षेत्रफल$=$भु$\times$को$=\frac{२१}{२}\times\frac{३५}{३}=\frac{७\times ३५}{२}=\frac{२४५}{२}=१२२\frac{१}{२}=$ प्रत्युत्पन्न।

लीलावती में 'छेदघ्नरूपेषु लवाधनर्णमि' त्यादि 'अंशाहतिश्छेदवधेनभक्ता' इत्यादि 'लवालवघ्नाश्च हराहरघ्ना' इत्यादि भास्करोक्त आचार्योक्त 'रूपाणिच्छेदगुणानि' इत्यादि आचार्योक्त सदृश ही है, आयतक्षेत्र का फल क्या होता है इसके अज्ञान से आयतक्षेत्र सम्बन्ध से जो उदाहरण चतुर्वेदाचार्य ने दिया सो मुझे ठीक नहीं मालूम होता है इस बात का विद्वान् लोग विचार करें ॥३॥

उपपत्ति ।

$\frac{अ}{क}$ = गुण्य = ल । $\frac{ग}{घ}$ = गुणक = व

∴ अ = ल × क...(१) । ग = व × घ...(२),

अब (१) (२) इन दोनों का घात करने से अ × ग = क. ल. व. घ

दोनों पक्षों को क. घ से भाग देने से

$\frac{अ. ग}{क. घ}$ = ल × व = गुण्य × गुणक = गुणनफल ।

इससे 'छेदवधेनोद्धृतोंऽशवध इत्यादि आचार्योक्त' तथा 'अंशाहतिश्छेदवधेनभक्ता' इत्यादि भास्करोक्त भी उपपन्न होता है ॥३॥

इदानीं भागहारे करणसूत्रमाह ।

परिवर्त्य भागहारच्छेदांशौ छेदसंगुणश्छेदः ।
अंशोऽशगुणो भाज्यस्य भागहारः सवर्णितयोः ॥४॥

सु. भा.—भागहारच्छेदांशौ भाजकस्य छेदांशौ परिवर्त्य भाज्यस्य छेदः परिवर्तितछेदसङ्गुणश्छेदो भवति । एवं भाज्यस्यांशः परिवर्तितांशगुणोंऽशो भवति । एवं सवर्णितयोर्द्वयोर्भिन्नयोर्भागहारो भवति । सवर्णनं तु 'रूपाणि च्छेद-गुणानि' इति विधिना । भास्करभागहारोऽप्येतदनुरूप एव । उद्देशकश्चतुर्वे-दोक्तः —

यत्रायते फलं दृष्टं सार्धनेत्रयमेन्दवः ।
सार्धा दशभुजश्चैव कोटिस्तत्राभिधीयताम् ॥

न्यासः । क्षेत्रफलम् १२२$\frac{१}{२}$ भुजः १०$\frac{१}{२}$ । उक्तवज्जाता कोटिः ११$\frac{२}{३}$ । अत्र पुनश्चतुर्वेदाचार्यः । अन्ये पुनरिहापि त्रैराशिकात्मकमुदाहरणं ददति यथा—

रूपत्रिभागसंयुक्तं रूपलक्षं ददौ नृपः ।
दशभ्यो द्विजमुख्येभ्यः किमेकस्य धनं ततः ॥

इदानीं वर्गे मूले च करणसूत्रम् ।

वि. भा.—भागहारच्छेदांशौ (भाजकस्य हरांशौ) परिवर्त्य भाज्यस्य छेदः परिवर्त्तितच्छेद सङ्गुणश्छेदो भवति, तथा भाज्यस्यांशः परिवर्त्तितांश गुणोंऽशो भवति, तदा सवर्णितयोर्द्वयोर्भिन्नयोर्भागहारो भवति, सवर्णनं तु 'रूपाणि च्छेदगुणानि' इत्याचार्योक्तविधिना कर्त्तव्यम् ॥

यत्रायते फलं दृष्टं सार्धनेत्र यमेन्दवः ।
सार्धा दशभुजश्चैव कोटिस्तत्राभिधीयम् ॥

उद्देशकश्चतुर्वेदाचार्योक्तः ।

न्यासः क्षेत्रफलम् $= १२२\frac{१}{२}$, भुजः $= १०\frac{१}{२} = \frac{२१}{२}$

अथायत क्षेत्रफलम् $=$ भुज $\times$ को $= १२२\frac{१}{२} = \frac{२१}{२} \times$ कोटि

अतः $\frac{१२२\frac{१}{२}}{\frac{२१}{२}} = \frac{\text{आयतक्षेत्रे}}{\text{भुज}} = \frac{२४५ \times २}{२ \times २१} = \frac{२४५}{२१} = ११\frac{१४}{२१} = ११\frac{२}{३} =$ कोटिः ॥४॥

अत्रोपपत्तिः ।

$$\frac{\text{अ}}{\text{क}} = \text{भाज्यः} \;।\; \frac{\text{ग}}{\text{घ}} = \text{भाजकः तदा} \;\; \frac{\frac{\text{अ}}{\text{क}}}{\frac{\text{ग}}{\text{घ}}} = \frac{\text{भाज्य}}{\text{भाजक}} = \frac{\text{ल}}{\text{व}} \;।$$

$$\frac{\text{अ}}{\text{क}} = \text{ल}, \; \frac{\text{ग}}{\text{घ}} = \text{व} \quad \text{अ} = \text{भाज्य} \times \text{क} = \text{ल} \times \text{क}, \quad \text{ग} = \text{भाजक} \times \text{घ} = \text{व} \times \text{घ}$$

पक्षौ घ गुणितौ तदा अ. घ $=$ ल. क. घ. पक्षौ कगुणितौ तदा ग. क $=$ व. घ. क

अतः $\frac{\text{अ. घ}}{\text{ग. क}} = \frac{\text{ल. क. घ}}{\text{व. क. घ.}} = \frac{}{\text{व}} = \frac{\text{भाज्य}}{\text{भाजक}}$ एतेन 'परिवर्त्य भागहारच्छेदांशादित्याचार्योक्त'' । छेदं लवं च परिवर्त्य हरस्य शेष इत्यादिभास्करोक्तं चोपपद्यते, अधोहरोर्ध्वांशवधं विदध्यादधोहरं चोर्ध्वहरेण हन्यात् । अधस्तनांशोर्ध्वहराभिघातमूर्ध्वांशकेषु क्षिपभागजातावित्यादि सिद्धान्तशेखरे श्रीपत्युक्तमप्याचार्योक्तानुरूपमेवेति ॥४॥

अब भागहरण के लिये कहते हैं ।

ह. भा.— भाजक के हर और अंश को परिवर्त्तित कर भाज्य के हर को गुणने से

हर होता है। तथा भाज्य के अंश को परिवर्त्तित अंश से गुणने मे अंश होता है, तब सवर्णित दोनों भिन्नाङ्को का भागहार होता है, 'रूपाणिच्छेदगुणानि' इत्यादि आचार्योक्त विधि से सवर्णन करना चाहिये ॥

चतुर्वेदाचार्योक्त उदाहरण—

जिस आयत क्षेत्र का फल है $१२२\frac{१}{२}$, भुज$=१०\frac{१}{२}=\frac{२१}{२}$ उसमें कोटि प्रमाण क्या होगा ? आयतक्षेत्र का फल$=$भुज$\times$कोटि$=१२२\frac{१}{२}=\frac{२१}{२}\times$कोटि

$$\therefore \frac{१२२\frac{१}{२}}{\frac{२१}{२}}=\text{कोटि}=\frac{\text{आयतक्षेत्रफल}}{\text{भुज}}=\frac{२४५\times२}{२\times२१}=\frac{२४५}{२१}=११\frac{१४}{२१}$$

$$=११\frac{२}{३}=\text{कोटि} \;॥४॥$$

उपपत्ति।

$$\frac{\text{अ}}{\text{क}}=\text{भाज्य}।\quad \frac{\text{ग}}{\text{घ}}=\text{भाजक}\quad \text{तब}\quad \frac{\frac{\text{अ}}{\text{क}}}{\frac{\text{ग}}{\text{घ}}}=\frac{\text{भाज्य}}{\text{भाजक}}=\frac{\text{ल}}{\text{व}},\ \text{यहां}\ \frac{\text{अ}}{\text{क}}$$

$=$ल, $\frac{\text{ग}}{\text{घ}}=$व, अ$=$भाज्य$\times$क$=$ल$\times$क। ग$=$भाजक$\times$घ$=$व$\times$घ दोनों पक्षों को क से गुणने से ग. क$=$व. घ. क दोनों पक्षो को घ से गुणने मे अ. घ$=$ल. क. घ.,

अतः $\frac{\text{अ. घ}}{\text{ग. क}}=\frac{\text{ल. क. घ}}{\text{व. क. घ}}=\frac{\text{ल}}{\text{व}}=\frac{\text{भाज्य}}{\text{भाजक}}$ इससे 'परिवर्त्यभागहारच्छेदांशौ' इत्यादि आचार्योक्त तथा 'छेदलव च परिवर्त्य हरस्यशेप.' इत्यादि भास्करोक्त भी उपपन्न हुआ, सिद्धान्तशेखर में 'अधोहरोर्ध्वादिवध विदध्यादित्यादि' संस्कृत विज्ञान भाष्य मे लिखित श्रीपति पद्य भी आचार्योक्त के अनुरूप ही है ॥४॥

अत्र पुनश्चतुर्वेदाचार्यः।

अन्ये पुनरिहापि त्रैराशिकात्पकमुदाहरणं ददति.। यथा—

"रूपत्रिभाग संयुक्तं रूपलक्षं ददौ नृपः।
दशभ्यो द्विजमुख्येभ्यः किमेकस्य धनं वद ॥"

नृपः (राजा) रूपतृतीयांशयुक्तं रूपलक्षं श्रेष्ठदशभ्यो ब्राह्मणेभ्यो ददौ तदैकस्य ब्राह्मणस्य धनं किमिति वद.॥ गणितं स्पष्टमेव यथा, यदि दश ब्राह्मणानां धना $१००००० + \frac{१}{३}$ न्येतावन्ति सन्ति तदैकस्य ब्राह्मणस्य धनं किमित्यनुपातेन तद्धनप्रमाणं सुखेनागच्छतीति.॥४॥

यहा फिर चतुर्वेदाचार्य कहते हैं।

हि. भा.—अन्य आचार्य लोग यहा भी त्रैराशिकात्मक उदाहरण देते है - जैसे किसी राजा ने दश ब्राह्मणों को एक का तृतीयाश युक्त एक लाख रुपया दिया तब एक ब्राह्मण का धन क्या होना है सो कहो। इसका गणित स्पष्ट है जैसे यदि दस ब्राह्मणों का धन १००००० $+\frac{1}{3}$ है तो एक का क्या इस अनुपात से एक ब्राह्मण का धन सुलभता ही से आजाता है ॥ ४

इदानीं वर्गे मूले च करण सूत्रमाह ।

संवर्णितांश वर्गश्छेदकृतिविभाजितो भवति वर्गः ।
संवर्णितांशमूलं छेदपदेनोद्धृतं मूलम् ॥ ५ ॥

सु० भा०—संवर्णितः सवर्णितः। शेषं स्पष्टार्थम्। वर्गे कृती इत्यादिभास्करोक्तमेतदनुरूपमेव ।

अत्र चतुर्वेदाचार्योक्तोद्देशकः—
भुजकोटी समे यत्र सप्तार्धपरिसंख्यया ।
चतुरस्रे समे तत्र क्षेत्रे फलमिहोच्यताम् ॥
सपादार्काः फलं यत्र चतुरस्रे समे स्थितम् ।
भुजकोटी समे तत्र ब्रूहि त्वं यदि वर्गवित् ॥
वर्गलक्षणं समद्विवधो वर्ग इति चतुर्वेदाचार्यः ॥५॥

वि. भा.—सर्वर्णितांशवर्गो हरवर्गभक्तस्तदा भिन्नाङ्क वर्गो भवति। तथा सर्वणितांशमूलं हरमूलभक्तं तदा भिन्नाङ्कस्य मूलं भवतीति लीलावत्यां 'वर्गे कृती घनविधौ तु घनौ विधेयावित्यादि' भास्करोक्तमेतादृशमेवास्ति सिद्धान्त शेखरे 'हरराशिवर्गविहृतांशकृतिः क्रियते विभिन्न कृतये कृतिभिरिति' श्रीपत्युक्तमप्येतादृशमेवास्तीति विज्ञैर्ज्ञेयम् ॥

अत्र चतुर्वेदाचार्योक्तोद्देशकः।

भुज कोटी समे यत्र सप्तार्धपरिसंख्यया।
चतुरस्रे समे तत्र क्षेत्रेफलमिहोच्यताम्।
सपादार्काः फलं यत्र चतुरस्रे समे स्थितम्।
भुजकोटी समे तत्र ब्रूहि त्वं यदि वर्गवित् ॥

यत्र समे चतुस्रे (सम चतुर्भुजे) सप्तार्ध (सार्धत्रय) परिसंख्यया तुल्ये भुजकोटीस्ततस्तत्र क्षेत्रफलं किमिति कथ्यताम्। अत्रोत्तरार्थ न्यासः समचतुर्भुजस्य

भुजः $=3\frac{1}{2}$, कोटिः $=3\frac{1}{2}$ आयते (समचतुर्भुजे) भुजकोटिघातः फलमित्यनेन भुज $\times$ कोटि $=$ समचतुर्भुजफल $=(3\frac{1}{2})\times(3\frac{1}{2})=(\frac{7}{2})\times(\frac{7}{2})=\frac{49}{4}$ अर्थाद्भिन्नाङ्कस्य वर्गे क्रियमाणेऽंशवर्गो हरवर्गभक्तस्तदा भिन्नाङ्कवर्गो भवति तथा भिन्नाङ्कस्य मूलं हरमूलभक्तं तदा तद्भिन्नाङ्कस्य मूलं भवतीति। वर्गलक्षणं समद्विवधो वर्ग इति चतुर्वेदाचार्यः। लीलावत्यां 'समद्विघातः कृतिरुच्यते' इत्यादिना भास्करेण, सिद्धान्त शेखरे 'वर्गोऽभिघातः सदृगद्विराश्योरित्यनेन श्रीपतिनापि तदेव कथ्यते ॥ ५॥

अब भिन्नाङ्क के वर्ग और मूल को कहते हैं।

हि. भा.—भिन्नाङ्क के अंश वर्ग को हर वर्ग से भाग देने से उस भिन्नाङ्क का वर्ग होता है। एवं भिन्नाङ्क के अंशमूल को हर के मूल से भाग देने से भिन्नाङ्क का मूल होता है। लीलावती में 'वर्गकृतौ घनविधौ तु घनौ विधेयौ' इत्यादि भास्करोक्त भी इसी के अनुरूप है, सिद्धान्त शेखर में 'हरराशिवर्ग विहृतांशकृतिः' इत्यादि से श्रीपति भी इसी बात को कहते है ॥

यहाँ चतुर्वेदाचार्योक्त उदाहरण यह है—

जिस समचतुर्भुज में सात का आधा भुज और कोटि है उस क्षेत्र का फल क्या होता है सो कहो। इस के उत्तर केलिये न्यास—समचतुर्भुज का भुज $=\frac{7}{2}$, कोटि $=\frac{7}{2}$, भुज और कोटि का घात करने से समचतुर्भुज (आयत क्षेत्र) का फल होता है, अतः समचतुर्भुज फल $=\frac{7}{2}\times\frac{7}{2}=\frac{49}{4}$ अर्थात् भिन्नाङ्क का वर्ग करना हो तो अंशवर्ग को हरवर्ग से भाग देने से उस भिन्नाङ्क का वर्ग होता है। एवं भिन्नाङ्क के मूल के लिये अंशमूल को हर के मूल से भाग देने से भिन्नाङ्क का वर्गमूल होता है। वर्ग का लक्षण चतुर्वेदाचार्य कहते हे 'समद्विवधोवर्ग' अर्थात् समान दो अंङ्कों के गुणन करने से उस अङ्क का वर्ग होता है। लीलावती में 'समद्विघातः कृतिरुच्यते' इससे भास्कराचार्य, तथा सिद्धान्त शेखर में 'वर्गोऽभिघातः सदृगद्विराश्योः' इससे श्रीपति भी वही बात कहते हैं ॥५ ॥

इदानीं घने करणसूत्रमाह।

स्थाप्योऽन्त्यघनोऽन्त्य कृतिस्त्रिगुणोत्तरसङ्गुणा च प्रथमात्।
उत्तरकृतिरन्त्यगुणा त्रिगुणा चोत्तरघनश्च घनः ॥६॥

सु. भा.—स्पष्टार्थम्। 'स्थाप्यो घनोऽन्त्यस्य ततोऽन्त्यवर्गे' इत्यादि भास्करोक्त मेतदनुरूपमेव।

अत्र चतुर्वेदोक्तोद्देशकः—

चतुरस्रा समा वापी हस्तैस्त्रिघनसंमिता।
वेधेन च तथा तस्याः फलं ब्रूहि घनात्मकम् ॥६॥

वि. भा.—द्वयोरङ्कयोर्योगस्य घनकरणार्थं प्रथमाङ्कोऽन्त्य संज्ञकः। द्वितीयोऽङ्क उत्तरसञ्ज्ञकः, तदा अन्त्यघनः स्थाप्यः, ततोऽन्त्यकृतिः (अन्त्यवर्गः) त्रिगुणोत्तरसङ्गुणा, उत्तरकृतिः (उत्तर वर्गः) अन्त्यगुणा त्रिगुणा च, उत्तर घनश्च कार्यः सर्वेषां योगकरणेनाङ्कयोर्योगस्य घनो भवतीति। अत्र चतुर्वेदाचार्योद्देशकः—'चतुरस्रा समा वापी हस्तत्रिघन समिता। वेधेन च तथा तस्याः फलं ब्रूहि घनात्मकम्'॥

न्यासः (वापी: भुजाः २७, २७, २७, २७; मध्ये २७)

वापीभुजाः=२७

वेधश्च=२७

वापिक्षेत्रफलम्=२७×२७=७२९

क्षेत्रफलं वेधगुणमित्यादिना वाप्या घनात्मकं फलम् =क्षेत्रफल×वेध=७२९×२७ चतुर्वेदाचार्येण क्षेत्र सम्बन्धेन याग्युदाहरणानि प्रदर्शितानि तानि न समीचीनानीति सुधीभिर्ज्ञातव्यानीति ॥ ६ ॥

अत्रोपपत्तिः

अ+क अस्य घन करणार्थं समत्रिघातश्च घन इति घनपरिभाषया $(\text{अ}+\text{क})(\text{अ}+\text{क})(\text{अ}+\text{क})=(\text{अ}+\text{क})^3$ खण्ड गुणनेन $(\text{अ}^2+\text{अ}.\text{क}+\text{क}^2)(\text{अ}+\text{क})=(\text{अ}^2+२\,\text{अ}.\text{क}+\text{क}^2)(\text{अ}+\text{क})=\text{अ}^3+२.\text{अ}^2.\text{क}+\text{अ}.\text{क}^2+\text{अ}^2.\text{क}+२\,\text{अ}.\text{क}^2+\text{क}^3=\text{अ}^3+३\,\text{अ}^2\text{क}+३\text{अ}.\text{क}^2+\text{क}^3=(\text{अ}+\text{क})^3$ एतेन 'स्थाप्योऽन्त्यघन इत्याचार्योक्तमुपपद्यते। 'स्थाप्योऽन्त्यवर्गो द्विगुणान्त्यनिघ्ना' इत्यादि लीलावत्यां भास्करोक्तमेतदनुरूपमेवास्ति। प्राचीनैः केवलं वर्गघनयोर्विचारः कृतः। द्वयोरङ्कयोर्योगस्य चतुर्घात पञ्चघातादीनां विचारो न कृतः। नवीनैस्तु द्वयोरङ्कयोर्योगस्येष्टाङ्कघातपर्यन्तं कीदृशं रूपं भवतीत्येतदर्थकाश्रेढ्युत्पादिता। यथा श्रेढ्या रूपम्=अयमेव द्वियुक् पदसिद्धान्तः। $(\text{अ}+\text{क})^{\text{न}}=\text{अ}^{\text{न}}+$

$$\frac{\text{अ}^{\text{न}-१}\times\text{न}\times\text{क}}{१}+\frac{\text{अ}^{\text{न}-२}\times\text{न}\,(\text{न}-१)\text{क}^{२}}{१\times२}+\frac{\text{अ}^{\text{न}-३}\times\text{न}\,(\text{न}-१)\,(\text{न}-२)\,\text{क}^{३}}{१\times२\times३}+\cdots\cdots$$

अत्र यदि न=२ तदा $(\text{अ}+\text{क})^2=\text{अ}^2+\text{अ}\times२\times\text{क}+\text{क}^2$

यदि न=३ तदा $(\text{अ}+\text{क})^3=\text{अ}^3+\text{अ}^2\times३\times\text{क}+\text{अ}\times३\times\text{क}^2+\text{क}^3$

एतावता 'स्थाप्योऽन्त्यवर्गो द्विगुणान्त्यनिघ्नेत्यादि वर्गोपपत्तिः 'स्थाप्यो

यदि न=४, तदोत्थापनेना $(अ+क)^{४}$ ऽस्यचतुर्घातस्वरूपं जायते एवमेव न=५, न=६, न=७, न=८……तदोत्थापनेन $(अ+क)^{५}$, $(अ+क)^{६}$, $(अ+क)^{७}$ इत्यादीनां स्वरूपं जायते। परं पूर्वोक्ता श्रेढ़ी कथमुत्पद्यते तदर्थं युक्तिर्ग्रन्थान्ते प्रदर्शयिष्यत इति ॥ ६ ॥

अब घन करने के लिये कहते हैं।

हि. भा.—दो अङ्को के योग का घन करने के लिये प्रथमाङ्क=अन्त्यसंज्ञक, द्वितीयाङ्क=उत्तर संज्ञक, तब पहले अन्त्य का घन स्थापन करना, उस के बाद अन्त्य वर्ग को तीन और उत्तर से गुणा देना उसके बाद उत्तर वर्ग को तीन से और अन्त्य से गुणा करना उसके बाद उत्तर का घन करना, सबो का योग करने से दो अङ्को के योग का घन होता है यहाँ चतुर्वेदाचार्योक्त उदाहरण है कि किसी वापी के चारों भुज=२७ है, वेध भी २७ है तब उस वापी का घनफल क्या होता है सो कहो। यहा वापी का क्षेत्र फल=२७×२७=७२९, 'क्षेत्रफलं वेधगुणं' इत्यादि से क्षेत्रफल×वेध=७२९×२७=वापी घनफल। चतुर्वेदाचार्य ने सब जगह क्षेत्रसम्बन्ध से जो उदाहरण दिये हैं वे मुझे ठीक नही मालूम होते है इस बात को विज्ञलोग विचार कर समझे ॥ ६ ॥

उपपत्ति

अ+क इसके घन के लिये 'समत्रिघातश्च घन' इस परिभाषा से (अ+क)(अ+क)(अ+क)=$(अ+क)^{३}$ खण्ड गुणन से $(अ^{२}+अ.क+अ.क+क^{२})$ $(अ+क)=(अ^{२}+२अ.क+क^{२})(अ+क)=अ^{३}+२अ.^{२}क+अ.क^{२}+अ.^{२}क+२अ.क^{२}+क^{३}=अ^{३}+३अ.^{२}क+३अ.क^{२}+क^{३}=(अ+क)^{३}$ इससे 'स्थाप्योऽन्त्य घन' इत्यादि आचार्योक्त उपपन्न होता है, 'स्थाप्योऽन्त्य वर्गो द्विगुणान्त्य निघ्ना' इत्यादि लीलावती मे भास्करोक्त इसके अनुरूप ही है। प्राचीनाचार्यो ने केवल वर्ग (द्विघात) और घन (त्रिघात) के लिये विचार किया है। दो अङ्कों के योग के चतुर्घात-पञ्चघात आदि के लिये विचार नही किया है। नवीन लोगों ने दो अङ्को के योग के इष्टाङ्कघात पर्यन्त कैसा रूप होता है इसके लिये एक श्रेढ़ी उत्पादन की है इसी को द्वियुक पद सिद्धान्त कहते है। जैसे श्रेढ़ी का स्वरूप=$(अ+क)^{न}$

$$=अ^{न}+\frac{अ^{न-१}\times न\times क}{१}+\frac{अ^{न-२}\times न\times(न-१)क^{२}}{१\times२}+\frac{अ^{न-३}\times न(न-१)(न-२)क^{३}}{१\times२\times३}+\cdots\cdots$$

यहां यदि न=२ तब उत्थापन से $(अ+क)^{२}=अ^{२}+२अ.क+क^{२}$ यदि न=३ तब $(अ+क)^{३}=अ^{३}+३अ.^{२}क+३अ.क^{२}+क^{३}$ इससे 'स्थाप्योऽन्त्यवर्गो द्विगुणान्त्य निघ्ना' इत्यादि वर्गोपपत्ति तथा 'स्थाप्यो घनोऽन्त्यस्य ततोऽन्त्यवर्ग' इत्यादि भास्करोक्त घनोपपत्ति उपपन्न होती है। यहां न=इष्टाङ्क है, यदि न=४ तब उत्थापन से $(अ+क)^{४}$ चतुर्घात

रूप होता है। इसी तरह न=५, न=६, न=७ इत्यादि मानने से उत्थापन देने से (अ+क)^{५}, (अ+क)^{६}, (अ+क)^{७} इन सबो के स्वरूप निष्पन्न होता है। लेकिन पूर्वोक्त श्रेढी कैसे बनती है उसके लिए ग्रन्थान्त में युक्ति कही जायगी ।। ६ ।।

इदानीं घनमूले करणसूत्रम् ।

छेदो घनाद् द्वितीयाद् घनमूलकृतिस्त्रिसङ्गुणाप्तकृतिः ।
शोध्या त्रिपूर्वगुणिता प्रथमाद् घनतो घनोमूलम् ।। ७ ।।

सु. भा.—अत्रचतुर्वेदाचार्यः—

'अत्रोद्दिष्टघनराशेः प्रथमस्थानस्य घनसंज्ञा ततो विलोमतः स्थानद्वयस्य अघनसंज्ञा ततः परं पुनरेकस्य घनसंज्ञा ततश्च द्वयोरघनसंज्ञैवमापादसमाप्तेः। एवं स्थिते सूत्रावतारः । आदिभाजकः घनमूल कृतिस्त्रिसंगुणा कुत इत्याह। अघनाद् द्वितीयात् ततो यदाप्तं तस्य कृतिः शोध्या किन्तु सा त्रिगुणिता पूर्वगुणिता च कुतः प्रथमादघनात् ततश्च घनतो घनः शोध्यः। एवं कृते घनमूलं भवति। अत्रोद्देशकः—

घनात्मकं फलं यत्र सप्ताष्टिरविभिः समम् ।
पार्श्वोत्सेधाः समास्तत्रचितौ ब्रूहि घनात्पदम् ।।७।।

वि. भा.– अत्र चतुर्वेदाचार्यः—'अत्रोद्दिष्टघनराशेः प्रथमस्थानस्य घनसंज्ञा ततो विलोमतः स्थानद्वयस्य अघनसंज्ञा ततः परं पुनरेकस्य घनसंज्ञा ततश्च द्वयोर-घन संज्ञैवमापादसमाप्तेः। एवं स्थिते सूत्रावतारः आदि भाजकः घनमूलकृतिस्त्रि सङ्गुणा कुत इत्याह। अघनाद् द्वितीयात् ततो यदाप्तं तस्य कृतिः शोध्या किन्तु सा त्रिगुणिता पूर्व गुणिता च कुतः प्रथमाद् घनात् ततश्च घनतो घनः शोध्यः। एवं कृते घनमूलं भवतीति ।।

अत्रोद्देशकः।

घनात्मकं फलं यत्र सप्ताष्टिरविभिः समम् ।
पार्श्वोत्सेधाः समास्तत्र चितौ ब्रूहि घनात् पदम्।।

यस्याश्चितेर्घनात्मकं फलं सप्ताष्टिरविभिः १२१६७ सममस्ति, पार्श्वाणा-मुच्छ्रायाश्च तुल्यास्तत्र घनात्मकात्तत्फलान्मूलं किं, घनमूलानयनरीत्या तन्मूलम् =२३ ।।

अत्रोपपत्तिः।

यदि अ=य+र तदाऽस्य घनः=अ^{३}=(य+र)^{३}=य^{३}+३ य.^{२}र+३ य.र^{२}

$+ र^3$ अत्र घनराशिस्वरूपे प्रथममन्तिमाङ्क घनोऽस्ति ततः परमन्तिमाङ्कवर्ग त्रिगुणितोपान्तिमघातस्ततः परं त्रिगुणितान्तिमाङ्कोपान्तिमवर्गघातस्ततः परमुपान्तिमघनः। अतोऽत्रान्तिमाङ्कघनाद्यस्य घनः शुद्धयेत्सशोध्यः। तद्वर्गेण त्रिगुणितेन भक्तेऽघने लब्धमुपान्तिमाङ्कः। ततस्तद्वर्गत्रिगुणितान्तिमघातस्य विशोधनेन यच्छेषं तत्रोपान्तिमस्य घनशोधनेन यदि शेषाभावस्तदा तदेव घनमूलं बोध्यम्। शेषसत्वे पुनः पूर्वोक्ता क्रिया कार्या। एतेन 'अन्त्याद् घनतोघनं विशोध्य। घनं पृथक्स्थं पदमस्य कृत्या त्रिघ्न्या तदाद्यं विभजेत् फलं नु.=लीलावत्याँ भास्करोक्तमुपपद्यते। सिद्धान्त शेखरे 'घनोऽघनद्वन्द्वमिति प्रपात्य घनं घनान्मूलमतः पदस्य। योज्यं तृतीयस्य हरेच्च शेषत्रिनिघ्नकृत्याऽस्य निवेश्य लब्धम्॥ पङ्क्त्यां ततस्तत्कृतिमन्त्यनिघ्नीं त्रिसङ्गुणाँ चापनयेद् घनं च विधानमेवं गुणकेन नूनं पुनर्विधेय घनमूललब्धेः॥ श्रीपत्युक्तमिदमेव भास्करोक्तस्य बीजम्। आचार्योक्त घनमूलानयन प्रक्रिया न शोभना। चतुर्वेदाचार्येण घनाघनयोः संज्ञा या लिखिता सा युक्ति सङ्गताऽस्ति किन्तु ततः परं ते स्पष्टीकरणं न कृतमिति॥ ७॥

हि. भा. – यहा चतुर्वेदाचार्य का मत है कि बताई हुई घनराशि मे प्रथम स्थान की घन संज्ञा होती है। उसके पश्चात् विलोम रूप मे दो स्थानो की अघन सज्ञा होती है। उसके बाद फिर एक स्थान की घनसज्ञा और दो स्थानों की अघन सज्ञा। इसी प्रकार पद की समाप्ति तक यह क्रम चलता है। ऐसी स्थिति मे सूत्र के नियमानुसार पहला भाजक घनमूल का वर्ग त्रिगुणित कैसे होता है, यह बात बताते है। दूसरे अघन से जो प्राप्त होता है उसका वर्ग घटाना चाहिये, किन्तु वह त्रिगुणित पहले प्रथम घन मे उसके पश्चात् द्वितीय घन में से घन को घटाने से धनमूल होता है।

उदाहरणतः १२१६७ संख्या का घनमूल २३ होता है, जैसा कि घनमूल की प्रक्रिया मे सिद्ध होता है। चिति (भाठा) का घनात्मक फल १२१६७ है, पार्श्व की ऊचाई भी बराबर है वहां घनात्मक फल का मूल घनमूलानयन की प्रक्रिया से = २३ है।

उपपत्ति

यदि $अ = य + र$, तब इसका घन $= अ^3 = (य+र)^3 = य^3 + ३य^2 र + ३य . र^2 + र^3$ यहां घनराशि के रूप में पहला अन्तिम अङ्क $(य^3)$ घन है, इसके बाद अन्तिम वर्ग त्रिगुणित और उपान्तिय का घात है, उसके बाद त्रिगुणित अन्तिम और उपान्तिम का वर्ग घात है, उसके पश्चात् त्रिगुणित अन्तिम और उपान्तिम का वर्ग घात है, उसके पश्चात् उपान्तिम का घन है। इसलिए अन्तिम घन में से जिसका घन घटे वह घटाना चाहिए। उस त्रिगुणित वर्ग से अघन में भाग देकर जो लब्धि हो वह उपान्तिम अङ्क है। उसके पश्चात् उसके वर्ग त्रिगुणित उपान्तिम के घात को घटाने से जो शेष हो, उसमें से उपान्तिम का घन घटाने से कुछ शेष न बचे तो उसको घनमूल समझना चाहिए।

यदि शेष बच जाय तो पहले की भाति प्रक्रिया करनी चाहिए। इससे "अन्त्यात् घन तो घन विशोध्य घनं पृथक्स्थ पदमस्य कृत्या त्रिघ्न्या तदाद्यं विभजेत् फलं तु" यह लीलावती मे कही हुई भास्कर की उक्ति सिद्ध होती है। सिद्धान्त शेखर में "घनोऽघन-द्वन्द्वमिति प्रपात्य घनं घनान्मूलनतः पदस्य। योज्य तृतीयस्यहरेच्च शेषत्रिनिघ्नकृत्याऽस्य निवेश्य लब्धम् पङ्क्त्यां ततस्तत्कृतिमन्त्यनिघ्नीं त्रिसङ्गुणां चापनयेद् घन च विधानमेवं गुणकेन नूनं पुनर्विधेय घन मूललब्धेः" यह श्रीपति का कथन भास्करोक्त बीज के समान है। आचार्य द्वारा बतलाई गई घनमूल की प्रक्रिया उपयुक्त नहीं है। चतुर्वेदाचार्य ने घनाघन की जो संज्ञा लिखी है वह युक्ति सङ्गत है परन्तु उसके पश्चात् उन्होने स्पष्टीकरण नही किया।

इदानी प्रथमद्वितीयजात्योः सवर्णनमाह।

सदृशच्छेदांश युतिश्छेदविभक्ता फलं प्रथमजातौ।
अंशैरंशा गुणिताश्छेदैश्छेदा द्वितीयायाम् ॥ ८ ॥

सु. भा.—सदृशच्छेदांशानां युतिश्छेदविभक्ता समच्छेदहृता फलं प्रथम-जातौ सवर्णनं स्यादिति 'योगोऽन्तरं तुल्यहरांशकाना' मित्यादि भास्करोक्तमेव एवं द्वितीयायां प्रभागजातौ अंशा अंशैर्गुणिता अंशो भवति। छेदाश्छेदैर्गुणिता-श्छेदो भवतीत्येतदनुरूपमेव 'लवा लवघ्नाश्च हरा हरघ्नाः' इत्यादिभास्करोक्तम्।

अत्र चतुर्वेदोक्तोद्देशकः—

रूपार्ध रूपषड्भागो रूपांशो द्वादशस्तथा।
रूपस्य च तुरीयांशः कोऽर्थः सम्पिण्डिते भवेत् ॥

न्यासः। $\frac{१}{२}$। $\frac{१}{६}$ $\frac{१}{१२}$। $\frac{१}{४}$ उक्तवज्जातोयोगः १।

अन्योद्देशकः—

द्वियमा रसषट्काश्च वसुलोका नवाग्नयः।
त्रीन्दवः कृतरुद्राश्च छेदस्थाने प्रकल्पिताः ॥
पञ्चागा नवरूपं च वेदा रुद्रास्तदंशकाः।
मिलिता यत्र दृश्यन्ते कस्तत्र धनसञ्चयः ॥

न्यासः। $\frac{५}{२२}$। $\frac{७}{६६}$। $\frac{९}{३८}$। $\frac{१}{३९}$। $\frac{४}{१३}$। $\frac{११}{११४}$ उक्तवज्जातो योगः १।

प्रभागजातौ चतुर्वेदोद्देशकः—

पादार्ध पादषड्भागं पादांशद्वादशं तथा।
दशघ्नादष्टमं पादात् सप्तघ्नात् पञ्चमं तथा ॥
सम्पीड्याऽऽचक्ष्व मे शीघ्रं विंशत्यंशैस्त्रिभिर्युतम्।
धनं तद्देयमस्माभिर्ज्योतिः शास्त्रविदे सदा ॥

न्यासः । $\frac{१}{४}$ $\frac{१}{२}$ । $\frac{१}{४}$ $\frac{१}{६}$ । $\frac{१}{४}$ $\frac{१}{१२}$ । $\frac{१०}{४}$ $\frac{१}{८}$ । $\frac{७}{४}$ $\frac{१}{५}$ । $\frac{३}{२०}$ ।
सवर्णिते $\frac{१}{८}$ । $\frac{१}{२४}$ $\frac{१}{४८}$ $\frac{१०}{३२}$ । $\frac{७}{२०}$ $\frac{३}{२०}$ उक्तवज्जातो योगः $\frac{२३}{३२}$ ।

वि. भा.—सदृशच्छेदांशयुतिः (तुल्यहरांशानां योगः) छेदविभक्ता (हरभक्ता) फलं प्रथमजातौ सवर्णनं भवति । द्वितीयजातौ-अंशैरंशा गुणिताः, छेदैः (हरैः) छेदाः (हराः) गुणितास्तदांऽशा हरभक्ता फलं सवर्णनं भवति । प्रथमजाति सवर्णनं तु 'योगोऽन्तर तुल्यहरांशकानामित्यादि भास्करोक्तानुरूपमेव तथा द्वितीय प्रभागजातिसवर्णनं यत्तदनुरूपमेव लीलावत्यां 'लवालवघ्नाश्च हरा हरघ्नाः' इत्यादि भास्करोक्तम् ॥ ८ ॥

अत्र प्रथम प्रभाग जात्यर्थं चतुर्वेदाचार्योक्तमुदाहरणम् ।

रूपार्धं रूपषड्भागो रूपांशो द्वादशस्तथा ।
रूपस्य च चतुर्थांश कोऽर्थः सम्पीड़िते भवेत् ॥

सम्पीडिते (सवर्णने), अर्थः (धनम्) शेषं स्पष्टम् ।

न्यासः $\frac{१}{२}+\frac{१}{६}+\frac{१}{१२}+\frac{१}{४}$ विपरीतच्छेदगुणा इत्याचार्योक्तेन 'लीलावत्यां' अन्योन्य हाराभिहतौ हराशावित्यादि भास्करोक्तेन वा $\frac{६}{१२}+\frac{२}{१२}+\frac{१}{१२}+\frac{१}{४}$ $=\frac{९}{१२}+\frac{१}{४}=\frac{३६}{४८}+\frac{१२}{४८}=\frac{४८}{४८}=१=$योगफलम् ॥ ८ ॥

अथवा लघुतमापवर्त्येन गणितम्

न्यासः $\frac{१}{२}+\frac{१}{६}+\frac{१}{१२}+\frac{१}{४}$ अत्रहराणा २, ६, १२, ४ मेषा २ मनेनापवर्त्तनेन

२ | २।६।१२।४ पुनः ३।६।२ द्वाभ्यामपवर्त्तनेन २ | ३।६।२ पुनः ३।३ त्रिभिरपवर्त्तनेन
| १।३। ६ ।२ | ३।३।१

३ | ३।३।१ ततोऽपवर्त्तनाङ्क घातः २ × २ × ३ = १२ शेष १।१।१ गुणितः १२, अनेनै-
| १।१।१

$\frac{१}{२}+\frac{१}{६}+\frac{१}{१२}+\frac{१}{४}$ षां हरांशयोर्गुणनेन $\frac{१}{२}\times\frac{१२}{१२}+\frac{१}{६}\times\frac{१२}{१२}+\frac{१}{१२}\times\frac{१२}{१२}+\frac{१}{४}\times\frac{१२}{१२}$ $=\frac{६}{१२}+\frac{२}{१२}+\frac{१}{१२}+\frac{३}{१२}=\frac{१२}{१२}=१=$योगफलम् ॥ ८ ॥

अत्रोपपत्तिः

रूपाणिच्छेदगुणान्यंशयुतानि द्वयोर्बहूनां वा । प्रत्युत्पन्नो भवति च्छेदवधेनोद्धृतोंऽशवध इत्याचार्योक्तेन योगोऽन्तरं तुल्यहरांशकानामित्यादि भास्करोक्तेन वा प्रथमप्रभागजातिस्वरूपवासना स्पष्टैवास्ति, द्वितीयप्रभागजातिसवर्णनोपपत्तिरपि "लवालवघ्नाश्च हरा हरघ्नाः" इत्यादि भास्करोक्तेन 'अंशाहतिश्छेदवधेन भक्ते त्यादि भास्करोक्तेन वा स्पष्टैवास्तीति, सिद्धान्तशेखरे 'प्रभागजातौ

तु सवर्णनाय छिदां लवानां च समाहतिः स्यात्' श्रीपत्युक्तमिदमेतदनुरूप-मेवेति ॥ ८ ॥

अब प्रथम प्रभागजाति और द्वितीय प्रभाग जाति के सवर्णन को कहते हैं ।

हि॰ भा॰—तुल्य हरवाले अंशों के योग को हर से भाग देने से प्रथम जाति में सवर्णन होता है । तथा अशो को अंश से गुरण कर हरों के घात से भाग देने से द्वितीय प्रभाग जाति मे सवर्णन होता है । लीलावती में 'योगोऽन्तरं तुल्य हरांशकानां' इत्यादि भास्करोक्त आचार्योक्त प्रथम प्रभाग जाति सवर्णन के अनुरूप ही है । तथा आचार्योक्त द्वितीय प्रभाग जाति सवर्णन जो है तदनुरूप ही लीलावती में 'लवा लवघ्नाश्च हराहरघ्नाः' इत्यादि भास्करोक्त है इति ॥ ८ ॥

यहाँ प्रथम प्रभाग जाति के लिए चतुर्वेदाचार्योक्त उदाहरण है जैसे-

न्यासः $\frac{१}{२}+\frac{१}{६}+\frac{१}{१२}+\frac{१}{४}$ इन सवो का योग करने के लिये 'विपरीतच्छेदगुणा' इत्यादि आचार्योक्त से वा लीलावती में 'अन्योन्य हाराभिहतौ' इत्यादि भास्करोक्त से $\frac{६}{१२}+\frac{२}{१२}+\frac{१}{१२}+\frac{१}{४}=\frac{९}{१२}+\frac{१}{४}=\frac{३६}{४८}+\frac{१२}{४८}=\frac{४८}{४८}=१=$योगफल हुआ ॥ ८ ॥

अथवा लघुतमापवर्त्य से गणित दिखलाते हैं ।

न्यास $\frac{१}{२}+\frac{१}{६}+\frac{१}{१२}+\frac{१}{४}$ यहाँ २।६।१२।४ इन हरो को दो से अपवर्त्तन देने मे
२ | २।६।१२।४ पुनः ३।६।२ इन को दो से अपवर्त्तन देने से २ | ३।६।२ फिर ३।३ इनको
  | १।३।६।२　　　　　　　　　　　　　　　　| ३।३।१
तीन से अपवर्त्तन देने से ३ | ३।३।१ अब अपवर्त्तनाङ्को के घात $२\times२\times३=१२$ को
　　　　　　　　　　　　　| १।१
शेष १।१।१ से गुणने से $१२\times१\times१\times१=१२$ इससे $\frac{१}{२}+\frac{३}{६}+\frac{१}{१२}+\frac{१}{४}$ इन के हर अग को गुणने से $\frac{१}{२}\times\frac{१२}{१२}+\frac{१}{६}\times\frac{१२}{१२}+\frac{१}{१२}\times\frac{१२}{१२}+\frac{१}{४}\times\frac{१२}{१२}=\frac{६}{१२}+\frac{२}{१२}+\frac{१}{१२}+\frac{३}{१२}$ $=\frac{१२}{१२}=१=$योगफल हुआ ॥ ८ ॥

उपपत्ति ।

'रूपाणिच्छेदगुणान्यंशयुतानि द्वयोर्बहूनां वा । प्रत्युत्पन्नो भवति च्छेदवधेनोद्धृतो ऽशवधः' इस आचार्योक्त से अथवा 'योगोऽन्तर तुल्यहरांशकानां' इत्यादि भास्करोक्त मे उपपत्ति स्पष्ट है । 'लवा लवघ्नाश्च हरा हरघ्ना' इत्यादि वा 'अंशा हतिश्छेदवधेन भक्ता' इत्यादि भास्करोक्त से द्वितीय प्रभागजाति की उपपत्ति स्पष्ट है । सिद्धान्त शेखर में 'प्रभाग जातौ तु सवर्णनाय छिदां लवानां च समाहतिः स्यात्' यह श्रीपति की उक्ति भी इसी के अनुरूप है इति ॥ ८ ॥

प्रभाग जातावुदाहरणम् ।

रत्नार्धस्य चतुर्लवोऽस्य चरणस्तस्यापि पञ्चांशक
स्तत्त्वांशोऽस्य महीभृता गुणवता सत्पण्डितायार्पितः ।
बाले कोमलवाग्विलास कुशले भाग प्रभागभिधां
जाति वेत्सि यदा तदा वद मिति तद्रत्न दानस्य माम् ॥

न्यासः $\frac{1}{1}|\frac{1}{2}|\frac{1}{4}|\frac{1}{4}|\frac{1}{5}|\frac{1}{25}$ लवा लवघ्नाश्चहरा हरघ्ना $\frac{१\times१\times१\times१\times१}{२\times४\times४\times५\times२५}$

$\frac{१}{२\times४\times४\times५\times२५}=\frac{१}{४०००}$, एवं दत्तानि रत्नानि=२५

प्रभाग जाति में उदाहरण ।

किसी राजा ने आधेरत्न के चतुर्थांश के पञ्चांश का पच्चीसवा अंश अच्छे पण्डित को दिया तब कितना रत्न दिया गया सो कहो ॥

न्यास $\frac{1}{1}|\frac{1}{2}|\frac{1}{4}|\frac{1}{4}|\frac{1}{5}|\frac{1}{25}$ लवालवघ्नाश्च हरा हरघ्ना इत्यादि से $\frac{१\times१\times१\times१\times१}{२\times४\times४\times५\times२५}$

$=\frac{१}{२\times४\times४\times५\times२५}=\frac{१}{४०००}$ इस तरह दिया हुआ रत्न प्रमाण=२५ हुआ ॥ ८ ॥

तृतीय जातौ सवर्णनमाह ।

ऊर्ध्वांशाश्छेदगुणास्तृतीयजातौ प्रथमपरयोः ।
छेदैश्छेदा गुणिताः स्वांश युतोनैरुपरिगांशाः ॥ ९ ॥

सु. भा.—ऊर्ध्वांशाश्छेदगुणाः कार्यास्तदा तृतीयजातौ सवर्णनं भवति । अत्र चतुर्वेदाचार्यः—

'ऊर्ध्वांशा उपरि स्थितांशाश्छेदगुणाः सन्तोऽधः स्थितस्य छेदांशा भवन्त्यधः स्थितच्छेदास्त्यज्यन्ते । एवं कृत्वा सदृशच्छेदविधानेन फलं कार्यम् । एतदुक्तं भवति । भाज्यराशिरूर्ध्वांशशब्देनोच्यते । अधःस्थराशिश्च स्वच्छेदसहितो भागहारस्तेनात्र जातं परिवर्त्त्य भागहारच्छेदांशौ इत्यादि । द्वयोः प्रथमपरयोरित्येतत् सूत्रखण्डकमुत्तरसूत्रसम्बद्धं भविष्यति ।'

उद्देशकः—

दिनार्धपादपंचांशैः कुल्याः याः पूरणं पृथक् ।
वाप्याः कुर्वन्ति ता मुक्ता युगपत् पूरणं कदा ॥

न्यसः । | $\frac{१}{१}$ | १ १ २ | १ १ ४ | १ १ ५ | ऊर्ध्वांशाश्छेदगुणा इतिकृते दर्शनम् ।'

$\frac{१}{१}$ । $\frac{२}{१}$ । $\frac{४}{१}$ । $\frac{५}{१}$ । रूपसञ्चयोऽयम् १२ । एतावन्ति दिवसप्रमाणानि भवन्ति सर्वकुल्याभिरतस्त्रैराशिकम् । यदि द्वादशभिः पूरणैर्दिनं भवति तदैकपूरणेन कियत् कालः । फलम् $\frac{१}{१२}$ । 'एवं भजेच्छिदोऽशैः' - इति भास्करोक्तमेतदनुरूपम् ।

अन्योद्देशकः—

दिनत्रिभागेन ददाति रूपं दलेन चान्यः प्रयतो द्विजेभ्यः ।
त्रिरूपदाता दिनपञ्चकेऽन्यः समं प्रवृत्ताः शतदाः कदा स्युः ॥

न्यासः । | १ १ ३ | १ १ २ | ३ ५ १ | उक्तवद्दिनानि १७$\frac{६}{७}$ ।

प्रथमद्वितीय तृतीयजातिभ्यो ये अन्ये परे जाती द्वे चतुर्थीपञ्चम्यौ तयोर्द्वयोः परयोः सवर्णनार्थमधःस्थच्छेदैरुपरिष्ठाश्छेदा गुणिताः । स्वांशयुतोनैस्तैरेव छेदैरुपरिगांशा गुणिताः । अंशानुबन्धे स्वांशयुतैर्भागापवाहे स्वांशहीनैश्छेदैरित्यर्थः । 'तलस्थहारेण हरं निहन्यात्' इति भास्करोक्तमेतदनुरूपमेव ।

अत्र चतुर्वेदोद्देशकः—

वणिजः शिशुरत्यल्पः पादमादाय रूपकात् ।
दिनानि सप्तलाभार्थं पण्यं चक्रे फलादिभिः ॥
स्वार्धत्रिपादभागैश्च पंचषट् सप्तमैर्युतम् ।
दिनं प्रतिदिनं तेन कृतं मूल्यं कियद्धनम् ॥
तद्वदन्योऽपि रूपेण रूपैः षड्भिस्तथा परः ।
तयोरपि धनं ब्रूहि यदि भागानुबन्धवित् ॥

न्यासः ।

$\frac{१}{४}$	$\frac{१}{१}$	$\frac{६}{१}$
$\frac{१}{२}$	$\frac{१}{२}$	$\frac{१}{२}$
$\frac{१}{३}$	$\frac{१}{३}$	$\frac{१}{३}$
$\frac{१}{४}$	$\frac{१}{४}$	$\frac{१}{४}$
$\frac{१}{५}$	$\frac{१}{५}$	$\frac{१}{५}$
$\frac{१}{६}$	$\frac{१}{६}$	$\frac{१}{६}$
$\frac{१}{७}$	$\frac{१}{७}$	$\frac{१}{७}$

उक्तवत् क्रमेण धनानि प्रथमस्य १ । द्वितीयस्य ४ । तृतीयस्य ५४ ।

भागापवाहे चापि चतुर्वेदोद्देशकः ।

अष्टौ पलानि वणिजा सितचन्दनस्य
नीतानि चोत्तरगिरिं किल कान्यकुब्जात् ।

दानं च दत्तमपि पंचसु तेन मान-
स्यार्धत्रिपचनवमाष्टसम तदा किम् ॥

न्यासः । $\frac{५}{१}$ $\frac{१}{२}$ $\frac{१}{६}$ $\frac{१}{५}$ $\frac{१}{९}$ $\frac{१}{८}$ — उक्तवत् करणेन जातम् १$\frac{५६}{१३५}$ । अत्र कोलब्रूकसाहिवेन भ्रमात् $\frac{११२}{१३५}$ इत्युत्तरं वास्तव लिखितम् ।
(See his translation P. 283.)
अत्र चतुर्वेदाचार्यः स्वटीकायाम् ।
एवमिहाचार्येण पंचजातय एवोक्ता । यतः षष्ठीति तदात्मिकैवातो गतार्थेति कृत्वा नोक्ता । स्कन्दसेनादिभिस्तस्या नाम कृत भागमातेति' ।

भागमात्रर्थ द्रष्टव्या (मच्छोधिता त्रिशतिका पृ० १२)

वि. भा.—ऊर्ध्वांशा हरगुणितास्तदा तृतीयजातौ सवर्णनं भवति । छेदैः (हरैः) छेदाः (हराः) गुणिताः स्वांशयुतोनैरुपरिस्था अंशा गुणनीयास्तदांऽशांनुबन्धेऽपवाहे च सवर्णनं भवतीति ॥ ९ ॥

उदाहरणम् ।

दिनार्धपादपंचांशैः कुल्या याः पूरणं पृथक् ।
वाप्याः कुर्वन्ति ता मुक्ता युगपत् पूरणं कदा ॥

वि. भा.—याः कुल्याः (निर्झराः) पृथक्-पृथक् दिन-दिनार्ध-दिन-चतुर्थांश-दिनपंचांशैः वाप्याः पूरणं कुर्वन्ति (संपूरयन्तीत्यर्थः) यदि ता युगपत् (एक कालावच्छेदेन) मुक्ता भवेयुस्तदा कदा(कियत्कालेन) वापी सम्पूरयन्तीति ॥

न्यासः $\frac{१}{१}$ | $\frac{१}{१}$ $\frac{}{२}$ | $\frac{१}{१}$ $\frac{}{४}$ | $\frac{१}{१}$ $\frac{}{५}$ ऊर्ध्वांशाश्छेदगुणा अनेन $\frac{१}{१}$, $\frac{२}{१}$, $\frac{४}{१}$ $\frac{५}{१}$ एषां योगः $=\frac{१२}{१}$ सर्वकुल्याभिरेतावन्ति पूरणदिनप्रमाणानि भवन्ति, ततोऽनुपातो यदि $\frac{१२}{१}$ एभिरेकं दिनं लभ्यते तदैकपूरणेन किं जातं पूरण-काल-प्रमाणम् $=\frac{१}{१२}$ ॥ ९ ॥

उपपत्तिः

एका कुल्या यद्येकेन दिनेनैकां वापीं संपूरयति तदैकेन दिनेन किमिति जातमेक दिन सम्बन्धि पूरण कालः $=\frac{१}{१}$, एवं यदि द्वितीया कुल्या दिनार्धेन तां वापीं संपूरयन्ति तदैकेन दिनेन किमिति जातमेक दिन सम्बन्धितत्पूरणकाल. $=\frac{२}{१}$, एवमेव यदि तृतीया कुल्या दिनचतुर्थांशे तां वापीं संपूरयति तदैकेन दिनेन किमिति जातमेकदिनसम्बन्धितत्पूरण कालः $=\frac{४}{१}$, एवमवशिष्टस्या $\frac{१}{५}$ ऽस्यैक

दिन सम्वन्धिपूरणकालः$=\frac{५}{१}$ सर्वेषां योगः$=\frac{१२}{१}$, ततोऽनुपातेनैक कालावच्छेदेन मुक्तसर्वकुल्याभिर्वापीसंपूरणकालः$=\frac{१}{१२}$, एतावताऽऽचार्योक्तमुपपन्नम् । लीलावत्यां भास्करोक्त 'भजेच्छिदोंशैरथतै र्विमिश्रै'रित्यादि, मिदमाचार्योक्तानु-रुपमेव ॥ ९ ॥

तृतीय जाति में सवर्णन को कहते हैं ।

हि. भा.—ऊर्ध्वस्थित अंश को अंश से गुणने से तृतीय जाति में सवर्णन होता है। हर से हर को गुण देना और अपने अंश करके युत-ऊन हर से उपस्थित अंश को गुण देना तब अंशानुबन्ध और अंशापवाह में सवर्णन होता है। इसका सम्बन्ध आगे से है ॥ ९ ॥

उदाहरण

एक निर्झर एक दिन में एक वापी (पोखड़ा) को भरता है, द्वितीय निर्झर उसी वापी को एक दिन के आधा समय में भरता है, तृतोय निर्झर उसी वापी को एक दिन के चतुर्थांश समय मे भरता है, चतुर्थ निर्झर उसी वापी को एकदिन के पञ्चमांश समय में भरता है, यदि एक ही समय मे सब निर्झरों को खोल दिया जाय तव वे कितने समय में उस वापी को भरेगे ?

न्यास $\frac{१}{१} \Big| \begin{matrix}१\\१\\२\end{matrix} \Big| \begin{matrix}१\\१\\४\end{matrix} \Big| \begin{matrix}१\\१\\५\end{matrix}$ 'ऊर्ध्वाशाश्च्छेदगुणा' इस सूत्र के अनुसार $\frac{१}{१}$, $\frac{२}{१}$, $\frac{४}{१}$, $\frac{५}{१}$ इन सबों का योग करने से $\frac{१२}{१}$=सब निर्झरों से इतने पूरण दिन प्रमाण हुए। अब अनुपात करते हैं यदि $\frac{१२}{१}$ इसमें एक दिन पाते है तो एक पूरण में क्या इस अनुपात से पूरणकालप्रमाण $\frac{१}{१२}$ हुआ ॥ ९ ॥

उपपत्ति ।

एक निर्झर एक दिन में एक वापी को भरता है, द्वितीय निर्झर दिनार्ध में भरता है तो एक दिन में क्या इस अनुपात से एक दिन सम्बन्धी पूरण काल$=\frac{२}{१}$, यदि तृतीय निर्झर एक दिन के चतुर्थांश समय में उसी वापी को भरता है तो एक दिन में क्या इस अनुपात से एक दिन सम्बन्धी पूरण काल$=\frac{४}{१}$, यदि चतुर्थ निर्झर एक दिन के पञ्चमांश में उसी वापी को भरता है तो एक दिन में क्या इससे एक दिन सम्बन्धी उसका पूरण काल$=\frac{५}{१}$ सबों का योग$=\frac{१२}{१}$ तब अनुपात करते हैं यदि $\frac{१२}{१}$ इसमें एक दिन पाते हैं तब एक पूरण में क्या इस अनुपात से एकही समय में खोले गये सब निर्झरों से वापी संपूरण काल$=\frac{१}{१२}$ । इससे आचार्योक्त सूत्र उपपन्न होता है। लीलावती में 'भजेच्छिदोंशैरथ तैर्विमिश्रै.' इत्यादि, भास्करोक्त सूत्र आचार्योक्त सूत्र के अनुरूप ही है ॥ ९ ॥

अथ छेदैश्छेदा गुणिता इत्यादे र्व्याख्या—

प्रथम द्वितीय तृतीय जातिभ्यो ये अन्ये परे द्वे जाती चतुर्थीपञ्चम्यौ तयोः स्वर्णनार्थमधः स्थच्छेदैः (हरैः) उपरिस्थिता हरा गुणनीयाः स्वांशयुतोनैस्तैरेव हरैरुपरिस्था अंशा गुणनीयाः, अंशानुबन्धे स्वांशयुतैर्हरैरंशापवाहे स्वांशहीनै र्हरैरुपरिस्था अंशा गुणनीया इत्यर्थः। लीलावत्यां 'तलस्थहारेण हर निहन्यात्स्वांशाधिकोनेन तु तेन भागान्' भास्करोक्तमिदमाचार्योक्तानुरूपमेव।

उदाहरणं चतुर्वेदाचार्योक्तम्।

वणिजः शिशुरत्यल्पः पादमादाय रूपकात्।
दिनानि सप्त लाभार्थं पण्यं चक्रे फलादिभिः॥

स्वार्धं त्रिपादभागैश्च पञ्चषट्सप्तमैर्युतम्।
दिनं प्रतिदिनं तेन कृतं मूल्य कियद्धनम्॥

तद्वदन्योऽपि रूपेण रूपैः षड्भिस्तथा परः।
तयोरपि धनं ब्रूहि यदि भागानुबन्धवित्॥

श्लोकानुसारेण न्यासः $\frac{१}{४}$ तलस्थ हारेणमरं निहन्या
$\frac{१}{२}$ दित्यादिना क्रिया करणेन
$\frac{१}{३}$ $\frac{८\times७\times६\times५\times४\times३}{४\times७\times६\times५\times४\times३\times२}=\frac{१}{१}=१=$प्रथमस्यधनम्।
$\frac{१}{४}$ द्वितीयार्थन्यासः $\frac{१}{१}$
$\frac{१}{५}$ $\frac{१}{२}$ तलस्थ हारेण हरं निहन्यादित्यादिना
$\frac{१}{६}$ $\frac{१}{३}$ $\frac{८}{७}\times\frac{७}{६}\times\frac{६}{५}\times\frac{५}{४}\times\frac{४}{३}\times\frac{३}{२}=\frac{८}{२}=४=$
$\frac{१}{७}$ $\frac{१}{४}$ द्वितीयस्य धनम्=४।
$\frac{१}{५}$ तृतीयार्थ न्यासः।
$\frac{१}{६}$ $\frac{६}{१}$
$\frac{१}{७}$ $\frac{१}{२}$
$\frac{१}{३}$
$\frac{१}{४}$
$\frac{१}{५}$
$\frac{१}{६}$
$\frac{१}{७}$ तलस्थ हारेण हरं निहन्यादि-

त्यादिना $\frac{६\times८}{७}\times७\times\frac{६}{५}\times\frac{५}{४}\times\frac{४}{३}\times\frac{३}{२}=\frac{६\times८}{२}=३\times८=२४=$तृतीयस्यधनम्।

अब अंशानुबन्धु और अशापाह के लिए कहते हैं।

प्रथम-द्वितीय-तृतीय जातियो से परे जो दो 'चतुर्थी और पञ्चमी' जातियां हैं उनके सवर्णन लिए अधः स्थित हरो से उपस्थित हरो को गुणा देना, अपने अंश करके युत-ऊन उन्हीं से उपरिस्थ अंशो को गुणा देना अर्थात् अशानुबन्ध में अपने अश करके युत हरों से अंशापवाह मे अपने अंश करके हीन हरो से उपरिस्थ अंशो को गुणा देना। लीलावती में 'तलस्थ हारेण हर निहन्यात्' इत्यादि भास्करोक्त सूत्र आचार्योक्तानुरूप ही है।

यहां चतुर्वेदाचार्योक्त उदाहरण यह है।

किसी बनिये के छोटे लड़के ने अपने धन के चतुर्थांश को लेकर लाभ के लिए सात दिनों तक बाजार किया, प्रत्येक दिन तृतीयांश-चतुर्थांश-पञ्चमांश-षष्ठांश सप्तांशों से युत धन के आधे भाग को व्यापार में लगाया तब उसका धन प्रमाण कितना है सो कहो। एवं दूसरा लड़का एक रूप से तीसरा लडका छः रूप से उसी तरह से बाजार गया तब उन दोनो के धन प्रमाण कितने कितने है सो कहो।

उदाहरण के अनुसार न्यास करने से—

$\frac{१}{४}$ तलस्थ हारेण हरं निहन्यादित्यादि से

$\frac{१}{२}$ $\frac{८\times७\times६\times५\times४\times३}{४\times७\times६\times५\times४\times३\times२}$

$\frac{१}{३}$

$\frac{१}{४}$ $=\frac{८}{८}=१=$ प्रथम का धन

$\frac{१}{५}$

$\frac{१}{६}$

$\frac{१}{७}$

द्वितीय के लिए न्यास

$\frac{१}{१}$ तलस्थ हारेण हर निहन्यादि त्यादि से

$\frac{१}{२}$ $\frac{८\times७\times६\times५\times४\times३}{७\times६\times५\times४\times३\times२}=\frac{८}{२}=४$

$\frac{१}{३}$

$\frac{१}{४}$ =द्वितीय धन।

$\frac{१}{५}$

$\frac{१}{६}$

$\frac{१}{७}$

तृतीय के लिए न्यास

$\frac{६}{१}$ तलस्थ हारेण हरं निहन्यात् इत्यादि से

$\frac{१}{२}$ $\frac{६\times८}{७}\times\frac{७}{६}\times\frac{६}{५}\times\frac{५}{४}\times\frac{४}{३}\times\frac{३}{२}=\frac{६\times८}{२}=३\times८=२४=$ तृतीय धन।

$\frac{१}{३}$

$\frac{१}{४}$

$\frac{१}{५}$

$\frac{१}{६}$

$\frac{१}{७}$

भागापवाहेऽपि चतुर्वेदाचार्योक्तमुदाहरणम् ।

अष्टौ पलानि वणिजा सित चन्दनस्य नीतानि चोत्तर गिरिं किल कान्यकुब्जात् ।
दानं च दत्तमपि पंचसुतेन मानस्यार्धत्रिपंचनवमाष्टसमं तदा किम् ॥

वि. भा.—केनापि वणिजा सितचन्दनस्य (श्वेतचन्दस्य) अष्टौ पलानि कायकुब्ज-देशादुत्तरगिरिं नीतानि, तेन (वणिजा) पंचसु जनेषु धनस्यार्धं—तृतीयांशं, पंचांश, नवमांशं, अष्टमांशं दानं दत्त तदा तद्धन कियदिति ॥
उदाहरणोक्तया न्यासः

$\frac{8}{1}$ $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{5}$ $\frac{1}{9}$ $\frac{1}{8}$

अत्र तलस्थ हारेण हरा गुणनीयाः, स्वांश-हीनैर्हरैरंशा गुणनीयास्तदा

$$\frac{८\times७}{१\times८}\times\frac{८}{९}\times\frac{४}{५}\times\frac{२}{३}\times\frac{१}{२}$$

$$=\frac{८\times७\times४}{९\times५\times३}=\frac{२२४}{१३५}=१+\frac{८९}{१३५}$$

अत्र कोलब्रूक महाशयेन $\frac{११२}{१३५}$ इत्युत्तरं लिखितम् ।

(See his Translation p. 283)

अत्र चतुर्वेदाचार्यः स्वटीकायाम् 'एवमिहाचार्येण पंच जातय एवोक्ताः' यतः षष्ठीति तदात्मिकैवातो गतार्थेति कृत्वा नोक्ता। स्कन्द-सेनादिभिस्तस्या नाम भागमातेति कृतम् ।'

भागापवाह के लिये भी चतुर्वेदाचार्योक्त उदाहरण ।

कोई व्यापारी आठ पल श्वेत चन्दन कान्य कुब्ज देश से उत्तर गिरि में लाया, और पाच आदमियों को उसका आधा, तृतीयांश, पंचमांश, नवमांश, अष्टांश दान में दिया तब धन प्रमाण क्या है सो कहो ।

उदाहरण के अनुसार न्यास करने से

$\frac{8}{1}$ $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{5}$ $\frac{1}{9}$ $\frac{1}{8}$

यहां अधः स्थित हरों से हरों को गुणना चाहिये, अपने अंशों से हीन हरों से अंशों को गुणना चाहिये, वैसा करने से $\frac{८\times७}{१\times८}\times\frac{८}{९}\times\frac{४}{५}\times\frac{२}{३}\times\frac{१}{२}=\frac{८\times७\times४}{९\times५\times३}=\frac{२२४}{१३५}=१\frac{८९}{१३५}$ = धनमान

यहां कोलब्रूक साहेब ने $\frac{११२}{१३५}$ उत्तर लिखा है जो बिलकुल असङ्गत हैं इति ॥

शून्य परिकर्म सम्बन्धे विचारः ।

वि.भा.—आचार्येण शून्यपरिकर्म नोक्तं, सिद्धान्त शेखरे श्रीपतिनापि तदनुकरणमेव कृतम् । परं लीलावत्यां भास्कराचार्येण शून्य परिकर्मोक्तं यथा तदीयं सूत्रद्वयम्

योगे खं क्षेपसमं वर्गादौ खं खभाजितो राशिः ।
खहरः स्यात् खगुणः खं खगुणश्चिन्त्यश्च शेषविधौ ॥
शून्ये गुणके जाते खं हारश्चेत् पुनस्तदा राशिः ।
अविकृत एव ज्ञेयस्तथैव खेनोनितश्च युतः ॥

तदुदाहरणम् ।

'खं पञ्च युग्भवति किं वद खस्य वर्ग मूलं घनं घनपदं खगुणाश्च पञ्च । खेनोद्धृता दश चेत्यादि' न्यासः 'तदा सूत्रानुसारेण ० एतत् पञ्चयुतं $0+5=5$ । खस्य (शून्यस्य) वर्गः $=0\times0=0$, शून्यस्य मूलम् $=\sqrt{0}=0$ । शून्यस्य घनः $=0\times0\times0=(0)^3=0$, मूलम् $=\sqrt[3]{0}=0$, पञ्च शून्येन गुणिता जाताः $=5\times0=0$, दश शून्येन भक्ताः $=\frac{10}{0}=$ खहरः । शून्येन गुणितो भक्तश्च राशिरविकृतएवेति ।

अत्रोपपत्तिः ।

शून्यस्य मानाभावात्तत्र यत्किञ्चिद्योज्यते तत्सम (योजक) मेव योगफलं भवितुमर्हति, शून्यस्य वर्गघनादयोऽपि शून्यान्येव । शून्येन भक्तो राशिः खहरोऽनन्तसमः कथमेतदर्थं विचार्यते । यदि कोऽपि राशिः केनापि नाऽङ्केन भक्तो भवेत्तदा भाजकमानं यथायथाऽल्पं भवेत्तथा तथा लब्धिरधिका भवेदतो भाजकमान यदि शून्यमितं भवेत्तदा लब्धिः परमाधिकाऽनन्तसमा भवेत् सा लब्धिः कियती भवतीति कथितुं न शक्यतेऽतस्तन्नाम खहर इति । ऋणात्मकराशिः शून्यतोऽप्यल्पो भवति तेन कोऽपि राशिः शून्येन भक्तो लब्धिरनन्तसमा भवति, यदि स एव राशिः शून्याऽल्पेन-ऋणात्मकाङ्केन भक्तो भवेत्तदा लब्धिरनन्ततोऽप्यधिका भवेत् । यथा $0>-$य राशिः $=$ य^2, अयं शून्येन भक्तस्तदा $\frac{\text{य}^2}{0}$ लब्धिः $=$ अनन्ता यदि $\frac{\text{य}^2}{-\text{य}}=-$य $=$ लब्धि $>$ अनन्तादधिका । तेनैव हेतुना बीजगणिते स्वोपपत्तावृणात्मकराशेर्निम्नलिखित श्लोकेन प्रशंसा कृता सुधाकर द्विवेदिना ।

अत्यल्पमानमुपलभ्य सकृत्प्रकृत्या मानं महाधिकमनन्तमितेर्यदेति ।
मूलं च नो मिलति यस्य रसातलेऽपि तस्मै नमोऽच्युतकला महतेऽधनाय ॥

अत्र शून्यस्य वैचित्र्यं प्रदर्श्यते।

यदि य=र तदा य-र=०, तथा $य^2$--$र^2$=० वर्गान्तरस्य योगान्तरघात समत्वात् (य--र) (य+र)=०=० (य+र) अतः $\frac{0}{0}$=य+र, परं य+र इति तु शून्ये समं नास्त्यतः सिद्धं यद $\frac{0}{0}$ त्र शून्यद्वयं समं नास्ति कथमन्यथे $\frac{0}{0}$= य+र तिलब्धिर्भवेत्। अथवा दृश्यताम् ६--६=०, ३--३ =०∴ $\frac{६—६}{३—३}$ =$\frac{0}{0}$ $\frac{६ (१—१)}{३(१—१)}$ =$\frac{6}{3}$एतेन प्रत्यक्षमेव दृश्यते यद $\frac{0}{0}$ त्यं फलं $\frac{6}{3}$भवत्यतः सर्वाणि शून्यमानानि समानानि नेति सिद्धम्। स्वप्रकाशित लीलावत्या केनापि 'शून्ये-गुणके जाते खंहारश्चेत्तदा राशिरविकृत एवे' त्यस्योपपत्तौ व्यक्तवासना लेखकोपरि यो ह्याक्षेपः कृतः स मह्यं न रोचते। यतोहि पूर्वशून्यानां न्यूनाधिकत्वं यन्मया-प्रदर्शितं तद्गणितवैचित्र्यमस्ति, वस्तुतः शून्यानां माना भावाद् व्यवहारे सर्वाणि शून्यमानानि समानान्येव मन्यन्तेऽतो भास्करोक्तं 'शून्ये गुणके जातमित्यादि' युक्तियुक्तमेव तदुपपत्तिलेखकस्य व्यक्तवासना रचयितुरपि कथन युक्ति सङ्गत-मिति ॥

अत्र प्रसङ्गाच्छून्यपरिकर्मसम्बन्धे गणितमंजर्यां गणेशदैवज्ञोक्तं सूत्रं लिख्यते

राशिः शून्ययुतोनितो ह्यविकृतः शून्याहृतः खं भवेत्
शून्याप्तः खहरोऽप्यसावविकृतः शून्यस्य वर्गो घनः।
शून्यं मूलमपीह शून्यकमथो राशिः खहारो यदा
भिन्नाङ्कैः सहितोऽथवा विरहितो गच्छेद्विकारं तदा ॥

उदाहरणमपि।

चत्वारो वियता युता विरहिताः शून्येन संताड़िताः शून्याप्ताः कति शून्यतः कृतिघनौ मूलं च किं जायते। सार्धैः पञ्चभिरन्वितो विरहितो राशिः खभक्तः कियांस्तन्मे ब्रूहि कलाकलापकुशले वाले विलोलेक्षणे॥ यथा ४, अत्र शून्य योजनेन ४+०=४। शून्य वियोजनेन ४--०=४। शून्येन गुणनेन ४×०=० शून्यस्य वर्गः=०×०=$(०)^2$, मूलम् =$\sqrt{०}$=०, शून्यघन=०×०×०=$(०)^3$ =०। घनमूलम्=$\sqrt[3]{०}$=०। शून्येन भक्ता ४ एते $\frac{४}{०}$=खहरः=अनन्तः।

$\frac{४}{०}$ अत्र सार्धं पंच योजने $\frac{४}{०}$+$\frac{११}{२}$ समच्छेदेन योगेन $\frac{८}{०}$ तथा $\frac{४}{०}$--$\frac{११}{२}$ =$\frac{८}{०}$ एतेन खहर राशौ विकारो जायत इति।

"अस्मिन् विकारः खहरे न राशौ यद्भास्करीये गणिते प्रणीतम्। व्यक्ता स्त्यनैकान्तिकता हि तस्य भिन्नाङ्कयोगे यदि वा वियोगे॥ विष्णुपदाभ्यसनात्

प्रतिपन्नोऽनन्तमयत्वमतोऽपि पुनस्तत् । प्रापयितुं विकृतिहर-संज्ञो नैव कदापि भवेत् सुसमर्थः" अनेन भास्करोक्तं खण्डयते ॥

पाटीसारे मुनीश्वरेण

ननु यो येन भक्तोऽसौ तद्धरः स्यादतो न सत् ।
खभक्त इति पृच्छाया उत्तरं खहरात्मकम् ॥
तस्मात् खभक्त राशेः किं फलं प्रश्नार्थं गोचरम् ।
अस्योत्तरं खहारोऽयमनन्त फल उच्यते ॥

भाज्याद्धरापचयकेन फलस्य वृद्धिरस्मात्परापचित खात्महरेण भक्तात् । लब्धेः परोपचय एतदनन्तसंख्यामारोहतीति नियते परता न चास्ति ॥ श्रीभास्कराचार्येण कृतेऽत्रबीजे खहारराशौ परमेशसाम्यम् । उक्तं यतोऽङ्केन वियोजितोऽयं सयोजितश्चाविकृतोऽस्ति नित्यम् ॥ अस्मिन् विकारः खहरेऽस्ति राशौ भिन्नाङ्क योगेत्वथ भिन्नहीने । योगोऽन्तर तुल्यहरत्वपूर्व कार्यं ततः केचिदिदं वदन्ति ॥ तन्नैव युक्तं गुणकेन जातो विकारको नैव युतेर्वियोगात् । यतः समच्छेदतया वियोगयोगाङ्गता तद्गुणनस्य सिद्धा ॥ विकारेऽपि नानन्त लब्धेर्विकारो यतस्तुल्यलब्धं द्वयोर्नाधिकोनम् । यतश्चोदयेऽनेकराशित्रयज्यावशा-च्छून्यहार प्रभेदेऽपि भैक्यम्[1] । एवं पितृव्याः प्रवदन्ति बीजनवाङ्कुरे ते खहराः समानाः । फलेन सिद्धान्तजवासनाभिर्युक्ता यतस्तत्खलु युक्तियुक्तम् ॥" एभिः श्लोकैः खहरराशौ गणेशादिभिर्यो हि विकारः प्रदर्शितस्तत्खण्डनं युक्तियुक्तं जातम् । वस्तुतः खहर राशौ कस्याश्चित् संख्याया योजनेन वियोजनेन वा तस्य खहरत्वे (अनन्तत्वज्ञापके) न काचिद्धानिर्भवत्यतो गणेश दैवज्ञादिभिर्यद्भास्करोक्तस्य खण्डनं कृतं तन्न युक्ति युक्तमिति सुधियो विभावयन्त्विति ॥

अब शून्य परिकर्म सम्बन्ध में विचार करते है ।

हि. भा.— आचार्य ने शून्य परिकर्म नही कहा है । सिद्धान्त शेखर में श्रीपति ने भी उन्हीं का अनुकरण किया है । लेकिन लीलावती मे भास्कराचार्य ने शून्य परिकर्म कहा है जैसे कि उनके निम्न लिखित सूत्र है—

'योगे खं क्षेपसमं वर्गादौ खं खभाजितोराशिः' इत्यादि संस्कृत विज्ञान भाष्य मे लिखित श्लोकों को देखिये । इसका तात्पर्य है कि शून्य में जितना जोड़ा जाता है उतना (योजकाङ्क)ही रहता है, शून्यका वर्ग शून्य होता है शून्यका मूल, शून्यका घन, शून्यका घनमूल शून्य होता है । जिस राशिको शून्यसे भाग दिया जाता है वह खहर कहलाती है इसीको

(१) सूर्योदय काले शङ्कु $=$ ०, तेन दृग्ज्या $=$ त्रि $\therefore \frac{१२ \text{ त्रि}}{\text{शंकु}} = \frac{१२ \text{ त्रि}}{०} =$ छाया त्रिज्याया भिन्नत्वेऽपि सर्वत्रैव खहरत्वात् छायामानमनन्तं भवेदिति श्लोकतात्पर्यम् ।

अनन्त भी कहते है । किसी राशि को शून्य मे गुणा करने मे शून्य होता है । किसी राशिको शून्य से गुणा किया जाय और शून्य ही से भाग दिया जाय तो वह राशि प्रमाण ज्यों का त्यों रहता है । इसी तरह किसी राशि मे शून्य जोड़ा जाय और घटाया जाय तो वह राशि ज्यों का त्यों रहती है ॥

उदाहरण ।

शून्य में पांच जोड़ने से क्या होना है । शून्यका वर्ग, वर्गमूल, घन, घनमूल क्या होना है ? पांच को शून्य से गुणा करने मे क्या होता है, दश को शून्य मे भाग देने मे क्या होता है ?

न्यास ०, इसमें पांच जोड़ते है $0+5=5$। शून्य का वर्ग $=0\times 0=(0)^2=0$ शून्य का वर्गमूल $=\sqrt{0}=0$, शून्य का घन $=0\times 0\times 0=(0)^3=0$ । घनमूल $=\sqrt[3]{0}=0$, पाच को शून्य से गुणा करने से $5\times 0=0$, दश को शून्य मे भाग देने से $\frac{10}{0}$ =खहर=अनन्त, ॥

उपपत्ति ।

शून्य का कुछ मान नहीं है इसलिये उसमे जितना जोडा जायगा या घटाया जायगा उतना ही होगा । शून्य के वर्ग घनादि भी वर्गादि की परिभाषाओं मे शून्य ही होते है ; किसी राशि को शून्य से भाग देने से फल अनन्त के बराबर क्यों होता है इसके लिए विचार करते है । भाज्य सख्या स्थिर रहने से उसको ज्यों ज्यों छोटे हर से भाग देगे त्यो त्यो भागफल अधिक होगा, इसलिये हर का मान जब शून्य होगा तब लब्धि सर्वाधिक (अनन्त) होगी लेकिन वह लब्धि कितनी होगी नहीं कह सकते है इसलिए उसका नाम खहर रक्खा गया । ऋणात्मक राशि शून्य से भी छोटी है इसलिए जिस सख्या को शून्य मे भाग देने मे लब्धि अनन्त होती है, उसी संख्या को शून्य से अल्प ऋणात्मक राशि मे भाग देने से लब्धि अनन्त से भी अधिक होती है ।

जैसे $-0>-$य, राशि$=$य^2 इसको शून्यसे भाग देनेसे $\frac{\text{य}^2}{0}$ =लब्धि=अनन्त । यदि $\frac{\text{य}^2}{-\text{य}}=-$य $>$अनन्त से ज्यादा इसीलिए पण्डित सुधाकर द्विवेदी ने बीजगणित की अपनी उपपत्ति में ऋणात्मकराशि की प्रशंसा निम्न लिखित श्लोक से की है ।

'अत्यल्पमानमुपलभ्य सकृत्प्रकृत्या मानं' इत्यादि संस्कृतोपपत्ति लिखित श्लोक को देखिये ।

अब शून्य की कुछ विचित्रता दिखलाते हैं ।

यदि य$=$र तब य$^2-$र$^2=0$, वर्गान्तर योगान्तर घात के बराबर होता है इस

लिए (य—र) (य+र)=० परन्तु य—र=० ∴ (य—र) (य+र)=०×(य+र) =० ∴ य+र=$\frac{०}{०}$ परन्तु य+र यह शून्य के बराबर नही है इसलिए यहाँ सिद्ध हुआ कि दोनों शून्य बराबर नहीं है। अथवा देखिए ६—६=०, तथा ३—३=० ∴ $\frac{६-६}{३-३}$ $=\frac{०}{०}=\frac{६(१-१)}{३(१-१)}=\frac{६}{३}$ इससे प्रत्यक्ष देखने में आता है कि $\frac{०}{०}$ इसमें भाज्य के शून्य से हर के शून्य द्विगुणित है, अर्थात् इससे सिद्ध होता है कि प्रत्येक शून्य बराबर नहीं है।

लीलावती में 'शून्ये गुणके जाते खं हारश्चेत्' इत्यादि की उपपत्ति में किसी पण्डित ने व्यक्त वासना के लेखक के ऊपर आक्षेप किये हैं सो मुझे ठीक नहीं लगता है, क्योकि पहले शून्यो में न्यूनाधिकता जो दिखलायी गई है सो गणित का वैचित्र्य है, वस्तुत: शून्यों का कुछ मान नही होता है इसीलिए व्यवहार में सब शून्यों को बराबर ही माना जाता है, इसलिए 'शून्ये गुण के जातं' इत्यादि भास्करोक्त युक्ति युक्त ही है और व्यक्त वासना में उसकी उपपत्ति लेखक का कथन भी ठीक ही है।

यहाँ प्रसङ्ग से शून्य परिकर्म के सम्बन्ध में गणित मञ्जरी में गणेशोक्त विषयो को कहते है। 'राशिः शून्य युतोनितो ह्यविकृतः शून्याहतः खं भवेत्' इत्यादि सस्कृतोपपत्ति में लिखित श्लोक को देखिए। इसका तात्पर्य यह है कि किसी संख्या में शून्य को जोड़ने से या घटाने से वह संख्या ज्यों की त्यों रहती है, किसी संख्या को शून्य से गुणा करने से गुणनफल शून्य होता है, किसी सख्या को शून्य से भाग देने से वह खहर कहलाती है, उसमें किसी तरह का विकार नहीं होता है, शून्य का वर्ग, वर्गमूल, घन, घनमूल शून्य होता है, खहर राशि में भिन्नाङ्क को जोडने या घटाने से उसमें विकार होता है, इससे गणेश दैवज्ञ ने बीज गणित में 'अस्मिन् विकारः खहरे न राशौ, इत्यादि भास्कराचार्योक्त में दोष दिखलाया है।

उनका उदाहरण निम्नलिखित है।

'चत्वारो वियुता युता विरहिताः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक को देखिये। इसका अभिप्राय है कि चार ४ में शून्य को घटाने से या जोड़ने से क्या होताहै, चार को शून्य से गुणा करने से क्या होता है, चार को शून्य से भाग देने से क्या होता है, शून्य का वर्ग– घन—मूल क्या होता है, चार में साढे पाँच को जोड़ने या घटाने से क्या होता है, $\frac{४}{०}+५\frac{१}{२}=\frac{४}{०}+\frac{११}{२}$ समच्छेद से योग करने से $\frac{८}{०}$, एवं $\frac{४}{०}-\frac{११}{२}=\frac{८}{०}$ इससे खहर राशि में विकार होता है यह गणेश दैवज्ञ कहते हैं।

'अस्मिन् विकारः खहरे न राशौ यद्भास्करीये गणिते प्रणीतम्' इत्यादि संस्कृतोपपत्ति लिखित श्लोकों को देखिये, इन श्लोकों से 'अस्मिन् विकारः खहरे न राशौ' इत्यादि भास्करोक्त का खण्डन करते हैं। पाटीसार में 'ननु यो येन भक्तोऽसौ तद्धरः स्यादतो न सत्' इत्यादि संस्कृतोपपत्ति में लिखित श्लोकों से खहर राशि द्वारा गणेशादि से जो विकार दिखलाया गया

है उसका खण्डन मुनीश्वर ने किया है जो कि बहुत युक्ति युक्त है। वस्तुतः खहर राशि मे किसी संख्या को जोडने या घटाने से उस के खहरत्व में जो कि अनन्तत्व का ज्ञापक है किसी तरह का विकार नही होता है, इसलिए गणेशादि आचार्यों ने भास्करोक्त का जो खण्डन किया है सो निर्युक्तिक है इस विषय को विज्ञ लोग विचार कर देखें ॥

इदानीं त्रैराशिकादिषु सूत्राण्याह ।

त्रैराशिके प्रमाणं फलमिच्छाद्यन्तयोः सदृशराशी ।
इच्छाफलेन गुणिता प्रमाणभक्ता फलं भवति ॥ १० ॥
व्यस्तत्रैराशिकफलमिच्छाभक्तः प्रमाणफलघातः ।
त्रैराशिकादिषु फलं विषमेष्वेकादशान्तेषु ॥ ११ ॥
फलसंक्रमणमुभयतो बहुराशिवधोऽल्पवध हृतो ज्ञेयम् ।
सकलेष्वेवं भिन्नेषूभयतश्छेदसंक्रमणम् ॥ १२ ॥

सु. भा.—अत्र चतुर्वेदाचार्यः । 'अनदगुणसंविज्ञानोऽयं बहुव्रीहिस्त्रैराशिकोक्तत्वात् । तेनायमर्थः । त्रैराशिकमादौ येषां तानि त्रैराशिकादीनि । पंचराशिक सप्तराशिक-नवराशिकैकादशराशिकादीनीत्यर्थः । तेषु विषमेष्वेकादशान्तेषु न तु समेषु चतुर्थादिष्वित्यर्थः ।'

फलसङ्क्रमणमुभयतोऽन्योऽन्यपक्षनयनं फलयोरेवं भिन्नेषु राशिषु उभयतश्छेदसङ्क्रमणमर्थादन्योऽन्यपक्षनयनं छेदानामपि कार्यम् शेषं स्पष्टार्थम् । भास्करस्य त्रैराशिकादिसूत्राण्येतदनुरूपाण्येव ।

अत्र चतुर्वेदोक्तोद्देशकः ।

शतमष्टोत्तरं धेनोर्यो ददाति दिनैस्त्रिभिः ।
मासयुक्तेन सोऽब्देन कियतीर्गाः प्रयच्छति ॥

न्यासः । दि ३ । गावः १०८ । दि ३९० । उक्तवत् लब्धा गावः १००४० ।

अन्योद्देशकः ।

यः पिपीलो दिने याति स्वपंचोनं यवाष्टकम् ।
त्र्यहेण विनिवर्तेत विंशत्यंशं तथाऽङ्गुलम् ॥
आभ्यां गतिनिवृत्तिभ्यां यस्य यातं प्रकल्पितम् ।
योजनानां शतं पूर्णं केन कालेन स व्रजेत् ॥

अत्र चतुर्वेदोक्ता परिभाषा 'अष्टभिर्यवोदरैरङ्गुलं चतुर्विंशत्यङ्गुलैर्हस्तः । चतुर्हस्तं धनुः । अष्टौ धनुःसहस्राणि योजनम् ।' अत्रैकदिनगतिर्यवात्मिका

$=\frac{३२}{५}$ । एकदिननिवृत्तिरङ्गुलात्मिका = $\frac{१}{६०}$ । दिनगतिरङ्गुलात्मिका = $\frac{४}{५}$ अनयोरन्तरेण $\frac{४७}{६०}$ योजनाङ्गुलानि = १ । ८००० × ४ × २४ भक्तानि लब्धानि दिनानि $\frac{८०० \times ४ \times २४ \times ६०}{४७}$ = ९८०४२५५३ $\frac{६}{४७}$ ।

व्यस्तत्रैराशिक उद्देशकः ।

षट्सौवर्णिकया भारस्तुलया सम्मितः पुराः ।
पंचसौवर्णिकायास्तु तया किं स्याद्वद स्फुटम् ॥

न्यासः । सु० ६ । भा० १ । सु० ५ । उक्तवत्फलम् = (भा. १ पलानि ४०० ।) अत्र चतुर्वेदोक्तेयं परिभाषा। 'षोडशभिर्यवैर्माषकस्तैः षोडशभिः सुवर्णं तैश्चतुर्भिः पलं पलसहस्रद्वयेन भार इति ।'

अन्योद्देशकः

सार्धत्रिकेण याः खार्यः प्रस्थानां दश सम्मिताः ।
सार्धपंचकमानेन कियत्यस्ता वदाशु मे ॥

न्यासः । $\frac{७}{२}$ । १० । $\frac{११}{२}$ । उक्तवत्फलम् = (द्रो० १ आ० ३ । खा० ६ । मा० १ । प्र० १ । कु० $\frac{४}{११}$ ।) अत्र चतुर्वेदोक्तेयं परिभाषा—

चतुर्भिः कुडवैः प्रस्थस्तैश्चतुर्भिरथाढकम् ।
आढकानां चतुष्केण द्रोणः ख्यातः पुरातनैः ॥

माणिका तैश्चतुर्भिः स्यान्माणिकानां चतुष्टयम् ।
खार्याः प्रमाणमेतत् स्यान्मागधानां प्रसिद्धतः ॥

पंचराशिकादौ चतुर्वेदोक्तोदाहरणानि ।
शतस्य दशका वृद्धिस्त्रिभिर्मासैर्निरूपिता ॥ १०-११-१२ ॥

पंचमासप्रयुक्तायाः षष्टेर्लाभो निगद्यताम् ॥ उक्तवल्लब्धम् १० ।
मासेन सत्रिभागेन सार्धायास्त्रिशतेः फलम् ।
अध्यर्धं यदि वर्षेण सार्धषष्टेरिहोच्यताम् ॥ उक्तवल्लब्धम् २६ $\frac{६५}{९२२}$ ।

शतस्य दशभिर्मासैश्चत्वारिंशत् फलं यदि ।
मसाष्टके शतं लब्धं कस्येयं वृद्धिरुच्यताम् ॥ उक्तल्लब्धम् ६२५ मू. ध. ।

द्विपंचकानि वासांसि त्रीणि षड्भिः पणैर्यदि ।
त्रिषट्काणि गृहीतानि दशमूल्यं वद स्फुटम् ॥ उक्तवन्मूल्यम् ३६१ ।

द्विपंचकानि वासांसि त्रीणि षड्भिः पणैर्यदि ।
षट्कृत्या कति वासांसि त्रिषट्काणि वदाशु मे ॥

आयामौत्सेधविस्तारैः षोडशाष्टौ तथा दश ।
यासां मूल्यं शतं तासां दीनाराः षट् प्रकीर्तिताः ॥
इष्टकानां तथा ऽन्यासामायामाद्यैः पदोनकैः ।
लक्षं गृहीतमस्माभिर्यद्देयं तद्वद स्फुटम् ॥ उक्तवद्दीनारा २५३१$\frac{1}{3}$ ।
हस्तिनौ दश दैर्ध्येण विस्तारेण तथा नव ।
परिणाहेन षट्त्रिंशद्ययोरौच्च्येन सप्तकम् ॥
तौ चेद्द्रोणाशिनौ स्यातां तदन्ये दश हस्तिनः ।
दीर्घाद्यैः पादसंयुक्तैस्तेषां भोगो निगद्यताम् ॥ उक्तवत्फलं द्रो १२ । प्र ३
कु १$\frac{3}{4}$ ।

वि. भा.—त्रैराशिके गणिते प्रमाणं फलमिच्छा चेति त्रयोऽवयवा भवन्ति तेषु प्रथमान्तौ (प्रमाणमिच्छा च) समानराशी अर्थादेकजातिकौ भवतः । फल च भिन्नजातिकं भवति । इच्छाफलेन गुणिता प्रमाणभक्ता तदा फलं भवति ॥ प्रमाणफलयोर्घात इच्छाभक्तस्तदा व्यस्तत्रैराशिके फलं भवति । त्रैराशिकादिषु त्रैराशिकमादौ येषां तानि त्रैराशिकादीनि (पंचराशिक-सप्तराशिक नवराशिकैका-दशराशिकानि) तेषु विषमेष्वेकादशान्तेषु-उभयतः फलसंक्रमणमर्थात्फलयोरन्योन्य-पक्षनयनमेवं सर्वेषु भिन्नेषु राशिषु-उभयतश्छेदसंक्रमणमर्थात् छेदानामप्यन्योन्य-पक्षनयनं कार्यम् । ततो बहुराशिघातोऽल्पराशिघातभक्तस्तदाफलं भवतीति ॥ लीलावत्यां प्रमाणमिच्छा च समानजाती आद्यन्तयोस्तत्फलमन्यजातिः । मध्ये तदिच्छाहतमाद्यहृत्स्यादिच्छाफलं व्यस्तविधिर्विलोमे । इच्छावृद्धौ फले ह्रासो ह्रासे वृद्धिश्च जायते । व्यस्तं त्रैराशिकं तत्र ज्ञेयं गणितकोविदैः ॥ पंचसप्तनवराशिकादिषु अन्योन्यपक्षनयनं फलच्छिदाम् । संविधाय बहुराशिजे वधे स्वल्पराशिवधभाजिते फलमिति सर्वमाचार्योक्तसदृशमेव । परमाचार्येण व्यस्तत्रैराशिकलक्षणं न कथितं भास्करेण तल्लक्षणं कथितम् ॥ १०-११-१२॥

अत्र त्रैराशिकार्थं चतुर्वेदोक्तमुदाहरणम् ।

शतमष्टोत्तरं धेनोर्यो ददाति दिनैस्त्रिभिः ।
मासयुक्तेन सोऽब्देन कियतोर्गाः प्रयच्छति ॥

अत्र प्रमाणम्=३ दिनानि, फलम्=१०८ गावः । इच्छा=१ वर्ष+१ मास=३६० दिन+३० दि=३९० दिनानि ।

अत्राऽनुपातो यदि कोऽपि त्रिभिर्दिनैः १०८ गावः प्रयच्छति तदा ३९० दिनैः

कियतीर्गा ददाति $\frac{१०८ \times ३९०}{३}$ =१४०४०=इच्छाफलम् । अत्र प्रमाणमिच्छा च समानजाती, फलं १०८ भिन्नजातिकमिति स्पष्टमेव दृश्यते ।

अन्यदुदाहरणम् ।

यः पिपीलो दिने याति स्वपञ्चोनं यवाष्टकम् ।
त्र्यहेण विनिवर्त्तेत विंशत्यंशं तथाऽङ्गुलम् ॥
आभ्यां गतिनिवृत्तिभ्यां यस्य यातं प्रकल्पितम् ।
योजनानां शतं पूर्णं केन कालेन सो व्रजेत् ॥

अत्र चतुर्वेदोक्त परिभाषा 'अष्टभिर्यवोदरैरङ्गुलं, चतुर्विंशत्यङ्गुलैर्हस्तः । चतुर्हस्तं धनुः । अष्टौ धनुःसहस्राणि योजनम् । सर्वमेतत् 'यवोदरैरङ्गुलमष्टसंख्यैर्हस्तोऽङ्गुलैः षड्गुणितैश्चतुर्भिः । हस्तैश्चतुर्भिर्भवतीह दण्डः क्रोशः सहस्रद्वितयेनतेषाम्, भास्करोक्त परिभाषानुरूपमेव । अत्र धनुः=दण्डः । यवात्मिकैक दिन गतिः $=८-\frac{८}{५}=\frac{४०-८}{५}=\frac{३२}{५}$, तथैकदिन निवृत्तिरंगुलात्मिका $=\frac{\text{त्रिदिननिवृत्तिमान}}{३}$ $=\frac{१ \text{ अङ्गुल}}{२० \times ३}=\frac{१}{६०}$, दिनगतिरंगुलात्मिका $=\frac{\text{यवात्मिकैक दिनगति}}{८}=\frac{३२}{५ \times ८}=\frac{४}{५}$

अनयोरन्तरेण $\frac{४}{५}-\frac{१}{६०}=\frac{४७}{६०}$ योजनांगुलानि $१ \times ८००० \times ४ \times २४$ भक्तानि

$$\frac{८००० \times ४ \times २४}{\frac{४७}{६०}} = \frac{८००० \times ४ \times २४ \times ६०}{४७} = \frac{३२००० \times २४ \times ६०}{४७} =$$

$$\frac{१९२०००० \times २४}{४७}=\frac{४६०८००००}{४७}=९८०४२५\frac{२५}{४७}=\text{दिनानि इति ॥}$$

अब त्रैराशिकादियों के लिये कहते हैं ।

हि. भा.—त्रैराशिक में प्रमाण और इच्छा एक जातिक होती है, दोनों के बीच फल भिन्न जातिक होता है फल को इच्छा से गुण कर प्रमाण से भाग देने से इच्छा सम्बन्धी फल होता है ॥ १० ॥

प्रमाण और फलके घात को इच्छा से भाग देने से व्यस्तत्रैराशिक में फल होता है । पंचराशिक-सप्तराशिक नवराशिक एकादश राशियों में फल और हर को परस्पर पक्षनयन अर्थात् एक पक्ष के फल और हर को दूसरे पक्ष में ले जाना तथा दूसरे पक्ष के फल और हर को एक पक्ष में लाना, तब बहुराशि घात को अल्पराशिघात से भाग देने से फल होता है । लीलावती

में 'प्रमाणमिच्छा च समान जाती आद्यन्तयोस्तत्फलमन्यजाति । मध्येनदिच्छाहतमाद्य हृत्' इत्यादि संस्कृत विज्ञान भाष्य में लिखित श्लोक, आचार्योक्त के सदृश ही है, लेकिन आचार्य ने व्यस्त त्रैराशिक के लक्षण नहीं कहे हैं। इसका लक्षण भास्कराचार्य ने कहा है इति ॥ १०-११-१२ ॥

त्रैराशिक के लिये चतुर्वेदाचार्योक्त उदाहरण।

हि. भा.—कोई आदमी तीन दिन में एक सौ आठ गौ दान करता है तो तीन सौ नव्वे ३९० दिनों में कितनी गौ दान करेगा।

यहां ३ दिन=प्रमाण है, १०८=फल है, ३९० दिन=इच्छा है=१ वर्ष+१ मास यहां प्रमाण और इच्छा एक जाति के (दिनात्मक) है, और फल भिन्न जाति 'गौ' का है, तब प्रमाण और फल के घात को इच्छा से भाग देने से $\frac{१०८ \times ३९०}{३}$ = १४० ४०= इच्छाफल हुआ ॥

दूसरा उदाहरण।

जो पिपीलिका (पिल्लू) एक दिन में अपने पञ्चांश घटा कर आठ जौ जाती है, वह तीन दिनों मे एक अंगुल के बीसवे भाग में लौटती है। इस जाने और लौटने के क्रम से कितने समय में सौ योजन जायगी ?

चतुर्वेदोक्त परिभाषा यह है ८ यवोदर=१ अङ्गुल, २४ अगुल=१ हाथ, ४ हाथ =१ धनुष, ८००० धनुष=१ योजन, 'यवोदरैरगुलमष्टसंख्यैः' इत्यादि लीलावती में भास्करोक्त के अनुसार ही चतुर्वेदोक्त परिभाषा है। यवात्मक एक दिनगति=$८ - \frac{८}{५} = \frac{३२}{५}$

एक दिन सम्बन्धी अंगुलात्मक निवृत्ति=$\frac{\text{तीन दिनों के निवृत्तिमान}}{३} = \frac{१ \text{ अंगुल}}{२० \times ३} = \frac{१}{६०}$

अगुलात्मक दिनगति $= \frac{\text{यवात्मक एकदिनगति}}{८} = \frac{३२}{५ \times ८} = \frac{४}{५}$, इन दोनों के अन्तर

$\frac{४}{५} - \frac{१}{६०} = \frac{४७}{६०}$ से योजनांगुल (१×८०००×४×२४) को भाग देने से $\frac{८००० \times ४ \times २४}{\frac{४७}{६०}}$

$= \frac{८००० \times ४ \times २४ \times ६०}{४७} = \frac{३२००० \times २४ \times ६०}{४७} = \frac{१९२०००० \times २४}{४७}$

$= \frac{४६०८००००}{४७} = ९८०४२५\frac{३५}{४७}$ दिन, यही उत्तर हुआ ॥१०॥

व्यस्तत्रैराशिकसम्बन्धे कथ्यते ।

यत्रेच्छाया वृद्धिः फले ह्रासो वेच्छाया ह्रासे फलस्य वृद्धिर्भवेत्तत्र व्यसत्रै-राशिकं बोध्यम् ॥

उदाहरणम् ।

षट्सौवर्णिका या भारस्तुलया संमित पुरा ।
पंचसौवर्णिकायास्तु तया किं स्याद्वद स्फुटम् ॥

वि. भा.—यदि षट् सौवर्णिकाया भारस्तुलया तुल्यस्तदा पंचसौवर्णिकाया किं जातं तत्सम्बन्धि फलम् $=\frac{1\times 5}{6}$ अत्रेच्छाया ह्रासः फलवृद्धिश्च दृश्यते तेन प्रमाणफलयोर्घात इच्छाभक्त स्तदा व्यस्तत्रैराशिके फलम् $=\frac{1\times 6}{5}=\frac{6}{5}$ $=1+\frac{1}{5}$ अत्र चतुर्वेदोक्तपरिभाषया $\frac{1}{5}=400$ पलानि, तदा फलम् $=1$ भार$+$ ४०० पलानि, चतुर्वेदोक्तपरिभाषा चेयम् 'षोडशभिर्यवैर्माषकः, तैः षोड़शभिः सुवर्ण, तैश्चतुर्भिः पलं, पलसहस्रद्वयेन भार, इति ॥ व्यस्तत्रैराशिकस्योदाहरणं भास्करस्याप्यतीव सुन्दरमस्ति । आचार्येण व्यस्तत्रैराशिक संभावना कुत्र कुत्र कदा भवतीति न प्रदर्शितं, भास्कराचार्येण 'इच्छावृद्धौ फले ह्रासो ह्रासे वृद्धिः फलस्य तु' इत्यादिना तस्य स्पष्टीकणं लीलावत्यां कृतम् ।

"इच्छाधिक्ये फलाल्पत्वं ज्ञायते यत्र निश्चितम् । इच्छाल्पत्वे फलाधिक्यं तत्र व्यस्तानुपातता ॥ विभिन्नवर्णस्य सुवर्णकस्य तौल्ये तथा प्राणिवयो विमूल्ये । धान्ये च मानेन विभज्यमाने व्यस्तानुपातो ननु चिन्तनीयः ॥"इति गणितमञ्जरी-कारेण गणेशदैवज्ञेन भास्करोक्तमेव कथितम् ।

सुवर्णतौल्ये उदाहरणम् ।

येनेष्टमूल्येन सुवर्णतुल्यं सुवर्णकं द्वादशवर्णकं चेत् ।
लभ्यं च तेनैव शरेन्दुवर्ण कियन्मितं तद्वद मे विचिन्त्य ॥

न्यासः १२ । १ । १५ तदा लब्धं कर्षाः $=0$ । माषाः $=12$ । गुंजाः $=4$ । अत्र कल्पितं मूल्यं २५ $=$ निष्काः ।

एभिर्द्वादशवर्ण सुवर्ण कर्षमितं लभ्यते पंचदशवर्ण तु द्वादशमाषाश्चतु र्गुन्जाधिका लभ्यन्त इति ॥ 'दशवर्ण सुवर्ण चेत् गद्याणमवाप्यते' इत्यादि भास्क-रोक्तोदाहरणानुरूपमेवेतिबोध्यम् ॥

धान्यराशि संख्यायामुदाहरणम् ।

पंचद्रोणेन मानेन विशालेशालिसचये ।
मापिते मानषष्टिश्चेत् नवद्रोणेन किं तदा ॥

न्यास: ५ । ६० । ९ तदा व्यस्तत्रैराशिकेन $\frac{५\times६०}{९}=\frac{३००}{९}=३३\frac{१}{३}$ मानानि । लीलावत्यां 'सप्ताढ़केन मानेन राशौ सस्यस्यमापिते । यदिमानशतं जातं तदा पंचाढ़केन किम्' भास्करोक्तोदाहरणानुरूपनेवेति ॥

प्राणिमूल्योदाहरणम् ।

कोकिलासरस कोमल कण्ठी नीलकण्ठनटिनीरटिनी चेत् ।
षोड़शोन्मित समाशतषट्कं पंचविंशति समालभते किम् ॥

न्यास: $\frac{६००\times२५}{१६}$ अत्रेच्छाधिक्यं फलाल्पत्वमस्त्यतोऽत्र व्यस्तत्रैराशिकम् । व्यस्तत्रैराशिकेन $\frac{६००\times१६}{२५}=२४\times१६=३८४$ निष्का:=मूल्यम् ।

लीलावत्यां 'प्राप्नोति चेत्षोड़शवत्सरा स्त्री द्वात्रिंशतं विंशतिवत्सरा किम्' भास्करोक्तस्यास्यानुरूपमेव पूर्वयुक्तं प्राणिमूल्योदाहरणम् ॥

व्यस्तत्रैराशिकं कुत्र भवतीत्येतदर्थं लीलावत्यां 'जीवानां वयसो मौल्ये तौल्ये वर्णस्य हैमने । भागहारे च राशीनां व्यस्तं त्रैराशिकं भवेत्' भास्करेणोक्तमिति ॥११॥

अब व्यस्तत्रैराशिकके विषय में कहते हैं ।

हि. भा.— प्रमाण और इच्छा के मध्य में जो भिन्न जातिक फल है उस को प्रमाण से गुणा कर इच्छा से भाग देने से व्यस्त त्रैराशिक में फल होता है ।

उदाहरण ।

यदि छः सौवर्णिक का भार एक तोला होता है तो पांच सौवर्णिक का भार क्या होगा सो कहो ॥

न्यास उदाहरण के अनुसार $\frac{१\times५}{६}$ यह प्रमाण और फल के घात को इच्छा से भाग

देने से फल हुआ $\frac{१\times६}{५}=\frac{६}{५}=१+\frac{१}{५}$ यहां चतुर्वेदाचार्योक्त परिभाषा से $\frac{१}{५}$=४०० पल, तब फल=१भार+४०० पल, चतुर्वेदोक्त परिभाषा यह है—१६ यवों के १ माषक १६ का माषक का १ सुवर्ण, ४ सुवर्ण का १ पल, तथा दो हजार २००० पलों का एक भार होता है। व्यस्तत्रैराशिक की सभावना कहा कहां पर होती है सो आचार्य ने नही कहा है। इसके विषय में लीलावती में 'इच्छा वृद्धौ फले ह्रासो ह्रासे वृद्धिः फलस्य तु' इत्यादि संस्कृत विज्ञान भाष्य में लिखित पद्यों से भास्कराचार्य ने स्पटीकरण किया है।

"इच्छाधिक्ये फलाल्पत्वं ज्ञायते यत्र निश्चितम्" इत्यादि संस्कृत विज्ञान भाष्य में लिखित पद्यों से गणितमञ्जरी में गणेश दैवज्ञ ने भास्कराचार्योक्त विषय ही लिखे हैं।

सुवर्ण तौल्य में उदाहरण।

जिस इष्ट मूल्य से बारह वर्णांक सुवर्ण—सुवर्णतुल्य पाते है उसी मूल्य से पञ्चदश (पन्द्रह) वर्णांक सुवर्ण कितना पावेगें।

न्यास १२। १। १५ इससे लब्ध हुआ कर्ष=०। माषा=१२। गुञ्जा ४ लीलावती में 'दशवर्ण सुवर्णं चेत्' इत्यादि भास्करोक्त उदाहरण के अनुरूप ही यह उदाहरण है।

धान्यराशि संख्या में उदाहरण।

किसी धान्यराशि को पांच द्रोण मान से मापन करने से यदि साठ मान होता हैं तो नौ द्रोण मान से मापन करने से क्या होगा?

न्यास $\frac{६०\times९}{५}$ यहां प्रमाण और मध्य फल के घात को इच्छा से भाग देने से $\frac{६००\times५}{९}=\frac{३०००}{९}=३३\frac{१}{३}$ मान यही उत्तर हुआ। लीलावती में 'सप्ताढ़केन मानेन राशौ सम्यस्य मापिते' इत्यादि भास्करोक्त के अनुरूप ही यह उदाहरण है।

प्राणी मूल्य में उदाहरण।

यदि सोलह वर्ष की स्त्री छः सौ निष्क पाती है तो पच्चीस वर्ष की स्त्री क्या पावेगी?

न्यास $\frac{६००\times२५}{२५}$ यहां इच्छा की अधिकता है और फल की अल्पता है इसलिये यहां प्रमाण और फल के घात को इच्छा से भाग देने से $\frac{६००\times१६}{२५}=२४\times१६=$ ३८४ निष्क=मूल्य, लीलावती में 'प्राप्नोति चेत् षोढ़श वत्सरा स्त्री' इत्यादि भास्करोक्त

के अनुरूप ही यह उदाहरण है। व्यस्तत्रैराशिक कहां होता है इसके सम्बन्ध मे लीलावती में 'जीवानां वयसे मौल्ये तौल्ये वर्णस्य हैमने' इत्यादि से स्पष्टी करण किया गया हैं ॥ ११ ॥

पञ्च राशिकादौ चतुर्वेदोक्तोदाहरणानि ।

शतस्य दशका वृद्धिस्त्रिभिर्मासैर्निरूपिता ।
पञ्चमास प्रयुक्तायाः षष्टेर्लाभो निगद्यताम् ॥

वि. भा.—यदि त्रिभिर्मासैः शतस्य दशका वृद्धिस्तदा पञ्च मासे षष्टे कियती वृद्धि रिति ॥

उदाहरणोक्त्या न्यासः ३ | ५, १०० | ६०, १० | फलच्छिदामन्योन्यपक्षनयनमित्यादिना ३, ५; १००, ६०; १०

ततो बहुराशिजे वधे स्वल्पराशिवधभाजिते फलमित्यनेन $\frac{५ \times ६० \times १०}{३ \times १००}$ =

$\frac{५ \times ६०}{३ \times १०} = \frac{६०}{३ \times २} = \frac{६०}{६}$ = १० = फलम् ।

बहुराशिजे वधे स्वल्पराशिवधभाजिते फलमित्यस्योपपत्तिः ।

उपरि लिखितोदाहरणे यदि शतस्य त्रिभिर्मासैर्दशकलान्तर (वृद्धिः सूदो वा) तदा षष्टेः किमित्यनुपातेन त्रिमास सम्बन्धि षष्टेः कलान्तरम् = $\frac{१० \times ६०}{१००}$ ततोऽनुपातो यदि त्रिषु मासेषु षष्टेरि ानीतं त्रिमास सम्बन्धि कलान्तरं लभ्यते तदा पंचसु मासेषु किं जातं पंचमाससम्बन्धि तत्कलान्तरम् = $\frac{१० \times ६० \times ५}{१०० \times ३}$ = १० एतावता 'वहुराजिजे वधे स्वल्पराशि वध भाजिते फलं भास्करोक्तमिदं' बहुराशिवधोऽल्पवध हृत इत्याचार्योक्तश्चोपपद्यत इति ॥ अयमेवविधिः सप्तराशिकादावपि ज्ञेय इति ॥

पंचराशिकादियों के लिए चतुर्वेदाचार्योक्त उदाहरण

हि. भा.—तीन महीनो में सौ रुपये का सूद दस रुपये होता है तो पांच महीनों में साठ रुपये की कितनी वृद्धि (सूद) होगी ॥ उदाहरण के अनुसार न्यास ३ | ५, १०० | ६०, १० |

'फलच्छिदामन्योन्य पक्षनयनं' इस से ३ | ५, १०० | ६०, | १० 'बहुराशिवधोऽल्पवध हृतः' इससे $\frac{५ \times ६० \times १०}{३ \times १००}$

$= \frac{५ \times ६०}{३ \times १०} = \frac{६०}{३ \times २} = \frac{६०}{६} = १० =$फल यही उत्तर है ॥

'बहुराशिवधोऽल्पवध हृत' इसकी उपपत्ति ।

उपर्युक्त उदाहरण मे यदि सौ रुपये का तीन महीनों में कलान्तर (सूद) दस होता है तो साठ रुपये का क्या इस अनुपात से तीन महीना सम्बन्धी साठ रुपये का कलान्तर $= \frac{१० \times ६०}{१००}$ फिर अनुपात करते हैं यदि साठ रुपये का तीन मास सम्बन्धी यह कलान्तर पाते हैं तो पांच महीने में इस अनुपात से पांच महीनासम्बन्धी साठ रुपये का क्या कलान्तर हुआ $\frac{१० \times ६० \times ५}{१०० \times ३} = १०$ इससे आचार्योक्त 'वहुराशिवधोऽल्पवध हृतः' तथा भास्करोक्त 'बहुराशिजेवधे स्वल्पराशिवध भाजित फलम्' उपपन्न होता है ॥ सप्तराशिकादियों के लिये भी यही रीति समझनी चाहिये ॥

अत्र चतुर्वेदोक्तमन्यदुदाहरणम् ।

मासेन सत्रिभागेन सार्धयास्त्रिशतेः फलम् ।
अध्यर्ध यदि वर्षेण सार्धषष्टेरिहोच्यताम् ॥

उदाहरणोक्त्या न्यासः

$\frac{४}{३}$	१२
$\frac{६१}{२}$	$\frac{१२१}{२}$
३	

फलच्छिदामन्योन्यपक्षनयनं विधाय बहुराशिजे वधे स्वल्प राशि वधभाजितेफलमिति

$$\frac{१२ \times १२१ \times ३ \times २ \times ३}{२ \times ४ \times ६१ \times २} = \frac{३ \times १२१ \times ३ \times ३}{१२२} = \frac{२७ \times १२१}{१२२} = \frac{३२६७}{१२२}$$

$= २६\frac{१०३}{१२२}$ इति ॥

यहां अब चतुर्वेदोक्त दूसरा उदाहरण ।

यदि तृतीयांश सहित एक महीने में साढ़े तीस रुपये का फल (सूद) $\frac{३}{२}$ मिलता है तो एक वर्ष में साढ़े साठ रुपये का फल (कलान्तर-सूद) क्या होता है सो कहो ॥

उदाहरण के अनुसार न्यास

$\frac{४}{३}$	१२
$\frac{६१}{२}$	$\frac{१२१}{२}$
$\frac{३}{२}$	

'फलच्छिदामन्योन्य पक्षनयनं तथा वहुराशिजेवधे ।

स्वल्प राशिवध भाजिते फलम्' इससे $\frac{१२ \times १२१ \times ३ \times २ \times ३}{२ \times ४ \times ६२ \times २} = \frac{३ \times १२१ \times ३ \times ३}{१२२} =$

$\frac{२६ \times १२१}{१२२} = \frac{३२६७}{१२२} = २६\frac{१०३}{१२२}$ यही उत्तर हुआ ॥

अन्यान्यप्युदाहरणानि ।

शतस्य दशभिर्मासैश्चत्वारिंशत् फलं यदि ।
मासाष्टके शतं लब्धं कस्येयं वृद्धिरुच्यताम् ॥
पूर्ववल्लब्धम् ६२५ मू० ध०

द्विपंचकानि वासांसि त्रीणि षड्भिः पणैर्यदि ।
त्रिषट्काणि गृहीतानि दश मूल्यं वद स्फुटम् ॥
पूर्ववल्लब्धम् = २६१ = मूल्यम्

द्विपंचकानि वासांसि त्रीणि षड्भिः पणैर्यदि ।
षट्कृत्या कति वासांसि त्रिषट्काणि वदाशु मे ॥

आयामोत्सेधविस्तारैः षोड्शाष्टौ तथा दश ।
यासां मूल्यं शतं तासां दीनाराः षट् प्रकीर्त्तिताः ॥
इष्टकानां तथान्यासामायामाद्यैः पदोनकैः ।
लक्ष गृहीतमस्माभिर्यद्देयं तद्वद स्फुटम् ॥
पूर्ववद्दीनारः २५३१$\frac{1}{3}$

हस्तिनौ दश दैर्घ्येण विस्तारेण तथा नव ।
परिणाहेन षट्त्रिंशद्ययोरौच्च्येन सप्तकम् ॥
तौ चेद् द्रोणाशिनौ यातां तदन्ये दश हस्तिनः ।
दीर्घाद्यैः पादसंयुक्तैस्तेषां भोगो निगद्यताम् ॥
पूर्ववत्फलं द्रो १२, प्र = ३, कु = १$\frac{1}{4}$ ॥

उपर्युक्तानि सप्तराशिकाद्युदाहरणानि न परिस्फुटानीति विज्ञैर्विवेचनीयानि ॥

सप्तराशिकादियों के लिये भी उदाहरण के अनुसार न्यास करके 'फलच्छिदामन्योन्यपक्षनयनं विधाय' इससे तथा 'बहुराशिजे वधेस्वल्पराशिवधभाजिते फलं' इससे गणित करना सुगम ही है ॥ १२ ॥

इदानीं भाण्डप्रतिभाण्डके करण सूत्रम् ।

प्राग्मूल्य व्यस्यासो भाण्डप्रतिभाण्डकेऽन्यदुक्तसमम् ।
परिकर्माण्यष्टानां व्यवहाराणामभिहितानि ॥ १३ ॥

सु. भा.—'प्राक् प्रथमस्थाने यौ मूल्यराशी तयोर्व्यत्यासः कार्य' इति चतुर्वेदाचार्यः । 'तथैव भाण्डप्रतिभाण्डके विधि' रित्यादि भास्करोक्तमेतदनुरूपमेव ।

अत्र चतुर्वेदाचार्योक्तोद्देशकः—

पणैर्दशभिराम्राणां दाडिमानां तथाऽष्टभिः ।
यदा शतं तदाऽम्रैस्तु विंशत्या कति दाडिमाः ॥
लब्धा उक्तवद्दाडिमाः २५ ।

अत्र चतुर्वेदाचार्यः—

'एवमार्जवेन मार्गेण सङ्कलनादीन्युक्तानि यानि तु करणीगतानि अव्यक्तगतानि धनर्णशून्यगतानि च तान्याचार्य एव कुट्टकाध्याये वक्ष्यति वयमपि तत्रैव तेष्वेव सूत्रेषु व्याख्यास्यामः ।'

इति परिक्रमविंशतिः ॥ १३ ॥

वि. भा.—भाण्डप्रतिभाण्डके (एक वस्तुनाऽन्यवस्तु विनिमये) प्रथमं मूल्यविपर्ययः कार्यः । अन्यत्सर्वं पूर्वोक्तसममेवाऽर्थाद्यथा पंचराशिकादौ फलच्छिदामन्योन्यपक्षनयनं तथैवात्रापि ज्ञेयमिति । 'तथैव भाण्डप्रतिभाण्डकेऽपीत्यादि' भास्करोक्तानुरूपमेवेति ॥ 'प्राक् प्रथमस्थाने यौ मूल्यराशी तयोर्व्यत्यासः कार्यः' इति चतुर्वेदाचार्यः ॥ १३ ॥

चतुर्वेदाचार्योक्तमुदाहरणम् ।

पणैर्दशभिराम्राणां दाड़िमानां तथाष्टभिः ।
यदा शतं तदाऽऽम्रैस्तु विंशत्या कति दाडिमानि ॥

उदाहरणोक्तचा न्यासः १०=पणैः ८=पणैः
१००=आम्राणि १००=दाड़िमानि
२०=आम्राणि

अत्र मूल्ययोर्व्यत्यासे फलस्य च द्वितीयपक्षनयने कृते

८	१०
१००	१००
	२०

ततो बहुराशिजे वधे स्वल्पराशिवधभाजिते फलमित्यनेन $\frac{१०\times१००\times२०}{८\times१००}=\frac{१०\times२०}{८}=\frac{२००}{८}$ =२५ दाड़िमाः ॥ १३ ॥

अत्रोपपत्तिः ।

यदि दशभिः पणैराम्राणां शतं लभ्यते तदाऽष्टभिः पणैः किमित्यनुपातेनाष्ट पणजनितान्याम्राणि$=\frac{१००\times८}{१०}$, पुनरनुपातो यद्यष्टपणजनितैराम्रैरष्टपणजनितदाड़िमानि लभ्यन्ते तदा विंशतिभिराम्रैः कि $\frac{१००\times२०}{\frac{१००\times८}{१०}}$

$=\frac{१००\times२०\times१०}{१००\times८}=\frac{२००}{८}$=२५ दाड़िमानि ।

अत्र प्रत्यक्षमेव मूल्ये व्यत्यासो दृश्यतेऽन्यत्सर्वं पूर्वसदृशमेवेत्युपपन्नमाचार्योक्तसूत्रम् ॥ १३ ॥

इति परिकर्म विंशतिः समाप्ता

अब भाण्ड प्रति भाण्ड (एक चीज से दूसरी चीज के बदलने) के लिए कहते है।

हि. भा.—भाण्ड प्रति भाण्ड (एक चीज से दूसरी चीज के बदलने) में मूल्य का विपर्यय (उल्टा पल्टा) होता है, और सब कुछ पूर्वोक्त 'दोनों पक्षो के हरों को परस्पर बदलना तथा फल को भी एक पक्ष से दूसरे पक्ष में लेजाना' सदृश ही समझना चाहिये। 'तथैव भाण्ड प्रति भाण्डकेऽपि' इत्यादि लीलावती मे भास्करोक्त इसके अनुरूप ही है। 'प्राक् प्रथमस्थाने यौ मूल्य राशी तयोर्व्यत्यासः कार्यः इति चतुर्वेदाचार्यः' अर्थात् प्रथम स्थान में जो दोनों मूल्य राशि (दाम) हो उन दोनों को उलट पुलट करना चाहिए ॥

चतुर्वेदाचार्योक्त उदाहरण।

यदि दस पण (पैसे) मे एक सौ आम मिलते है तथा आठ पण (पैसे) में एक सौ दाड़िम (अनार) मिलते है तो बीस आम में कितने दाडिम मिलेंगे ॥

उदाहरण के अनुसार न्यास करने से

१० पैसे	८ पैसे
१००=आम	१००=दाड़िम
२०=आम	

यहाँ मूल्यों (दामों) को बदलने तथा फल २० को द्वितीय पक्ष में लाने से

८	१०
१००	१००
	२०

अब 'बहुराशिजे वधे स्वल्प राशि वध भाजिते फलं इससे $\frac{१० \times १०० \times २०}{८ \times १००} = \frac{१० \times २०}{८} = \frac{२००}{८}$ =२५ दाड़िम हुआ ॥ १३ ॥

उपपत्ति

यदि दस पैसे में सौ आम पाते है तो आठ पैसे में क्या इस अनुपात से आठ पैसा सम्बन्धित आम आये $= \frac{१०० \times ८}{१०}$ फिर अनुपात करते है यदि आठ पैसा सम्बन्धित आम में आठ पैसा सम्बन्धित दाड़िम पाते हैं तो बीस आम में क्या इससे बीस आम सम्बन्धित दाडिम प्रमाण आया $\frac{१०० \times २०}{\frac{१०० \times ८}{१०}} = \frac{१०० \times १० \times २०}{१०० \times ८} = \frac{१० \times २०}{८} = \frac{२००}{८}$ =२५ दाड़िम, यहाँ मूल्यों में उलट पलट प्रत्यक्ष ही देखते हैं, और सब कुछ पूर्व सदृश ही है, इससे आचार्योक्त सूत्र उपपन्न हुआ ॥ १३ ॥

यहाँ परिकर्म विंशति समाप्त हुई

अथ मिश्रकव्यवहारः प्रारभ्यते ।

कालगुणितं प्रमाणं फलभक्तं व्येक गुणहतं कालः ।
स्वफलयुतरूपभक्तं मूलफलैक्यं भवति मूलम् ॥ १४ ॥

सु. भा.—प्रमाणं प्रमाणधनं कालगुणितं प्रमाणकालेन गुणितं ततः फलभक्तं प्रमाणफलेन भक्तं यल्लब्धं तद्व्येकगुणहतं यद्गुणं सकलान्तरं धनमपेक्षितं तेन व्येकेन हतं कालो भवति । तावत्कालपर्यन्तं दत्त धनं सकलान्तरं तद्गुणं भवति ।

अत्र चतुर्वेदोक्तोद्देशकः—

शतद्वयस्य मासेन षड्द्रम्मा यदि वृद्धितः ।
त्रिगुणं केन कालेन प्रयुक्तं तद्धनं भवेत् ॥

अत्र $\frac{\text{प्रका} \times \text{प्रध}}{\text{प्रफ}} = \frac{१ \times २००}{६} = \frac{१००}{३} = \text{ल}$ । ततः

कालः $= \frac{१०० \times \text{व्येगु}}{३} = \frac{२००}{३} = ६६\frac{२}{३}$ मासाः ।

अन्योद्देशकः—

मासद्वये पणाः पंच विंशतेर्यदि वृद्धितः ।
तदध्यर्धगुणं ब्रूहि केन कालेन मे धनम् ॥

अत्र $\frac{\text{प्रका. प्रध}}{\text{प्रफ}} = \frac{२ \times २०}{५} = ८$ । ततो मासाः $= ८ \times \text{व्येगु}$
$= ८ \times \frac{१}{२} = ४$ ।

अत्रोपपत्तिः ।

कल्प्यन्तेऽभीष्टमासाः $=$ मा । ततोऽनुपातेनैतावद्भिर्मासैर्वृद्धिः $= \frac{\text{प्रफ} \times \text{मा}}{\text{प्रमा}}$

इयं प्रमाणधनयुता जातमभीष्टगुणं मूलधनम् $=$ गु. प्रध $= \frac{\text{प्रफ. मा}}{\text{प्रमा}} + \text{प्रध}$

$\therefore \text{मा} = \frac{\text{प्रमाप्रध. (गु-१)}}{\text{प्रफ}}$ अत उपपन्नम् । मूलफलैक्यं सकलान्तरं धनं स्वफलयुतरूपभक्तं रूपस्य तत्कालसंबंधि यत् कलान्तरं तत् स्वफलं तेन स्वफलेन युतं यद्रूपं तेन भक्तं लब्धं मूलं धनं भवति । 'यद्वेष्टकर्माख्यविधेस्तु मूलम्' इत्यादि भास्करोक्तमेतदनुरूपमेव ।

अत्र चतुर्वेदोक्तोद्देशकः—

शतेन पंचकेनेह मासवृद्ध्या धने स्थिते ।
षट्कृतिर्दशभिर्मासैः प्रदत्ता मूलमत्र किम् ॥

उक्तवल्लब्धं मूलं २४ ।

अन्योद्देशकः—

अर्पितं हेमकारस्य सुवर्णानां शताष्टकम् ।
द्विजार्थं कुरु पात्राणि पंचमौर्वर्णिकं शतम् ॥
घटनाय त्वया ग्राह्यं क्तं तेन तथैव तत् ।
घटितस्य सुवर्णस्य तत्र संख्यां वदस्व मे ॥

उक्तवद्घटितसुवर्णमानम् = ७६१$\frac{३}{६}$ मिश्रात् ८०० विशोध्य घटनप्रमाणत् ३८$\frac{३}{६}$ ॥

वि. भा.—प्रमाणं (प्रमाण धनं) कालगुणितं (प्रमाण कालेन गुणित) फल (प्रमाण फल) भक्तं यल्लब्धं तद्व्येकगुणहतं यद्गुणं सकलान्तरं धनमपेक्षितं तेन व्येकेन गुणितं कालो भवति । तावत्कालपर्यन्ते दत्त धनं सकलानान्तरं तद्गुणं भवति ॥ १४ ॥

अत्र चतुर्वेदोक्तमुदाहरणम् ।

शतद्वयस्य मासेन षड्द्रम्मा यदि वृद्धितः ।
त्रिगुणं केन कालेन प्रयुक्तं तद्धनं भवेत् ॥

अत्र प्रमाणधनम् = प्रध, प्रमाण कालः = प्रका, प्रमाणफलम् = प्रफ, ततः सूत्रोक्त्या $\frac{\text{प्रका. प्रध}}{\text{प्रफ}} = \frac{१ \times २००}{६} = \frac{१००}{३}$ एतद्व्येकगुणगुणितं तदा $\frac{१०० \times (३-१)}{३} = \frac{१०० \times २}{३} = \frac{२००}{३}$ = ६६$\frac{२}{३}$ मासाः = कालः । अत्र गुणः = ३ ॥

अन्यदुदाहरणम् ।

मास द्वये पणाः पंच विंशतेर्यदि वृद्धितः ।
तदध्यर्धगुणं ब्रूहि केन कालेन मे धनम् ॥

सूत्रोक्त्या क्रियाकरणेन $\frac{\text{प्रका. प्रध}}{\text{प्रफ}} = \frac{२ \times २०}{५}$ = ८ एतेद्व्येक गुण गुणितं तदा ८ × ($\frac{३}{२}$—१) = ८ × $\frac{१}{२}$ = ४ = मासाः अत्र गुणः = १$\frac{१}{२}$ = $\frac{३}{२}$ ।

अत्रोपपत्तिः ।

अत्र कल्प्यन्तेऽभीष्टमासाः = मा, ततोऽनुपातेनैतावद्भिर्मासैर्वृद्धिः = $\frac{\text{प्रफ} \times \text{मा}}{\text{प्रका}}$ इयं प्रमाण धनयुता जातमभीष्टगुणं मूलधनम् गु.प्रध = $\frac{\text{प्रफ. मा}}{\text{प्रका}}$

$+$प्रध $= \frac{\text{प्रफ. मा} + \text{प्रध. प्रका}}{\text{प्रका}}$ छेदगमेन गु. प्रध. प्रका$=$प्रफ. मा$+$प्रध. प्रका समशोधनेन गु. प्रध. प्रका$-$प्रध. प्रका$=$प्रध. प्रका(गु$-$१)$=$प्रफ. मा पक्षौ प्रफ भक्तौ तदा $\frac{\text{प्रध, प्रका (गु}-\text{१)}}{\text{प्रफ}}$$=$मां एतेनोपपन्नमाचार्योक्तसूत्रम् ।

मूल फलैक्यं (सकलान्तरं धनं) स्वफल युत रूपभक्तमर्थाद्रूपस्य ।
तत्काल सम्बन्धि यत्कलान्तरं तत्स्वफलं तेन स्वफलेन—
युतं यद्रूपं तेन भक्तं लब्धं मूलं धनं भवति ।
'यद्वेष्ट कर्माख्य विधेस्तु मूलमित्यादि' भास्करोक्तमेतदनुरूपमेवेति ॥

अत्र चतुर्वेदोक्तमुदाहरणम् ।

शतकेन पंचकेनेह मासवृद्धया धने स्थिते ।
षट् कृतिर्दशभिर्मासैः प्रदत्ता मूलमत्र किम् ॥

अत्रेष्ट कर्मणा गणितम्

इष्टम् $=$१ । दृश्य प्रमाणम्$=$३६ तदा दशभिर्मासैः कल्पितेष्ट धनस्य रूपस्य किम्

१	१०
१००	१
५	

फलच्छिदामन्योन्य पक्षनयनं विधाय बहुराशिजे वधे स्वल्पराशिवधभाजिते फलमित्यनेन—

$\frac{१० \times १ \times ५}{१ \times १००} = \frac{५०}{१००} = \frac{१}{२}$ इति रूप धने योज्यम्$= १ + \frac{१}{२} = \frac{३}{२}$ तदेष्टाहतं दृश्यमनेन भक्तमित्यादिना $\frac{\text{इष्ट} \times \text{दृश्य}}{\frac{३}{२}} = \frac{१ \times ३६}{\frac{३}{२}} = \frac{१ \times ३६ \times २}{३} = \frac{७२}{३} = २४$ $=$मूलधनम् ॥

अन्यदुदाहरणम् ।

अर्पितं हेम कारस्य सुवर्णानां शताष्टकम् ।
द्विजार्थं कुरु पात्राणि पंचसौवर्णिकं शतम् ॥
घटनाय त्वया ग्राह्यं कृतं तेन तथैव तत् ।
घटितस्य सुवर्णस्य तत्र संख्यां वदस्व मे ॥

केनापि सुवर्णानां शताष्टकम् (ब्राह्मण पात्रनिर्माणार्थं) सुवर्णकारस्य दत्तं कथितं तेन प्रतिशतपात्रघटन पारिश्रमिकं पचसौवर्णिकं ग्राह्यं तेन सुवर्णं कारेण तथैव स्वीकृतं तदा घटित सुवर्णस्य संख्यां वद ॥ अत्र कल्प्यते इष्टम्$=$१ । दृश्य प्रमाणम्$=$८०० सुवर्ण मा०$=$मिश्रधनम् । सुवर्णपात्र निर्माणपारिश्रमिकं प्रतिशतं

पंच सौवर्णिकम् । ततो यदि शतप्रमितपात्रनिर्माणे तच्छुल्कं पंच लभ्यन्ते तदेष्टेनैकेन किं जातमिष्टकल्पित धनसम्बन्धि शुल्कम् $= \frac{५ \times १}{१००} = \frac{१}{२०}$ इति रूपे (इष्टे योज्यम् $= १ + \frac{१}{२०} = \frac{२१}{२०}$ = निष्पन्नाङ्क तदेष्टाहतं द्रव्यमनेनेत्यादिना $\frac{८०० \times १}{\text{निष्पन्नाङ्क}} = \frac{८००}{\frac{२१}{२०}} = \frac{८०० \times २०}{२१} = \frac{१६०००}{२१} = ७६१\frac{१९}{२१}$ = घटित सुवर्णमानम् एतन्मिश्रधना-८०० द्विशोध्य घटनप्रमाणम् $= ३८\frac{२}{२१}$ ॥१४॥

अब मिश्रक व्यवहार आरम्भ किया जाता है ।

हि. भा.— प्रमाण धन को प्रमाण काल से गुणाकर प्रमाण फल से भाग देने से जो लब्धि हो उसको एक हीन गुणक से गुण देना अर्थात् यद् गुणित सकलान्तर धन अपेक्षित हो उस गुणक में एक घटा कर गुणने से काल होता है तावत्कालपर्यन्त दिया हुआ धन कलान्तर (सूद) सहित तद्गुणित होता है ॥ १४ ॥

चतुर्वेदोक्त उदाहरण ।

यदि एक महीने में सौ रुपये का सूद छः द्रम्म होता है तो कितने काल में लगाया हुआ वह धन त्रिगुणित होता है सो कहो ।

यहां प्रमाण धन = प्रध, प्रमाण काल = प्रका । प्रमाण फल = प्रफ तब हिन्दी भाष्य में लिखित नियम के अनुसार क्रिया करने से $\frac{\text{प्रका. प्रध}}{\text{प्रफ}} = \frac{१ \times २००}{६} = \frac{१००}{३}$ = लब्धि, इस एक हीन गुणक से गुणने से $\frac{१००(३-१)}{३} = \frac{१०० \times २}{३} = \frac{२००}{३} = ६६\frac{२}{३}$ मास = काल । यहां गुणक = ३ ॥

दूसरा उदाहरण ।

यदि दो महीने मे बीस रुपये का सूद पांच पण होता है तो कितने काल में $१\frac{१}{४}$ एतद्गुणित धन होगा सो कहो । पूर्ववत् क्रिया करने से $\frac{\text{प्रका. प्रध}}{\text{प्रफ}} = \frac{२ \times २०}{५} = ८$, इसको एक हीन गुणक से गुणा करने से $८ \times (\frac{५}{४} - १) = ८ \times \frac{१}{४} = ४$ मास । यहां गुणक है $१\frac{१}{४} = \frac{५}{४}$ ॥

उपपत्ति ।

कल्पना करते है अभीष्टमास = मा । तब अनुपात से इन महीनों में वृद्धि $= \frac{\text{प्रफ.मा}}{\text{प्रका}}$

इसमें प्रमाण धन जोडने से अभीष्ट गुणित मूलधन $= \text{गु. प्रध} = \frac{\text{प्रफ.मा}}{\text{प्रका}} + \text{प्रध} =$

$\frac{\text{प्रफ. मा} + \text{प्रध. प्रका}}{\text{प्रका}}$ छेदगम से मु. प्रध. प्रका $=$ प्रफ.मा $+$ प्रध. प्रका समशोधन करने से

गु. प्रध.प्रका $-$ प्रध. प्रका $=$ प्रध. प्रका (गु$-$१) $=$ प्रफ. मा $\therefore \frac{\text{प्रध. प्रका (गु}-\text{१)}}{\text{प्रफ}} =$ मा

इससे हिन्दी भाष्योक्त विषय उपपन्न हुआ ॥

सकलान्तर धन को रूप का तत्काल सम्बन्धी जो कलान्तर (सूद) हो उसको रूप में जोड़ कर जो हो उस से भाग देने से मूल धन होता है लीलावती में 'यद्वेष्ट कर्माख्य विधेस्तु मूलं' इत्यादि भास्करोक्त इसके अनुरूप ही है ॥

उदाहरण ।

एक महीने में सौ रुपये को पाच रुपये सूद पर लगाया गया, दस महीनों में ३६ रुपये दिये गये तब मूलधन प्रमाण कहो ।

यहां कल्पना करते है इष्ट $=$ १, दृश्य प्रमाण $=$ ३६ है, तब दस महीनो मे कल्पित इष्ट धन रूप $=$ १ का क्या होगा

१	१०
१००	१
५	

यहां 'फलच्छिदामन्योन्य पक्षनयन' इत्यादि से

$\frac{\text{१०} \times \text{१} \times \text{५}}{\text{१} \times \text{१००}} = \frac{\text{१०} \times \text{५}}{\text{१००}} = \frac{\text{५०}}{\text{१००}} = \frac{\text{१}}{\text{२}}$ इसको रूपधन में जोड़ने से $\text{१} + \frac{\text{१}}{\text{२}} = \frac{\text{३}}{\text{२}}$, तब

'इष्टा हतं दृश्य मनेन भक्तं' इत्यादि से $\frac{\text{इष्ट} \times \text{दृश्य}}{\frac{\text{३}}{\text{२}}} = \frac{\text{१} \times \text{३६}}{\frac{\text{३}}{\text{२}}} = \frac{\text{३६} \times \text{२}}{\text{३}} = \frac{\text{७२}}{\text{३}} = \text{२४}$ मूलधन यही उत्तर है ॥

दूसरा उदाहरण ।

किसी आदमी ने आठ सौ सुवर्ण ब्राह्मणार्थं पात्र निर्माण के लिए सुनार को दिये और कहा कि तुम गढ़ने का पारिश्रमिक पांच सैकड़ा सौवर्णिक लो । उस सुनार ने उस वात को स्वीकार कर लिया । गढ़े हुए सुवर्ण की संख्या कहो ॥

यहां कल्पना करते है इष्ट $=$ १, दृश्य प्रमाण $=$ ८०० $=$ मिश्रधन, तब एक सौ पात्र निर्माण में उसका पारिश्रमिक पांच पाते है तो इष्ट एक में क्या इससे आया कल्पित इष्ट धन सम्बन्धी पारिश्रमिक $\frac{\text{५} \times \text{१}}{\text{१००}} = \frac{\text{१}}{\text{२०}}$ इसको रूप (कल्पितइष्ट धन) में जोडने से $\text{१} + \frac{\text{१}}{\text{२०}}$ $= \frac{\text{२१}}{\text{२०}}$ अब 'इष्टाहतं दृष्टं' इत्यादि से $\frac{\text{८००} \times \text{१}}{\frac{\text{२१}}{\text{२०}}} = \frac{\text{८००} \times \text{२०}}{\text{२१}} = \frac{\text{१६०००}}{\text{२१}} = \text{७६१} + \frac{\text{१९}}{\text{२१}}$ घटित सुवर्णमान । इसको मिश्रधन में घटाने से घटन प्रमाण हुआ $= \text{३८}\frac{\text{२}}{\text{२१}}$ ॥ १४ ॥

मिश्रान्तरे करणसूत्रम् ।

कालप्रमाणघातः परकालहृतो द्विधाऽद्यमिश्रवधात् ।
अन्यार्धकृतियुतात्पदमन्यार्धोनं प्रमाणफलम् ॥ १५ ॥

सु० भा०—कालप्रमाणघातः प्रमाणकालप्रमाणधनघातः परकालेन हृतः फलं द्विधा स्थाप्यम् । आद्यस्थाने स्थापितस्य मिश्रधनस्य च वधः कार्यस्तस्माद्वधादन्यस्थापितार्धवर्गयुतात् पदं ग्राह्यं तदन्यार्धेन हीनं प्रमाणफलं भवति ।

अत्र चतुर्वेदोक्तोद्देशकः—

अज्ञातवृद्धिकर्णत्वं द्रम्माणां शतपंचकम ।
वृद्धिर्मासिचतुष्कस्य तदीयाऽन्यत्र योजिता ॥
कालान्तरेण तेनैव जाताऽष्टासप्ततिस्ततः ।
मासैर्दशभिरत्र त्वं प्रमाणस्य फलं वद ॥

न्यासः । प्रका=४ । प्रमाध=५०० । परका=१० । मिश्रध=७८ ।

$\frac{\text{प्रका. प्रध}}{\text{प्रका}} = \frac{४\times५००}{१०} = २००$ । आ. मि $= २००\times७८ = १५६००$

$$\sqrt{\frac{\text{अ}^2}{४} + \text{आ. मि}} = \sqrt{१०००० + १५६००} = \sqrt{२५६००} = १६० = \text{प}$$

$\text{प} - \frac{\text{अ}}{२} = १६० - १०० = ६० =$ प्रमाणफलम् ।

अत्रोपपत्तिः ।

प्रमाणफलम् = या । ततो दशभिर्मासैरस्य कलान्तरम् $= \frac{\text{या}^2 \times \text{पका}}{\text{प्रध} \times \text{प्रका}}$ ।

इदं मूलधनेन यावत्तावन्मितेन युतं जातम् ।

$\text{मि} = \frac{\text{पका. या}^2 + \text{प्रध. प्रका. या}}{\text{प्रध. प्रका}}$ समशोधनादिना

$\frac{\text{मि. प्रध. प्रका}}{\text{पका}} = \text{या}^2 + \frac{\text{प्रध. प्रका}}{\text{पका}} \text{या} = \text{मि. आ} = \text{या}^2 + \text{अ. या}$, ततो या

$= \sqrt{\text{मि. आ} + \frac{\text{अ}^2}{४}} - \frac{\text{अ}}{२}$, अत उपपद्यते ।१५।

वि. भा.—प्रमाणकाल प्रमाणधनघातः परकालेन भक्तफलं स्थानद्वये स्थाप्यम् । प्रथम स्थाने स्थापितस्य मिश्रधनस्य च वधः कार्यस्तस्माद्वधादन्य

(द्वितीय स्थान) स्थापितवर्गयुतात्पदं (मूलं) ग्राह्यं तदन्यार्धेन हीनं कार्यं तदा प्रमाणफलं (मूलधनं) भवतीति ॥ १५ ॥

अत्र चतुर्वेदाचार्योक्तमुदाहरणम् ।

अज्ञातवृद्धि कर्णत्वं द्रम्माणां शतपञ्चकम् ।
वृद्धिर्मासि चतुष्कस्य तदीयाऽन्यत्र योजिता ॥
कालान्तरेण तेनैव जाताऽष्टा सप्ततिस्ततः ।
मासैर्दशभिरत्रत्वं प्रमाणस्य फलं वद ॥

उदाहरणोक्त्या न्यासः । प्रमाण कालः = ४, प्रमाणधनम् = ५००, परकालः = १० । मिश्रधनम् = ७८, तदा सूत्रानुसारेण $\frac{\text{प्रमाणकाल} \times \text{प्रमाणध}}{\text{परकाल}} = \frac{४ \times ५००}{१०}$ = २०० = आद्य, आद्य × मिश्रध = २०० × ७८ = १५६००, द्वितीयस्थाने स्थापितः $\frac{\text{प्रका. प्रध}}{\text{प्रका}}$ = अन्यसंज्ञकः $\sqrt{\text{आ. मिध} + \frac{(\text{अन्य})^२}{२}}$ = $\sqrt{१५६०० + १००००}$ = $\sqrt{२५६००}$ = १६० = पदम्, ततः पद $- \frac{\text{अन्य}}{२}$ = १६० — १०० = ६० = प्रमाण-फलम् । १५ ॥

अत्रोपपत्तिः ।

कल्प्यते प्रमाण फलम् = य, ततो दशभिर्मासैरस्य कलान्तरम् = $\frac{\text{य}^२.\ \text{पका}}{\text{प्रध. प्रका}}$

इदं प्रमाण फलेन (मूलधनेन) युतं तदा मिश्रधनम् = मिध = $\frac{\text{य}^२.\ \text{पका}}{\text{प्रध. प्रका}} + \text{य}$ = $\frac{\text{य}^२\ \text{पका} + \text{प्रध. प्रका. य}}{\text{प्रध. प्रका}}$ = मिध पक्षौ प्रध. प्रका गुणितौ तदा य^२. पका + प्रध. प्रका. य = मिध. प्रध. प्रका, पक्षौ पका भक्तौ तदा $\text{य}^२ + \frac{\text{प्रध. प्रका. य}}{\text{प्रका}}$ = $\frac{\text{मिध.प्रध.प्रका}}{\text{पका}}$ = मिध. आ. । अत्र $\frac{\text{प्रध. प्रका}}{\text{पका}}$ = आदिः = आ = य^२ + य. अन्य = मिध. आ. पक्षौ $\frac{(\text{अन्य})^२}{२}$ युतौ तदा य^२ + य.अन्य + $\frac{(\text{अन्य})^२}{२}$ = मिध. = आ. + $\left(\frac{\text{अन्य}}{२}\right)^२$

पक्षयोर्मूलग्रहणेन $\text{य} + \frac{\text{अन्य}}{२} = \sqrt{\text{मिध.आ} + \left(\frac{\text{अन्य}}{२}\right)^२}$ ततः $\text{य} = \sqrt{\text{मिध.आ} + \frac{(\text{अन्य})^२}{२}}$ $- \frac{\text{अन्य}}{२}$ एतेनोपपन्नमाचार्योक्तसूत्रम् ॥ १५ ॥

अब पुनः मिश्र गणित के लिये कहते हैं।

हि. भा.—प्रमाण काल और प्रमाणधन के घात में परकाल से भाग देकर जो फल हो उसको दो स्थानों में स्थापन करना, प्रथम स्थान स्थित फल का नाम=आद्य, द्वितीय स्थान स्थित फल=अन्य आद्य और मिश्रधन के घात मे अन्य के आधे का वर्ग जोड़ कर मूल लेना, उसमे अन्यार्ध को घटाने से प्रमाण फल होता है ॥ १५ ॥

चतुर्वेदाचार्योक्त उदाहरण।

पांच सौ द्रम्मों को सूद पर लगाया गया, चार महीनो मे जो सूद हुआ उसको पुनः दूसरे स्थान में सूद पर लगाया गया, कालान्तर में दस महीनों में उसी से अठहत्तर रुपये हो गये तब प्रमाण फल को कहो ॥ १५ ॥

उदाहरण के अनुसार न्यास प्रमाण काल=४, प्रमाण धन=५००, परकाल=१० मिश्रधन=७८, तब सूत्र के अनुसार $\frac{\text{प्रमाणकाल. प्रमाणधन}}{\text{परकाल}}=\frac{४\times ५००}{१०}=२००=$ आद्य

द्वितीय स्थान में $\frac{\text{प्रका. प्रध}}{\text{पका}}=$ अन्य। आद्य. मिध$=२००\times ७८=१५६००$ आद्य. मिध.$+$ $\frac{(\text{अन्य})^2}{२}=१५६००+१००००=२५६००$ मूल लेने से $\sqrt{\text{आ.मिध}+\frac{(\text{अन्य})^2}{२}}=\sqrt{२५६००}$ $=१६०$ इसमें $\frac{\text{अन्य}}{२}$ घटाने से $१६०-१००=६०=$ प्रमाण फल हुआ ॥१५॥

उपपत्ति।

कल्पना करते है प्रमाणफल = य, तब परकाल (१० महीनों) में इसका कलान्तर (सूद)= $\frac{\text{य}^2\text{. पका}}{\text{प्रध. प्रका}}$ इसमें प्रमाणफल (मूलधन) जोड़ने से मिश्रधन हुआ। $\frac{\text{य}^2\text{. पका}}{\text{प्रध. प्रका}}$ $+\text{य}=\text{मिध}=\frac{\text{य}^2\text{. पका}+\text{य प्रध. प्रका}}{\text{प्रध. प्रका}}$ छेदगम करने से मिध. प्रध. प्रका$=\text{य}^2$. पका $+$य.प्रध. प्रका दोनों पक्षों को पका से भाग देने से $\frac{\text{मिध. प्रध. प्रका}}{\text{पका}}=\text{मिध. आ}=\text{य}^2+$ $\frac{\text{य. प्रध. प्रका}}{\text{पका}}=\text{य}^2+$य.अन्य, दोनों पक्षों में $\left(\frac{\text{अन्य}}{२}\right)^2$ जोड़ने से $\text{मिध}\times\text{आ}+\left(\frac{\text{अन्य}}{२}\right)^2$ $=\text{य}^2+\text{य. अन्य}+\left(\frac{\text{अन्य}}{२}\right)^2$ मूल लेने से $\text{य}+\frac{\text{अन्य}}{२}=\sqrt{\text{मिध. आ}+\left(\frac{\text{अन्य}}{२}\right)^2}$

$\therefore$ य = $\sqrt{\text{मिध. आ} + \left(\frac{\text{अन्य}}{२}\right)^{२}}$ —अन्य, इससे आचार्योक्त उपपन्न होता है ।।१५।।

पुनर्मिश्रान्तरे करणसूत्रम् ।

प्रक्षेपयोगहृतया लब्ध्या प्रक्षेपका गुणा लाभाः ।
ऊनाधिकोत्तरास्तद्युतोनया स्वफलमूनयुतम् ।।१६।।

सु. भा.—लब्ध्या लाभेन । यदि प्रक्षेपका ऊनाधिकोत्तरास्तदा तद्युतोनया लब्ध्या कर्म कर्तव्यम् । अर्थाद्यद्यूनोत्तरास्तदोनोत्तरयुतया यदाऽधिकोत्तराः प्रक्षेपास्तदोत्तरोनया फलं साध्यम् । स्वफलानि न्यूनोत्तरहीनानि अधिकोत्तराधिकानि च क्रमेण कार्याणि ।

अत्र चतुर्वेदोक्तोद्देशकः—

एकाद्यैर्नवपर्यन्तैर्वणिजैर्मूलराशिभिः ।
क्रीतो हयोऽसौ विक्रीतः पंचोनैः पंचभिः शतैः ।।
किमेकैकस्य तत्रासीद्ब्रूहि त्वं मिश्रकान् मम ।

न्यासः । प्रक्षेपकाः १ । २ । ३ । ४ । ५ । ६ । ७ । ८ । ९ । मिश्रलाभाः ४९५ । उक्तवत्प्रत्येकस्य लाभाः ११ । २२ । ३३ । ४४ । ५५ । ६६ । ७७ । ८८ । ९९

अन्योद्देशकः—

मठस्थानानि चत्वारि छात्राणां समसंख्यया ।
भोक्तु समन्त्रितान्यासन् दीक्षायां किल यज्वना ।।
पंचार्धत्रिचतुर्थांशास्तेभ्यो भोक्तुं समागताः ।।
एकद्वित्रिचतुर्युक्ता दृष्टाशीतिः ससप्तका ।।
स्वोत्तरैरथवा हीना सप्तषष्टिश्च तेऽशकाः ।
मठेभ्यश्छात्रसंख्यां मे ब्रूहि ये चागता यतः ।।

अथ प्रथमोदाहरणेऽधिकोत्तराणां १ । २ । ३ । ४ योगेन १० लब्धिः सप्ताशीतिर्हीना ७७ लब्धिर्ज्ञेया । ततः प्रक्षेपाणां $\frac{१}{२}$ । $\frac{१}{२}$ । $\frac{१}{३}$ । $\frac{१}{४}$ योगेन हृतया लब्ध्येत्यादिना फलानि १२ । ३० । २० । १५ । स्वोत्तरयुतानि १३ । ३२ । २३ । १९ । मठच्छात्रसंख्या ६० । एवं द्वितीयोदाहरणे ऊनोत्तरयुतया लब्ध्या ६७+१० अनया पूर्ववत् कृते आगता छात्रसंख्या ११ । २८ । १७ । ११ ।

अन्योद्देशकः—

घृतोदकमधूनां ये त्रयः कलसकाः पलैः ।
रदषष्टिजिनैः पूर्णा एकीभूतास्ततः पुनः ।।

मिश्रेण पूरिता यावत् तावत् संख्यां न वेद्म्यहम् ।
घृतोदकमधूनां तामेकैकत्र गतां वद ॥

अत्र चतुर्वेदाचार्यः । 'इह गणिताध्याये सुवर्णगणितं नास्ति । तदर्थं श्लोकोऽयम् ।

सुवर्णहेमसंवर्गानेकीकृत्य विभाजयेत् ।
इष्टवर्णेन तत्संख्या हेमयोगेन वर्णकः ॥

इति मिश्रक व्यवहारः ॥

वि. भा.—प्रक्षेपाणां योगेन मिश्रलाभा भक्ता या लब्धिस्तया प्रक्षेपका गुणास्तदा प्रत्येकस्य लाभा भवन्ति । यदि प्रक्षेपका ऊनाधिकोत्तरास्तदा तद्युनोनया लब्ध्या क्रिया कार्या अर्थाद्यद्यूनोत्तरास्तदोनोत्तरयुतया यद्यधिकोत्तराः प्रक्षेपास्तदोत्तरोनया फलं साध्यम् । स्वफलानि न्यूनोत्तरहीनानि—अधिकोत्तराधिकानि च क्रमेण कर्त्तव्यानीति, प्रक्षिप्यन्ते मिश्रीक्रियन्ते ये ते प्रक्षेपकाः खण्डरूपा इति ॥१६॥

चतुर्वेदोक्तमुदाहरणम् ।

एकाद्यैर्नवपर्यन्तै वणिजैर्मूलराशिभिः ।
क्रीतो हयोऽसौ विक्रीतः पचोनैः पंचभिः शतैः ॥
किमेकैकस्य तत्रासीद् ब्रूहि त्वं मिश्रकान् मम ।

न्यासः प्रक्षेपकाः १ । २ । ३ । ४ । ५ । ६ । ७ । ८ । ९ ॥ मिश्रलाभाः= ४९५=मिध.

प्रक्षेपकाणां योगः=१+२+३+४+५+६+७+८+९=४५, एभिर्मिश्रलाभा भक्तास्तदा $\frac{४९५}{४५}$=११=लब्धिः, एतया लब्ध्या प्रक्षेपका गुणास्तदा ११ । २२ । ३३ । ४४ । ५५ । ६६ । ७७ । ८८ । ९९ इति प्रत्येकस्य लाभा भवन्तीति ॥१६॥

अत्रोपपत्तिः ।

प्रक्षेपकाः=प्रक्षे, $\overset{।}{\text{प्रक्षे}}$, $\overset{॥}{\text{प्रक्षे}}$............

प्रक्षे × गु + $\overset{।}{\text{प्रक्षे}}$ × गु + $\overset{॥}{\text{प्रक्षे}}$ × गु.........=मिध

=गु (प्रक्षे + $\overset{।}{\text{प्रक्षे}}$ + $\overset{॥}{\text{प्रक्षे}}$)=मिध

$$\therefore \frac{\text{मिध}}{\text{प्रक्षे} + \overset{।}{\text{प्रक्षे}} + \overset{॥}{\text{प्रक्षे}} \cdots} = \text{गु} = \frac{\text{मिध}}{\text{प्रक्षेपयोग}}$$

ततः $\frac{\text{मिध} \times \text{प्रक्षे}}{\text{प्रक्षेपयो}}$ = प्रथमधनम् । $\frac{\text{मिध} \times \text{प्रक्षे}}{\text{प्रक्षेपयोग}}$ = द्वितीयधनम्

एवमेव सर्वेषां धनानि, एतेनाऽऽचार्योक्त सूत्रमुपपद्यते, लीलावत्यां 'प्रक्षेपका मिश्रहता विभक्ताः प्रक्षेपयोगेन पृथक् फलानीति' भास्करोक्तमेतदनुरूपमेव। तथा सिद्धान्तशेखरे 'प्रक्षेपकान् मिश्रधनेन हन्यात् पृथकफलाप्त्यै विभजेत् स्वयुत्या' ऽनेन श्रीपतिनाप्याचार्योक्तानुरूपमेवोक्तम् । अत्र श्रीधराचार्योक्त मुदाहरणम्—

शतस्य लब्धवानेकः पञ्चशत्यास्तथापरः ।
फलमन्यः सहस्रस्य सहस्रे षट्शताधिके ॥
सर्वग्रामफले विद्वन् तत्रोत्पन्नं शतद्वयम् ।
ततः कि कस्य भागे स्यात् गणयित्वा निगद्यताम् ॥

न्यासः —प्रक्षेपकाः १००, ५००, १०००, मिश्रधनं लाभात्मकम्=२०० तदा सूत्रानुसारेण क्रियाकरणेन पृथक् पृथक् फलम्=$\frac{२५}{२}$, $\frac{१२५}{२}$, १२५ अथवा मिश्रधनम्=१८००, प्रक्षेपयोगः सर्वग्रामफल संज्ञकः=१६०० तदोक्तक्रियया पृथक् पृथक् फलम्=११२$\frac{१}{२}$, ५६२$\frac{१}{२}$ । ११२५ । अत्रैव गणेश दैवज्ञोक्तमुदाहरणम् येषामाद्यधनानि वर्यवणिजां षष्टिस्त्यशीतिः शतं—विंशत्याढ्यशतं च मिश्रितधनैर्जातोद्यमैस्तैर्यदा । चत्वारिंशदुपेतपंचशतकं लब्धं हि वाणिज्यतो वाणिज्येन विभज्य मित्र रूपदि प्रब्रूहि लाभान् पृथक् । उदाहरणोक्त्या न्यासः प्रक्षेपकाः=६०, ८०, १००,१२०, मिश्रधनम्=५४०, प्रक्षेपकाणां योगः=३६० तदा प्रक्षेपका मिश्र हताः (मिश्रधनगुणिताः) ३२४००, ४३२००, ५४०००, ६४८०० प्रक्षेपकाणां योगेना ३६० नेनभक्तास्तदा समागतानि धनानि=९०, १२०, १५०, १८० एतानि स्वप्रक्षेपैरूनानि तदा जाता लाभाः=३०, ४०, ५०, ६० ।

अथवा मिश्रधनं=५४०, प्रक्षेपकयोगेना ३६० नेन हीनं १८०=मिश्रधनम्, अनेन प्रक्षेपका गुणिताः १०८००, १४४००, १८०००, २१६०० प्रक्षेपक योगेना ३६० नेन भक्तास्तदा जाता लाभाः=३० । ४० । ५० । ६० ॥१६॥

पुनः मिश्रान्तर में कहते हैं ।

हि॰ भा॰—प्रक्षेपक 'प्रक्षिप्यन्ते मिश्री क्रियन्ते ये ते प्रक्षेपकाः खण्डरूपाः' अर्थात् जो खण्डरूप पदार्थ मिलाये जाते हैं उनको प्रक्षेपक कहते हैं । मिश्रलाभ (मिश्रधन) में प्रक्षेपकों के योग द्वारा भाग देने से लो लब्धि होती है उससे प्रक्षेपकों को गुणने से पृथक् पृथक् लाभ होते हैं ॥१६॥

उदाहरण ।

एक से नौ (नव) पर्यन्त मूल धनों से वणिक् (बनियों) ने घोड़े खरीदे और ४६५ रुपये में बेच दिये तब प्रत्येक बनिये के पास कितना धन लाभ हुआ सो कहो ।

न्यास प्रक्षेपक=१ । २ । ३ । ४ । ५ । ६ । ७ । ८ । ९, मिश्रलाभ=४९५= मिश्रधन । प्रक्षेपकों के योग=१+२+३+४+५+६+७+८+९=४५ इससे मिश्र-धन को भाग देने से $\frac{४९५}{४५}$ =११=लब्धिः, इससे प्रक्षेपकों को गुणने से ११ । २२ । ३३ । ४४ । ५५ । ६६ । ७७ । ८८ । ९९ यह क्रमशः नौ बनियों को लाभ हुआ ॥१६॥

उपपत्ति ।

$$\text{प्रक्षेपक} = \text{प्रक्षे}, \overset{\text{I}}{\text{प्रक्षे}}, \overset{\text{II}}{\text{प्रक्षे}} \cdots\cdots$$

$$\text{प्रक्षे गु} + \overset{\text{I}}{\text{प्रक्षे}}.\ \text{गु} + \overset{\text{II}}{\text{प्रक्षे}}.\ \text{गु} \cdots\cdots = \text{मिध}$$

$$= \text{गु}\ (\text{प्रक्षे} + \overset{\text{I}}{\text{प्रक्षे}} + \overset{\text{II}}{\text{प्रक्षे}}) \cdots\cdots = \text{मिध}$$

$$\therefore \frac{\text{मिध}}{(\text{प्रक्षे} + \overset{\text{I}}{\text{प्रक्षे}} + \overset{\text{II}}{\text{प्रक्षे}})} = \text{गु} = \frac{\text{मिध}}{\text{प्रक्षेपयोग}}$$

$$\therefore \frac{\text{मिध. प्रक्षे}}{\text{प्रक्षेपयो}} = \text{प्रथमधन} \text{।} \quad \frac{\text{मिध}\ \overset{\text{I}}{\text{प्रक्षे}}}{\text{प्रक्षेपयो}} = \text{द्वितीयधन},$$ इसी तरह धन होते हैं इससे आचार्योक्त सूत्र उपपन्न होता है। लीलावती में 'प्रक्षेपका मिश्रहता विभक्ता' इत्यादि भास्करोक्त भी उपपन्न होता है, भास्करोक्त 'प्रक्षेपका मिश्रहता' इत्यादि आचार्योक्त के अनु-रूप ही है। सिद्धान्त शेखर में 'प्रक्षेपकान् मिश्रधनेन हन्यात्' इत्यादि संस्कृत विज्ञान भाष्य में लिखित श्लोकोक्त विषय आचार्योक्तानुरूप ही है।

यहां श्रीधराचार्योक्त उदाहरण है।

एक व्यापारी ने सौ रुपये से व्यापार किया, दूसरे ने पांच सौ से, तीसरे ने एक हजार रुपये से व्यापार किया। एक हजार छः सौ प्रक्षेपयोग से लाभ हुए । २००=लाभात्मक मिश्रधन, तब प्रत्येक को कितना कितना लाभ हुआ सो कहो ।

न्यास प्रक्षेपक=१००, ५००, १०००, लाभात्मक मिश्रधन=२०० तब पूर्वोक्त के अनुसार क्रिया करने से पृथक् पृथक् फल=$\frac{२५}{२}$, $\frac{१२५}{२}$, १२५, अथवा मिश्रधन=१८०० प्रक्षेपकों के योग=१६००, तब उक्तवत् क्रिया करने से पृथक् पृथक् फल=११२$\frac{१}{२}$, ५६२$\frac{१}{२}$ ११२५ ॥

यहाँ गणेश दैवज्ञोक्त उदाहरण भी है।

जिन चार बनियों का मूलधन है ६०, ८०, १००, १२० उन सब बनियों ने धन

मिलकर व्यापार किया तो उससे लाभ हुआ ५४० तब प्रत्येक व्यापारी का लाभ धन पृथक् पृथक् कहो इति ।।

उदाहरण के अनुसार प्रक्षेपक = ६०, ८०, १००, १२० । मिश्रधन = ५४०, प्रक्षेप-योग = ३६० प्रक्षेपको का योग = ३६०, तब 'प्रक्षेपका मिश्रहता' इत्यादि से क्रिया करने से

$\frac{\text{प्रक्षेप} \times \text{मिध}}{\text{प्रक्षेपयो}} = \frac{६० \times ५४०}{३६०} = \frac{३२४००}{३६०} = ९०, \frac{८० \times ५४०}{३६०} = \frac{४३२००}{३६०} = १२०,$

$\frac{१०० \times ५४०}{३६०} = \frac{५४०००}{३६०} = १५०, \frac{१२० \times ५४०}{३६०} = \frac{६४८००}{३६०} = १८०$ इस तरह फल आये ।

९०, १२०, १५०, १८० इनमें से क्रमशः प्रक्षेपकों को घटाने से पृथक् पृथक् लाभ प्राप्त हुआ ३०, ४०, ५०, ६० अथवा मिश्रधन = ५४०, प्रक्षेपकों के योग ३६० को मिश्रधन ५४० में से घटाने से १८० = मिश्रधन । तब पुनः प्रक्षेपकों को मिश्रधन से गुणने से १०८००, १४४००, १८०००, २१६०० प्राप्त हुए प्रक्षेपको के योग को ३६० से भाग देने से लाभ प्रमाण ३०, ४०, ५०, ६० हुए इति ।। ११ ।।

ऊनाधिकोत्तरास्तद्युतोनया स्वफलमूनयुतमित्याचार्योक्तसूत्रार्धस्य कृते चतुर्वेदोक्त-मुदाहरणम् -

मठस्थानानि चत्वारि छात्राणां सम संख्यया ।
भोक्तुं समन्त्रितान्यासन् दीक्षायां किल यज्वना ।।
पंचार्धत्रिचतुर्थांशास्तेभ्यो भोक्तुं समागताः ।
एक द्वित्रिचतुर्युक्ता दृष्टाशीतिः ससप्तकाः ।।
स्वोत्तरैरथवा हीनाः सप्तषष्टिश्च तेंऽशकाः ।
मठेभ्यश्छात्र संख्यां मे ब्रूहि ये चागता यतः ।।

प्रथमोदाहरणेऽधिकोत्तराः १ । २ । ३ । ४ एषां योगेन १० सप्ताशीति ८७ हीना ७७=लब्धिर्ज्ञेया, प्रक्षेपकाः = $\frac{१}{५}, \frac{१}{२}, \frac{१}{३}, \frac{१}{४}$ ततः प्रक्षेपयोगहृतया लब्ध्येत्यादिना फलानि १२. ३०, २०, १५ एतानि स्वोत्तर १, २, ३, ४ युतानि १३, ३२, २३ १९=समागता मठच्छात्र संख्याः द्वितीयोदाहरणे ऊनोत्तरयुतया लब्ध्या ६७ पूर्ववत् कृते समागताश्छात्र संख्याः ११ । २८ । १७ । ११

अब १६ वें श्लोक के उत्तरार्ध के लिये चतुर्वेदाचार्योक्त उदाहरण ।

छात्रों के चार मठस्थान (रहने के स्थान, छात्रावास) थे, किसी यज्ञ कर्त्ता ने इन मठों के सम संख्यक छात्रों को भोजन के लिये निमन्त्रण दिया, उनमें से पंचांश, आधे, तृतीयांश, चतुर्थांश छात्र भोजन के लिये आये, इनमें क्रमशः एक, दो, तीन, चार को जोड़ने से ८७ देखा गया, अथवा स्वोत्तरों १, २, ३, ४ से हीन सतसठ देखा गया तब मठ से भोजन के लिये आये हुए छात्रों की संख्या को कहो ।।

प्रथम उदाहरण में अधिकोत्तरों १, २, ३, ४ के योग १० को सतासी ८७ में हीन करने से ७७ लब्धि समझनी चाहिए, प्रक्षेपक $=\frac{1}{2}, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}$ तब 'प्रक्षेपका मिश्रहता विभक्ता' इत्यादि से फल=१२, ३०, २०, १५ इनमें स्वोत्तर १, २, ३, ४ जोड़ने से १३, ३२, २३, १९ समागत मठ छात्र संख्या, द्वितीय उदाहरण में ऊनोत्तरयुत लब्धि ६७+१० पूर्ववत् से क्रिया करने से भोजन के लिये समागत छात्र संख्या ११ । २८ । १७ । ११ ॥

अन्यदुदाहरणम्

घृतोदक मधूनां येत्रयः कलसकाः पलैः
रदपष्टिजिनैः पूर्णा एकीभूतास्ततः पुनः ॥
मिश्रेण पूरितायावत् तावत् संख्यां न वेदम्यहम् ।
घृतोदक मधूनां तामेकैकत्र गतां वद ॥
अत्र चतुर्वेदाचार्यः । 'इह गणिताध्याये सुवर्णगणितं
नास्ति तदर्थ श्लोकोऽयम् ।
सुवर्ण हेमसंवर्गानेकीकृत्य विभाजयेत् ।
इष्टवर्णेन तत्संख्या हेमयोगेन वर्णकः ॥

इति मिश्रकव्यवहारः ॥

अथ श्रेढी व्यवहारः

भिन्नं भिन्नं यत् किंचित् द्रव्यादिकमेकीक्रियते तत् श्रेढी गणितं कथ्यते ।
तत्राऽदिचयगच्छेषु ज्ञातेष्वन्त्यधनादिज्ञानार्थं सूत्रम् ।

पदमेकहीनमुत्तरगुणितं संयुक्तमादिनाऽन्त्यधनम् ।
आदियुतान्त्यधनार्धं मध्यधनं पदगुणं गणितम् ॥ १७ ॥

सु. भा.—स्पष्टार्थम् । व्येकपदघ्नचयो मुखयुक् स्यादन्त्यधनम्' इत्यादि भास्करोक्तमेतदनुरूपमेव ।

अत्र चतुर्वेदोक्तोदाहरणानि—

मुखे द्वे इष्टके यत्र तिस्रस्तिस्रोऽधिकाश्च ये ।
पञ्चहारचितिर्दृष्टा वद तत्रेष्टकाफलम् ॥
अध्यर्धमादौ किल पादवृद्धया दत्तं द्विजेभ्यः सततं नृपेण ।
हेम त्रिरात्रं नवभागयुक्तं मध्यान्त्यसर्वाख्यधनानि कानि ॥
केनापि गृहजामातुः षोडशाऽऽद्ये दिने पणाः ।
प्रदत्ताः पुण्यपुष्यार्थ द्विहान्या च ततः क्रमात् ॥
दिवसे नवमे जाते कियन्तस्तस्य ते पणाः ।
संपीड्यै तत् ममाचक्ष्व यदि श्रेढ्यां श्रमः कृतः ॥

अत्र चतुर्वेदाचार्यः। 'इदानीं द्विगुणत्रिगुणादिकोत्तरेण फलानयनप्रदर्शनार्थं श्लोकत्रयमस्मदीयमेतावद्यथा'—

इष्टगच्छे दलेऽरूपे वर्गं कल्पं न्यसेदतः।
गच्छेन्निःशेषतां यावत् ततश्चोत्क्रमवर्णतः॥

गुणकारसमाकल्पे वर्गो वर्गप्रसिद्धितः।
व्येकरूपं ततो राशिं रूपहीनगुणोद्धृतम्॥

आद्यसंख्याहतं कृत्वा द्विगुणादौ फलं वदेत्।
छन्दश्चित्युत्तरादेष प्रकार इह दर्शितः॥

एतच्छ्लोकत्रयस्य व्याख्या च चतुर्वेदाचार्यकृता तथैव वर्त्तते यथा भास्करस्य 'विषमे गच्छे व्येके गुणकः स्थाप्य' इत्यादि सूत्रम्।

अत्र चतुर्वेदाचार्योक्तोद्देशकः—
त्रिगुणोत्तरया वृद्धया रूपषट्कं दिने दिने।
यो ददाति दशाहानि दत्तं तेन कियद्भवेत्॥
अन्योद्देशकः—
पञ्चार्धगुणया वृद्धया यो ददाति दिनत्रयम्।
सार्धरूपत्रयं तेन कियद्दत्तं धनं वद॥

अत्रोपपत्त्यर्थं चतुर्वेदाचार्यः। 'गोपगणनया प्रत्यय' इति। गोपानां यादृशी लोष्टकादिना गणना भवति तया प्रतीतिरुत्पाद्येत्यर्थः। अत्र भास्कर श्रेढीव्यवहारेण सर्वोदाहरणानामुत्तराणि स्फुटान्यतो न लिखितानि मयेति॥१७॥

वि. भा.—पदं (गच्छमानं) एक हीनमुत्तर (चय) गुणितमादिना युतं तदाऽन्त्यधनं भवेत्। आदियुतान्त्यधनार्ध (आद्यन्त्यधनयोर्योगार्धं) मध्यधनं भवति, मध्यधनं पदगुणं तदा गणितं (सर्वधनं) भवतीति॥ १७॥

अत्र चतुर्वेदोक्तान्युदाहरणानि।

मुखे द्वे इष्टके यत्र तिस्रस्तिस्रोऽधिकाश्च ग्रे।
पंचहारचितिर्दृष्टा वद तत्रेष्टका फलम्॥
अध्यर्धमादौ किल पादवृद्धया दत्तं द्विजेभ्यः सततं नृपेण।
हेम त्रिरात्रं नव भागयुक्तं मध्यान्त्य सर्वाख्य धनानि कानि।
केनापि गृहजामातुः षोडशाऽऽद्ये दिने पणाः।
प्रदत्ताः पुण्यपुष्यार्थं द्विहान्या च ततः क्रमात्॥
दिवसे नवमे जाते कियन्तस्तस्य ते पणाः।
सम्पीड्यं तत् समाचक्ष्व यदि श्रेढ्यां श्रमः कृतः॥

अत्रैव लीलावत्यां भास्करोक्तमुदाहरणम् ।

आद्ये दिने द्रम्मचतुष्टयं यो दत्त्वा द्विजेभ्योऽनुदिनं प्रवृत्तः ।
दातुं सखे पंचचयेन पक्षे द्रम्मा वद द्राक् कति तेन दत्ताः ॥

न्यासः आदिः=४ । चयः=५ । गच्छः=१५ तदाऽऽचार्यं सूत्रानुसारेणा—न्त्यनम्=७४, मध्यधनम्=३९ सर्वधनम्=५८५ ॥

अत्र गणेशदैवज्ञोक्तमुदाहरणम् ।

भूपालो नगरावलोकनमनाः पंचाश्विसोपानके
प्रासादे रचनाविशेषविशदे कुर्वन् समारोहणम् ।
चम्पूपद्यविवेककारिणि कवौ तावद् द्वयं दत्तवा
नग्रे वेद चयेन तस्य निखिलं वित्त द्रुतं मे वद ॥

न्यासः आदिः=२ । पदम्=२५ । चयः=४ तदाऽऽचार्योक्त सूत्रेणान्त्यधनम् =९८ । मध्यधनम्=५० । सर्वधनम्=१२५० ॥

तथात्र

दशमितं वदनं गगनाश्विभिः परिमितः प्रचयः समुदीरितः ।
अपि पदं गगनाग्निमितं तदा वद सखे गणितं गणितज्ञ मे ॥

न्यासः आदिः=१०, चयः=२०, गच्छः=३० तदाऽऽचार्योक्तसूत्रेण पूर्ववत् गणितम्=सर्वधनम्=९००० ॥

अत्रोपपत्तिः ।

आदिः=आ । चयः=च, गच्छः=पदम्=प । सर्वधनम्=सध, तत उदाहरणोक्त्या आ+ (आ+च)+(आ+२च)+(आ+३च)······+आ+(प—१) च=सध अथवा

आ+च (प-१)+आ+च (प—२)+··· ·····+आ=सध

द्वयोर्योगेन

२ सध=२ आ+च (प—१)+२ आ+च (प—१)······पदपर्यन्तम्
=प {२आ+च (प—१)} पक्षौ द्वाभ्यां भक्तौ तदा

सध=$\frac{\text{प \{२आ+च (प—१)\}}}{२}$ एतावताऽऽचार्योक्तं सम्यगुपपद्यते ।

अत्र आ+च (प—१)=अन्त्यधनम् । $\frac{\text{२आ+च (प—१)}}{२}$=मध्यधनम् ।

मध्यध × प = सर्वधनम् । सिद्धान्त शेखरे "व्येक गच्छचययोर्वधे मुखेनान्वितेऽन्त्यधनमादियुतं तत् । अर्धितं भवति मध्यमं धनं तत्पदघ्नमखिलं धनं भवेत्" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव । लीलावत्यां 'व्येक पदघ्नचयोमुखयुक् स्यादन्त्यधनं मुखयुक् दलितं तत् । मध्यधनम् पदसङ्गुणितं तत्सर्वधनं गणितं च तदुक्तम् ।। भास्करोक्तमिदमाचार्योक्तानुरुपमेव विज्ञैर्ज्ञेयमिति ।। १७ ।।

अब श्रेढ़ी व्यवहार आरम्भ किया जाता है ।

हि. भा. — आदि-चय और गच्छके ज्ञान से अन्त्यधन-मध्यधन और सर्वधन के ज्ञान के लिये विधि निम्नांकित है । पद में से एक घटाकर चय से गुणा करने से जो आता हो उसमें आदि जोड़ने से अन्त्यधन होता है । अन्त्यधन में आदि जोड़ कर आधा करने से मध्यधन होता है, मध्यधन को पद से गुणा करने से सर्वधन होता है ।। १७ ।।

उदाहरण ।

यदि किसी आदमी ने प्रथम दिन में ब्राह्मण के लिये चार द्रम्म दिये और प्रत्येक दिन पांच बढ़ाकर देने के लिये निश्चय किया तो बताओ उसने एक पक्ष (पन्द्रह दिनों) में कितने द्रम्म दिये ?

न्यास आदि = ४ । चय = ५ । गच्छ = १५. तब पूर्व लिखित विधि से अन्त्यधन — ७४, मध्यधन = ३९ । सर्वधन = ५८५ इसी तरह सर्वत्र समझना चाहिए ।। १७ ।।

उपपत्ति ।

आदि = आ । चय = च । गच्छ = पद = प । सर्वधन = सध

तब उदाहरण के अनुसार आ + (आ + च) + (आ + २च) (आ + ३ च) ··· + आ + (प — १) च = सध अथवा आ + च (प — १) आ + च (प — २) + ··· + आ = सध

दोनों का योगकरने से

२ आ + च (प - १) + २ आ + च (प — १) ········ पदपर्यन्त = २ सध = प {२ आ + च (प — १} = २ सध $\therefore$ सध = $\frac{\text{प}\{\text{२ आ + च (प — १)}\}}{\text{२}}$ यहां आ + च (प — १) = अन्त्यधन । $\frac{\text{२आ + च (प १)}}{\text{२}}$ = मध्यधन । मध्यधन × प = सर्वधन । इससे आचार्योक्त उपपन्न हुआ ।। सिद्धान्त शेखर में 'व्येकगच्छ चययोर्वधे' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपत्युक्त पद्य तथा लीलावती में 'व्येकपदघ्नचयो मुखयुक्' इत्यादि संस्कृतोपपत्ति में लिखित भास्करोक्त पद्य भी आचार्योक्तानुरूप ही है इति ।। १७ ।।

अत्र चतुर्वेदाचार्यः। 'इदानीं द्विगुणत्रिगुणादिकोत्तरेण फलानयन प्रदर्शनार्थं श्लोकत्रयमस्मदीयमेनावद्यथा'—

इष्ठगच्छेऽवलेऽरूपे वर्ग कल्पं न्यसेदनः।
गच्छे निःशेपतां यावत् तनश्चोत्क्रमवर्णनः॥

गुणाकारसमाकल्पे वर्गो वर्गप्रसिद्धित'।
व्येकरूपं ततो राशिं रूपहीनगुणोद्धृतम्।

आद्यसंख्याहत कृत्वा द्विगुणादौ फलं वदेत्।
छन्दश्चित्युत्तरादेव प्रकार इह दर्शित्'॥

इष्टगच्छेऽरूपे ये (समे) दले (अर्धिते) वर्ग न्यस्येत्। विपमे गच्छे नरेके कृते गुणकं स्थापयेत्। एवं गच्छे निःशेपतां यावदर्थाद्गच्छनाशपर्यन्तं कार्यम्। तत उत्क्रमेण गुणवर्गजं फलमिनि तत्रान्ते सर्वदैव गुणक एव भवति, अन्ते गुणकस्थाने उद्दिष्टगुणकं दृश्यत्वेन विन्यस्य तस्मात् उत्क्रमेण गुणवर्गजं फलमर्थाद्गुणकस्य पदधातरूपं फल यद् भवति तद्व्येकं (एकेन हीनं) कार्यम् रूपहीनगुणोद्धृतं (एकहीनेन गुणेन भक्तं) आद्य संख्याहतं (आद्येन गुणितं) तदा द्विगुणादौ (द्वयादि गुणोत्तरश्रेढ्या) फलं (सर्वधनं) भवेत्। उपर्युक्त श्लोकैः स्पष्टतयाऽयमाशयो नावगम्यते। लीलावत्यां भास्करोक्तसूत्रादेनस्याऽशयः स्पष्टरूपेणावगम्यते॥

अत्र चतुर्वेदाचार्योक्तमुदाहरणम्।

त्रिगुणोत्तरया वृद्धया रूपपट्कं दिने दिने।
यो ददाति दशाहानि दत्त तेन कियद् भवेत्॥

न्यासः आदिः=६। चयस्त्रिगुणः=३। गच्छः=१० तदा व्येकरूपं ततो राशिं रुपहीनगुणोद्धृतमित्यादिना गणितं (सर्वधनं)=१७७१४४ भवतीति॥

अन्यदुदाहरणम्।

पंचार्ध गुणया वृद्धया यो ददाति दिनत्रयम्।
सार्धरूपत्रयं तेन कियद्दत्तं धनं वद॥

न्यासः आदिः=सार्धरूपत्रयम्=$\frac{7}{2}$। चयः सार्धरूपद्वयम्=$\frac{5}{2}$। गच्छः=३ तदा पूर्ववत्क्रियया जातं सर्वधनम्=२७३॥

भास्कराचार्योक्तमुदाहरणम्।

पूर्व वराटक युगं येन द्विगुणोत्तरं प्रतिज्ञातम्।
प्रत्यहमर्थिजनाय स मासे निष्कान् ददाति कति॥

न्यासः आदिः=२ । चयो द्विगुण वृद्धिः=२ । गच्छः=३०

तदा सूत्रानु सारेण $\frac{३०}{२}$ = १५ वर्गः

१५—१ = १४ गुणकः

$\frac{१४}{२}$ = ७ वर्ग.

७—१ = ६ गुणकः

$\frac{६}{२}$ = ३ वर्गः

३—१ = २ गुणकः

$\frac{२}{२}$ = १ = वर्गः

१—१ = ० गुणकः :

ततोऽन्त्याद् व्यस्तं 'व्येकरूपं ततो राशिं रूपहीनगुणोद्धृत 'मित्यादिना $\frac{\text{गुणवर्गज फल—१}}{\text{गु—१}}$ × आदि = $\frac{१०७३७४१८२४—१}{२—१}$ × २ = २१४७४८३६४६ = सर्वधनम् = वराटकाः, ततो निष्काः=१०४८५७, द्रमाः = ९ पणाः=९, काकिण्यौ=२, वराटकाः = ६ ॥

अन्यदुदाहरणम् ।

आदिर्द्वयं सखे वृद्धिः प्रत्यहं त्रिगुणोत्तरा ।

गच्छः सप्त दिनं यत्र गणितं तत्र किं वद ॥

न्यासः आदिः=२ । चयः=३ । गच्छ ७ तदा पूर्ववत्क्रिया करणेन जातं सर्वधनम्=२१८६ ॥

अत्रोपपत्तिः ।

उदाहरणानुसारेण = आ + आ.गु + आ.गु^{२} + आ.गु^{३} + ⋯ = सर्वधनम् = सध पक्षौ गुणकेन गुणितौ आ. गु + आ. गु^{२} + आ. गु^{३} + आ.गु^{४} + ⋯⋯ ⋯ = सध × गु

द्वयोरन्तरेण ।

आ. गु^{४}—आ = (गु^{४}—१) = सध × गु—सध = सध (गु—१), पक्षौ गु—१ भक्तौ तदा $\frac{\text{आ. (गु}^{४}\text{—१)}}{\text{गु—१}}$ = सध । अत्र पदम् = ४, गुणवर्गज फलम् = गु^{४}, एतेन 'व्येक रूपं ततो राशिं रूपहीनगुणोद्धृत' मित्याद्याचार्योक्तमुपपद्यते । सिद्धान्त शेखरे 'स्थापयेत् समपदेऽर्धिते कृतिं व्येकके च विषमे पदे गुणम् । उत्क्रमेण गुणवर्गजं फलमित्यादि' श्री पत्युक्तमिदमाचार्योक्ता स्पष्टमस्ति, तदुक्तितो नायमाशयः

समागच्छति । लीलावत्यां 'विषमे गच्छे व्येके गुणकः स्थाप्यः समेऽर्धिते वर्गः । गच्छक्षयान्तमन्त्याद्व्यस्तं गुणवर्गजं फल यत्तत् । व्येकं व्येकगुणोद्धृतमादिगुणं स्याद् गुणोत्तरे गणितम् भास्करोक्तमिद श्रीपत्युक्तेऽनुरूपमेवेति ।। गणेश दैवज्ञेनापि—

"गुणो निरेके विषमाख्य गच्छे समे समाभ्यां विहृतेऽपिवर्गः ।
वसुन्धरा शेष पदान्तमेवं विधिर्विधेयो विपरीतमस्मात् ।।
गुणात्प्रसाध्यं गुणवर्गजातं फलं निरेकं च निरेककेण ।
गुणेन भक्तं वदनेन निघ्नं गुणोत्तरे तद्गणितं प्रणीतम्" इति भास्करोक्तानुरूपमेव कथ्यते ।

अस्योदाहरणम् ।

सुवर्णयुग्मं प्रथमेऽन्हि दत्वा दातुं प्रवृत्तो द्विगुणोनरं यः ।
महीभुजा तेन दश प्रमाणैर्दिनैः कियद्दत्तमिदं वदाशु ।।

न्यासः आदिः = २ । चयः = २ । गच्छः = १० तदा स्थापयेत् समपदेऽर्धिते कृतिमित्यादिना गुणवर्गज फलम् = १०२४ । ततो गुणवर्गज फलं व्येक गुणोद्धृत मादिगुणमित्यनेन सर्वधनम् = २०४६ ।।

अत्र सर्वधनानयने मया यत्र यत्राऽऽचार्य शब्द प्रयोगः कृतस्तत्र तत्र तेन चतुर्वेदाचार्यो बोध्य इति ।।

अब द्विगुणत्रिगुणादिक चय (गुणोत्तर श्रेढ़ी) में फलानयन के लिये चतुर्वेदाचार्य कहते हैं ।

हि. भा.—विषम संख्यक गच्छ रहने से उसमें एक घटा कर गुणक स्थापन करना, सम संख्यक गच्छ में उसको आधा करके वर्ग स्थापन करना, यह क्रिया गच्छ की समाप्ति तक करनी चाहिये, अन्त्य से विपरीत (गुणक को वर्ग—वर्ग को गुणक मान कर) गुण वर्गज फल (गुणक का पदघात) जो हो उस में से एक घटा देना चाहिये तब उसको एक रहित गुणक से भाग देकर जो लब्धि हो उसको आदि से गुणा करने से गुणोत्तर श्रेढी में गणित (सर्वधन) होता है इस तरह स्पष्ट विषय चतुर्वेदाचार्य के सूत्रों से नहीं होता है । लीलावती में भास्करोक्त पद्यों से उपर्युक्त आशय स्पष्ट होता है ।

यहां चतुर्वेदाचार्योक्त दो उदाहरण हैं प्रथम उदाहरण यह है—जो किसी आदमी ने पहले दिन में छः रुपये किसी को दिये—और दस दिनों तक त्रिगुण वृद्धि करके दिये तब उसने कितना धन दिया सो कहो ।।

न्यास—आदि=६ । चय=३ । गच्छ=१० तब उपर्युक्त भाष्योक्त क्रिया से गणित=१७४१४४=सर्वधन ॥

दूसरा उदाहरण ।

जब एक आदमी ने किसी को प्रथम दिन साढ़े तीन रुपये दिये, और तीन दिन तक $\frac{५}{२}$ गुणित वृद्धि करके दिये तब उसे कितना धन दिया गया सो कहो ॥

न्यास आदि=$३\frac{१}{२}=\frac{७}{२}$ । चय=$\frac{५}{२}$ । गच्छ=३ तब पूर्ववत् क्रिया करने से सर्वधन =२७३ हुआ ।

यहाँ भास्करोक्त उदाहरण यह है ।

किसी आदमी ने याचक के लिये प्रथम दिन में दो वराटक (कौडी) दी । तथा प्रत्येक दिन द्विगुण वृद्धि से देने के लिये प्रतिज्ञा की तो उसने एक महीने में कितना निष्क दिया सो कहो ।

न्यास आदि=२ । चय=२ । गच्छ=३०

भाष्योक्त स्थापन क्रम से $\frac{३०}{२}$=१५ वर्ग

१५—१=१४ गुणक

$\frac{१४}{२}$=७ वर्ग

७—१=६ गुणक

$\frac{६}{२}$=३ वर्ग

३—१=२ गुणक

$\frac{३}{२}$=१ वर्ग

१—१=० गुणक

अब अन्त्य से विपरीत भाष्योक्त क्रिया से $\frac{\text{गुणवर्गजफल}-१}{\text{गु}-१}\times$ आदि

$=\frac{१०७३७४१८२४-१}{२-१}\times२=२१४७४८३६४६$ वराटक=सर्वधन, अब इस से निष्क=१०४८५७, द्रम्म=९, पण=९, काकिणी=२ वराटक=६=सर्वधन ॥

दूसरा उदाहरण ।

आदि=२ । चय=३ । गच्छ=७ तब पूर्ववत् स्थापनादि क्रिया करने से सर्वधन =२१८६ हुआ ॥

उपपत्ति ।

उदाहरण के अनुसार आ+आ.गु+आ. $\text{गु}^२$+$\text{आ}^३$गु+ ………… सर्वधन=सध

दोनों पक्षों को गु गुणने से आ. गु+आ. $\text{गु}^२$+आ. $\text{गु}^३$+आ. $\text{गु}^४$…=सध. गु

दोनों का अन्तर करने से

$आ. गु^{४} — आ = आ (गु^{४} — १) = सध. गु — सध = सध (गु — १)$

दोनो पक्षों को गु — १ इससे भाग देने से $\frac{आ (गु^{४} — १)}{गु — १}$ = सध, यहां पद = ४, गुणवर्गफल = $गु^{४}$, इससे सिद्धान्त शेखरोक्त 'स्थापयेत् समपदेऽर्धिते' इत्यादि संस्कृतोपपत्ति में लिखित पद्य उपपन्न होता है, लीलावती में 'विषमे गच्छेव्येके गुणकः स्थाप्यः' इत्यादि संस्कृतोपपत्ति में लिखित भास्करोक्त पद्य श्रीपत्युक्त सूत्र के अनुरूप ही है।

गणेश दैवज्ञ भी 'गुणोनिरेके विषमाख्य गच्छे' इत्यादि संस्कृतोपपत्ति में लिखित पद्यों से श्रीपत्युक्त के अनुसार ही कहते है इति ॥

इदानीं गच्छ (पद) ज्ञानार्थ सूत्रम् ।

उत्तरहीन द्विगुणादिशेषवर्गं धनोत्तराष्टवधे ।
प्रक्षिप्य पदं शेषोनं द्विगुणोत्तरहृतं गच्छः ॥१८॥

सु. भा.—द्विगुणश्चासावादिश्च द्विगुणादिः । उत्तरहीनाद् द्विगुणादेर्यः शेषः स उत्तरहीनद्विगुणादिशेषस्तस्य वर्ग धनोत्तराष्टवधे सर्वधनचयाष्टानां वधे प्रक्षिप्य पदं ग्राह्यं तत्पूर्वसाधितशेषोनं द्विगुणचयहृतं गच्छः स्यात् ।

अत्रोपपत्यर्थं मच्छोधितभास्करलीलावती द्रष्टव्या ।

अत्र चतुर्वेदोक्तोद्देशकः—

मुखे दशेष्टका यत्र पंच पंचाधिकाश्चये ।
इष्टकानां शतं लग्नं चितौ तत्र पदं वद ॥

न्यासः । आ १० । च ५ । सर्वधनम् १०० । करणम् ।

शे = २ आ — च = २ × १० — ५ = १५ ।

सध × च × ८ = १०० × ५ × ८ = ४०००

$शे^{२}$ + सध × च × ८ = २२५ + ४००० = ४२२५ अस्य मूलम् ६५ ।

$\frac{मू — शे}{२ च} = \frac{६५ — १५}{२ × ५} = \frac{५०}{१०} = ५$ = गच्छः ।

अत्र चतुर्वेदाचार्येण निजटीकायां ये मुखादिज्ञानाय प्रकारा लिखितास्त एव भास्करेण लीलावत्यां सूत्रत्वेन निबद्धाः ।

अत्रैव चतुर्वेदाचार्यः ।

'एवमादि बालव्युत्पत्त्यर्थं बहुधोदाहरणीयम् । अस्माभिर्ग्रन्थगौरवभयान्नोदाहृतं यतः सकलसिद्धान्तोऽस्माभिर्व्याख्यातुमारब्ध' इति ।१८।

वि. भा.—उत्तर (चय) हीनाद् द्विगुणितादेर्यः शेषः स उत्तरहीनद्विगुणादिशेषस्तस्य वर्गं धनोत्तराष्टवधे (सर्वधनचयाष्टानां घाते) प्रक्षिप्य पदं (मूलं) ग्राह्यं तत्पूर्वोक्त शेषेण हीनं द्विगुणितचयेन भक्तं तदा गच्छो भवतीति ॥१८॥

अत्र चतुर्वेदाचार्योक्तमुदाहरणम् ।

मुखेदशेष्टका यत्र पंच पंचाधिकाश्च ये ।
इष्टकानां शतं लग्नं चितौ तत्र पदं वद ॥

उदाहरणानुसारेण न्यासः आदिः$=$१० । चयः$=$५ । सर्वधनम्$=$सध $=$१०० । तदा सूत्रोक्तया २ आ$-$च$=$शे$=$२$\times$१०$-$५$=$२०$-$५$=$१५ $\therefore$ शे$^{२}=$ २२५, ८ सध$\times$चय$=$८$\times$१००$\times$५$=$४०००, ततः ८ सध$\times$च$+$शे$^{२}=$४००० $+$२२५$=$४२२५ अस्य मूलम्$=$६५, $\frac{\text{मूल}-\text{शेष}}{२\ \text{चय}}=\frac{६५-१५}{२\times५}=\frac{५०}{१०}=५$ $=$गच्छः ॥१८॥

अत्रोपपत्तिः ।

अत्र कल्प्यते आदिः$=$आ । चयः$=$च । सर्वधनम्$=$सध । गच्छः$=$य ।

तदा व्येक पदघ्नचयो मुखयुगित्यादि भास्करोक्त्या 'पदमेकहीनमुत्तर गुणितमित्याद्याचार्योक्त्या वा' $\frac{\{(य-१)\ च+२\ आ)\}य}{२}=\frac{य^{२}.\ च-य.\ च+२आ.य}{२}$ $=$सध, पक्षौ द्वाभ्यां गुणितौ तदा य^{२}. च$+$२ आ. य$-$य. च$=$य^{२}. च$+$य (२आ $-$च)$=$२ सध, पक्षौ चतुर्भिर्गुणितौ तदा ४य^{२}. च$+$४य (२ आ$-$च)$=$८ सध, पक्षौ चयभक्तौ तदा $४\ य^{२}+\frac{४\ य\ (२\ आ-च)}{च}=\frac{८\ सध}{च}$ पुनः पक्षयो $\left(\frac{२\ आ-च}{च}\right)^{२}$ रितियोजनेन $४य^{२}+\frac{४\ य\ (२\ आ-च)}{च}+\frac{(२\ आ-च)^{२}}{च^{२}}$ $\frac{८\ सध}{च}+\frac{(२आ-च)^{२}}{च^{२}}=\frac{८\ सध.\ च+(२\ आ\ \ च)^{२}}{च}$ पक्षयोर्मूल ग्रहणेन

$$२य+\frac{२\ आ-च}{च}=\frac{\sqrt{८\ सध.च+(२आ-च)^{२}}}{च}=\frac{\sqrt{८\ सध\ च.+शेष^{२}}}{च}$$

$=२\ य+\frac{शेष}{च}=\frac{\sqrt{८सध.\ च+शे^{२}}}{च}$ पक्षौ $\frac{शेष}{च}$ हीनौ तदा २य$=$ $\frac{\sqrt{८सध.\ च+शे^{२}}}{च}-\frac{शेष}{च}\ \therefore य=\frac{\sqrt{८सध.\ च+शे^{२}}-शेष}{२च}$ एतेनाऽऽचार्योक्तं

सम्यगुपपद्यते । सिद्धान्तशेखरे 'चयार्धभक्ते गणिते निदध्यात् गतोत्तरार्ध मुखमुत्तराप्तम् । कृतीकृतं तस्य पदं विहीनं प्राग्राशिमूलेन च गच्छमाहुः' इति श्रीपत्युक्ते मूलमाचार्योक्तसूत्रमेव । लीलावत्यां भास्कराचार्येण श्रीपत्युक्तमेव किंचित्परिवर्त्य "श्रेढीफलादुत्तर लोचनघ्नाच्चयार्धवक्त्रान्तरवर्गयुक्तात् । मूलं मुखोनं चयखण्डयुक्तं चयोद्धृतं गच्छमुदाहरन्ति" इति कथितम् । श्रीधराचार्येणापि "अष्टोत्तरहतफलतो द्विगुणादिप्रचयविवरकृतियुक्तात् । मूलं द्विगुण मुखोनं सचयं द्विचयोद्धृतं गच्छः" आचार्योक्तानुरूपमेवोक्त मिति ॥१८॥

अब गच्छानयन के लिये कहते है ।

हि. भा.—द्विगुणित आदि में चय को घटाकर जो शेष रहे उसके वर्ग को सर्वधन चय और आठ के घात में जोडकर मूल लेना, उस (मूल) मे से शेष को घटाकर द्विगुणित चय से भाग देने से गच्छ होता है ॥१८॥

यहां चतुर्वेदाचार्योक्त उदाहरण है ।

किसी चिति (भाठा) मे मुख में दस ईट है और पाच पाच की वृद्धि करके सौ ईट लगा तब उसमे पद (गच्छ) को कहो ।

उदाहरण के अनुसार न्यास आदि $=$ १० । चय $=$ ५ । सर्वधन $=$ १०० $=$ सध

तब $२ \text{ आ} - \text{च} = \text{शेष} = २ \times १० \quad ५ = २० - ५ = १५ \quad \therefore \text{ शेष}^२ = २२५$ ।

$८ \text{ सध} \times \text{चय} = ८ \times १०० \times ५ = ४००० \quad \therefore ८ \text{ सध. चय} + \text{शेष}^२ = ४००० + २२५$

$= ४२२५$, इसका मूल $= ६५ \quad \frac{\text{मूल} - \text{शेष}}{२ \text{ चय}} = \frac{६५ - १५}{२ \times ५} = \frac{५०}{१०} = ५ = \text{गच्छ}$ ॥१८॥

उपपत्ति ।

आदि $=$ आ । चयः $=$ च । सर्वधन $=$ सध, गच्छ प्रमाण $=$ य, तब 'व्येक पदघ्नचयो मुखयुक्' इत्यादि से $\frac{\{(\text{य} - १) \text{ च} + २\text{आ})\}}{२} \text{ य} = \text{सध} = \frac{\text{य}^२.\text{च} - \text{य. च} + २\text{आ. य}}{२}$

दोनों पक्षों को दो से गुणा करने से $\text{य}^२.\text{ च} + २ \text{ आ. य} - \text{य. च} = २ = \text{सध} = \text{य}^२.\text{च} + \text{य} (२ \text{ आ} - \text{च}) = २ \text{ सध}$, दोनों पक्षों को चार से से गुणा करने शे $४\text{य}^२.\text{च} + ४ \text{य} (२ \text{ आ} - \text{च}) = ८ \text{ सध}$ दोनों पक्षों को चय से भाग देने से $४ \text{ य}^२ + \frac{४ \text{ य} (२ \text{ आ} - \text{च})}{\text{च}} = \frac{८\text{सध}}{\text{च}}$ पुनः दोनों पक्षों में $\left(\frac{२ \text{ आ} - \text{च}}{\text{च}}\right)^२$ जोड़ने से $४\text{य}^२ + ४\text{य} \frac{(२ \text{ आ} - \text{च})}{\text{च}} + \frac{(२ \text{ आ} - \text{च})^२}{\text{च}^२}$

$= \frac{८ \text{ सध}}{\text{च}} + \frac{(२ \text{ आ} - \text{च})^२}{\text{च}^२} = \frac{८ \text{ सध. च} + (२ \text{ आ} - \text{च})^२}{\text{च}^२}$ दोनों पक्षों का मूल

लेने से $२ य + \frac{२ आ - च}{च} = \frac{\sqrt{८ सध. च + (२ आ - च)^२}}{च} = \frac{\sqrt{८ सध. च + शेष^२}}{च}$

$२ य + \frac{शेष}{च}$ दोनों पक्षों में $\frac{शेष}{च}$ इसको घटाने से $\frac{\sqrt{८ सध. च + शेष^२}}{च} - \frac{शेष}{च}$

$= २य \therefore \frac{\sqrt{८ सध. च + शेष^२}}{२ च} - \frac{शेष}{२ च} = \frac{\sqrt{८ सध. च + शेष^२} - शेष}{२ च} = य = गच्छ$

इससे आचार्योक्त गच्छानयन उपपन्न हुआ। सिद्धान्त शेखर में "चयार्धभक्ते गणिते निदध्यात्' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपत्युक्त सूत्र का मूल आचार्योक्त सूत्र ही है। श्रीपत्युक्त ही को कुछ परिवर्त्तन कर लीलावती में भास्कराचार्य 'श्रेढ़ीफलादुत्तर लोचनघ्नात्' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से' गच्छानयन किया है इति ॥१८॥

इदानी सङ्कलितैक्यानयनाय करण सूत्रम्।

एकोत्तरमेकाद्यं यदीष्ट गच्छस्य भवति सङ्कलितम्।
तद् द्वियुतगच्छ गुणितं त्रिहृतं सङ्कलित सङ्कलितम्॥ १९॥

सु. भा.—स्पष्टार्थम्। 'सा द्वियुतेन पदेन विनिघ्नी स्यात् त्रिहृता खलु सङ्कलितैक्यम्' इति भास्करोक्तमेतदनुरूपमेव।

अत्रोपपत्यर्थं द्रष्टव्या मच्छोधिता भास्कर लीलावती।

वि. भा.—यद्येकोत्तरमेकाद्यमर्थादेकमारभ्य इष्टस्य गच्छस्य एकोत्तरं सङ्कलितं यद्भवेत्तद् द्वियुतगच्छगुणितं त्रिभक्तं तदा सङ्कलितसङ्कलितं (सङ्कलितैक्यं) भवतीति। सङ्कलितं नाम पदपर्यन्तानामेकाद्यङ्कानां योगः, तदर्थमाचार्येण कोऽपि विधिर्नोक्तः। यतोगच्छाधिक्ये योगकरणक्रियया सङ्कलितानयनाय महानेवायासो भवतीति, सङ्कलितानयनाय लीलावत्यां 'सैक पदघ्नपदार्थमथैकाद्यङ्कयुतिः किल सङ्कलिताख्या' इति भास्करोक्ता रीतिरतीवशोभनाऽस्ति, आचार्येणोदाहरणमपि न दत्तमतोऽत्र भास्करोक्तमुदाहरणम्—

एकादीनां नवान्तानां पृथक् सङ्कलितानि मे।
तेषां सङ्कलितैक्यानि प्रचक्ष्व गणकद्रुतम्॥

न्यासः १। २। ३। ४। ५। ६। ७। ८। ९ भास्करोक्त सूत्रानुसारेणैषां पृथक् सङ्कलितानि=१। ३। ६। १०। १५। २१। २८। ३६। ४५ आचार्योक्तसूत्रेण क्रमेण सङ्कलितैक्यानि च=१। ४। १०। २०। ३५। ५६। ८४। १२०। १६५॥ १९॥

अत्रोपपत्तिः

यदि पदम्=५ तदैकादीनामङ्कानां पदपर्यन्तं क्रमेणोत्क्रमेण च स्थापनेन १।२।३।४।५ एनयोर्योगकरणेन सर्वत्रैव ६।६।६।६।६=प+१ इति
५।४।३।२।१
पद पर्यन्तमस्ति तेने (प+१) नि पद गुणितं तदा सर्वेषां योगो भवेत्तथाकृते प (प+१)=२ सङ्कलितम् ∴ $\frac{प (प+१)}{२}$ = सङ्कलितम्, एनेन भास्करोक्तं सङ्कलितानयनं 'सैकपदघ्न पदार्ध' सम्यगुपपन्नम् ॥ अनेन विधिना यस्मात्कस्माचिदप्यङ्कादेकवृद्धयङ्कानां सङ्कलितानयनं न भवत्यतस्तदर्थं विधिः प्रदर्श्यते । कल्प्यते योगमानम्=आ+(आ+१)+(आ+२)+(आ+३)+(आ+४)+...प

=आ. प+$\frac{प (प—१)}{२}$ एतेन सिद्धं यद्वचेक पदगुणितं पदार्धं पदगुणितेनाद्येन युतं तदाऽभीष्टाङ्कतः पदपर्यन्तानामेकोत्तराणामङ्कानां योगो भवेदिति ॥

अब एक से लेकर पद पर्यन्त अङ्कों के योग (सङ्कलित) के लिये विधि कहते हैं।

हि. भा.—पद पर्यन्त एकादि अङ्कों के योग को सङ्कलित कहते हैं। इसके लिये आचार्य ने कोई विधि नही बताई है। गच्छ (पद) संख्या की अधिकता मे योग करने की क्रिया से सङ्कलितानयन के लिये बहुत श्रम होता है, सङ्कलितानयन के लिये लीलावती में 'सैक पदघ्नपदार्धमथैकाद्यङ्कयुतिः' यह भास्करोक्तरीति बहुत अच्छी है। आचार्य ने उदाहरण भी नहीं दिये हैं इसलिये यहा भास्करोक्त उदाहरण ही हम देते हैं।

उदाहरण

एक से लेकर नौ पर्यन्त अङ्कों के पृथक्-पृथक् सङ्कलित (योगफल) कहो।

न्यास १।२।३।४।५।६।७।८।९। भास्करोक्त सूत्र के अनुसार इन सवों के पृथक्-पृथक् सङ्कलित १।३।१०।१५।२१।२८।३६।४५ यही उत्तर हुआ।

उपपत्ति।

यदि प=५ तक एकादि अङ्कों को पद पर्यन्त क्रम से और उत्क्रम से स्थापन करने से १।२।३।४।५ इन दोनों का योग करने से सब जगह ६।६।६।६।६
५।४।३।२।१
=प+१, परन्तु प+१, यह पद पर्यन्त है इसलिये प+१ इसको पद से गुणा देने से सवों का योग हुआ प (प+१)=२ सङ्कलित ∴ $\frac{प (प+१)}{२}$ =सङ्कलित, इससे भास्करोक्त सङ्कलितानयन उपपन्न होता है। सिद्धान्त शेखर में श्रीपति ने भी आचार्य ही की तरह इसके लिये कोई विधि नहीं लिखी है॥

यदि किसी अङ्क से पदपर्यन्त एकोत्तर अङ्कों का योग करना होगा तो पूर्वोक्त सङ्कलितानयन की रीति से नही होगा, इसलिये उसके लिये नियम लिखते है।

कल्पना करते है योगमान

$= \text{आ} + (\text{आ}+१) + (\text{आ}+२) + (\text{आ}+३) + (\text{आ}+४) + \cdots\cdots \text{प}$

$$= \text{आ}.\ \text{प} + \frac{\text{प}\ (\text{प}-१)}{२}\ ।\ \text{प} = \text{पद}$$

इससे सिद्ध हुआ कि एकोन पद से पदार्ध को गुणा कर जो हो उसमे पद गुणित आदि को जोड़ने से इष्टाङ्क से लेकर पद पर्यन्त एकोत्तर अङ्कों के योगफल होता है ॥ १८ ॥

अथ सङ्कलितैक्यानयनार्थमुपपत्तिः ।

अथ कल्पते $\text{प}.^{३}\text{गु} + \text{प}.^{२}\text{गु}_{१} + \text{प}.\text{गु}_{२} = \text{सङ्कलितैक्यम्} = \text{संऐ}$

यदि $\text{प} = १$ तदा $\text{गु} + \text{गु}_{१} + \text{गु}_{२} = १\ \therefore\ \text{गु} = १ - (\text{गु}_{१} + \text{गु}_{२})$ ………(१)

यदि $\text{प} = २$ तदा सङ्कलितैक्य स्वरूपे उत्थापनेन $८\ \text{गु} + ४\ \text{गु}_{१} + २\ \text{गु}_{२} = ४$

$\therefore\ \text{गु} = \frac{४ - ४\ \text{गु}_{१} - २\ \text{गु}_{२}}{८}$ ……………………………………… (२)

यदि $\text{प} = ३$ तदोत्थापनेन $२७\ \text{गु} + ९\ \text{गु}_{१} + ३\ \text{गु}_{२} = १०$ समशोधनेन $२७\ \text{गु} =$ $१० - ९\ \text{गु}_{१} - ३\ \text{गु}_{२}\ \therefore\ \text{गु} = \frac{१० - ९\ \text{गु}_{१} - ३\ \text{गु}_{२}}{२७}$ ……………… ……(३)

ततः (१) (२) अनयोः समीकरणम् $१ - \text{गु}_{१} - \text{गु}_{२} = \frac{४ - ४\ \text{गु}_{१} - २\ \text{गु}_{२}}{८}$

छेदगमेन $८ - ८\ \text{गु}_{१} - ८\ \text{गु}_{२} = ४ - ४\ \text{गु}_{१} - २\ \text{गु}_{२}$ समशोधनेन $४ - ६\ \text{गु}_{२} = ४\ \text{गु}_{१}$

$\therefore\ \frac{४ - ६\ \text{गु}_{२}}{४} = \text{गु}_{१}$ ………(क)

तथा (१) (३) एतयोः समीकरणम् $१ - \text{गु}_{१} - \text{गु}_{२} = \frac{१० - ९\ \text{गु}_{१} - ३\ \text{गु}_{२}}{२७}$

छेदगमेन $२७ - २७\ \text{गु}_{१} - २७\ \text{गु}_{२} = १० - ९\ \text{गु}_{१} - ३\ \text{गु}_{२}$ समशोधनेन $१७ - २४\ \text{गु}_{२} =$ $१८\ \text{गु}_{१}$

$\therefore\ \frac{१७ - २४\ \text{गु}_{२}}{१८} = \text{गु}_{१}$ … (ख) ततोऽनयोः (क) (ख) समीकरणम्

$\frac{४ - ६\ \text{गु}_{२}}{४} = \frac{२ - ३\ \text{गु}_{२}}{२} = \frac{१७ - २४\ \text{गु}_{२}}{१७}$ छेदगमेन $३६ - ५४\ \text{गु} = ३४ - ४८\ \text{गु}_{२}$

समशोधनेन $२ = ६\ \text{गु}_{२}\ \therefore\ \frac{२}{६} = \frac{१}{३} = \text{गु}_{२}$ तत उत्थापनेन $\text{गु}_{१} = \frac{१}{२}$, $\text{गु} = \frac{१}{३}$ अत एभिः (गु, $\text{गु}_{१}$, $\text{गु}_{२}$) सङ्कलितैक्यस्वरूपे उत्थापनेन $\frac{१}{६}.\ \text{प}^{३} + \text{प}^{२}.\ \frac{१}{२} + \text{प}.\ \frac{१}{३} = \text{संऐ}$

$$=\frac{प^3+3प^2+2प}{6}=\frac{प}{6}(प^2+3प+2)=\frac{प}{6}\{(प+2)(प+1)\}$$

$$=\frac{प}{3\times2}\{(प+2)(प+1)\}$$

$$=\frac{(प+2)}{3}\;\frac{(प+1)प}{2}=\frac{(प+2)}{3}\times सङ्कलित=सङ्कलितैक्यम्$$

एतेना 'तद्द्वियुतगच्छगुणितं त्रिहृतमित्यादि' आचार्योक्तमिदमुपपन्नम् । लीलावत्यां 'सा द्वियुतेन पदेन विनिघ्नी स्यात् त्रिहृता खलु सङ्कलितैक्यम्' भास्करोक्त मिदमाचार्योदितानुरूपमेव । सिद्धान्त शेखरे 'द्वियुक्तगच्छाभिहतं त्रिभक्तं मनस्विन: सङ्कलितैक्यमाहु: श्रीपत्युक्तमिदमप्याचार्योक्तानुरूपमेवेति ॥ १९ ॥

अब सङ्कलितैक्यानयन के लिये कहते हैं।

हि. भा.—एक से आरम्भ कर इष्ट गच्छका एकोत्तर सङ्कलित जो होता है उसको दो युक्त गच्छ से गुणा कर तीन से भाग देने से सङ्कलितैक्य प्रमाण होता है। गच्छ (पद) पर्यन्त एकादि अङ्कों के योग का नाम सङ्कलित है उसके लिए आचार्य ने विधि नहीं लिखी है, सो ठीक नहीं है, क्योंकि गच्छ प्रमाण अधिक रहने से योग करने की क्रिया द्वारा सङ्कलित ज्ञान के लिये बहुत ही श्रम करना होगा, सङ्कलितानयन के लिए लीलावती में 'सैक पदघ्न पदार्ध मथैकाद्यङ्कयुति.' इत्यादि भास्करोक्त रीति बहुत ही सुन्दर है, आचार्य ने उदाहरण भी नहीं दिये है इसलिये यहां भास्करोक्त उदाहरण देते है।

एकादि से नौ पर्यन्त अङ्कों के पृथक् पृथक् सङ्कलित कहो, और उन्हीं अङ्कों के सङ्कलितैक्यो को कहो ।।

न्यास १। २। ३। ४। ५। ६। ७। ८। ९। भास्करोक्त सूत्र के अनुसार इनके पृथक् पृथक् सङ्कलित=१ । ३ ।६। १० । १५ । २१ । २८ । ३६ । ४५, तथा आचार्योक्त सूत्र के अनुसार उन्हीं अङ्को के सङ्कलितैक्य=१ । ४ । १० । २० । ३५ । ५६ । ८४ । १२० । १६५ ॥ १९ ॥

उपपत्ति

यदि पद=५ तब एकादि अङ्कों को पदपर्यन्त क्रम से और उत्क्रमसे स्थापन करने से
१ । २ । ३ । ४ । ५ इनका योग करने से प्रत्येक स्थान मे ६, ६, ६, ६, ६=प+१, यह
५ । ४ । ३ । २ । १
पद पर्यन्त है इसलिए प+१ इसको पद से गुणा करने से सबो के योग होता है वैसा करने से $प(प+1)=2$ सङ्कलित $\therefore \frac{प(प+1)}{2}$ = सङ्कलित, इससे भास्करोक्त सङ्कलितानयन उपपन्न होता है ॥

अब सङ्कलितैक्यानयन के लिये उपपत्ति ।

यहाँ कल्पना करते है $प^3 गु + प^2 गु_1 + प. गु$ सङ्कलितैक्य = संऐ । प = पद

यदि प = १ तब उत्थापन से $गु + गु_1 + गु_2 = १$ समशोधन करने से $१ - (गु_1 + गु_2) = १ - गु_1 - गु_2 \quad \cdots (१)$

यदि प = २ तब सङ्कलितैक्य स्वरूप मे उत्थापन से $८गु + ४गु_1 + २गु_2 = ४$, $\therefore \frac{४ - ४गु_1 - २गु_2}{८} = गु \cdots\cdots (२)$

यदि प = ३ तब उत्थापन से $२७गु + ९गु_1 + ३गु_2 = १०$ समशोधन करने से $२७ गु = १० - ९गु_1 - ३गु_2 \therefore \frac{१० - ९गु_1 - ३गु_2}{२७} = गु \cdots\cdots (३)$ ।

अब (१) (२) इन दोनों के समीकरण करने से $१ - गु_1 - गु_2 = \frac{४ - ४गु_1 - २गु_2}{८}$ छेदगम से $८ - ८गु_1 - ८गु_2 = ४ - ४गु_1 - २गु_2$ समशोधन से $४ - ६गु_2 = ४गु_1 \therefore \frac{४ - ६गु_2}{४} = गु_1 \cdots\cdots (क)$ । तथा (१) (३) इन दोनो का समीकरण करने से $१ - गु_1 - गु_2 = \frac{१० - ९गु_1 - ३गु_2}{२७}$ छेदगम से $२७ - २७गु_1 - २७गु_2 = १० - ९गु_1 - ३गु_2$ समशोधन करने से $१७ - २४गु_2 = १८गु_1 \therefore \frac{१७ - २४गु_2}{१८} = गु_1 \cdots\cdots (ख)$ अब (क) (ख) इन दोनों का समीकरण करने से $\frac{४ - ६गु_2}{४} = \frac{२ - ३गु_2}{२} = \frac{१७ - २४गु_2}{१८}$ छेदगम से $३६ - ५४गु_2 = ३४ - ४८गु_2$ समशोधन करने से $२ = ६गु_2 \therefore \frac{२}{६} = \frac{१}{३} = गु_2$ इससे उत्थापन देने से $गु_1 = \frac{१}{२}$, $गु = \frac{१}{६}$ अब गु, $गु_1$, $गु_2$ इन सबों से सङ्कलितैक्य के स्वरूप में उत्थापन से $\frac{१}{६}. प^3 + प^2. \frac{१}{२} + प. \frac{१}{३}$ = सङ्कलिततैक्य = सऐ $= \frac{प^3 + ३प^2 + २प}{६} = \frac{प}{६}(प^2 + ३प + २) = \frac{प}{६}\{(प+२)(प+१)\} = \frac{प}{३ \times २}\{(प+२)(प+१)\} = \frac{प(प+१)}{२} \frac{(प+२)}{३}$ = सङ्कलित $\times \frac{(प+२)}{३}$ = सङ्कलितैक्य = संऐ

इससे 'तद् द्वियुगच्छगुणितं' इत्यादि आचार्योक्त सूत्र उपपन्न हुआ । लीलावती में 'सा द्वियुतेन पदेन विनिघ्नी' इत्यादि भास्करोक्त तथा सिद्धान्त शेखर में 'द्वियुक्तगच्छाभिहतं त्रिभक्तं' यह श्रीपति कथित सङ्कलितैक्यानयन आचार्योक्त के अनुरूप ही है इति ॥ १९ ॥

इदानी वर्गसंङ्कलितघनसङ्कलितयोः करणसूत्रम् ।

द्विगुणपदसैकगुणितं तत् त्रिहृतं भवति वर्गसंङ्कलितम् ।
घनसंङ्कलितं तत्कृतिरेषां समगोलकैश्चितयः ॥२०॥

सु. भा.—तत् सङ्कलिनं द्विगुणपदमेकयुगिनं द्विगुणं पदं कुयुतं यत् तेन गुणितं त्रिहृतं तदा वर्गसंकलितं वर्गयोगो भवेत्। तस्य सङ्कलितस्य कृतिस्तत्कृतिर्घनसङ्कलितमेकादिघनयोगो भवेत्। एषां पूर्वप्रतिपादितप्रकाराणां समगोलकैर्लोष्टिकादिभिश्चितयः प्रदर्श्याः। 'गोपालाङ्गनादिप्रत्ययार्थम्'— इति चतुर्वेदाचार्यः

तद्यथा। आ १। उ १। ग० ३ अत्र त्रिपदेयं चितिः $\begin{matrix}1\\12\\123\end{matrix}$ एवं त्रिके गच्छे

$\begin{matrix}1\\49\\9\end{matrix}$ वर्गचितिः। $\begin{matrix}1\\8\\27\end{matrix}$ घनचितिः। समकन्दुकनिवेशेन समत्रिबाहूनि कार्याणि।

तदुपरि एकोनबाहूनि कन्दुकपरिमाणानि निवेश्यानि। एवमुपरि एककन्दुकनिवेशो भवेदेवं सर्वकन्दुकानां योगः सङ्कलितमङ्कलितं भवेदेवमन्याश्चितयश्च विचिन्त्याः ॥२०॥

इति श्रेढीव्यवहारः।

वि. भा.—तत् संङ्कलितं द्विगुणपद नैकयुगितं (रूपयुत द्विगुणित पदगुणितं) त्रिभक्तं तदा वर्गसङ्कलितं (वर्गयोगो) भवति, तत्कृतिः (सङ्कलितस्य वर्गः) घनसङ्कलितं(घनयोगः) भवति, एषां समगोलकैश्चितयो भवन्तीति। आचार्येणोदाहरणं न दत्तमतो भास्करोक्तमुदाहरणं दीयते।

'तेषामेव च वर्गैक्यं धनैक्यं च वदद्रुतम्।
कृतिसङ्कलना मार्गे कुशला यदि ते मतिः॥

तेषामेवैकादीनां नवान्तानां वर्गैक्यं घनैक्यं च किं भवतीति वद।

न्यासः १। २। ३। ४। ५। ६। ७। ८। ९ सूत्रोनयैषां वर्गैक्यम् १। ५। १४। ३०। ५५। ९१। १४०। २०४। २८५ घनैक्यं च १। ९। ३६। १००। २२५। ४४१। ७८४। १२९६। २०२५ इति ॥२०॥

अत्रोपपत्तिः।

कल्प्यते $प^3.गु + प^2.गु_1 + प\ गु_2$ = वर्गयोगः = वयो, यदि प = १ तदा $गु + गु_1 + गु_2 = १ \therefore गु = १ - (गु_1 + गु_2) \cdots\cdots (१)$

यदि प = २ तदोत्थापनेन $८गु + ४\ गु_1 + २प_2 = ५$, समशोधनेन $८गु = ५ - ४गु_1 - २\ गु_2 \therefore गु = \frac{५ - ४गु_1 - २\ गु_2}{८} \cdots (२)$

यदि प = ३ तदोत्थापनेन $२७\ गु + ९\ गु_1 + ३\ गु_2 = १४$ समशोधनेन $२७\ गु = १४ - ९गु_1 - ३\ गु_2 \therefore \frac{१४ - ९\ गु_1 - ३\ गु_2}{२७} = गु \cdots\cdots\cdots (३)$

(१) (२) अनयोः समीकरणम् $१-(गु_१+गु_२)=१-गु_१-गु_२=\frac{५-४गु_१-२गु_२}{८}$ छेदगमेन $८-८गु_१-८गु_२=५-४गु_१-२गु_२$ समशोधनेन $४गु_१=३-६गु_२ \therefore गु_१=\frac{३-६गु_२}{४}$ ·········(क)

तथा (१) (३) अनयोः समीकरणम् $=१-गु_१-गु_२=\frac{१४-९गु_१-३गु_२}{२७}$
छेदगमेन $२७-२७गु_१-२७गु_२=१४-९गु_१-३गु_२$ समशोधधेन $१८गु_१=१३-२४गु_२ \therefore \frac{१३-२४गु_२}{१८}=गु_१$······ (ख)

पुनरनयोः (क) (ख) समीकरणम् $=\frac{३-६गु_२}{४}=\frac{१३-२४गु_२}{१८}$ छेदगमेन $५४-१०८गु_२=५२-९६गु_२$ समशोधनेन $२=१२गु_२ \therefore \frac{२}{१२}=\frac{१}{६}=गु_२$ तत उत्थापनेन $गु=\frac{१}{३}$, $गु_१=\frac{१}{२}$ एभिर्मानैर्वर्गयोगस्वरूपे उत्थापनेन $प^३.\frac{१}{३}+प^२.\frac{१}{२}+प.\frac{१}{६}=$ वर्गयोग $=\frac{१}{६}\left(प^३\times२+३प^२+प\right)=\frac{प}{६}\left(प^२\times२+३प+१\right)=\frac{प}{६}\left\{(प+१)(२प+१)\right\}=\frac{प}{२\times३}\left\{(प+१)(२प+१)\right\}=\frac{प(प+१)}{२}\frac{(२प+१)}{३}$
=सङ्कलित $\frac{(२प+१)}{३}$ =वर्गयोगः

इससे अचार्योक्त वर्गयोगानयन उपपन्न हुआ। लीलावत्यां 'द्विघ्नपदं कुयुतं त्रिविभक्तं संकलितेन हतं कृतियोगः' भास्करोक्तमिदं सिद्धान्तशेखरे 'संकलितं द्विगुणेन पदेन क्ष्मासहितेन हतं त्रिविभक्तम्' सकलितं कृतिजमिति श्री पत्युक्तं चाऽऽचार्योक्तानुरूपमेवेति ॥२०॥

अब वर्गयोग और घनयोग के लिये कहते हैं।

हि. भा.— द्विगुणित पद मे एक जोड़ देने से जो हो उसको सङ्कलित से गुणा कर तीन से भाग देने से वर्गयोग होता है तथा सङ्कलित के वर्ग के बराबर एकादि अङ्कों का घनैक्य होता है।

आचार्य ने उदाहरण नहीं दिया है इसलिये भास्कराचार्योक्त उदाहरण ही देते हैं। एक सौ नौ पर्यन्त अङ्कों का वर्गयोग और घनयोग क्या होता है सो कहो।

न्यास १ । २ । ३ । ४ । ५ । ६ । ७ । ८ । ९ सूत्रानुसार क्रिया करने से इन सबों का वर्गयोग=१ । ५ । १४ । ३० । ५५ । ९१ । १४० । २०४ । २८५ । तथा सङ्कलितवर्ग =घनयोग=१ । ९ । ३६ । १०० । २२५ । ४४१ । ७८४ । १२९६ । २०२५ इति ।२०।

उपपत्ति ।

कल्पना करते है $\text{प}^3 . \text{गु} + \text{प}^2 . \text{गु}_1 + \text{प} . \text{गु}_2$ = वर्गयोग = वयो.
यदि प = १ तब $\text{गु} + \text{गु}_1 + \text{गु}_2 = १ \therefore \text{गु} = १ - (\text{गु}_1 + \text{गु}_2) = १ - \text{गु}_1 - \text{गु}_2$ .... (१)

यदि प = २ तब $८ \text{ गु} + ४ \text{ गु}_1 + २ \text{ गु}_2 = ५$ समशोधन से $८ \text{ गु} = ५ - ४\text{गु}_1 - २\text{गु}_2 \therefore \text{गु} = \frac{५ - ४\text{गु}_1 - २ \text{ गु}_2}{८}$ ... (२)

यदि प = ३ तब उत्थापन से $२७ \text{ गु} + ९ \text{ गु}_1 + ३ \text{ गु}_2 = १४$ समशोधन से $२७ \text{ गु} = १४ - ९\text{गु}_1 - ३\text{गु}_2 \therefore \text{गु} = \frac{१४ - ९ \text{ गु}_1 - ३\text{गु}_2}{२७}$ ...... (३)

(१) (२) इन दोनों का समीकरण करने से $१ - \text{गु}_1 - \text{गु}_2 = \frac{५ - ४ \text{ गु}_1 - २\text{गु}_2}{८}$ छेदगम से $८ - ८\text{गु}_1 - ८ \text{ गु}_2 = ५ - ४ \text{ गु}_1 - २\text{गु}_2$ समशोधन से $४ \text{ गु}_1 = ३ - ६ \text{ गु}_2 \therefore \text{गु}_1 = \frac{३ - ६\text{गु}_2}{४}$ .... (क)

तथा (१) (३) इन दोनो का समीकरण करने से $१ - \text{गु}_1 - \text{गु}_2 = \frac{१४ - ९ \text{ गु}_1 - ३ \text{ गु}_2}{२७}$ छेदगम से $२७ - २७ \text{ गु}_1 - २७\text{गु}_2 = १४ - ९ \text{ गु}_1 - ३ \text{ गु}_2$ समशोधन करने से $१८ \text{ गु}_1 = १३ - २४\text{गु}_2 \therefore \text{गु}_1 = \frac{१३ - २४ \text{ गु}_2}{१८}$ .... (ख)

अब (क) (ख) इन दोनों का समीकरण करने से $\frac{३ - ६ \text{ गु}_2}{४} = \frac{१३ - २४ \text{ गु}_2}{१८}$ छेदगम से $५४ - १०८ \text{ गु}_2 = ५२ - ९६ . \text{ गु}_2$ समशोधन करने से $२ = १२\text{गु}_2 \therefore \frac{२}{१२} = \frac{१}{६} = \text{गु}_2$ इससे उत्थापन करने से $\text{गु} = \frac{१}{३}, \text{गु}_1 = \frac{१}{२}$ अब इन सबो को वर्गयोग स्वरूप में उत्थापन देने से $\text{प}^3 \times \frac{१}{३} + \text{प}^2 . \frac{१}{२} + \text{प} . \frac{१}{६}$ = बर्गयोग $= \frac{१}{६} (\text{प}^3 \times २ + ३\text{प}^2 + \text{प}) = \frac{\text{प}}{६} (\text{प}^2 \times २ + ३\text{प} + १)$

$= \frac{\text{प}}{६} \left\{ (\text{प}+१)(२\text{प}+१) \right\} = \frac{\text{प}}{२ \times ३} \left\{ (\text{प}+१)(२\text{प}+१) \right\} = \frac{\text{प}(\text{प}+१)}{२} . \frac{(२\text{प}+१)}{३}$ = सङ्कलित $\times \frac{(२\text{प}+१)}{३}$ = वर्गयोग,
इससे आचार्योक्त वर्ग योगानयन उपपन्न हुआ ।

लीलावती में 'द्विघ्नपदं कुयुत त्रिविभक्त'' इत्यादि भास्करोक्त तथा सिद्धान्त शेखर में 'सङ्कलितं द्विगुणेन पदेन इत्यादि' श्रीपतिकथित वर्गयोगानयन आचार्योक्त के अनुरूप ही है इति ॥ २० ॥

घन संकलितं तत्कृति रेषां समगोल कैश्चितय इत्यस्योपपत्तिः

वि. भा.—तत्कृतिः (संकलित वर्गः) घन संकलितं (एकादीनामकानां) घन योगो भवतीति ॥ २० ॥

अत्रोपपत्ति ।

अत्र कल्प्यते पदम्=प । एकादीनामंकानां घन योगा र्थं । $(१)^३+(२)^३+(३)^३+(४)^३+\cdots$ प । विचारः क्रियते ।

द्वियुक् पद मिद्धान्तेन $प^४-(प-१)^४=४प^३-६प^२+४प-१$ एवं $(प-१)^४-(प-२)^४=४(प-१)^३-६(प-१)^२+४(प-१)-१$ एवमेव $(प-२)^४-(प-३)^४=४(प-२)^३-६(प-२)^२+४(प-२)-१$ एवमग्रेऽपि ।

सर्वेषां योगेन $प^४=४\{प^३+(प-१)^३+(प-२)^३+(प-३)^३+\cdots+१^३\}-६\{प^२+(प-१)^२+(प-२)^२+(प+३)^२\cdots\cdots१^२\}+४\{प+(प-१)+(प-२)+\cdots\cdots१\}-प=४$ घनयोग-६ वर्गयोग$+४$ संकलित$-प$

ततः ४ घनयोग$=प^४+प+प(प+१)(२प+१)-२प(प+१)$
$=प^४+प+२प^३+प^२-प=प^४+२प^३+प^२$ पक्षौ चतुर्भिर्भक्तौ तदा

घनयोग $=\dfrac{प^४+२प^३+प^२}{४}=\left\{\dfrac{प(प+१)}{२}\right\}^२$ एतेनोपपन्नमाचार्योक्तम् ।

लीलावत्यां 'संकलितस्य कृतेः सममेकाद्यङ्क घनैक्यमुदीरितमाद्यैरिति, भास्करोक्तमाचार्योक्तानुरूपमेव सिद्धान्त शेखरे 'संकलितं घनजं स्यात् संकलितस्य तथा कृतिरेव' ऽनेन श्रीपतिनाप्याचार्योक्तमेव कथ्यत इति ॥ २० ॥

तत् संकलितं द्विपदसैकगुणितं द्विगुणं पदं कुयुतं यत् तेन गुणितं त्रिहृतं तदा वर्गसंकलितं वर्गयोगो भवेत् । तस्य संकलितस्य कृतिस्तत्कृतिर्धनसंकलितमेकादि घनयोगो भवेत् । एषां पूर्वप्रतिपादितप्रकाराणां समगोलकैर्लोष्टकादिभिश्चितयः प्रदर्श्याः । 'गोपालाङ्गनादि प्रत्ययार्थम्' इति चतुर्वेदाचार्यः । तद्यथा आ=१, उ=१, गच्छः=३ अत्र त्रिपदेयं चितिः १ | १२ | १२३ एवं त्रिके गच्छे वर्गाचितिः १ | ४ | ९

घनचितिः १ | ८ | २७ समकन्दुकनिवेशेन समत्रिबाहूनि कार्याणि तदुपरि एकोनबाहूनि कन्दुक परिमाणानि निवेश्यानि । एवमुपरि एककन्दुकनिवेशो भवेदेवं सर्वकन्दुकानां योगः संकलितसंकलितं भवेदेवमन्याश्चितयश्च विचिन्त्याः । चतुर्वेदाचार्येण सर्वत्रैवोदाहरणादिकमद्भुतमेव कथं प्रतिपादितमिति न जाने विज्ञा इति पश्यन्त्विति ॥ २० ॥

इति श्रेढ़ीव्यवहारः समाप्तः ।

अब एकादि अङ्कों के घनयोग के लिये कहते है।

हि. भा.—एकादि अङ्कों का जो सङ्कलित है उसका वर्ग एकादि अङ्कों का घन योग होता है ॥ २० ॥

उपपत्ति।

कल्पना करते हैं पद=प। एकादि अङ्कों का घन योग $(१^३+२^३+३^३+४^३\cdots प)$ के लिये विचार करते है।

द्वियुक् पद सिद्धान्त से $प^४-(प-१)^४=४प^३-६प^२+४प-१$ एवं
$(प-१)^४-(प-२)^४=४(प-१)^३-६(प-१)^२+४(प-१)-१$ इसीतरह
$(प-२)^४-(प-३)^४=४(प-२)^३-६(प-२)^२+४(प-२)-१$
इसीतरह आगे भी

सबों का योग करने से $प^४=४\{प^३+(प-१)^३+(प-२)^३+\cdots+१^३\}-६\{प^२+(प-१)^२+(प-२)^२+\cdots+१^२\}+४\{प+(प-१)+(प-२)+\cdots १\}-प=४$ घनयोग-६ वर्गयोग$+४$सङ्कलित$-प$,

अतः ४ घनयोग$=प^४+प+प(प+१)(२प+१)-२प(प+१)=प^४+प+२प^३+प^२-प=प^४+२प^३+प^२$ दोनो पक्षों को चार से भाग देने से घन योग $=\frac{प^४+२प^३+प^२}{४}=\left\{\frac{प(प+१)}{२}\right\}^२$ इससे आचार्योक्त 'एकादि अङ्कों के सङ्कलित के वर्ग के बराबर एकादि अङ्कों का घनयोग होता है' उपपन्न हुआ। लीलावती में 'सङ्कलितस्य कृतेः समं' इत्यादि से भास्कराचार्य भी आचार्योक्त के अनुरूप ही कहते है। सिद्धान्त शेखर में श्री पति भी इसी बात को कहते हैं ॥ २० ॥

इति श्रेढीव्यवहार समाप्त हुआ ॥

सङ्कलितज्ञानेन तत्पदज्ञानार्थं विधिः।

सैकपदघ्नपदार्धमथैकाद्यङ्कयुतिरित्यादिना सङ्कलितम्$=सं=\frac{प(प+१)}{२}=\frac{प^२+प}{२}$ | प=पदम् पक्षौ द्वाभ्यां गुणितौ $२सं=प^२+प$ पुनः पक्षौ चतुर्भिर्गुणितौ तदा $८सं=४प^२+४प$ पक्षयोरुपयोजनेन $८सं+१=४प^२+४प+१$ पक्षयोर्मूल ग्रहणेन $\sqrt{८सं+१}=२प+१$ $\therefore \frac{\sqrt{८सं+१}-१}{२}=प$ एतेन सङ्कलितज्ञानेन तत्पदानयनं जातमिति ॥

अब सङ्कलित ज्ञान से उसके पदज्ञान के लिये नियमार्थ विचार ।

'सैकपदघ्नपदार्धमथैकाद्यङ्कयुतिः' इससे सङ्कलित स्वरूप $=\frac{प\,(प+१)}{२}=\frac{प^२+प}{२}$ । प=पद दोनों पक्षों को आठ से गुणा करने से ८ सं=४ $(प^२+प)=४प^२+४प$ दोनों पक्षों में रूप जोडने से ८ सं+१=४ $प^२+४प+१$ मूल लेने से $\sqrt{८ सं+१}=२\;\; प+१$

$\therefore \sqrt{\frac{८ सं+१-१}{२}}=प$ इससे पदानयन हो गया ।।

अथ विषमाङ्कानां योग ज्ञानार्थ विधिः ।

यथा यो=विषमाङ्क योगः=१+३+५+............प

यदि पदम्=३ तदैकतः पञ्चपर्यन्तं विषमाङ्कानां क्रमेणोत्क्रमेण च स्थापनेन $\frac{१}{५}$ । $\frac{३}{३}$ । $\frac{५}{१}$ एतयोर्योगकरणेन सर्वत्रैव ६ । ६ । ६=२ प इति पद पर्यन्तमस्त्यतः (२ प) प=६+६+६=२ यो=$२प^२$ $\therefore$ यो=$प^२$ एतेन सिद्धम् यद्यत्पदपर्यन्तं विषमाङ्कानां योगोऽपेक्षितस्तत्पद वर्गसमस्तद्योगो भवेदिति ।। विपमाङ्कयोगज्ञानेन तत्पदज्ञानं सुलभमेव यतः—विषमाङ्कयोगः=$प^२$ मूलग्रहणेन $\sqrt{यो}$=प एतेन सिद्धम् यद्विषमाङ्कयोगस्य यन्मूलं तत्सममेव तत्पदं भवतीति ।।

अब विषमाङ्कों के योग ज्ञानार्थ नियम कहते है ।

जैसे विषमाङ्क योग=यो=१+३+५+७+६+...... ..प

यहाँ यदि पद=३ तब पद पर्यन्त विषमाङ्को को क्रम से और उत्क्रम से स्थापन करने से $\frac{१}{५}$ । $\frac{३}{३}$ । $\frac{५}{१}$ इन दोनों के योग करने से प्रत्येक स्थान मे ६ । ६ । ६=२प, यह पद पर्यन्त है इसलिये इसको पद से गुणा करने (२प) प=$२प^२$=६+६+६=पद पर्यन्त विषमाङ्कयोग × २ $\therefore$ $प^२$=विषमाङ्कयोग=यो इससे सिद्ध हुआ कि जिस पद तक विषमाङ्कों का योग अपेक्षित हो उस पद के वर्ग के बराबर विषमाङ्को का योग होता है ।। विषमाङ्कों के योगज्ञान से उसका पद ज्ञान सुलभ ही है जैसे विषमाङ्कयोग=$प^२$ मूल लेने से $\sqrt{यो}$=प अर्थात् योग के मूल के बरावर पद होता है यह सिद्ध हुआ ।।

समाङ्कानां योगज्ञानार्थ विधिः ।

समाङ्कयोगः=यो=२+४+६+८+१०.........प

यदि पदम्=३ तदा पद पर्यन्तं समाङ्कानां क्रमेणोत्क्रमेण च स्थापनेन $\frac{२}{६}$ । $\frac{४}{४}$ । $\frac{६}{२}$ एतयोर्योगेन सर्वत्रैव ८ । ८ । ८=२प+२ इति पद पर्यन्तमस्त्यतः प (२प+२)=२ $प^२$+२ प=२ यो $\therefore$ यो=$प^२$+प $\therefore$ सिद्धम् ।

अब समाङ्को के योगज्ञान के लिए नियम कहते है ।

जैसे समाङ्को के योग=यो=२+४+६+८+.........प

यदि प=३ तब पद पर्यन्त समाङ्कों को क्रम से और उत्क्रम से स्थापन करने से $\frac{२}{६}$ । $\frac{४}{४}$ । $\frac{६}{२}$ इन दोनों के योग करने से प्रत्येक स्थान में ८ । ८ । ८=२प+२ यह पद पर्यन्त है इसलिए २प+२ इसको पद से गुणा करने से (२प+२) प=२प^{२}+२प=२ यो ∴ यो=प^{२}+प ∴ सिद्ध हुआ कि पदवर्ग में पद जोड़ देने से पद पर्यन्त समाङ्कों का योग मान होता है ॥

अथ समाङ्कानां वर्ग योगार्थ नियमः ।

योगः=(२)^{२}+(४)^{२}+(६)^{२}+(८)^{२}+(१०)^{२}+.........प

=४+१६+३६+६४+१००.........

=४ (१+४+९+१६+२५)+.........

=४×एकाद्यङ्कानां वर्गयोग. । एतेन सिद्धं यदेकादीनामङ्कानां वर्गयोगश्चतुर्भिर्गुणितस्तदा द्वयादि समाङ्कानां वर्गयोगो भवेदिति ॥

अब समाङ्को के वर्गयोग ज्ञान के लिये विधि दिखलाते है ।

जैसे योग=(२)^{२}+(४)^{२}+(६)^{२}+(८)^{२}+.........प

=४+१६+३६+६४+.........

=४+४×४+४×९+४×१६+.........

=४ (१+४+९+१६)+.........

=४×एकादि अङ्कों का वर्गयोग । इससे सिद्ध हुआ कि एकादि अङ्कों के वर्गयोग को चार से गुणा करने से दो आदि समाङ्को का वर्गयोग प्रमाण होता है ॥

अथ गुणोत्तर श्रेढ़ी-सम्बन्धे कश्चिद्विचारः ।

गुणोत्तर श्रेढ़्या स्वरूपम्=१+$\frac{१}{२}$+($\frac{१}{२}$)^{२}+($\frac{१}{२}$)^{३}+($\frac{१}{२}$)^{४}+($\frac{१}{२}$)^{५}+.........प

अत्र श्रेढ़्या ($\frac{१}{२}$) मेतस्योत्तरोत्तरं हरमानं वर्धते यदा तस्या (हरमानस्य) नन्तत्वं तदैतस्याः श्रेढ़्या योग फलं किम् । अत्र चयः=$\frac{१}{२}$ गुणः । गुणवगज-फलं व्येकं व्येक गुणोद्धृतमित्यादिना योग फलम् =$\frac{१\times\{(\frac{१}{२})^{प}-१\}}{\frac{१}{२}-१}$ अत्रादिः =१ । हरस्याऽनन्तत्वे ($\frac{१}{२}$)^{प}=० तदा योगफलं=$\frac{-१}{+\frac{१}{२}-१}$=$\frac{-१}{-\frac{१}{२}}$=२ इदमेवोत्तर मिति ॥ (१)

अब गुणोत्तर श्रेढी के सम्बन्ध में कुछ विचार करते हैं।

गुणोत्तर श्रेढी का स्वरूप $= १ + \frac{१}{२} + (\frac{१}{२})^२ + (\frac{१}{२})^३ + (\frac{१}{२})^४ + \cdots\cdots$ प

यहाँ चय $= \frac{१}{२}$ गुणित। आदि $= १$। पद $=$ प

इस श्रेढी में $\frac{१}{२}$ का हरमान उत्तरोत्तर बढता गया है, जब हर का मान अनन्त होगा तब श्रेढी का फल क्या होगा।

'गुणावर्गजफल व्येकं व्येकगुणोद्धृतं' इत्यादि से योगफल $=$ सर्वधन $=$
$\frac{१ \times \{(\frac{१}{२})^{प} - १\}}{\frac{१}{२} - १} = \frac{(\frac{१}{२})^{प} - १}{-\frac{१}{२}}$ जब हर का मान अनन्त होगा तब $(\frac{१}{२})^{प}$ यह शून्य के बराबर होगा तव योगफल $= \frac{-१}{-\frac{१}{२}} = २$ यही उत्तर हुआ ॥$\cdots\cdots\cdots$(२)

(१) अत्रैवानन्तपदगुणोत्तरश्रेढ्या आदिधनम् $= १$। तदुत्तरपद योगतुल्य-मन्यधनं तदा श्रेढीधनानि कथय।

कल्प्यते द्वितीय धनम् $= \frac{\text{तृतीयध}}{१ - \text{गु}}$ तदा $\frac{\text{तृध}}{\text{द्विध}} = १ - \text{गु}$ परन्तु $\frac{\text{तृध}}{\text{द्विध}} = \text{गु}$

गु $= १ -$ गु $\therefore$ २गु $= १$ पक्षौ द्वाभ्यां भक्तौ तदा गु $= \frac{१}{२}$। ततः श्रेढीधनमानानि
$१, \frac{१}{२}, (\frac{१}{२})^२, (\frac{१}{२})^३, (\frac{१}{२})^४, (\frac{१}{२})^५ \cdots\cdots$। वा $१, \frac{१}{२}, \frac{१}{४}, \frac{१}{८}, \frac{१}{१६}, \frac{१}{३२}, \cdots\cdots$। इत्युत्तरम्।

(२) यही अनन्त पद गुणोत्तर श्रेढी का आदिधन $= १$, उसके चय और पद के योग के बराबर अन्य धन है तब श्रेढी का धनमान क्या होगा?

यहाँ कल्पना करते है द्वितीयधन $= \frac{\text{तृतीयध}}{१ - \text{गु}}$ तब $\frac{\text{तृध}}{\text{द्विध}} = १ - \text{गु}$ लेकिन $\frac{\text{तृध}}{\text{द्विध}} = \text{गु}$

$\therefore$ १ $-$ गु $=$ गु समान जोड़ने से १ $=$ गु $+$ गु $=$ २ गु $\therefore \frac{१}{२} =$ गु।

$\therefore$ श्रेढीधनमान $१, \frac{१}{२}, (\frac{१}{२})^२, (\frac{१}{२})^३, (\frac{१}{२})^४, (\frac{१}{२})^५, \cdots \quad \cdots$

वा $१, \frac{१}{२}, \frac{१}{४}, \frac{१}{८}, \frac{१}{१६}, \frac{१}{३२}, \cdots\cdots$, यही उत्तर हुआ।

यदि क $= ३ + ३३ + ३३३ + \cdots\cdots$ पद पर्यन्तं तदैतस्याः श्रेढ्या योगफलं किम्

क $= ३ + ३३ + ३३३ + \cdots\cdots$ पदपर्यन्त।

$= ३\ (१ + ११ + १११ + \cdots\cdots$ पदपर्यन्तं। नवभिर्गुणनेन भजनेन च

$= \frac{३ \times ९}{९}\ (१ + ११ + १११ + \cdots$ पदपर्यन्तं$) = \frac{३}{९}\ (९ + ९९ + ९९९ + \cdots$ पदपर्यन्तं$)$

$= \frac{३}{९}\{(१० - १) + (१०^२ - १) + १०^३ - १) + \cdots\cdots\cdots \quad \}$

$= \frac{३}{९}\{(१० + १०^२ + १०^३ \cdots\cdots\cdots$ पदपर्यन्तं$) - १ - १ - १ \cdots\cdots$ पदपर्यन्तं$\}$

$= \frac{३}{९}\{(१० + १०^२ + १०^३ \cdots\cdots\cdots$ पदपर्यन्तं$) -$ प$\}$

गुणवर्गजफलं व्येकं व्येकगुणोद्धृतमित्यादिना

$$\frac{३}{९}\left\{\frac{१०\ (१०^{प}-१)}{१०-१}-प\right\}=\frac{३}{९}\left\{\frac{१०(१०^{प}-१)}{\ }-प\right\}$$ =योगफलम् ।

यदि क=४+४४+४४४+··· पदपर्यन्त, तदैतस्याः श्रेढ्या योगफल किमित्यानीयते
क=४+४४+४४४+······पद पर्यन्त=४ (१+११+१११+······ पदपर्यन्त)
अत्रापि नवभिर्गुणनेन भजनेन च $\frac{४\times९}{९}$ (१+११+१११+············पदपर्यन्त)

=$\frac{४}{९}$ (९+९९+९९९+·········पदपर्यन्तं)
=$\frac{४}{९}$ {(१०−१) + (१०^{२}−१) + (१०^{३}− १) + ···पदपर्यन्त}=$\frac{४}{९}$
{१०+१०^{२}+१०^{३}+·········प—प}

ततो व्येक व्येकगुणोत्तरमित्यादिना श्रेढ्या योगफलम्=

$$\frac{४}{९}\left\{\frac{१०(\ १०^{प}-१\ )}{१०-१}-प\right\}=\frac{४}{९}\left\{\frac{१०\ (१०^{प}-१)}{९}-प\right\}$$ =योगफलम् ।

एवमेव ५+५५+५५५+··· ·········पदपर्यन्तम्
६+६६+६६६+············पदपर्यन्तम्
७+७७+७७७+·············पदपर्यन्तम्
···············+··· · ·······पदपर्यन्तम्
···············+·············पदपर्यन्तम्

आसां श्रेढीनां योगफलंपूर्व विधिनैव समागच्छन्ति।

यदि क=३+३३+३३३+··· ··· · पदपर्यन्त, तब इस श्रेढी का योगफल क्या होगा ?

क=३+३३+३३३+······ ·· पदपर्यन्त =
३(१+११+१११+············पदपर्यन्त)

नौ से गुणा करने से और भागदेने से

$\frac{३\times९}{९}$(१+११+१११+······पदपर्यन्त)= $\frac{३}{९}$
(९+९९+९९९+······पदपर्यन्त)
=$\frac{३}{९}$ {(१०−१)+(१०^{२}—१)+(१०^{३}—१)+············}=$\frac{३}{९}$
{१०+१०^{२}+१०^{३}+············पदपर्यन्त—प}

गुण वर्गजफलं व्येक व्येक गुणोद्धृत इत्यादि से

$$\frac{३}{९}\left\{\frac{१०(१०^{प}-१)}{१०-१}-प\right\}=\frac{३}{९}\left\{\frac{१०(१०^{प}-१)}{९}-प\right\} = \text{योगफल.}$$

यही उत्तर हुआ।

यदि क$=४+४४+४४४+$ ....पदपर्यन्त, तब इस श्रेढी का योगफल क्या होगा ?

$$क=४+४४+४४४+ \cdots\cdots \text{पदपर्यन्त,}$$

$$=४(१+११+१११+\cdots\cdots \text{पदपर्यन्त})$$

यहां नौ से गुणा करने से और भाग देने से

$$\frac{४\times९}{९}(१+११+१११+\cdots\cdots \text{पदपर्यन्त})$$

$$=\frac{४}{९}(९+९९+९९९+\cdots\cdots \text{पदपर्यन्त})$$

$$=\frac{४}{९}\{(१०-१)+(१०^{२}-१)+(१०^{३}-१)+\cdots\cdots\}$$

$$=\frac{४}{९}\{१०+१०^{२}+१०^{३}+\cdots\cdots \text{पदपर्यन्त}-प\}$$

$$=\frac{४}{९}\left\{\frac{१०(१०^{प}-१)}{१०-१}-प\right\}$$

$$=\frac{४}{९}\left\{\frac{१०(१०^{प}-१)}{९}-प\right\}=\text{श्रढ़ी का योगफल।}$$

इसी तरह $५+५५+५५५+\cdots\cdots$ पदपर्यन्त

$६+६६+६६६+\cdots\cdots$ पदपर्यन्त

$७+७७+७७७+\cdots\cdots$ पदपर्यन्त

..............+........... ,,

..............+........... ,,

इन श्रेढ़ियों का भी योगफल उपर्युक्त विधि से सुगमता से ही सिद्ध होता है ॥

अधोलिखितश्रेढ़्या योगफलं किम् ?

$$\text{यदि } क = \frac{१}{१\times२}+\frac{१}{२\times३}+\frac{१}{३\times४}+\frac{१}{४\times५}+\cdots\cdots \text{पदपर्यन्तम्।}$$

अत्राऽऽद्यधनम् $= \frac{१}{१\times२} = १ - \frac{१}{२}$

द्वितीय धनम् $= \frac{१}{२\times३} = \frac{१}{२} - \frac{१}{३}$

तृतीय धनम् $= \frac{१}{३\times४} = \frac{१}{३} - \frac{१}{४}$

एवमग्रेऽपि, तदाऽन्त्यधनमानम् $= \frac{१}{प(प+१)} = \frac{१}{प} - \frac{१}{प+१}$

सर्वेषां योगेन क $= १ - \frac{१}{प+१} = \frac{प}{प+१}$ इदमेवोत्तरम् ।

अधो लिखित श्रेढी का योगफल क्या होगा ?

यदि क $= \frac{१}{१\times२} + \frac{१}{२\times३} + \frac{१}{३\times४} + \frac{१}{४\times५} + \cdots\cdots$ पदपर्यन्त ।

यहां आद्यधन $= \frac{१}{१\times२} = १ - \frac{१}{२}$

द्वितीय धन $= \frac{१}{२\times३} = \frac{१}{२} - \frac{१}{३}$

तृतीय धन $= \frac{१}{३\times४} = \frac{१}{३} - \frac{१}{४}$

इसी तरह आगे भी तब अन्त्यधनमान $= \frac{१}{प(प+१)} = \frac{१}{प} - \frac{१}{प+१}$

सबों के योग करने से क $= १ - \frac{१}{प+१} = \frac{प}{प+१}$ यही उत्तर हुआ ॥

यदि क $= \frac{१}{१\times४} + \frac{१}{४\times७} + \frac{१}{७\times१०} + \frac{१}{१०\times१३} + \cdots\cdots$ पदपर्यन्त,

तदैतस्याः श्रेढ्या योगफल किम्

अथ $\frac{१}{१\times४} = \frac{१}{३}\left(१ - \frac{१}{४}\right)$, $\frac{१}{४\times७} = \frac{१}{३}\left(\frac{१}{४} - \frac{१}{७}\right)$, $\frac{१}{७\times१०} = \frac{१}{३}\left(\frac{१}{७} - \frac{१}{१०}\right)$

एवमग्रेऽपि, अत्रान्त्यधनम् $= \frac{१}{३}\left(\frac{१}{(३प-२)(३प+१)}\right) =$

$\frac{१}{३}\left(\frac{१}{३प-२} - \frac{१}{३प+१}\right)$ सर्वेषां योग करणेन

क $= \frac{१}{३}\left(१ - \frac{१}{३प+१}\right) = \frac{१}{३} \times \frac{३प}{३प+१} = \frac{प}{३प+१}$ इत्युत्तरम् ।

यदि क $= \frac{१}{१\times४} + \frac{१}{४\times७} + \frac{१}{७\times१०} + \frac{१}{१०\times१३} + \cdots$ पदपर्यन्त,

तब इसका योगफल क्या होगा ?

यहा $\frac{१}{१\times४} = \frac{१}{३}\left(१-\frac{१}{४}\right)$, $\frac{१}{४\times७} = \frac{१}{३}\left(\frac{१}{४}-\frac{१}{७}\right)$, $\frac{१}{७\times१०} = \frac{१}{३}\left(\frac{१}{७}-\frac{१}{१०}\right)$

इसी तरह आगे भी अन्त्यधन $= \frac{१}{३}\left(\frac{१}{(३प-२)(३प+१)}\right) = \frac{१}{३}\left(\frac{१}{३प-२} - \frac{१}{३प+१}\right)$

सबों का योग करने से क $= \frac{१}{३}\left(१ - \frac{१}{३प+१}\right) = \frac{१}{३} \times \frac{३प}{३प+१} = \frac{प}{३प+१}$ यही उत्तर हुआ ।

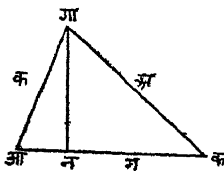
अथ क्षेत्र व्यवहारः ।

स्थूल फलं त्रिचतुर्भुज बाहु प्रतिबाहुयोगदलघातः ।
भुजयोगार्धचतुष्टय भुजोनघातात्पदं सूक्ष्मम् ॥ २१ ॥

सु. भा.—त्रिभुजस्य वा चतुर्भुजस्य बाहोः प्रतिबाहोस्तत् संमुखभुजस्य योगदल कार्यम् । एवमुभयथा । ततो दलयोर्घातस्त्रिभुजचतुर्भुजयोः स्थूलं फलम् । सूक्ष्मफलार्थं तु भुजयोगार्धेत्यादि 'सर्वदोर्युतिदलं चतुः स्थितम्' इत्यादि भास्करोक्त मेव । अत्र त्रिभुजस्य फलं सूक्ष्मं परन्तु वृत्तान्तर्गतचतुर्भुजस्यैव फलमनेन विधिना सूक्ष्मं नान्यस्य । त्रिभुजे भुजप्रतिभुजौ द्वौ बाहू एवमेकदिशि । अन्यत्राऽऽधार एको बाहुस्तत्प्रतिबाहुश्च शून्यसमौ ज्ञेयः । अत्रोपपत्त्यर्थं मच्छोधिता भास्करलीलावती द्रष्टव्या ॥२१॥

वि. भा.— त्रिभुजस्य चतुर्भुजस्य वा बाहोः प्रतिबाहोस्तत्संमुखभुजस्य योगार्धं कार्यम् तद्घातस्तयोस्त्रिभुजचतुर्भुजयोः स्थूलफलं भवति । त्रिभुजस्य भुजत्रय-योगार्धे भुजत्रयं स्थानत्रये पृथक् पृथक् हीनं कार्यं तेषां घातः कार्यस्तन्मूलं त्रिभु-जस्य सूक्ष्मं फलं भवति । एवं चतुर्भुजस्य भुजचतुष्टय योगार्धं स्थानचतुष्टये स्थाप्यम् तद्भुज चतुष्टयैर्हीन कार्यम् तेषां घातान्मूलं ग्राह्यं तच्चतुर्भुजस्य सूक्ष्मं फलं भव-तीति ॥

अथ त्रिभुज फलानयनार्थमुपपत्तिः ।



आकागा त्रिभुजमस्ति यत्फलानयनमपेक्षितम् ।
कागा, आगा भुजौ अ, क । आका=ग=भूमिः
आन=लघ्वाबाधा, कान=बृहदाबाधा, गा बिन्दुतः आका भुजोपरिलम्बः=लं, तदा 'भुज कृत्यन्तरभूहृत हीनयुता

भूरित्याद्याचार्योक्ताग्रिम २२ श्लोकेन, लीलावत्यां 'त्रिभुजे भुजयोर्योगस्तदन्तर गुण इत्यादि' भास्करोक्तेन वा लघ्वाबाधामानम् $= \frac{ग}{२} - \frac{(अ+क)\ (अ-क)}{ग \times २}$

$= \frac{ग^२ - (अ+क)\ (अ-क)}{२\ ग}$ योगान्तरघातस्य वर्गान्तर समत्वात् $\frac{ग^२ - (अ^२ - क^२)}{२\ ग}$

= लघ्वाबाधा, ततः स्वाबाधावर्गोनाद् भुजवर्गादित्याद्याचार्योक्त्या लीलावत्यां 'स्वाबाधाभुजकृत्योरन्तरमूलमित्यादि' भास्करोक्तेन वा लम्ब^२ $=क^२ -$

$\left\{ \frac{ग^२ - (अ^२ - क^२)}{२\ ग} \right\}^२$ वर्गान्तरस्य योगान्तरघातसमत्वात् लम्ब^२ =

$\left\{ क + \frac{\{ग^२ - (अ^२ - क^२)\}}{२\ ग} \right\} \quad क - \frac{\{ग^२ - (अ^२ - क^२)\}}{२\ ग}$

$= \frac{(क^२ + २\ क.ग + ग^२ - अ^२)\ \{अ^२ - (क^२ - २\ क.ग + ग^२\}}{४\ ग^२}$

$= \frac{\{(क+ग)^२ - अ^२\} - \{अ^२ - (क-ग)^२\}}{४\ ग^२}$ ततो लम्बगुणं भूम्यर्धमित्यादिना फलवर्गः

$= \frac{\{(क+ग)^२ - अ^२\}\{अ^२ - (क-ग)^२\}}{४\ ग^२} \times \frac{ग^२}{४} = \frac{\{(क+ग)^२ - अ^२\}\ \{अ^२ - (क-ग)^२\}}{१६}$

वर्गान्तरस्य योगान्तरघातसमत्वात् $\frac{(अ+क+ग)}{२} \cdot \frac{(क+ग-अ)}{२} \cdot \frac{(अ+क-ग)}{२}$

$\frac{(अ+ग-क)}{२}$ $=$ फल^२ अत्र यदि $\frac{अ+क+ग}{२}$ $=$ भुजयोगार्धम् $=$ स, तदा स $-$ अ $=$

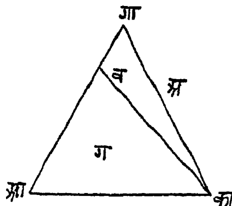
$\frac{क+ग-अ}{२}$, स $-$ ग $= \frac{अ+क-ग}{२}$, स $-$ क $= \frac{अ+ग-क}{२}$ तदोत्थापनेन फल^२

$=$ स (स $-$ अ) (स $-$ ग) (स $-$ क) मूलेन फल $= \sqrt{स\ (स-अ)\ (स-ग)\ (स-क)}$

एतेन त्रिभुजफलानयनसूक्ष्ममुपपद्यते। विषमचतुर्भुजस्य सूक्ष्मफलानयनार्थमाचार्येण विधिः कथ्यते परं तत्र त्रिभुजस्य चर्चा नास्ति, चतुर्भुजफलानयनार्थमाचार्येण यो विधिः कथ्यते तेन विधिना त्रिभुजस्यैव फलं सूक्ष्मं भवति। यदुपरि प्रदर्शितोपपत्त्या स्फुटमस्ति, आचार्योक्तानुरूपमेव सिद्धान्तशेखरे "भुजसमास दलाद्धि चतुः स्थितं निजभुजैः क्रमशः पृथगूनितम्। अथ परस्पर मेव समाहतं कृतिपदं त्रिचतुर्भुजयोः फलम्" श्रीपत्युक्तमस्ति, श्रीधराचार्येणाप्येवमेव कथ्यते। त्रिभुजस्य फलानयनं श्रीपत्यादिकथित सूक्ष्मं चतुर्भुजफलानयनं च स्थूलं भवति तदर्थमेव लीलावत्या 'चतुर्भुजस्यानियतौ हि कर्णौ कथं ततोऽस्मिन्नियतं फलं स्यात्। प्रसाधितौ तच्छ्रवणौ यदाद्यैः स्वकल्पितौ तावितरत्र न स्तः॥ तेष्वेव बाहुष्वपरौ च कर्णाव-

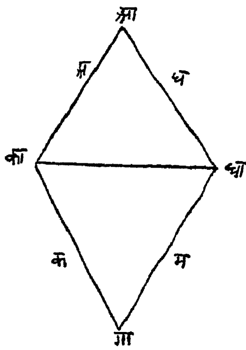
नेकधा क्षेत्रफलं ततश्च'। मित्यनेन भास्कराचार्येण बहुधा पूर्वाचार्योक्तचतुर्भुज फलानयनस्य स्थूलत्वंप्रतिपादितम् ॥

आचार्योक्त विधिना कथं विषमचतुर्भुजफलानयनं न सूक्ष्ममिति प्रदर्श्यते ।



आकागा त्रिभुजस्य अगा = क, कागा = अ, आका = ग, का बिन्दुतः आगा भुजोपरि लम्ब := कान, लम्ब गुणं भूम्यर्धमित्यादिना त्रिभुजफलम् $= \frac{\text{आगा} \times \text{कान}}{२} = \frac{\text{क} \times \text{कान}}{२}$,

परन्तु कानगा त्रिभुजेऽनुपातेन कान = लम्ब =
$= \frac{\text{कागा} \times \text{ज्यागा}}{\text{त्रि}} = \frac{\text{अ} \times \text{ज्यागा}}{१}$ अत्र त्रिज्याऽल्पमिता ग्राह्या। तत उत्थापनेन त्रिभुजफलम् $= \frac{\text{अ. क. ज्यागा}}{२}$ एतेन त्रिभुजे भुजयोर्घातोऽर्धो भुजान्तर्गतकोणस्य ज्यया गुणितं तदा तत् (त्रिभुज) फलं भवतीति सिद्धयति।



आकागाघा विषमचतुर्भुजमस्ति यत्फलानयनमपेक्षितमस्ति ।

आका = अ । कागा = क । गाघा = ग । आघा = घ काघा कर्णः = न

अथ आकाघा त्रिफल + कागाघा त्रिभुजफल आकागाघा चतुर्भुजफल परन्तूपरिप्रदर्शित त्रिभुजफलानयनेन $\frac{\text{अ. घ} \times \text{ज्याआ}}{२} + \frac{\text{क. ग. ज्यागा}}{२}$ = चतुर्भुजफलं, यद्यत्र आ + गा = १८० तदा आ = १८० — गा

$\therefore$ ज्याआ = ज्यागा (कोणज्या कोणोन भार्धज्ययोः समत्वात्)। अतश्चतुर्भुजफलम् $\frac{\text{अ. घ. ज्याआ} + \text{क. ग. ज्याआ}}{२}$ = ज्याआ $\left(\frac{\text{अ. घ.} + \text{क. ग}}{२}\right)$ ।

अथ आकाघा त्रिभुजे भुजवर्गयुतिर्भूमिवर्गोना भुजघ्नाप्ताद्धेत्यादि त्रिकोणमित्या कोज्याआ $= \frac{\text{अ}^२ + \text{घ}^२ - \text{न}^२}{२ \text{ अ. घ}}$, तथा कागाघा त्रिभुजेऽपि तेनैव विधिना $= \frac{\text{क}^२ + \text{ग}^२ - \text{न}^२}{२ \text{ क. ग}}$ = कोज्यागा ततश्छेदगमादिना अ^२ + घ^२ — २ अ. घ. कोज्याआ = न^२ क^२ + ग^२ — २ क. ग कोज्याआ = न^२

परं आ = १८० — गा $\therefore$ कोज्याआ = — कोज्यागा

$$\therefore \text{अ}^2+\text{घ}^2-2\,\text{अ. घ. कोज्याआ}=\text{क}^2+\text{ग}^2+2\,\text{क. ग. कोज्याआ}$$

$$\text{ततः}\ \frac{\text{क}^2+\text{ग}^2-(\text{अ}^2+\text{घ}^2)}{2\,\text{क. ग}+2\,\text{अ. घ}}=\text{कोज्याआ},\ \text{परन्तु त्रि}^2-\text{कोज्या}^2\text{आ}$$

$$=\text{ज्या}^2\,\text{आ}=1-\text{कोज्या}^2\text{आ}=1-\left\{\frac{\text{क}^2+\text{ग}^2-(\text{अ}^2+\text{घ}^2)}{2\,\text{क. ग}+2\,\text{अ घ}}\right\}^2\ \text{वर्गान्तरस्य योगान्तरघातसमत्वात्}$$

$$=\left\{1+\frac{\text{क}^2+\text{ग}^2-(\text{अ}^2+\text{घ}^2)}{2\,\text{क. ग}+2\,\text{अ घ}}\right\}\left\{1-\frac{\text{क}^2+\text{ग}^2-(\text{अ}^2+\text{घ}^2)}{2\,\text{क. ग}+2\,\text{अ. घ}}\right\}$$

$$=\left\{\frac{2\,\text{क ग}+2\,\text{अ. घ}+\text{क}^2+\text{ग}^2-(\text{अ}^2+\text{घ}^2)}{2\,\text{क. ग}+2\,\text{अ. घ}}\right\}\left\{\frac{2\,\text{क ग}+2\,\text{अ. घ}-\text{क}^2-\text{ग}^2-(\text{अ}^2+\text{घ}^2)}{2\,\text{क. ग}+2\,\text{अ. घ}}\right\}$$

$$=\frac{(\text{क}+\text{ग})^2-(\text{अ}-\text{घ})^2}{2\,\text{क. ग}+2\,\text{अ. घ}}\times\frac{(\text{अ}+\text{घ})^2-(\text{क}-\text{ग})^2}{2\,\text{क. ग}+2\,\text{अ. घ}}$$ वर्गान्तरस्य योगान्तर घात-समत्वात्

$$\frac{(\text{क}+\text{ग}+\text{अ}-\text{घ})\,(\text{क}+\text{ग}+\text{घ}-\text{अ})\,(\text{अ}+\text{क}+\text{घ}-\text{ग})\,(\text{अ}+\text{ग}+\text{घ}-\text{क})}{4\,(\text{क}\times\text{ग}+\text{अ. घ})^2}=\text{ज्या}^2\text{आ}$$

यद्यत्र $\text{अ}+\text{क}+\text{ग}+\text{घ}=2\,\text{स}$ तदा

$\text{क}+\text{ग}+\text{अ}-\text{घ}=2\,\text{स}-2\text{घ}=2\,(\text{स}-\text{घ})$, $\text{क}+\text{ग}+\text{घ}-\text{अ}=2\,\text{स}-2\,\text{अ}=2(\text{स}-\text{अ})$ $\text{अ}+\text{क}+\text{घ}-\text{ग}=2\,\text{स}-2\,\text{ग}=2\,(\text{स}-\text{ग})$, $\text{अ}+\text{ग}+\text{घ}-\text{क}=2\text{स}-2\,\text{क}=2(\text{स}-\text{क})$ तत उत्थापनेन

$$\frac{2\,(\text{स}-\text{अ}).\,2\,(\text{स}-\text{क}).\,2\,(\text{स}-\text{ग}).\,2\,(\text{स}-\text{घ})}{4\,(\text{क. ग}+\text{अघ})^2}=\text{ज्या}^2\text{आ}$$

$$=\frac{16\,(\text{स}-\text{अ})\,(\text{स}-\text{क})\,(\text{स}-\text{ग})\,(\text{स}-\text{घ})}{4\,(\text{क. ग}+\text{अ. घ})^2}=\frac{4(\text{स}-\text{अ})(\text{स}-\text{क})(\text{स}-\text{ग})(\text{स}-\text{घ})}{(\text{क. ग}+\text{अ. घ})^2}$$

$$=\text{ज्या}^2\text{आ मूलग्रहणेन}\ \frac{2}{\text{क. ग}+\text{अ. घ}}\sqrt{(\text{स}-\text{अ})(\text{स}-\text{क})\,(\text{स}-\text{ग})\,(\text{स}-\text{घ})}$$

$$=\text{ज्याआ तत उत्थापनेन चतुर्भुजफलम्}=\text{ज्याआ}\ \frac{(\text{अ. घ}+\text{क ग})}{2}$$

$$=\sqrt{(\text{स}-\text{अ})\,(\text{स}-\text{क})\,(\text{स}-\text{ग})\,(\text{स}-\text{घ})}$$ एतेनाऽऽचार्योक्तं श्रीपत्युक्तं भास्करोक्तं च चतुर्भुजफलानयन मुपपन्नम् ।

परञ्च पूर्वमुपपत्तौ आ+गा=१८० स्वीकृतम् । चतुर्भुजे संमुख कोणयोर्योगः =१८० केवलं वृतान्तर्गतचतुर्भुज एव भवति तेनाऽऽचार्यं श्रीधराचार्यं श्रीपत्यादि कथितं विषमचतुर्भुज फलानयनं न सूक्ष्ममिति प्रत्यक्षमेवोपपत्त्या सिद्धम् । केवलं भास्कराचार्येण ज्ञातं यच्चतुर्भुजफलानयनं यदन्यैः कृत तत्सूक्ष्मं न भवति तेनैव हेतुना लीलावत्यां "सर्वदोर्युतिदलं चतुः स्थितमित्यादौ" मूलमस्फुट फलं चतुर्भुजे भास्करेण कथितम् ॥२१॥

अथ कस्य चतुर्भुजस्य फलं महत्तमम् भवतीति विचार्यते ।

अथ पूर्वोपपत्तौ आका गाघा चतुर्भुजफलम् $= \frac{\text{अ. घ. ज्याआ}}{२} + \frac{\text{क.ग. ज्याआ}}{२}$ कस्यापि पदार्थस्य महत्तमत्वे परमन्यूनत्त्वे च चलन कलन रीत्या तदीया तात्कालिकगतिः शून्यसमा भवति । यदि चतुर्भुजस्य फलं महत्तमं स्यात्तदा पक्षयोस्तात्कालिकगतिग्रहणेन $\frac{\text{अ. घ. कोज्याआ}}{२} + \frac{\text{क. ग. कोज्यागा}}{२} = ०$, (१)

परन्तु "भू संमुखास्रोद्भव कोटि शिञ्जिनी दोर्घातगुण्या त्रिगुणार्धभक्ता । दोर्वर्ग-योगो रहितस्तया स्यादाधारवर्गोऽस्य पदं मही च" विशेषोक्तेनानेन 'भुजवर्गयुति भूमिवर्गोनाभुजघातहृत् । दलिता त्रिभुजस्यास्रकोटिज्या युग्मविस्तृतौ' इत्यादिना वा $\text{अ}^२+\text{घ}^२+२$ अ. घ. कोज्याआ $=\text{क}^२+\text{ग}^२+२$ क.ग. कोज्यागा ।

पक्षयोस्तात्कालिक गतिग्रहणेन ।

अ. घ. ज्याआ=क.ग. ज्यागा यतः स्थिराङ्कानां तात्कालिक गतयः=० । तथा कोटिज्यायास्तात्कालिकगतिर्ज्या भवति ।

अतः $\frac{\text{क. ग. ज्यागा}}{\text{ज्याआ}} =$ अ. घ. अनेन (१) समीकरणमुत्थापनेन

$\frac{\text{क. ग. कोज्याआ ज्यागा}}{\text{२ ज्याआ}} + \frac{\text{क. ग. कोज्यागा}}{२}$

$= \frac{\text{क. ग. कोज्याआ.+ज्यागा+क. ग. कोज्यागा. ज्याआ}}{\text{२ ज्याया}} = ०$ छेदगमेन क.ग.

कोज्याआ. ज्यागा.+कग कोज्यागा. ज्याआ=०

=क. ग (कोज्याआ. ज्यागा+कोज्यागा. ज्याआ)

=क. ग. ज्या (आ+गा)=० ∴ ज्या (आ+गा) $= \frac{०}{\text{क.ग.}}$ ०

∴आ+गा=१८० एतेन सिद्धं यदेकाधारे विद्यमानेष्वनेकेषु चतुर्भुजेषु यस्मिश्चतुर्भुजे संमुखकोणयोर्योगभार्धांश १८० समस्तस्यैव फलं महत्तमं (सर्वाधिकं) भवतीति ।

अब क्षेत्रव्यवहार आरम्भ किया जाता है।

हि. भा.—त्रिभुज और चतुर्भुज के संमुख भुजों के योगार्ध के घात करने से त्रिभुज और चतुर्भुज का फल स्थूल होता है। समुखभुजों के योगार्धघात चतुर्भुज के लिये स्थूल फल हो सकता है परन्तु त्रिभुज मे तो तीन ही भुजाए है इसलिये इस मे समुख भुजाभाव है अतः एक तरफ के भुजद्वय योग को तृतीयभुज से गुणा करने से नाम मात्र का स्थूल त्रिभुज फल होता है। त्रिभुज और चतुर्भुज के भुजों के योगार्ध को क्रमशः तीन और चार स्थानों मे स्थापन करना, पृथक् पृथक् अपने अपने भुजो को हीन करके घात करना तब मूल लेने से क्रमशः त्रिभुज और चतुर्भुज का सूक्ष्मफल होता है ॥२१॥

त्रिभुज फलानयन के लिये उपपत्ति।

यहां सस्कृतोपपत्ति मे लिखित (१) चित्र को देखिये। आकागा त्रिभुज है जिसका फलानयन करना है। कागा = अ। आगा = क भूमिः आका = ग। गा बिन्दु से आका भुजके ऊपरलम्ब = गान, तब 'भुज कृत्यन्तर भूहृत हीन युता भूः' इत्यादि, आचार्योक्त अगिम २२ वें श्लोक मे अथवा लीलावती मे 'त्रिभुजे भुजयोर्योगस्तदन्तर गुणः' इत्यादि, भास्करोक्त सूत्रमे लघ्वाबाधा = $\frac{ग}{२} - \frac{(अ+क)(अ-क)}{२ ग} = \frac{ग^२ - (अ+क)(अ-क)}{२ ग}$ योग और अन्तर का घात वर्गान्तर के बराबर होता है इसलिये $\frac{ग^२ - (अ^२ - क^२)}{२ ग}$ = लघ्वाबाधा, अब 'स्वाबाधावर्गोनाद्‌भुज वर्गात्' इत्यादि आचार्योक्त से अथवा 'स्वाबाधा भुज कृत्योरन्तर मूलम्' इत्यादि भास्करोक्त से लम्ब^२ = $क^२ - \left\{ \frac{ग^२ - (अ^२ - क^२)}{२ ग} \right\}^२$ वर्गान्तर योगान्तर घात के बराबर होने से $\left\{ क + \frac{ग^२ - (अ^२ - क^२)}{२ ग} \right\} . \left\{ क - \frac{ग^२ - (अ^२ - क^२)}{२ ग} \right\}$ = लम्ब^२

$$= \frac{(क^२ + २ क.ग + ग^२ - अ^२) \; \{अ^२ - (क^२ - २ क.ग + ग^२)\}}{४ ग^२}$$

$$= \frac{\{(क+ग)^२ - अ^२\}.\{अ^२ - (क-ग)^२\}}{४ ग^२}$$ 'लम्बगुणं भूम्यर्धम्' इत्यादि से फलवर्ग

$$= \frac{\{(क+ग)^२ - अ^२\}.\{अ^२ - (क-ग)^२\}}{४ ग^२} \times \frac{ग^२}{४}$$

$$= \frac{\{(क+ग)^२ - अ^२\}.\{अ^२ - (क-ग)^२\}}{१६} = \frac{(अ+क+ग)}{२} . \frac{(क+ग-अ)}{२} . \frac{(अ+क-ग)}{२} . \frac{(अ+ग-क)}{२}$$ = फल^२। यहां यदि $\frac{अ+क+ग}{१}$ = स तब

$स-अ = \frac{क+ग-अ}{२}$, $स-ग = \frac{अ+क-ग}{२}$, $स-क = \frac{अ+ग-क}{२}$ उत्थापन से $फल^{२} = स.$ $(स-अ)(स-ग)(स-क)$ मूल लेने से $फल = \sqrt{स(स-अ)(स-क)(स-ग)}$

इससे सूक्ष्म त्रिभुज फलानयन उपपन्न होता है।

अब विषम चतुर्भुज के सूक्ष्म फलानयन के लिए विधि लिखते हैं।

सूक्ष्म चतुर्भुज फलानयन के लिये आचार्य ने जो विधि बतलाई है उस में त्रिभुज की चर्चा नही है लेकिन उस विधि से त्रिभुज ही का फल सूक्ष्म आता है जो कि उपर्युक्त उपपत्ति से स्पष्ट है। सिद्धान्त शेखर में 'भुज समास दलं हि चतुः स्थित 'इत्यादि, श्रीपत्युक्त चतुर्भुज फलानयन आचार्योक्तानुरूप ही है लेकिन श्रीपति प्रकार में त्रिभुज की चर्चा है। श्रीधराचार्य भी इसी तरह कहते है। श्रीपति श्रीधराचार्य ने जो चतुर्भुज फला नयन किया है सो सूक्ष्म नहीं है इसीलिये लीलावती मे 'चतुर्भुजस्यानियतौ हि कर्णौ' इत्यादि सस्कृतोपपत्ति मे लिखित पद्यों से भास्कराचार्य ने बहुत पूर्वाचार्योक्त चतुर्भुज फलानयन की स्थूलता दिखलाई है।

अब आचार्योक्त विधि से क्यों विषम चतुर्भुज फलानयन सूक्ष्म नही होता है तदर्थ विचार करते है। संस्कृतोपपत्ति मे लिखित (ख) चित्र को देखिये।

आकागा त्रिभुज में आगा = क, कागा = अ, आका = ग, का बिन्दु से आगा भुज के ऊपर लम्ब = कान तब 'लम्ब गुण भूम्यर्ध' इत्यादि से $त्रिभुजफल = \frac{आगा \times कान}{२}$

$= \frac{कन \times कान}{२}$, परन्तु कानगा त्रिभुज में अनुपात से $कान = लम्ब = \frac{कागा.\ ज्यागा}{त्रि}$

$= \frac{अ.\ ज्याग}{१}$ यहां त्रिज्या = १ ग्रहण करते हैं तब उत्थापन से त्रिभुजफल

$= \frac{अ.\ क.\ ज्यागा}{२}$ इससे यह सिद्ध हुआ कि त्रिभुज में दो भुजों के घातार्ध को भुजद्वयान्तर्गत कोण की ज्या से गुणने से त्रिभुजफल होता है॥

आका गाघा विषमचतुर्भुज है जिसका फलानयन अपेक्षित है यहां संस्कृतोपपत्ति में लिखित (प) चित्र को देखिये। आका = अ। कागा = क, गाघा + ग, आघा = घ, काघाकर्ण = न आकाघा त्रिभुजफल + कागाघा त्रिभुजफल = आकागाघा चतुर्भुजफल, उपरि प्रदर्शित त्रिभुज फलानयन से $\frac{अ.\ घ.\ ज्याआ}{२} + \frac{क.\ ग.\ ज्यागा}{२} = चतुर्भुजफल$। यदि यहां $आ + गा = १८०$ माना जाय तब $आ = १८० - गा$ $\therefore$ $ज्याआ = ज्यागा$ (कोणज्या और कोणोन भार्धांशज्या

के बराबर होने से) इसलिये चतुर्भुजफल $= \frac{\text{अ.घ. ज्याआ} + \text{क.ग. ज्याआ}}{२} =$

$\frac{\text{ज्याआ (अ.घ} + \text{क.ग)}}{२}$

अब 'भू संमुखान्योद्भ कोटि शिञ्जनी' इत्यादि विशेषोक्त सूत्र से $\text{अ}^२ + \text{घ}^२ - २\ \text{अ. घ. कोज्याआ} = \text{न}^२$ तथा $\text{क}^२ + \text{ग}^२ - २\ \text{क. ग कोज्यागा} = \text{न}^२$, लेकिन $\text{आ} = १८० - \text{गा}$ ∴ $\text{कोज्याआ} = -\text{कोज्यागा}$ ∴ $\text{अ}^२ + \text{घ}^२ - २\ \text{अ. घ. कोज्याआ} = \text{क}^२ + \text{ग}^२ - २\ \text{क. ग. कोज्याआ}$ इसलिये $\frac{\text{क}^२ + \text{ग}^२ - (\text{अ}^२ + \text{घ}^२)}{२\ \text{अ घ} + २\ \text{क ग}} = \text{कोज्याआ}$ लेकिन

$\text{त्रि}^२ - \text{कोज्या}^२\text{आ} = \text{ज्या}^२\text{आ} = १ - \text{कोज्या}^२\text{आ} = १ - \left\{ \frac{\text{क}^२ + \text{ग}^२ - (\text{अ}^२ + \text{घ}^२)}{२\ \text{अ. घ} + २\ \text{क ग.}} \right\}^२$ परन्तु

वर्गान्तर योगान्तर घात के बराबर होता है इसलिये

$$\left\{ १ + \frac{\text{क}^२ + \text{ग}^२ - (\text{अ}^२ + \text{घ}^२)}{२\ \text{अ. घ} + २\ \text{क ग}} \right\} . \left\{ १ - \frac{\text{क}^२ + \text{ग}^२ - (\text{अ}^२ + \text{घ}^२)}{२\ \text{अ. घ} + २\ \text{क. ग}} \right\}$$

$$= \left\{ \frac{२\text{अ. घ} + २\text{क. ग} + \text{क.}^२ + \text{ग}^२ - (\text{अ}^२ + \text{घ}^२)}{२\ \text{अघ.} + २\ \text{कग}} \right\} .$$

$$\left\{ \frac{२\ \text{अ. घ} + २\ \text{क. ग} - \text{क}^२ - \text{ग}^२ - (\text{अ}^२ + \text{घ}^२)}{२\ \text{अ. घ} + २\ \text{क. ग}} \right\} = \frac{(\text{क} + \text{ग})^२ - (\text{अ} - \text{घ})^२}{२\ \text{अ. घ} + २\ \text{क. ग}}$$

$\times \left\{ \frac{(\text{अ} + \text{घ})^२ - (\text{क} - \text{ग})^२}{२\ \text{अ. घ} + २\ \text{क. ग}} \right\}$ वर्गान्तर योगान्तर घात के बराबर होता है इसलिये

$$\frac{(\text{क} + \text{अ} + \text{ग} - \text{घ})\ (\text{क} + \text{ग} + \text{घ} - \text{अ})\ (\text{अ} + \text{क} + \text{घ} - \text{ग})\ (\text{अ} + \text{ग} + \text{घ} - \text{क})}{४\ (\text{अ. घ} + \text{क. ग})^२}$$

$= \text{ज्या}^२\text{आ}$ । यदि यहां $\text{अ} + \text{क} + \text{ग} + \text{घ} = २\ \text{स}$ तब,

$\text{क} + \text{अ} + \text{ग} - \text{घ} = २\ \text{स} - २\ \text{घ} = २\ (\text{स} - \text{घ})$,

$\text{क} + \text{ग} + \text{घ} - \text{अ} = २\ \text{स} - २\ \text{अ} = २\ (\text{स} - \text{अ})$ $\text{अ} + \text{क} + \text{घ} - \text{ग} = २\ \text{स} - २\ \text{ग}$
$= २\ (\text{स} - \text{ग})$, $\text{अ} + \text{ग} + \text{ग} - \text{क} = २\text{स} - २\text{क} = २\ (\text{स} - \text{क})$ तब उत्थापन से

$$\frac{२\ (\text{स} - \text{अ}).\ २\ (\text{स} - \text{क}).\ २\ (\text{स} - \text{ग}).\ २(\text{स} - \text{घ})}{४\ (\text{अ. घ} + \text{क. ग})^२} = \text{ज्या}^२\text{आ} ।$$

$$= \frac{१६\ (\text{स} - \text{अ})\ (\text{स} - \text{क})\ (\text{स} - \text{ग})\ (\text{स} - \text{घ})}{४\ (\text{अ. घ} + \text{क. ग})^२}$$

$$= \frac{४\ (\text{स} - \text{अ})\ (\text{स} - \text{क})\ (\text{स} - \text{ग})\ (\text{स} - \text{घ})}{(\text{अ. घ} + \text{क. ग})^२} = \text{ज्या}^२\text{आ}$$ मूल लेने से

$$\frac{२}{\text{अ. घ} + \text{क. ग}}$$

$\times \sqrt{(स - अ)\ (स - क)\ (स - ग)\ (स - घ)}$ = ज्याआ। अब इस से उत्थापन देने से

$$चतुर्भुजफल = \frac{ज्याआ\ (अ.\ घ + क.\ ग)}{२} = \sqrt{(स - अ)\ (स - क)(स - ग)(स - घ)}$$

इससे आचार्योक्त श्रीपत्युक्त तथा भास्करोक्त चतुर्भुज फलानयन उपपन्न हुआ।

परन्तु उपरिलिखित उपपत्ति मे आ+गा=१८० स्वीकार किया गया है, संमुख कोणद्वय योग=१८० केवल वृत्तान्तर्गत चतुर्भुज में होता है इसलिये आनीत चतुर्भुज फल वृत्तान्तर्गत चतुर्भुज का वास्तव फल हुआ, साधारण विषम चतुर्भुज के लिये वह फल स्थूल है इसलिये आचार्य श्रीपति श्रीधराचार्य कथित विषम चतुर्भुजफलानयन स्थूल ही है जिसको वे लोग सूक्ष्म कहते है सूक्ष्म नही है। केवल भास्कराचार्य इस बात को समझे कि उपरि लिखित विषम चतुर्भुज फलानयन सूक्ष्म नहीं होता है इसलिये लीलावती मे अपने चतुर्भुज फलानयन श्लोक मे 'मूलमस्फुटफलं चतुर्भुजे' पूर्वोक्त रीति से आनीत फल को 'अस्फुट फल अर्थात् स्थूल फल' कहा है ।।२१।।

किस चतुर्भुज का फल महत्तम (सर्वाधिक) होता है इसके लिये विचार करते है। उपरि लिखित उपपत्ति में आकागाघा चतुर्भुजफल $= \frac{अ.घ.\ ज्याआ}{२} + \frac{क.ग.\ ज्यागा}{२}$

किसी पदार्थ के परमत्व में और परमन्यूनत्व में चलन कलन रीति से उसकी तात्कालिक गति शून्य के बराबर होती है यदि चतुर्भुज का फल महत्तम है तब दोनों पक्षों के तात्कालिक गति ग्रहण करने से $\frac{अ.\ घ.\ कोज्याआ}{२} + \frac{क.\ ग.\ कोज्यागा}{२} = ०$ ···(१) परन्तु 'भूसमुखाभ्रोद्भकोटि शिञ्जिनी' इत्यादि सस्कृतोपपत्ति में लिखित, विशेषोक्त सूत्र से $अ^२ + घ^२ + २\ अ.\ घ.\ कोज्याआ = क^२ + ग^२ + २क.\ ग.\ कोज्यागा$।

दोनों पक्षों के तात्कालिक गति ग्रहण करने से

अ. घ. ज्या आ = क. ग. ज्यागा क्यो कि स्थिराङ्को की गति=० होती है, तथा कोटिज्या की तात्कालिक गति ज्या होती है।

$\therefore अ.\ घ = \frac{क.\ ग.\ ज्यागा}{ज्याआ}$ इससे (१) इसको उत्थापन करने से

$$\frac{क.\ ग.\ कोज्याआ.\ ज्यागा}{२\ ज्या\ आ} + \frac{क.\ ग.\ कोज्यागा}{२}$$

$= \frac{क.\ ग.\ कोज्याआ.\ ज्यागा + क.\ ग.\ कोज्यागा.\ ज्याआ}{२\ ज्याआ} = ०$ छेदगम से क.ग. कोज्याआ ज्यागा + क. ग. कोज्यागा. ज्याआ = ०

$=$क. ग (कोज्याआ. ज्यागा$+$कोज्यागा. ज्याआ)$=$क. ग. ज्या (आ$+$गा)$=0$

$\therefore$ ज्या (आ$+$गा)$=\frac{0}{\text{क.ग.}}=0$ इसलिये आ$+$गा$=१८०$ इससे सिद्ध होता है कि एक आधार पर अनेक चतुर्भुजों के रहने से जिस चतुर्भुज का संमुखकोण द्वय योग एक सौ अस्सी अंश १८० होता है उसी (वृत्तान्तर्गतचतुर्भुज) का फल महत्तम होता है क्योंकि (वृत्तान्तर्गत चतुर्भुज ही का समुखकोणद्वय योग १८० के बराबर होता है ॥२१॥

इदानीमाबाधादिज्ञानाय करग सूत्रम् ।

भुजकृत्यन्तरभूहृतहीनयुता भूर्द्विभाजिताऽऽबाधे ।
स्वाबाधावर्गोनाद् भुजवर्गान्मूलमवलम्बः ॥२२॥

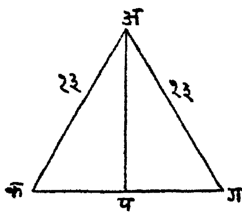
सु. भा.—भुजयोः कृत्यन्तरं भुजकृत्यन्तरं भुजयोगान्तरघातसममतो भास्करस्य 'त्रिभुजे भुजयोर्योगस्तदन्तरगुण' इत्यादि सूत्रं विचिन्त्यमेतदर्थम् ।

अत्र चतुर्वेदोक्तोद्देशकः । द्विसमत्रिभुजस्य दशभूमिकस्य त्रयोदशबाहुकस्याबाधादि । उक्तवदाबाधे ५ । ५ । अवलम्बः १२ । अन्योद्देशकश्चतुर्वेदोक्त एव भास्करेण 'क्षेत्रे महीमनुमिता त्रिभुजे' इत्यादिनोपनिबद्धः ॥२२॥

वि. भा.- भुजयोर्वर्गान्तरं भुवा भक्तं यल्लब्धं तेन भूर्हीनयुता कार्या तदर्धे ऽऽबाधे भवतः । स्वाबाधावर्ग हीनाद् भुजवर्गान्मूलं यत्स लम्बो भवतीति ॥२२॥

अत्र चतुर्वेदाचार्योक्तमुदाहरणम् ।

द्विसम त्रिभुजस्य दशभूमिकस्य त्रयोदश बाहुकस्याबाधादि ।



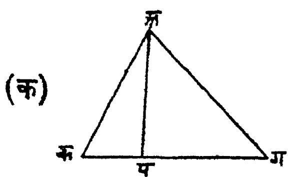
अकग त्रिभुजमस्ति यस्य अक, अग भुजौ$=१३$ । कग $=$ भूमिः$=१०$ तदा सूत्रानुसारेण

अक$+$अग$=१३+१३=२६$

अक$-$अग$=१३-१३=0$

अनयोर्घातः (अक$+$अग) (अक$-$अग)$=$अक$^2-$अग^2 $=(१३+१३)(१३-१३)=२६\times0=0$, अनेन भूहीन युता $१०+0=१०$ । $१०-0=१०$ अर्धिते जातेऽऽबाधे ५ । ५ आबाधावर्ग हीनाद् भुजवर्गात् $(१३)^2-(५)^2=१६९-२५=१४४$ मूलं$=१२=$लम्बः ।

अत्रोपपत्तिः ।



अकग त्रिभुजमस्ति यस्य भुजौ अक, अग, कग $=$भूमिः । अ बिन्दुतः कग भुजोपरिलम्बः$=$अप, कप$=$लघ्वाबाधा, पग$=$बृहदाबाधा । अग$=$बृहद्भुजः । अक$=$लघुभुजः । तदा अकप त्रिभुजे कर्णकोटयोर्वर्गान्तरं भुजवर्गः$=$अक$^2-$अप$^2=$कप^2

अगप त्रिभुजे कर्णकोटयोर्वर्गान्तरं भुजवर्गः $=$ अग^{2} $-$ अप^{2} $=$ पग^{2}

अनयोरन्तरं

अग^{2} $-$ अक^{2} $=$ पग^{2} $-$ कप^{2} वर्गान्तरस्य योगान्तरघातसमत्वात् अग^{2} $-$ अक^{2} $=$ (पग $+$ कप) (पग $-$ कप) $=$ कग (पग $-$ कप) $=$ भू $\times$ (बृहदावाधा $-$ लब्धावाधा) $=$ भू $\times$ आवाधान्तर

ततः $\frac{\text{अग}^{2} - \text{अक}^{2}}{\text{भू}}$ $=$ आवाधान्तर । बृहदावाधा $+$ लघ्वावाधा $=$ पग $+$ कप $=$ कग $=$ भूमि $=$ भू ।

ततः संक्रमणेन $\frac{\text{भू} - \text{आवाधान्तर}}{२}$ $=$ लघ्वावाधा, तथा $\frac{\text{भू} + \text{आवाधान्तर}}{२}$ $=$ बृहदावाधा ।

एतेनाऽऽचार्योक्तमुपपन्नम् । लीलावत्यां 'त्रिभुजे भुजयोर्योगस्तदन्तरगुणो भुवा हृतो लब्ध्या । द्विष्ठा भूरूनयुता दलिताऽऽवाधे तयोः स्याताम् । स्वावाधा भुजकृत्योरन्तरमूलं प्रजायते लम्बः' भास्करोक्तमिद सिद्धान्तशेखरे 'बाहुवर्गविवर-द्विनिघ्नभूभक्तवर्जितयुते स्वभूदले । तेऽवधे हि भवतोऽवधा भुजा वर्गजान्तर-पदं तु लम्बकः, श्रीपत्युक्तमिदं चा ऽऽचार्योक्तानुरूपमेव । 'द्विसम त्रिभुजक्षेत्रे त्रयोदश स्युर्भुजद्वये दण्डाः । दशभूरस्यावाधे वदावलंबं चे'ति महावीराचार्योक्तमुदाहरण-माचार्योक्तमेवास्ति । अन्यदुदाहरणं च ' विषम त्रिभुजस्य भुजा त्रयोदश प्रतिभुजा तु पञ्चदश । भूमिश्चतुर्दशास्य हि किं गणितं चावलम्बकावाधे ॥'

इदमेवोदाहरणं चतुर्वेदाचार्येणाऽन्योद्देशकरूपेण प्रदर्शितमस्ति । इदमे-वोदाहरणं श्रीधराचार्येण 'एको भुजस्त्रयोदश पञ्चदशान्यस्त्रिबाहुनि क्षेत्रे । चतुरधिकादशभूमिर्द्वादिशलम्बः कियद्गणितम्' त्रिशतिकायां प्रदत्तमस्ति, लीलावत्यां ' क्षेत्रे मही मनुमिता त्रिभुजे भुजौ तु यत्र त्रयोदशतिथिप्रमितौ च यस्य । तत्रावलम्बकमिति कथयावधे च क्षिप्रं तथा च समकोष्ठमिति फलाख्याम् ।' भास्करोक्तमिदमुदाहरणमपि तथैवास्ति 'कर्णस्त्रयोदश स्यात् पञ्चदशान्यो मही द्विसप्तैव । विषमत्रिभुजस्य सखे फलसंख्या का भवेदस्य' इत्यार्यभटीयतन्त्रटीका-कारस्य वृहद्भास्करीय-लघुभास्करीय ग्रन्थद्वयरचयितुर्भास्करस्योदाहरणं दृष्ट्वा ऽनन्तरं सर्वैराचार्यैस्तदनुसारमेव स्वस्वग्रन्थे लिखितमित्यनुमीयते ।' आवाधादि ज्ञानार्थमाचार्योक्तविधिरेव गणितमञ्जरीकारेण गणेशेना । "भुजान्तरैक्याभिहृ-तिर्धरित्री भक्ता फलेनोनयुता धरित्री । दलीकृता लम्बनिपात बाह्वोर्मध्ये कुखण्डे

भवतोऽवधाख्ये। भुजावधायोगवियोगघात मूलप्रमाणो गदितोऽवलम्बः' ऽनेन कथित इति ॥२२॥

अथ आवाधा आदि के ज्ञानार्थ विधि कहते है।

हि. भा.—विषम त्रिभुज मे दोनों भुजों के वर्गान्तर को भू (आधार) से भाग दे कर जो लब्धि हो उसको भू मे हीन और युत करके आधा करने से दोनों आवाधायें होती है। भुज और आवाधा के वर्गान्तर का मूल लम्ब प्रमाण होता है ॥२२॥

चतुर्वेदाचार्योक्त उदाहरण।

जिस त्रिभुज के दोनो भुज=१३ है, भूमि=१० उस त्रिभुज में आवाधा और लम्ब का प्रमाण क्या होगा? दोनों भुजों का वर्गान्तर=(१३)²−(१३)²=१६९—१६९=० इसको भू १० मे भाग देने से लब्धि =०/१०=० इसको भू में हीन और युत कर करने से १०—०=१०। १०+०=१० आधा करने से दोनो आवाधाओं के प्रमाण ५। ५ हुए। भुज और आवाधा का वर्गान्तर=(१३)²—(५)²=१६९—२५=१४४ इसका मूल= १२=लम्ब प्रमाण है ॥२२॥

उपपत्ति।

संस्कृतोपपत्ति में (क) चित्र देखिये। अकग विषम त्रिभुज है जिसकी दोनों भुजाएं अक, अग, है। कग=भूमि, अ विन्दु से कग भूमि के ऊपर लम्ब=अप, है। कप=लघ्वावाधा, पग=बृहदावाधा, अग=बृहद्भुज, अक=लघुभुज। तब अकप त्रिभुज मे कर्ण और कोटि का वर्गान्तर=भुजवर्ग=अक²—अप²=कप² एव अगप त्रिभुज मे कर्ण और कोटि का वर्गान्तर भुजवर्ग=अग²—अप²=पग² दोनो का अन्तर करने से अग²—अक²=पग² —कप² वर्गान्तर योगान्तर घात के बराबर होता है इसलिये अग²—अक²=(पग+कप) (पग — कप) = भू (बृहदावाधा —लघ्वावाधा) = भुजवर्गान्तर=भू × आवाधान्तर

∴ $\frac{\text{भुजवर्गान्तर}}{\text{भू}}$ =आवाधान्तर। बृहदावाधा+लघ्वावाधा=आवाधायोग=भू। तब

सङ्क्रमण गणित से $\frac{\text{भू}-\text{आवाधान्तर}}{२}$ =लघ्वावाधा, $\frac{\text{भू}+\text{आवाधान्तर}}{२}$ =बृहदावाधा।

इससे आचार्योक्त उपपन्न हुआ। लीलावती में 'त्रिभुजे भुजयोर्योगस्तदन्तरगुणः' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपति का कथन आचार्योक्त के अनुरूप ही है।

'द्विसमत्रिभुजक्षेत्रे त्रयोदश स्युः' इत्यादि महावीराचार्योक्त उदाहरण आचार्योक्त उदाहरण ही है। अन्य उदाहरण 'विषम त्रिभुजस्य भुजा त्रयोदश' इत्यादि संस्कृतोपपत्ति में लिखित को चतुर्वेदाचार्य ने अन्योद्देशक रूप मे दिखलाया है। इसी उदाहरण को श्रीधराचार्य ने 'एको भुजस्त्रयोदश पञ्चदशान्यः' इत्यादि त्रिशतिका में लिखा है। लीलावती में

'क्षेत्रे महीमनुमिता त्रिभुजे भुजौ तु' इत्यादि भास्करोक्त उदाहरण भी वेसा ही है। आबाधादि ज्ञान के लिये गणित मञ्जरी में 'भुजान्तरैक्याभिहतिर्धरित्री' इत्यादि संस्कृतोपपत्ति में लिखित पद्यों से गणेश दैवज्ञ ने आचार्योक्त रीति ही लिखी है इति ॥२२॥

इदानीं चतुर्भुजे कर्णलम्बज्ञानाय करणसूत्रम्।

अविषमचतुरस्रभुजप्रतिभुजवधयोर्युतेः पदं कर्णः।

कर्णकृतिर्भूमुखयुतिदलवर्गोना पदं लम्बः ॥ २३ ॥

सु. भा.—अविषमचतुरस्रं वर्गक्षेत्रमायतं समानान्तर चतुर्भुजं यत्र भुजत्रयं समानं तच्चतुर्भुजं चेति चतुर्वेदाचार्योक्तिः। आचार्योक्तविधिना वर्गायतयोरेव कर्णलम्बसिद्धिरन्यत्र स्थूलौ कर्णलम्बौ भवत इति रेखागणितेन स्फुटम्। व्याख्या चातिसुगमेति ॥ २३ ॥

वि. भा.—अविषम चतुरस्रं वर्गक्षेत्रमायतं समानान्तरचतुर्भुजं यत्र भुजत्रयं समानं तच्चतुर्भुजं चेति चतुर्वेदाचार्योक्तिः। आचार्योक्त प्रकारेण वर्गक्षेत्रायत-क्षेत्रयोरेव कर्णलम्बयोर्ज्ञानं भवितुमर्हति, अन्यचतुर्भुजेषु कर्णलम्बौ न वास्तविकौ भवत इति रेखागणितविदां स्फुटमेवेति ॥२३॥

अत्रोपपत्तिः।

वर्गक्षेत्रे सर्वे भुजाः समाना भवन्ति, कोणचतुष्टयं च समकोणसमम्, तेन संमुख भुजयोर्घातस्तद्वर्गो भवतोऽतो भुजप्रतिभुजयो (संमुखभुजयोः) र्घातयोगस्य मूलं कर्णो भवेदेव। एवमायतक्षेत्रेऽपि, अत्र लम्बानयनमपि सुगममेवेति ॥२३॥

अब चतुर्भुज में कर्ण और लम्ब के ज्ञानार्थ कहते है।

हि. भा.—अविषम चतुर्भुज से वर्गक्षेत्र, आयतक्षेत्र समानान्तर चतुर्भुज और जिस चतुर्भुज में तीन भुज बराबर है वे भी लिये जाते है। यह चतुर्वेदाचार्य कहते हैं। आचार्योक्त विधि से वर्गक्षेत्र और आयत क्षेत्र का ही कर्ण और लम्ब ज्ञान ठीक हो सकता है अन्य चतुर्भुजों में उस प्रकार से कर्ण और लम्ब वास्तविक नही होता है ॥२३॥

उपपत्ति।

वर्गक्षेत्र में सब भुज बराबर होते हैं, और चारों कोण समकोण होने हैं, इसलिये संमुख भुजद्वय का घात करने से उसका वर्ग होता है, अतः संमुख संमुखभुजद्वय घात योग के मूल लेने से कर्ण प्रमाण होता है आयतक्षेत्र में भी यही युक्ति है। यहां लम्बानयन भी स्पष्ट ही है इति ॥२३॥

इदानीं जात्यत्रिभुजे भुजकोटिकर्णानयनार्थं विधिः कथ्यते ।

कर्णकृतेः कोटिकृतिं विशोध्य मूलं भुजो भुजस्य कृतिम् ।
प्रोह्य पदं कोटिः कोटिबाहुकृतियुतिपदं कर्णः ॥२४॥

सु. भा.—स्पष्टार्थम् । 'तत्कृत्योर्योगपदं कर्णः' इत्यादि भास्करोक्तमेतदनुरूपमेव ।

अत्रोपपत्तिः ।

रेखागणित प्रथमाध्यायसप्तचत्वारिंशत्प्रतिज्ञया स्फुटा ॥२४॥

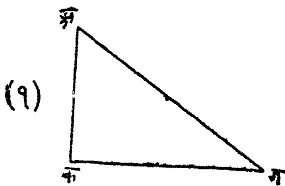
वि. भा.—कर्णवर्गात् कोटिवर्गं विशोध्य मूलं ग्राह्यं तदा भुजो भवेत्, कर्णवर्गाद् भुजवर्गं विशोध्य तन्मूलं ग्राह्यं तदा कोटिर्भवेत् ।

कोटिभुजयोर्वर्गयोगमूलं कर्णो भवतीति ॥२४॥

अत्रोपपत्तिः ।

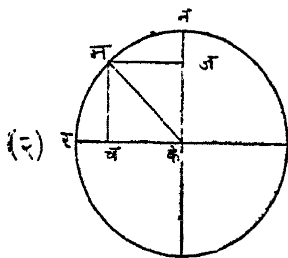
यत्र त्रिभुजे एकः कोणः समकोणस्तज्जात्यत्रिभुजम् । तत्र समकोणसंमुखभुजः कर्णः, समकोणसंलग्नभुजयोर्मध्ये एको भुजसंज्ञकोऽन्या कोटिसंज्ञिका । यथा

(१)



अकग त्रिभुजमस्ति यत्र अकग कोणः समकोणः=९० तदा अग=कर्णः । कग=भुजः । अक=कोटिः । अत्र $\sqrt{\text{कर्ण}^2-\text{कोटि}^2}$=भुज, $\sqrt{\text{कर्ण}^2-\text{भुज}^2}$=कोटिः $\sqrt{\text{कोटि}^2+\text{भुज}^2}$=कर्ण । इति कथं भवति तदर्थं युक्तिरुच्यते ।

(२)



किमप्येकं वृत्तमस्ति यद्व्यासः=नम, के=वृत्त केन्द्रम् । केन=वृत्तव्यासार्धम्=कम । नम=इष्टचापम्=चा नर=९०, ∴ ९०—नम=मर=९०—चा=चापकोटिः । मज=चापज्या । केज=चापकोटिज्या=मच, $\angle$ज=९० केम=त्रिज्या, तदाऽत्र केमज जात्य त्रिभुजे $\sqrt{\text{चापज्या}^2+\text{चापकोटिज्या}^2}$ =त्रि भविष्यति । यथा ज्या (मन+मर) ज्या (नर) = त्रि = ज्या (चाप+चापको) तदा 'चापयोरिष्टयोर्दोर्ज्ये मिथः कोटिज्यकाहते' इत्यादिना

$\frac{\text{चापज्या}\times\text{चापकोज्या}+\text{चापकोज्या}\times\text{चापज्या}}{\text{त्रि}}$

$= \frac{\text{चापज्या} \times \text{चापज्या} + \text{चापकोज्या} \times \text{चापकोज्या}}{\text{त्रि}} = \text{ज्या}\ (९०) = \text{त्रि}$

$= \frac{\text{चापज्या}^2 + \text{चापकोज्या}^2}{\text{त्रि}} = \text{त्रि}\ \therefore\ \text{चापज्या}^2 + \text{चापकोज्या}^2 = \text{त्रि}^2$ मूलेन $\sqrt{\text{चापज्या}^2 + \text{चापकोज्या}^2} = \text{त्रि}$ । अतः सिद्धं यज्जात्यत्रिभुजे भुजकोटिवर्गयोगस्य मूलं कर्णो भवति । ततः $\sqrt{\text{त्रि}^2 - \text{चापज्या}^2} = \text{चापकोज्या}$ । वा $\sqrt{\text{त्रि}^2 - \text{चापकोज्या}} = \text{चापज्या}$, एतेनाऽऽचार्योक्तमुपपद्यते । लीलावत्यां 'तत्कृत्योर्योगपदं कर्णोदोः कर्णवर्गयोर्विवरान्मूलं कोटिरित्यादि' भास्करोक्तमाचार्योक्तानुरूपमेवेति ॥२४॥

अब जात्य त्रिभुज में भुज कोटि और कर्ण के ज्ञान के लिये नियम कहते है ।

हि. भा.—कर्णवर्ग में से कोटिवर्ग को घटा कर मूल लेने से भुज होता है, कर्ण वर्ग में से भुज वर्ग को घटाकर मूल लेने से कोटि होती है । और भुज तथा कोटि का वर्गयोग मूल कर्ण होता है ॥२४॥

उपपत्ति ।

संस्कृतोपपत्ति में लिखित (१) क्षेत्र को देखिये । जिस त्रिभुज में एक कोण होता है वह जात्य त्रिभुज कहलाता है उसमें समकोण के संमुख भुजकर्ण कहलाता है, समकोण सलग्न भुजद्वय में एक भुज है, दूसरा भुज कोटि है । जैसे अकग त्रिभुज है जिसमें अकग कोण समकोण $= ९०$ है, तब अग $=$ कर्ण, कग $=$ भुज, अक $=$ कोटि ।

यहां $\sqrt{\text{कर्ण}^2 - \text{कोटि}^2} = \text{भुज}$, $\sqrt{\text{कर्ण}^2 - \text{भुज}^2} = \text{कोटि}$, $\sqrt{\text{कोटि}^2 + \text{भुज}^2} = \text{कर्ण}$ यह क्यों होता है इसके लिये युक्ति लिखते हैं । संस्कृतोपपति में लिखित (२) क्षेत्र को देखिये, कोई एक वृत्त है जिसका व्यास $=$ नस, के $=$ वृत्तकेन्द्र, केन $=$ वृत्तव्यासार्ध $=$ कम $=$ त्रिज्या । नम $=$ इष्टचाप $=$ चा, नर $= ९०$, $\therefore$ ९० $-$ नम $=$ मर $= ९० -$ चा $=$ चापकोटिः । मज $=$ चापज्या, केज $=$ चापकोटिज्या, $<$ ज $= ९०$, तब केमज जात्य त्रिभुज में $\sqrt{\text{चापज्या}^2 + \text{चापकोज्या}^2} = \text{त्रि}$, होगा । यहां चापज्या $=$ भुज है, चापकोटिज्या $=$ कोटि है, त्रिज्या कर्ण है, ज्या (मन $+$ मर) $=$ ज्या (नर) $=$ त्रि $=$ ज्या (चा $+$ चापको) तब 'चापयोरिष्टयोर्दोर्ज्ये मिथः कोटिज्यकाहते' इत्यादि से $\frac{\text{चापज्या} \times \text{चापकोज्या} + \text{चापकोज्या} \times \text{चापज्या}}{\text{त्रि}}$

$= \frac{\text{चापज्या} \times \text{चापज्या} + \text{चापकोज्या} \times \text{चापकोज्या}}{\text{त्रि}} = \text{ज्या}\ (९०) = \text{त्रि}$

$= \frac{\text{चापज्या}^2 + \text{चापकोज्या}^2}{\text{त्रि}}\ \therefore\ \text{चापज्या}^2 + \text{चापकोज्या}^2 = \text{त्रि}^2$ मूल लेने से

$\sqrt{\text{चापज्या}^2 + \text{चापकोज्या}^2} = \text{त्रि}$ । इससे सिद्ध हुआ कि जात्य त्रिभुज में भुज और कोटि का वर्ग योग मूल कर्ण के बराबर होता है ।

अतः $\sqrt{\text{त्रि}^2 - \text{चापज्या}^2} = \text{चापज्या}$, वा $\sqrt{\text{त्रि}^2 - \text{चापकोज्या}} = \text{चापज्या}$, इससे आचार्योक्त उपपन्न हुआ । लीलावती में 'तत्कृत्योर्योग पद कर्णोदो. कर्णवर्गयोर्विवरात्' इत्यादि भास्करोक्त आचार्योक्त के अनुरूप ही है ॥२४॥

इदानीं लम्बकर्णयोरूर्ध्वाधर खण्डानयनार्थमाह ।

कर्णयुतावूर्ध्वाधरखण्डे कर्णावलम्बयोगे वा ।
स्वाबाधे स्वयुतिहृते द्विधा पृथक् कर्णलम्बगुणे ॥ २५ ॥

सु० भा०—आकागाथा—चतुर्भुजे आजा, काता लम्बौ, आगा, काघा कर्णौ । कर्णयुतिः चाविन्दौ । काचा, चाघा, काघा कर्णस्य, आचा, चागा, आगाकर्णस्योर्ध्वाधरखण्डे । तत्र घामा, माता तथा मागा, माजा आबाधे । चामा चाविन्दोरागाधरोपरि लम्बः । एवं लम्बकर्णयुतौ दाविन्दौ थाविन्दौ च, घाजा, जाता तथा तागा, जाता क्रमेण आबाधे । तेनायमर्थः । स्वाबाधे कर्णगुणे स्वयुतिहृते स्वाबाधायुतिहृते कर्णयुतावूर्ध्वाधरखण्डे भवतः । एवं स्वाबाधे लम्बगुणे स्वाबाधायुतिहृते कर्णावलम्बकयोगे ऊर्ध्वाधरखण्डे भवतः ।

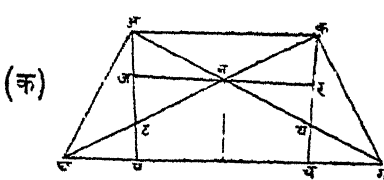
अत्रोपपत्तिः ।

उपरिलिखितक्षेत्रतः साजात्यानुपातेन स्फुटा ॥२५॥

वि. भा.—स्वाबाधे स्थानद्वये पृथक् कर्णगुणे स्वाबाधायोगेन भक्ते तदा कर्णयुतौ (कर्णयोर्योगविन्दौ) कर्णस्योर्ध्वाधरखण्डे भवत एवं स्वाबाधे स्थानद्वये लम्बगुणे स्वाबाधायोगेन भक्ते तदा कर्णलम्बयोर्योगविन्दौ लम्बस्योर्ध्वाधरखण्डे भवत इति ॥२५॥

अत्रोपपत्तिः ।

(क)



यथा अकगघ चतुर्भुजे अप, कच लम्बौ स्तः । तथा अग, कघ कर्णौ स्तः, कर्णयोर्योगविन्दुः = त, अत्र त विन्दौ अग कर्णस्योर्ध्वाधरखण्डे अत, तग, कघ कर्णस्य चोर्ध्वाधरखण्डे तक तघ

तत्र घम, मच तथा मग, मप आवाधे स्तः। न विन्दुतः घग आधारोपरि-लम्बः=नम, एव लम्वकर्णयुतौ ट बिन्दौ, य बिन्दौ च घप, पच तथा चग, पच क्रमेणावाधे, ततः अपग, नमग त्रिभुजयोः साजात्यात् $\frac{\text{अग. मग}}{\text{पग}} = \frac{\text{कर्ण. आवाधा}}{\text{आवाधायोग}}$ = नग = अग कर्णाधरुखण्डम् तथा अपग, अनज त्रिभुजयोः साजात्यात् $\frac{\text{अग. नज}}{\text{पग}}$

$= \frac{\text{कर्ण. आवाधा}}{\text{आवाधायोग}}$ = अन = अग कर्णोर्ध्वखण्डम् । एवं कघ कर्णस्यापि $\frac{\text{कघ. घम}}{\text{घच}}$

$= \frac{\text{कर्ण. आवाधा}}{\text{आवाधायोग}}$ = घन = घक कर्णाधर खण्डम् । तथा $\frac{\text{कघ. नर}}{\text{घच}}$

$= \frac{\text{कर्ण आबाधा,}}{\text{आवाधायोग}}$ = कन = घक कर्णोर्ध्व खण्डम् । एवमेव लम्बकर्ण योगबिन्दौ लम्बोर्ध्वाधरखण्डे अनुपातेन भवत इति ॥२५॥

अब लम्ब और कर्ण के ऊर्ध्वाधर खण्डानयन के लिये कहते हैं ।

हि. भा. – अपनी आवाधाओं को कर्ण से गुणाकर कर्ण से भाग देने से दोनों कर्णों के योग बिन्दु में कर्ण का ऊर्ध्व खण्ड और अधर खण्ड होता है, एवं अपनी आवाधाओं के लम्ब से गुणाकर अपनी आवाधायोग से भाग देने से कर्ण और लम्ब के योग बिन्दु मे लम्ब का ऊर्ध्वखण्ड और अधरखण्ड होता है ॥२५॥

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । जैसे अकगघ चतुर्भुज में अप, कच दोनों लम्ब हैं, तथा अग, कघ दोनों कर्ण हैं, दोनों कर्णो का योग विन्दु=न, इस न बिन्दु में अग कर्ण का ऊर्ध्वखण्ड=अन, और अधर खण्ड=नग है, कघ कर्ण का ऊर्ध्वखण्ड =नक है, अधरखण्ड=नघ है और मग, मप तथा घग, मच आवाधायें है । न बिन्दु से घग आधार के ऊपर लम्ब नम है, इसी तरह लम्ब और कर्ण के योग बिन्दु (ट, और य) में घप, पच तथा चग, पच आवाधाये है तब अपग, नमग दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं $\frac{\text{अ . .}}{\text{पग}} = \frac{\text{कर्ण आवाधा}}{\text{आवाधायोग}}$ = नग = अग कर्णाधरखण्ड तथा अपग, अनज दोनों त्रिभुजों के सजातीयत्व से $\frac{\text{अग. नज}}{\text{पग}} = \frac{\text{कर्ण. आवाधा}}{\text{आवाधायो}}$ = अन = अग कर्णोर्ध्व-खण्ड इसी तरह $\frac{\text{कघ. घन}}{\text{घच}} = \frac{\text{कर्ण. आवाधा,}}{\text{आवाधायोग}}$ = घन = घक कर्ण के अधर

(नीचे का खण्ड)

तथा $\frac{\text{कन नर}}{\text{घच}} = \frac{\text{कर्ण}^{1}.\ \text{आबाधा}^{1}}{\text{आबाधायोग}^{1}}$ = कन = घक कर्ण के ऊर्ध्व (ऊपर का) खण्ड;

इसी तरह लम्ब और कर्ण के योग बिन्दु में लम्ब का ऊर्ध्वखण्ड और अधरखण्ड अनुपात से होता है इति ॥ २५ ॥

इदानीं चतुर्भुजोपरिगत वृत्तस्य व्यासज्ञानार्थमाह ।

अविषम पार्श्वभुजगुणः कर्णो द्विगुणावलम्बकविभक्तः ।
हृदयं विषमस्य भुजप्रतिभुज कृतियोगमूलार्धम् ॥२६॥

सु० भा०—वर्गक्षेत्रे तथाऽऽयते कर्ण एव व्यास इति स्फुटम् । अत्राविषमेन तत् समलम्बचतुर्भुजम् (यत्र कर्णौ भुजौ द्वौ च तुल्यौ) उच्यते । तेनायमर्थः । कर्ण. पार्श्वभुजेन गुणो द्विगुणावलम्बकविभक्तः फलं हृदयं चतुर्भुजोपरिगवृत्तस्य व्यासार्धं भवेत् । विषमचतुर्भुजे यत्रोपरिगवृत्तं भवितुमर्हति तत्र भुजप्रतिभुजयो-र्वर्गयोगमूलार्धं हृदयं व्यासार्धं भवेत् ।

अत्रोपपत्तिः ।

तुल्यभुजसमलम्बचतुर्भुजे कर्णवशेन त्रिभुजद्वयमेकवृत्तान्तर्गतम् । अत एकत्रिभुजोपरिगवृत्तव्यास एवान्यत्रिभुजोपरिगवृत्तस्य वा चतुरस्रोपरिगवृत्तस्य व्यासो भवति । एकस्मिन् त्रिभुजे कर्णः पार्श्वभुजा भुजौ च लम्ब एव लम्बः । अतो रेखागणित षष्ठाध्यायेन 'त्रिबाहुकबहिर्लग्नवृत्तव्यासदलं किलेत्यादिना व्यासदं = $\frac{\text{क}\times\text{पाभु}}{\text{२ ल}}$ । वृत्तान्तर्गते विषमचतुर्भुजे यत्र भुजप्रतिभुजयोरर्थात् संमुखभुजयोरुपरि चापयोर्योगः परिध्यर्धसमस्तत्रैवाऽऽचार्यमते व्यासदलज्ञानं भवति यतस्तत्रैव भुजाग्रात् प्रतिभुजसमपूर्णज्यादानेन तदुपरिगचापयोगस्य परि-ध्यर्धसमत्वात् तदुत्पन्नकोणः समकोणस्तदग्रगता रेखा कर्णश्च व्यासो भवति नान्यथेति सुधीभिर्भृशं विचिन्त्यम् ॥ २६ ॥

वि: भा.—वर्गक्षेत्रे आयते च कर्ण एव तदुपरिगतवृत्त व्यासः । अत्राविषमेन समलम्बचतुर्भुजं बोध्यम् । यत्र कर्णौ भुजौ द्वौ च तुल्यौ, कर्णः पार्श्वभजेन गुणो द्विगुणावलम्बक विभक्तः फलं हृदयमर्थात् चतुर्भुजोपरिगत वृत्तस्य व्यासा-र्धभवेत् । विषम चतुर्भुजे यत्र तदुपरिगतवृत्तं भवितुमर्हति तत्र भुज प्रति भुजयो र्वर्गयोग मूलार्ध हृदय (व्यासार्ध) भवेत् ॥२६॥

अत्रोपपत्तिः ।

तुल्य भुज समलम्बचतुर्भुजे कर्णवशेन त्रिभुजद्वयमेक वृत्तान्तर्गतं भवति, तेन त्रिभुजोपरिगत वृत्तव्यास एव चतुर्भुजोपरिगत वृत्तव्यासो भवति, एकस्मिन् त्रिभुजे कर्णः पार्श्वभुजौ, लम्ब एव लम्बः । तदा त्रिबाहुकवहिर्लग्न वृत्त व्यासदलमित्यादिना $\frac{\text{कर्ण पार्श्वभुज}}{\text{२ लम्ब}}$ = व्यासार्धम् । वृत्तान्तर्गते विषमचतुर्भुजे यत्रभुज प्रतिभुजयोरर्थात् संमुखभुजयोरुपरि चापयोर्योगः परिध्यर्धसमस्तत्रैवाऽऽचर्य्यमतेन व्यासार्धज्ञानं भवति । यतस्तत्रैव भुजाग्रात् प्रतिभुजसमपूर्णज्यादानेन तदुपरिगचापयोगस्य परिध्यर्धसमत्वात् तदुत्पन्नकोणः समकोणस्तदग्रगतारेखा कर्णश्च व्यासो भवति नान्यथेति ॥२६॥

अब चतुर्भुजोपरि गत वृत्त के व्यासार्धज्ञान के लिए कहते है ।

हि. भा—वर्ग क्षेत्रोपरिगत वृत्त का व्यास उसका कर्ण ही होता है, आयत क्षेत्र में भी ऐसा ही होता है, आचार्योक्त पद्य में अविषम शब्द से समलम्ब समानान्तर चतुर्भुज समझना चाहिये जहाँ दोनों कर्ण दोनों भुज बराबर है । कर्ण को पार्श्वस्थ भुज से गुणा कर द्विगुणित लम्ब से भाग देने से चतुर्भुजोपरिगत वृत्त का व्यासार्ध होता है । विषम चतुर्भुज में जिसमें उसके ऊपर वृत्त हो सकता है उसमें भुज और प्रतिभुज (संमुख भुज) के वर्गयोग मूल का आधा व्यासार्ध होता है ॥ २६ ॥

उपपत्ति ।

तुल्यभुज सम लम्ब चतुर्भुजमें कर्णवश से जो त्रिभुजद्वय होता है वह त्रिभुज द्वय एक ही वृत्तान्तर्गत होता है इसलिए त्रिभुजोपरिगत वृत्त व्यास ही चतुर्भुजोपरिगत वृत्तव्यास होता है, एक त्रिभुज में कर्ण-पार्श्वभुज और भुज, लम्ब लम्ब ही है तब 'त्रिवाहुक वहिर्लग्न वृत्त व्यास दलं' इत्यादि संशोधकोक्त से $\frac{\text{कर्ण. पार्श्वभुज}}{\text{२ लम्ब}}$ = व्यासार्ध, वृत्तान्तर्गत चतुर्भुज में जहॉ कि संमुख दोनों भुजों के ऊपर चापद्वय का योग परिध्यर्ध (१८० अंश) के बराबर होता है वही पर आचार्य मत से व्यासार्धज्ञान होता है, क्योंकि वहीं पर भुजाग्र से संमुख भुजतुल्य पूर्णज्या दान देने से उसका उपरिगत चापयोग परिध्यर्ध के बराबर होता है, उससे उत्पन्न कोण समकोण होता है, उसका अग्रगत रेखा (कर्ण) व्यास होता है, इससे अन्यथा नहीं होता है ॥ २६ ॥

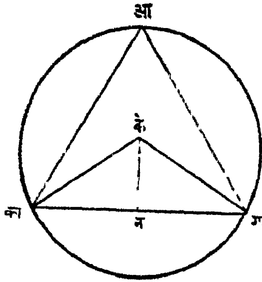
इदानीं त्रिभुजोपरिगतवृत्तव्यासार्धज्ञानार्थमाह ।

त्रिभुजस्य वधो भुजयोर्द्विगुणितलम्बोद्धृतो हृदयरज्जुः ।
सा द्विगुणा त्रिचतुर्भुजकोणस्पृग्वृत्तविष्कम्भः । २७ ॥

सु. भा.—स्पष्टार्थमुपपत्तिश्चोपरिगप्रकारेण स्फुटा ॥२७॥

वि. भा.—त्रिभुजे भुजद्वयघातार्धं भुजद्वययोगविन्दुत आधारोपरिलम्बेन भक्तं तदा तदुपरि (त्रिभुजोपरि) गतवृत्तव्यासार्धं भवति। द्विगुणी करणेन वृत्तव्यासो भवतीति ॥ २७ ॥

अत्रोपपत्तिः।



आकागा त्रिभुजमस्ति यदुपरिगत वृत्तस्य केन्द्रम् = के

केका = केगा = व्यासार्धम् = य

कागा = अ, आगा = क, आका = ग

रेखागणितयुक्त्या परिधिलग्न आ कोणात् केन्द्रलग्न के कोणो द्विगुणो भवति। तदा 'भुज मध्यगता जीवा क्षुण्णा दोष्णोर्वधेन सा। दलिता त्रिभुजस्य स्यात् फलमित्यादि' विशेषोक्त सूत्रेण आकागा त्रिभुज फलम् $= \frac{\text{क. ग. ज्या आ}}{२}$

$= \frac{\text{क. ग. ज्या}\frac{\text{के}}{२}}{२}$। काकेगा समद्विबाहुक त्रिभुजे के बिन्दुतः कागा भुजोपरिलम्बः $=$ केत, तदा कात = गात $= \frac{\text{अ}}{२}$, तथा $<$ काकेत $= <$ गाकेत $= \frac{<\text{के}}{२}$

काकेत त्रिभुजेऽनुपातेन $\frac{१ \times \text{कात}}{\text{काके}} = \frac{\text{कात}}{\text{काके}} = \frac{\text{अ}}{२\,\text{य}} = \text{ज्या}\,\frac{\text{के}}{२}$ तत उत्थापनेन

त्रिभुजफलम् $= \frac{\text{अ. क. ग}}{४\,\text{य}}$, आ बिन्दुतः कागा आधारोपरिलम्बः $=$ ल, तदा लम्ब गुणं भूम्यर्धमित्यादिना त्रिभुजफलम् $= \frac{\text{अ. ल}}{२}$, अतस्त्रिभुजफलयोः समीकरणम्

$\frac{\text{अ. क. ग}}{४\,\text{य}} = \frac{\text{अ. ल}}{२}$ पक्षौ द्वाभ्यां गुणितौ तदा $\frac{\text{अ. क. ग}}{२\,\text{य}} = \text{अ. ल}$ छेदगमेन अ. क.ग $= २\,\text{अ. य. ल}$

$\therefore \text{य} = \frac{\text{अ. क. ग}}{२\,\text{अ. ल}} = \frac{\text{क. ग}}{२\,\text{ल}}$ एतेनाऽऽचार्योक्तपद्यमुपपन्नम्। "त्रिबाहुक बहिर्लग्नवृत्तव्यासदलं किल। भुजयोगहृतेः खण्डाल्लम्बाप्तेन समं भवेत्" इति मशोधको (पं. बापूदेव शास्त्री) क्तमप्युपपद्यते। सिद्धान्त शेखरे 'त्रिबाहुतः पार्श्व भुजा वधार्ध लम्बेन भक्तं हृदयस्य रज्जुः' श्री पत्युक्तमिदमाचार्योक्तानुरूपमेवेति ॥ २७ ॥

अब त्रिभुजोपरिगतवृत्त व्यासार्ध के ज्ञानार्थ कहते हैं।

हि. भा.—त्रिभुज के दो भुजों के घातार्ध को दोनों भुजों के योग बिन्दु से आधार के ऊपर जो लम्ब होता है उससे भाग देने से त्रिभुजोपरिगत वृत्त का व्यासार्ध होता है, इस को द्विगुणित करने से वृत्तव्यास होता है ।।२६।।

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । आकागा त्रिभुज है जिसके उपरिगतवृत्तका केन्द्र = के है, केका = केगा = व्यासार्ध = य, कागा = अ, आगा = क, आका = ग, रेखागणित की युक्ति से परिधि लग्न आ कोण केन्द्रलग्न के कोण का आधा होता है, तब 'भुजमध्यगता जीवा' इत्यादि संस्कृतोपपत्ति में लिखित विशेषोक्त सूत्र से आकागा त्रिभुज फल $= \frac{\text{क. ग. ज्याआ}}{२} = \frac{\text{क. ग. ज्या} \frac{\text{के}}{२}}{२}$, काकेगा समद्विबाहुक त्रिभुज में के बिन्दुसे कागा भुज के ऊपर लम्ब = केन, तब कान = गान $= \frac{\text{अ}}{२}$, तथा $<$ काकेन $= \angle$ गाकेन $= \frac{\angle \text{के}}{२}$

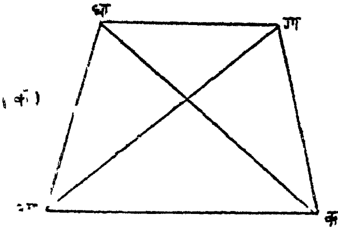
काकेन त्रिभुज में अनुपात से $\frac{१ \times \text{कान}}{\text{का के}} = \frac{\text{कान}}{\text{काके}} = \frac{\text{अ}}{२\,\text{य}} = \text{ज्या} \frac{\text{के}}{२}$ तब उत्थापन से त्रिभुजफल $= \frac{\text{अ क. ग}}{४\,\text{य}}$ आ बिन्दु से कागा आधार के ऊपर लम्ब = ल, तब 'लम्बगुणं भूम्यर्ध' इत्यादि से त्रिभुजफल $= \frac{\text{अ. ल}}{२}$, दोनों त्रिभुज फलों के समीकरण से $\frac{\text{अ. क. ग}}{४\,\text{य}} = \frac{\text{अ. ल}}{२}$ दोनो पक्ष को २ से गुणने पर $\frac{\text{अ.क.ग.}}{२\text{य}} = \text{अ. ल.}$ छेदगम से अ. क. ग = अ. ल. २य, $\therefore$ य $= \frac{\text{अ. क. ग}}{२.\,\text{अ. ल}} = \frac{\text{क. ग.}}{२\,\text{ल}}$ इससे आचार्योक्त उपपन्न हुआ । "त्रिबाहुकबहिर्लग्नवृत्तव्यासदलं" इत्यादि सस्कृतोपपत्तिमे लिखित सशोधकोक्त पद्य भी उपपन्न होता है । सिद्धान्त शेखर में 'त्रिबाहुनः पार्श्वभुजावधार्ध' यह श्रीपत्युक्त त्रिभुजो परिगतवृत्त-व्यासार्धनियन आचार्योक्त के अनुरूप ही है ।।२७।।

इदानीं विषमचतुर्भुजस्य कर्णयोरानयनार्थमाह ।

कर्णाश्रितभुजघातैक्यमुभयथाऽन्योन्य भाजितं गुणयेत् ।
योगेन भुज प्रति भुजवधयोः कर्णौ पदे विषमे ।।२८।।

सु० भा०—स्पष्टार्थ भास्करलीलावतीतः । अनेन प्रकारेण वृत्तान्तर्गत

चतुर्भुजस्यैव कर्णौ भवत इत्येनदर्थं मच्छोधिता भास्करलीलावती द्रष्टव्या ॥२८॥



वि. भा.—कर्णयोराश्रिते ये भुजे तयोर्यो घातस्तयोरैक्यं (योगः) अर्थात् उभयपार्श्वे कर्णाश्रितौ यौ यौ भुजौ तयोस्तयोर्भुजयोः पृथक् पृथक् यौ घातौ तयोरैक्यं विधेयम्। एवमन्य कर्णस्यापि तत् द्विधा परस्परं भाजितं कार्यम्। भुजघ्नि भुजवधयोः (संमुख संमुखभुज घातयोः) योगेन गुणयेत्, तयोः पदे (मूले) ये तौ विषम चतुर्भुजे कर्णौ भवेतामिति।

अत्रोपपत्तिः।

आकागाघा विषम चतुर्भुजमस्ति, यस्य भुजचतुष्टयेभ्यः कर्णद्वयाऽऽनयनमभीष्टमस्ति, कल्प्यते आका = अ, कागा = क, गाघा = ग, आघा = घ, काघाकर्णः = य, आगाकर्णः = र। तदा आकाघा त्रिभुजे, 'भूमंभूखास्रोद्भव कोटि शिञ्जिनी दोर्घातगुण्या त्रिगुणार्धभक्ता। दोर्वर्गयोगो रहितस्तया स्यादाधार वर्गोऽस्य पदं महीचे' ति विशेषोक्त सूत्रेण।

अ² + घ² — २ अ. घ. कोज्याआ = य², एवमेव कागाघा त्रिभुजेऽपि क² + ग² — २ क. ग. कोज्यागा = य² ततः समशोधनादिना $\frac{\text{अ}^2+\text{घ}^2-\text{य}^2}{2\,\text{अ.घ}}$ = कोज्याआ,

तथा $\frac{\text{क}^2+\text{ग}^2-\text{य}^2}{2\,\text{क.ग}}$ कोज्यागा यदि आ + गा = १८० तदा आ = १८० — गा

∴ कोज्याआ = कोज्या (१८० — गा) = —कोज्यागा ∴ $\frac{\text{अ}^2+\text{घ}^2-\text{य}^2}{2\,\text{अ.घ}}$

$= -\frac{\text{क}^2+\text{ग}^2-\text{य}^2}{2\,\text{क.ग}} = \frac{-\text{क}^2-\text{ग}^2+\text{य}^2}{2\,\text{क.ग}}$ छेदगमेन अ².क.ग + घ².क.ग — य².क.ग. = —क².अ.घ — ग².अ.घ + य².अ.घ समयोजनेन अ².क.ग + घ².क.ग + क².अ.घ + ग².अ.घ = य² अ.घ + य²क.ग = य² (अ.घ + क.ग) = अ.ग. (अ.क + ग.घ) + क.घ (अ.क + ग.घ) = (अ.क + ग.घ) (अ.ग + क.घ) = य² (अ.घ + क.ग)

∴ $\frac{(\text{अ.क}+\text{ग.घ})(\text{अ.ग}+\text{क.घ})}{\text{अ.घ}+\text{क.ग}}$ = य² मूलेन $\sqrt{\frac{(\text{अ.क}+\text{ग.घ})(\text{अ.ग}+\text{क.घ})}{\text{अ.घ}+\text{क.ग}}}$

= य एवमेव $\sqrt{\frac{(\text{अ.ग}+\text{क.घ})(\text{अ.घ}+\text{क.ग})}{\text{अ.क}+\text{ग.घ}}}$ = र, एतेनाऽऽचार्योक्तमुपपद्यते।

परं पूर्वं आ, गा संमुख कोणयोर्योग:=१८० इति स्वीकृत्य कर्णद्वयानयनं कृतं संमुख कोणयोर्योग: समकोणद्वयसमानो वृत्तान्तर्गत चतुर्भुज एव भवत्यत: सिद्धं यदानीतं कर्णद्वयमानं वृत्तान्तर्गतचतुर्भुजस्यैवार्थादाचार्योक्तसूत्रेण वृत्तान्तर्गतचतुर्भुजस्यैव कर्णानयनं वास्तवं भवितुमर्हति, नहि साधारण विषम चतुर्भुजस्य। सिद्धान्त शेखरे "कर्णान्ति-संश्रित-भुजाहृतिसयुतिर्या भक्ता परस्परमसौ गुणयेत् द्विधा ताम्। युत्या भुज प्रति भुजा वधयो: पदे तु कर्णाविमौ हि विषमाख्य चतुर्भुजस्य" श्रीपत्युक्तमिदं विषम चतुर्भुजकर्णानयन माचार्योक्तानुरूपमेव लीलावत्यां भास्करेण त्वाचार्योक्त पद्यमेवाऽक्षरशो लिखितं तत्खण्डनं च कृतम् ॥ २८ ॥

अब विषम चतुर्भुज में चारों भुजों से कर्णद्वय के आनयन को कहते है।

हि. भा.—उभय पार्श्व में कर्णाश्रित जो दो दो भुज है उन उन दोनों भुजों के पृथक् पृथक् घात का योग करना, इसी तरह दूसरे कर्ण का भी करना चाहिये, उसको दो जगह परस्पर भाजित करना अर्थात् भाजक स्थान में रखना, और संमुख संमुख भुजघात योग से गुणा करना, दोनों का मूल लेने से विषम चतुर्भुज मे दोनों कर्णों का मान होता है ॥२८॥

उपपत्ति।

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये। आकागाघा विषय चतुर्भुज है जिसके चारों भुजों से दोनों कर्णों का आनयन करना अभीष्ट है। कल्पना करते है आका= अ, कागा=क, गाघा=ग, आघा=घ, काघा कर्ण=य, आगा कर्ण=र, तब 'भूसंमुखास्रोद्भवकोटिशिञ्जिनी' इत्यादि सस्कृतोपपत्ति मे लिखित विशेषोक्त पद्य से आकाघा त्रिभुज में $अ^2+घ^2-2\ अ.\ घ.\ कोज्याआ=य^2$, इसी तरह कागाघा त्रिभुज में भी $क^2+ग^2-१\ क.\ ग.\ कोज्यागा=य^2$। समशोधनादि से $\frac{अ^2+घ^2\quad य^2}{२\ अ.\ घ}=कोज्याआ$,

तथा $\frac{क^2+ग^2-य^2}{२\ क.\ ग}=कोज्यागा$ यदि आ+गा=१८० तव आ=१८०—गा

$\therefore$ कोज्याआ=कोज्या (१८०—गा)=—कोज्यागा

$$\therefore \frac{अ^2+घ^2-य^2}{२\ अ.\ घ}=-\frac{क^2+ग^2-य^2}{२\ क.\ ग}=\frac{-क^2\quad ग^2+य^2}{२\ क.\ ग}$$ छेदगम से

$अ^2.\ क.\ ग+घ^2.\ क.\ ग-य^2.\ क.\ ग=-क^2\ अ.\ घ\quad ग^2.\ अ.\ घ+य^2.अ.\ घ$ दोनों पक्षों में समान जोड़ने से $अ^2.\ क.\ ग+घ^2\ क\ ग+क^2.\ अ\ घ=ग^2\ अ.\ घ=$ $य^2.\ अ.\ घ+य^2\ .क.\ ग=य^2\ (अ.\ घ+क.\ ग)=अ.\ ग\ (अ.\ क+ग.\ घ)+क.\ घ$ $(अ.\ क+ग.\ घ)=(अ.\ क+ग.\ घ)\ (अ.\ ग+क.\ घ)=य^2\ (अ.\ घ+क.\ ग)$

$\therefore \frac{(\text{अ. क}+\text{ग. घ})(\text{अ. ग}+\text{क. घ})}{\text{अ. घ}+\text{क. ग}} = \text{य}^2$ मूल लेने से

$$\sqrt{\frac{(\text{अ. क}+\text{ग. घ})(\text{अ. ग}+\text{क. घ})}{\text{अ. घ}+\text{क. ग}}} = \text{य}।$$

इसी तरह $\sqrt{\frac{(\text{अ. ग}+\text{क. घ})(\text{अ. घ}+\text{क. ग})}{\text{अ. क}+\text{ग. घ}}} = \text{र}$ इससे आचार्योक्त उपपन्न हुआ।

लेकिन पहले आ, गा सम्मुख कोण द्वय योग = १८० स्वीकार कर दोनों कर्णों का आनयन किया गया है। सम्मुख कोण द्वय का योग दो समकोण के बराबर केवल वृत्तान्तर्गत चतुर्भुज ही में होता है अतः सिद्ध हुआ कि पहले जो दोनों कर्णों का मान लाया गया वह वृत्तान्तर्गत चतुर्भुज ही का है अर्थात् आचार्योक्त सूत्र से वृत्तान्तर्गत चतुर्भुज ही का कर्णानयन वास्तव हो सकता है, साधारण विषम चतुर्भुज का नहीं हो सकता है। सिद्धान्त शेखर में 'कर्णान्तसंश्रितभुजाहतियुतिर्वा' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक में श्रीपति ने विषम चतुर्भुज का कर्णानयन आचार्योक्त के अनुरूप ही किया है। लीलावती में भास्कराचार्य ने आचार्योक्त कर्णानयन दिखला कर उसका खण्डन किया है ॥ २८ ॥

इदानीं विषमचतुर्भुजे लम्बानयनार्थमाह।

विषमचतुरस्रमध्ये विषमत्रिभुजद्वयं प्रकल्प्य पृथक्।
कर्णद्वयेन पूर्ववदाबाधे लम्बकौ च पृथक् ॥ २९ ॥

सु. भा.—कर्णभुजौ भुजौ भूरेव भूरिति त्रिभुजद्वयं भवति। शेषं स्पष्टार्थम्। 'चतुर्भुजान्तस्त्रिभुजेऽवलम्बः प्राग्वद्भुजौ' इत्यादि भास्करोक्तमेतदनुरूपमेव। अत्र विषमचतुर्भुजे चतुर्वेदाचार्येण गद्यमयं यदुदाहरणं प्रदर्शितं तदेव भास्करेण 'द्विपंचाशन्मितव्येकचत्वारिंशन्मितौ भुजौ' इत्यादि पद्येनोपबद्धमिति ॥२९॥

वि. भा.—विषमचतुर्भुजे कर्णद्वयवशेन पृथक् त्रिभुजद्वयं भवति, तत्र पूर्ववदाबाधे लम्बकौ च भवतः। यथैक त्रिभुजे कर्णभुजौ भुजौ तथा भूश्च भूस्तदा त्रिभुजे भुजयोर्योगस्तदन्तर गुणो भुवाहृत इत्यादिनाऽऽबाधे विदिते भवतस्ततः 'स्वाबाधाभुज कृत्योरन्तर मूल प्रजायते लम्बः' भास्करोक्तेनानेन लम्बज्ञानं भवेत् द्वितीयकर्णवशेन यत्त्रिभुजमुत्पद्यते तत्राप्येव मेव लम्बज्ञान भवेत्। लीलावत्यां 'चतुर्भुजान्तस्त्रिभुजेऽवलम्बः प्राग्वद्भुजौ कर्णभुजौ महीभूरिति' भास्करोक्तमाचार्योक्तानुरूपमेवास्ति, अस्योपपत्तिरपीयमेव बोध्येति ॥२९॥

अब विषम चतुर्भुज में लम्बानयन के लिये कहते हैं।

हि. भा.—विषम चतुर्भुज में कर्णवश से जो त्रिभुज बनता है उस में दोनों आबा-

धायें और लम्ब विदित होता है, जैसे कर्ण और भुज दोनो भुज तथा भू (आधार) इन तीनों भुजों से जो त्रिभुज बनता है उस मे त्रिभुजे भुजयोर्योगस्तदन्तर गुणः' इत्यादि से दोनों आवाधाये विदित हो जायगी, 'तब स्वावाधा भुजकृत्योरन्तरमूल प्रजायते लम्बः' इससे लम्बज्ञान होजायगा। लीलावती में 'चतुर्भुजान्तस्त्रिभुजेऽवलम्बः' इत्यादि भास्करोक्त लम्ब-ज्ञान विधि आचार्योक्त के अनुरूप ही है, इसकी उपपत्ति भी यही समझनी चाहिये ।।२९।।

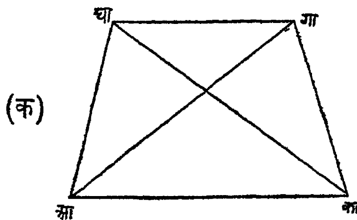
इदानीं विषमचतुर्भुजे कर्णद्वय योगतः कर्णोर्ध्वाधरखण्डयोरानयनार्थमाह।

विषम भुजान्तस्त्रिभुजे प्रकल्प्य कर्णौ भुवौ तदावाधे ।
पृथगूर्ध्वाधरखण्डे कर्णयुतौ कर्णयोरधरे ।।३०।।

सु. भा.—विषमभुजान्तर्विषमचतुर्भुजान्तः कर्णौ भूस्तल्लग्नभुजौभुजौ। एवं द्वे त्रिभुजे परिकल्प्य कर्णयुतौ पृथक् कर्णयोरूर्ध्वाधरखण्डे पूर्वोक्तक्षेत्रयुत्तया साध्ये। कर्णयोरधरे इत्यस्याग्रे सम्बंधः। विषमचतुर्भुजे यदा कर्णौ परस्परं लम्बरूपौ तदैवाचार्योक्तप्रकारेणेह कर्णयोरूर्ध्वाधरखण्डे सिद्धे भवतो नान्यथेति क्षेत्रयुत्तया-सर्व स्फुटम् ।।३०।।

वि. भा.—विषमभुजान्तः (विषमचतुर्भुजमध्ये) कर्णौ भूस्त ल्लग्नभुजौ भुजाविति भुजत्रयैरूत्पन्नमेकं त्रिभुजम् द्वितीय कर्ण सम्बन्धेनैवं द्वितीयं त्रिभुजं भवति, एवं द्वे त्रिभुजे प्रकल्प्य कर्णयुतौ (कर्णयोर्योग बिन्दौ) पृथक् कर्णयोरूर्ध्वाधर खण्डे साध्ये। कर्णयोरधरे इत्यस्याग्रिमश्लोकेन सम्बन्ध इति ।।३०।।

अत्रोपपत्तिः।



आकागाघा विषमचतुर्भुजमस्ति, यस्य आका=अ, कागा=क, गाघा=ग, आघा=घ इति भुजाः सन्ति, आगाकर्णः=र, काघा कर्णः=य, अत्र यदिकर्णौ परस्परं लम्वरूपौ स्तस्तदा आगाघा त्रिभुजे घा बिन्दुतो आगा कर्ण भूमौ लम्बः=घान आन, गान आवाधे घान=य कर्णोर्ध्वखण्डम्, कान=अधरखण्डम् कर्णद्वय योग बिन्दुः=न, गान=र कर्णोर्ध्व खण्डम्। आन=अधर खण्डम्। तदोक्त त्रिभुजे 'त्रिभुजे भुजयोर्योगस्त-दन्तर गुण इत्यादि' भास्करोक्तसूत्रेण आन, गान आवाधे विदिते भवतस्तथा घान लम्बमान मपि विदितं भवेत्। एवं आकागा त्रिभुजे 'त्रिभजे भुजयोर्योग इत्यादि-नैव' कान लम्बमानं य कर्णस्याधर खण्डं विदितं भवेत्। एतावतेति सिद्धयति

यद्यदा कर्णद्वयं परस्परं लम्बरूपं भवेत्तदैवाऽऽचार्योक्त प्रकारेण कर्णयो रूर्ध्वाधर खण्डयोरानयं भवितु मर्हति नान्यथेति ॥३०॥

अब विषमचतुर्भुज में कर्णद्वय योग विन्दु से कर्णों के ऊर्ध्वखण्ड और अधरखण्ड के आनयन के लिये कहते हैं ।

हि. भा.—विषम चतुर्भुज में कर्णरूप भू (आधार) और तल्लग्न भुजद्वय से एक त्रिभुज बनता है, द्वितीय कर्ण सम्बन्ध से भी द्वितीय त्रिभुज होता है, इस तरह दो त्रिभुजों के सम्बन्ध से कर्णयोग विन्दु से पृथक् पृथक् दोनों कर्णों के ऊर्ध्वाधर खण्ड साधन करना चाहिये ॥३०॥

उपपत्ति ।

यहां सस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । आकागाघा विषम चतुर्भुज है, जिसके आका = अ, कागा = क, गाघा = ग, आघा = घ, भुज है, काघा कर्ण = य, आगा कर्ण = र, यहां यदि दोनों कर्ण परस्पर लम्ब रूप है तब आगाघा त्रिभुज में घा विन्दु से आगा कर्ण भूमि पर लम्ब = घान, आन, गान आबाधाए है। घान = कर्णोर्ध्वखण्ड, कान = अधः खण्ड, दोनों कर्णों का योग विन्दु = न, गान = र कर्णोर्ध्वखण्ड, आन = अधः खण्ड, तब उक्त त्रिभुज में 'त्रिभुजे भुजयोर्योगस्तदन्तरगुणः' इत्यादि भास्करोक्त सूत्र से आन, गान दोनों आबाधाये विदित होंगी, और घान लम्ब मान भी विदित होगा, इसी तरह कान लम्बमान (य कर्ण का अधर खण्ड) विदित होगा, इससे यह सिद्ध होता है कि यदि चतुर्भुज में दोनों कर्ण परस्पर लम्बरूप है तब ही आचार्योक्त प्रकार से दोनों कर्णों के ऊर्ध्व खण्ड और अधः खण्ड का आनयन हो सकता है, अन्यथा नहीं ॥ ३० ॥

इदानीं विषमचतुर्भुजे मध्य लम्बोर्ध्वाधरखण्डज्ञानार्थमाह ।

त्रिभुजे भुजौ तु भूमिस्तल्लम्बो लम्बकाधर खण्डम् ।
ऊर्ध्वमवलम्बखण्डं लम्बकयोगार्धमधरोनम् ॥ ३१ ॥

सु. भा.—कर्णयोर्ये अधरे खण्डे ते एव कस्मिन्नपि त्रिभुजे भुजौ कल्प्यौ । भूमिस्तु चतुर्भुजे या सैव । ततस्तल्लम्बो यस्तदेव लम्बकाधरं मध्यलम्बकाधरं खण्डं भवेत् । चतुर्भुजलम्बयोर्योगार्धं पूर्वानीताधरखण्डोनमूर्ध्वमवलम्बखण्डं भवेत् । एवं चतुर्भुजलम्बयोरन्तरे यद्भूमिखण्डं तन्मध्ये एव कर्णयुतितो मध्यलम्बः पतेत् तदैवाचार्यप्रकारेणैव मध्यलम्बोर्ध्वखण्डसिद्धिर्नान्यथेति ॥३१॥

वि. भा.—कर्णयोर्ये अधरे खण्डे ते एव त्रिभुजे भुजौ, भूमिस्तु चतुर्भुजस्य या सैव तदैतद् भुजत्रयैरुत्पन्न त्रिभुजे यो लम्बतदेव लम्बकाधरं (मध्यलम्बका-

धरमर्थात्कर्णद्वय योग बिन्दुतो भूम्युपरिलम्बरूपं) खण्डं भवेत्। लम्बकयोगार्ध (चतुर्भुजस्य लम्बयोर्योगार्ध) समानीतेन लम्बकाधरखण्डेन हीनं कार्यं तदा मध्य-लम्बोर्ध्वखण्डं भवेत् ॥ ३१ ॥

अत्रोपपत्तिः ।

पूर्वश्लोकोपपत्तौ लिखित-आकागाघा-चतुर्भुजे कर्णयोर्योग बिन्दुः=न, आन, कान क्रमेण आगा, काघा कर्णयोरधरखण्डे, तदा आनका त्रिभुजे 'त्रिभुजे भुजयोरित्यादिना' न बिन्दुतो आका भूमौ यो लम्बस्तज्ज्ञानं भवेत्तदेव मध्य-लम्बकाधरं खण्डम्। गा, घा बिन्दुभ्यां आका भूमौ यौ लम्बौ तौ चतुर्भुजीय लम्बौ, एतयोर्योगार्धं मध्यलम्बकाधर खण्डेन हीनं तदा मध्यलम्वोर्ध्व खण्डं भवेत्। परमिति तदैव भवितुमर्हति यदा वर्धितमध्यलम्बकेन गाघा रेखाऽर्धिता भवेन्नान्यथा, तथा च चतुर्भुजीय लम्ब द्वयमूलयोर्मध्ये एव यदि कर्णद्वय योग बिन्दुतो भूम्युपरिलम्ब (मध्यलम्ब) मूलं पतेत्तदैवाऽऽचार्य प्रकारेणैवं मध्यलम्बोर्ध्व खण्डज्ञानं भवितुमर्हति नान्यथेति ॥ ३१ ॥

अब विषम चतुर्भुज में मध्य लम्ब के ऊर्ध्वाधर खण्डो के ज्ञान के लिये कहते हैं।

हि. भा.—दोनो कर्णों के जो अधर खण्ड है वे दोनों भुज और चतुर्भुज की भूमि, इन तीनों भुजों से उत्पन्न त्रिभुज में जो लम्ब होता है वही दोनो कर्णों के योग बिन्दु से भूमि के ऊपर लम्ब मध्यलम्ब के अधर खण्ड है। चतुर्भुज के दोनों लम्वों (मुखरेखा के दोनों प्रान्त बिन्दुओं से भूमि के उपर लम्बद्वय) के योगार्ध में मध्य लम्बके अधरखण्ड को घटाने से मध्यलम्ब का ऊर्ध्व खण्ड होता है ॥ ३१ ॥

उपपत्ति ।

पूर्व श्लोक की उपपत्ति में लिखित आकागाघा चतुर्भुज में दोनों कर्णों के योगबिन्दु =न, आन, कान क्रम से आगा, काघा दोनों कर्णों के अधर खण्ड है, तब आनका त्रिभुज में 'त्रिभुजे भुजयोर्योगः' इत्यादि से न बिन्दु से आका भूमि के ऊपर लम्ब का ज्ञान होगा वही मध्यलम्ब के अधर खण्ड है। गा, घा दोनों बिन्दुओं से आका भूमि के ऊपर जो लम्ब-द्वय होता है वे चतुर्भुज के दोनों लम्ब है, इन दोनों लम्वों के योगार्ध में मध्य लम्ब के अधर खण्ड को घटाने से मध्यलम्ब का ऊर्ध्व खण्ड होता है, लेकिन यह तब ही हो सकता हैं जबकि वर्धित मध्यलम्बाधरखण्ड से गाघा रेखा अर्धित होगी, अन्यथा नहीं, तथा चतुर्भुज के दोनों लम्ब मूलों के मध्य ही में यदि दोनों कर्णों के योग बिन्दु से भूमि के ऊपर लम्ब-मूल पतित होगा तबही आचार्योक्त इस प्रकार से मध्यलम्ब का ऊर्ध्वखण्ड ज्ञान हो सकता है अन्यथा नहीं इति ॥ ३१ ॥

इदानीं सूची क्षेत्रार्थमाह ।

कर्णावलम्बक युतौ खण्डे कर्णावलम्बयोरधरे ।
अनुपातेन तदूने ऊर्ध्वे सूच्यां सपाटायाम् ।। ३२ ।।

सु. भा.—सपाटायां सपीठायां सूच्यामनुपातेन कर्णावलम्बकयुतौ कर्णावलम्बयोरधरे खण्डे साध्ये कर्णावलम्बमाने तदूने तयोरूर्ध्वे खण्डे भवतः ।

अत्र चतुर्वेदाचार्येण त्रैराशिकेन यत् सर्वं साधितं तदेव भास्करेण सूत्रत्वेनोपनिबद्धम् । भास्करेण स्वसूत्रे नामान्तरमात्रमेव कृतम् । यथा चतुर्वेदाचार्येण यस्य पाटसंज्ञा कृता तस्यैव भास्करेण पीठसंज्ञा । एवं सूचीक्षेत्रानुपातो भास्कर लीलावतीतः स्फुटः किं ग्रन्थगौरवेणेति । चतुर्वेदाचार्येण सूचीक्षेत्रे तदेवोदाहरण लिखितं यद्भास्करेण 'द्विपञ्चाशन्मितव्येकचत्वारिंशन्मितौ भुजौ'—इत्यादि विषमचतुर्भुजे लिखितम् । अत्र लम्बादयो भिन्ना भवन्ति तेनात्र भुजादीन् पंचगुणान् कृत्वा भास्करेण सूचीक्षेत्रोदाहरणमुपनिबद्धमिति भास्करस्य कल्पना वस्तुतस्तश्चतुर्वेदोक्तैव ।।३२।।

वि. भा.—सपाटायां (सपीठायां) सूच्यां (सूची क्षेत्रे) कर्णावलम्बक योग बिन्दावनुपातेन कर्णावलम्बकयोरधरे खण्डे साध्ये, तदूने (कर्णावलम्बकाधरहीने) कर्णावलम्बकमाने तयोरूर्ध्व खण्डे भवेताम् । पुनः पुनराचार्येण कर्णावलम्बकयोरूर्ध्वाधर खण्डज्ञानसम्बन्धे पूर्वोक्तमेव कथ्यते, न किमपि वैशिष्ट्यम् । अत्र चतुर्वेदाचार्येणानुपातेन यत्सर्वं साधितं भास्करेण तदेव सूत्ररूपेण कथितम् । भास्करेण स्वसूत्रे केवल नामान्तरमात्रमेव कृतम् । चतुर्वेदोक्तपाटसंज्ञाया भास्करोक्तपीठसंज्ञा, एव सूचीक्षेत्रानुपातो लोलावतीतः स्फुटः । चतुर्वेदाचार्येण सूची क्षेत्रे तदेवोदाहरण लिखितं यद्भास्करेण 'द्विपञ्चाशन्मितव्येक चत्वारिंशन्मितौ भुजौ' इत्यादि विषम चतुर्भुजे लिखितम् । अत्र लम्बादयो-भिन्ना भवन्ति, तेन भुजादीन् पञ्चगुणान् कृत्वा भास्करेण सूचीक्षेत्रोदाहरणं रचितम् । भास्करीय कल्पना वस्तुतश्चतुर्वेदोक्तैव बोध्येति ।। ३२ ।।

अब सूची क्षेत्र के विषय मे कहते हैं ।

हि. भा.—सपीठ सूची मे अनुपात से कर्ण और लम्ब के योग बिन्दु मे कर्ण और लम्ब का अधर खण्ड साधन करना चाहिये, कर्णमान में कर्ण के अधर खण्ड को घटाने से कर्ण का ऊर्ध्व खण्ड होता है लम्ब मान में लम्ब के अधर खण्ड को घटाने से लम्ब का ऊर्ध्व खण्ड होता है ।

यहां चतुर्वेदाचार्यने त्रैराशिक से जिन विषयों का साधन किया है उन्ही विषयों को भास्क-

राचार्य सूत्र रूप में लिखते हैं। भास्कराचार्य ने अपने सूत्र में केवल नामान्तर मात्र किया है। जैसे चतुर्वेदाचार्य ने जिसका नाम पाट रखा है उसी का नाम भास्कराचार्य ने पीठ रखा है। सूचीक्षेत्रमें अनुपात सव है तथा भास्करीय लीलावती से स्पष्ट है। चतुर्वेदाचार्य ने सूचीक्षेत्रमें वही उदाहरण लिखे हैं जो विषम चतुर्भुज में भास्कराचार्य ने 'द्विपञ्चाशन्मितव्येक चत्वारिंशन्मितौ भुजौ' इत्यादि लिखे है यहां लम्ब आदि भिन्न होते है। इसलिये भुज आदि को पांच से गुणित कर भास्कराचार्य ने सूचीक्षेत्र के उदाहरण की रचना की, वस्तुतः भास्करोक्त कल्पना चतुर्वेदाचार्योक्त ही है ॥३२॥

इदानीमिष्टाभ्यां भुजकोटि कर्णानयनार्थमाह।

कृतियुतिरसदृशराश्योर्बाहुर्घातोद्विसङ्गुणो लम्बः।
कृत्यन्तरमसदृशयो द्विगुणं द्विसमत्रिभुजभूमिः ॥३३॥

सु० भा०—द्विसमत्रिभुजं समद्विबाहुकं त्रिभुजम्। समद्विबाहुनि शिरः कोणादाधारोपरिलम्बवशेन जात्यत्र्यस्रद्वय समानं भवेत् तत्र भुजो द्विगुणः समद्विबाहुभूमिर्भवेदत एतदनुरूपमेव भास्करोक्तम्—'इष्टयोराहति द्विघ्नी कोटिवर्गान्तरं भुजः' इत्यादि।

अत्रोपपत्तिः।

द्वयो राश्योर्युतिवर्गस्यान्तरवर्गस्य चान्तरं चतुर्गुणघातसमं भवतीति कल्पितौ वर्गात्मकौ राशी $इ^2_1$, $इ^2_2$। अनयोर्योगः कर्णः$=इ^2_1+इ^2_2$। भुजः$=इ^2_1-इ^2_2$ अनयोर्वर्गान्तरस्य $४\ इ^2_1 \times इ^2_2$ अस्य मूलं कोटिः$=२इ_1 \times इ_2$ ॥ ३३ ॥

वि. भा.—असमानराशिद्वययोर्वर्गयोगः कर्णो भवति, यद्यप्याचार्येण राश्योर्वर्गयोगः किं भवतीति न कथ्यते तथापि तदाशयः स एव। राश्योर्घातो द्विगुणितो भुजो भवति, राश्योर्वर्गान्तरं लम्बो (कोटिः) भवति, द्विगुणितो भुजो द्विसम त्रिभुजस्य (समद्विबाहुकस्य त्रिभुजस्य) भूमि (आधारः) र्भवेत्।

अत्रोपपत्तिः।

कल्प्येते राशी इ, $इ_1$ अनयोर्वर्गयोगः$=इ^2+इ^2_1=$कर्णः। तयोरेववर्गान्तरं $इ^2-इ^2_1=$कोटिः, तदा $कर्ण^2-कोटि^2=भुज^2=(इ^2+इ^2_1)^2-(इ^2-इ_2^2)^2=इ^4+२\ इ^2\times इ_1^2+इ_1^4-(इ^4-२\ इ^2\times इ_1^2+इ_1^4)=४\ इ^2\times इ_1^2$ मूलेन $२\ इ\times इ_1=$भुजः, एतेनाऽऽचार्योक्तमुपपद्यते।

समद्विबाहुकत्रिभुजे शिरः कोणादाधारोपरि लम्बवशेन जात्यत्रिभुजद्वयं

समानं भवति तत्र तद्भुजो द्विगुणस्तदा समद्विबाहोर्भूमिर्भवेत्। इष्टयोगहति-द्विघ्नी कोटिरित्यादि भास्करोक्तमेतदनुरूपमेव ॥३३॥

अब दो इष्टों से भुज, कोटि और कर्ण साधन के लिये विधि कहते हैं।

हि. भा.—दो राशियों का वर्गयोग कर्ण होता है, उन्हीं दोनों राशियों की वर्गान्तर कोटि होती है, दोनों राशियों का द्विगुणित घात भुज होता है ॥३३॥

उपपत्ति।

कल्पना करते हैं प्रथमराशि $=$ इ, द्वितीयराशि $=$ इ, इन दोनों का वर्गयोग $=$ $इ^2 + इ_1^2$ $=$ कर्ण उन्हीं दोनों के वर्गान्तर $इ^2 - इ_1^2$ $=$ कोटि तब $कर्ण^2 - कोटि^2 = भुज^2$ $= (इ^2 + इ_1^2)^2 - (इ^2 - इ_1^2)^2 = इ^4 + २ इ^2 \times इ_1^2 + इ_1^4 - इ^4 + २ इ^2 \times इ_1^2 - इ_1^4 = ४ इ^2 . इ_1^2$ मूल लेने से २ इ. इ $=$ भुज इससे आचार्योक्त उपपन्न होता है। समद्विबाहुक त्रिभुज में शिरः कोण से आधार के ऊपर लम्ब करने से लम्ब से दोनों तरफ जो त्रिभुज बनते हैं वे दोनों बराबर होते हैं, उनके भुज को द्विगुणित करने से समद्विबाहुक त्रिभुज की भूमि होती है। आचार्योक्त श्लोक में यह विषय जो लिखा गया है सो अप्रसङ्ग के कारण निरर्थक मालूम होता है। आचार्योक्त भुजकोटि कर्णानयन के अनुरूप ही लीलावती में 'इष्टयोगहति द्विघ्नीकोटि वर्गान्तरं भुजः' इत्यादि भास्करोक्त है इति ॥ ३३ ॥

इदानीमभीष्टजात्यद्वयेन विषमत्रिभुजानयनार्थं विधिमाह।

इष्टद्वयेन भक्तो द्विधेष्टवर्गः फलेष्टयोगार्धे।
विषमत्रिभुजस्य भुजाविष्टोनफलार्धयोगो भूः ॥ ३४ ॥

सु. भा.—इष्टवर्गो द्विधा स्थाप्यः। एकत्रैकेनेष्टेनापरत्रान्येनेष्टेन भक्तः। फलेष्टयोगार्धे विषमत्रिभुजस्य भुजौ भवतः। इष्टोनफलार्धे आबाधे भवतोऽतस्तयो-र्योगो विषमत्रिबाहोर्भूर्भवतीति।

अत्रोपपत्तिः।

इष्टो लम्बः प्रकल्पितः स च लम्बादुभयतो ये जात्ये तयोः कोटिस्तद्वर्गो भुजकर्णवर्गान्तरसमोऽतो द्वाविष्टौ जात्यद्वये भुजकर्णान्तरसमौ प्रकल्पितौ। ततो 'वर्गान्तरं राशिवियोग भक्तम्'—इत्यादिना भुजकर्णयुतिः सिध्यति। ततः सङ्क्र-मणेन भुजकर्णौ। अत्र भुजावेव लम्बादुभयत आबाधे अतस्तयोर्योगो विषमत्रि-बाह्वाधारो भवतीति ॥३४॥

वि. भा.—इष्टवर्गो द्विधा (स्थान द्वये) स्थाप्यः, इष्टद्वयेन भक्तः पृथक् पृथक्

यत्फलं तस्येष्टद्वयस्य च क्रमशो योगार्धे विषमत्रिभुजस्य भुजौ भवतः। इष्टोन-फलार्धे तस्य त्रिभुजस्यावाधे भवतः, तयोरावाधयोर्योगो तस्य (विषम त्रिभुजस्य) भूर्भवतीति ॥ ३४ ॥

अत्रोपपत्तिः।

इष्टो लम्बः प्रकल्पितः, लम्बादुभयपार्श्वे ये जात्ये तयोः स लम्बः कोटिः, $\text{लम्ब}^2 = \text{को}^2 = \text{क}^2 - \text{भु}^2$ प्रथम जात्यस्य कर्णः $=$ क, भुजः $=$ भु। द्वितीयजात्यस्य कर्णः $= \text{क}'$, भुजः $= \text{भु}'$, प्रथम जात्यस्य कृते कल्प्यते इष्टम् $= \text{क} - \text{भु}$। द्वितीय जात्यस्य कृते इष्टम् $= \text{क}' - \text{भु}'$। तदा वर्गान्तरं राशिवियोगभक्तमित्यनेन $\frac{\text{क}^2 - \text{भु}^2}{\text{क} - \text{भु}} = \text{क} + \text{भु}$, $\frac{\text{क}'^2 - \text{भु}'^2}{\text{क}' - \text{भु}'} = \text{क}' + \text{भु}'$ ततः संक्रमणेन

$$\left.\begin{aligned} \frac{\text{क}+\text{भु}+\text{क}-\text{भु}}{2} &= \frac{2\,\text{क}}{2} = \text{क} = \frac{\text{फल}+\text{इ}}{2} \\ \frac{\text{क}+\text{भु}-(\text{क}-\text{भु})}{2} &= \frac{2\,\text{भु}}{2} = \text{भु} = \frac{\text{फल}-\text{इ}}{2} \end{aligned}\right\}$$

$$\frac{\text{क}'+\text{भु}'+\text{क}'-\text{भु}'}{2} = \frac{2\,\text{क}'}{2} = \text{क}' = \frac{\text{फ}'\text{ल}+\text{इ}'}{2}$$

$$\frac{\text{क}'+\text{भु}'^2-(\text{क}'-\text{भु}')}{2} = \frac{2\,\text{भु}'}{2} = \text{भु}' = \frac{\text{फल}'^2\ \text{इ}'}{2}$$

अत्र लम्बादुभयभागे भुजा ($\text{भु}, \text{भु}'$) वेवावाधेस्तोऽतस्तयोर्योगो विषम-त्रिभुजस्य भू (आधारः) र्भवतीति आचार्येणैता वता न किमपि विशिष्टं वस्तु कथ्यते, गणित वैचित्र्यमपि नास्त्यत्रेति ॥ ३४ ॥

अब अभीष्ट दो जात्य त्रिभुजो से विषम त्रिभुजानयन के लिये कहते है।

हि. *भा.*—इष्ट वर्ग को दो स्थानों में दो इष्टों से भाग देने से जो पृथक् फल हो उसका और दोनों इष्टों का क्रमशः योग करके आधा करने से विषम त्रिभुज के दोनों भुज होते हैं, दोनों फलों में दोनों इष्टों को घटाकर आधा करने से विषम त्रिभुज की दोनों आवाधायें होती है, दोनों आवाधाओं का योग उस त्रिभुज की भू (आधार) होती है ॥ ३४ ॥

उपपत्ति।

कल्पना करते हैं इष्ट $=$ लम्ब, लम्ब से दोनों तरफ जो दो जात्य त्रिभुज बनते हैं

उनकी वह (लम्ब) कोटि है, $\text{लम्ब}^2 = \text{कोटि}^2 = \text{कर्ण}^2 - \text{भुज}^2$ । प्रथमजात्य त्रिभुज का कर्ण $= \text{क}$ । भुज $= \text{भु}$, द्वितीय जात्य का कर्ण $= \text{क}'$ भुज $= \text{भु}'$, तब वर्गान्तर राशि वियोगभक्त इससे $\frac{\text{क}^2 - \text{भु}^2}{\text{क} - \text{भु}} = \frac{\text{क}^2 - \text{भु}^2}{\text{इष्ट}} = \text{क} + \text{भु} = \text{फल} = \frac{\text{कोटि}^2}{\text{इष्ट}}$ तथा $\frac{\text{क}'^2 - \text{भु}'^2}{\text{क}' - \text{भु}'} =$

$\frac{\text{क}'^2 - \text{भु}'^2}{\text{इष्ट}} = \text{क}' + \text{भु}' = \text{फल}$, अब कर्ण और भुज के योगान्तरवश से संक्रमण गणित

से $\frac{\text{क} + \text{भु} + \text{क} - \text{भु}}{2} = \frac{2\text{क}}{2} = \text{क}$ । $\frac{\text{क}' + \text{भु}' + \text{क}' - \text{भु}'}{2} = \frac{2\text{क}'}{2} = \text{क}' = \frac{\text{फल} + \text{इ}}{2}$

$= \frac{\text{फल} + \text{इ}}{2}$ तथा $\frac{\text{क} + \text{भु} - (\text{क} - \text{भु})}{2} = \frac{2\text{भु}}{2} = \text{भु} = \frac{\text{फल} - \text{इ}}{2}$ ।

$\frac{\text{क}' + \text{भु}' - (\text{क}' - \text{भु}')}{2} = \frac{2\text{भु}'}{2}$

$= \text{भु}' = \frac{\text{फल} - \text{इ}}{2}$ यहां लम्ब से दोनों तरफ आसीन दोनों भुज ही दोनों आबाधायें हैं इसलिये दोनों आबाधाओं का योग विषम त्रिभुज की भू (आधार) होती है । आचार्य इस से किसी विशिष्ट वस्तु को नहीं कहते हैं ॥ ३४ ॥

इदानीं जात्यद्वयेनायतानयनाय सूत्रमाह ।

इष्टस्य भुजस्य कृतिर्भक्तोनेष्टेन तद्दलं कोटिः ।
आयतचतुरस्रस्य क्षेत्रस्येष्टाधिका कर्णः ॥ ३५ ॥

सु. भा.— इष्टस्य भुजस्य कृतिरिष्टेन भक्तेष्टोना च या संख्या भवति तद्दलमायतचतुरस्रस्य क्षेत्रस्य कोटिर्भवति । सा कोटिरिष्टार्धेनाढ्या आयत चतुरस्रस्य कर्णः स्यात् ।

अत्रोपपत्तिः ।

आयतचतुरस्रे कर्णवशेन जात्यद्वयं भवति । तत्रायतभुजो भुजः । आयतकोटिः कोटिः । आयतकर्णः कर्णः । अत आयतेष्टभुजं भुजं प्रकल्प्य कोटिकर्णान्तरमिष्टं प्रकल्प्य कोटिकर्णानयनं सुगमम् ॥३५॥

वि. भा.—इष्टस्य भुजस्य कृतिः (वर्गः) इष्टेन भक्तेष्टेन हीना च कार्या

तदर्धमायत चतुर्भुज क्षेत्रस्य कोटिर्भवति। सा कोटिरिष्टाधिका कार्या तदाऽऽय-तचतुर्भुजस्य कर्णो भवेदिति ॥ ३५ ॥

अत्रोपपत्तिः

आयत चतुर्भुजस्य कर्णवशेन जात्यत्रिभुजद्वयं भवति, तत्रायतस्य $भु^2 = क^2 — को^2$ वर्गान्तरस्य योगान्तरघात समत्वात् $भु^2 = (क—को).(क+को)$ अत्र यदि $क—को = $इष्टम् कल्प्यते तदा तेन पक्षौ भक्तौ $\frac{भु^2}{क—को} = \frac{भु^2}{इ} = क+को$ ततः संक्रमणेन $\frac{भु^2}{इ} — इ = क+को—इ = क+को-(क-को) = क+को-क+को = २को$

$\therefore \frac{\frac{भु^2}{इ}—इ}{२} = को$। तथा $\frac{भु^2}{इ}+इ = क+को+(क—को) = २ क$ पक्षौ द्वाभ्यां भक्तौ तदा $\frac{\frac{भु^2}{इ}+इ}{इ} = कर्णः$। एतेनाऽऽचार्योक्तमुपपद्यते, लीलावत्यां 'इष्टो भुजस्त-त्कृतिरिष्ट भक्तेत्यादि' भास्करोक्तमाचार्योक्तानुरूपमेवेति ॥ ३५ ॥

अब दो जात्य त्रिभुज से आयत चतुर्भुजानयन को कहते हैं।

हि. भा.—भुज वर्ग को इष्ट से भाग देकर जो फल हो उसमें से इष्ट को घटाकर आधा करने से आयत चतुर्भुज की कोटि होती है, उस कोटि में इष्ट को जोड़ देने से आयत चतुर्भुज का कर्ण होता है ॥ ३५ ॥

उपपत्ति।

आयत चतुर्भुज के कर्णवश से दो जात्य त्रिभुज होते हैं, उनमें त्रिभुज का भुजवर्ग या आयत का $भु^2 = क^2 — को^2$ परन्तु वर्गान्तिर योगान्तर घात के वरावर होता है अतः $भु^2 = (क—को).(क+को)$ यहाँ यदि $क—को = $इष्ट माना जाय तब उससे दोनों पक्षों को भाग देने से $\frac{भु^2}{क-को} = \frac{भु^2}{इ} = क+को$ तब संक्रमण गणित से $\frac{भु^2}{इ} — इ = क+को—इ$

$= क+को—(क—को) = क+को—क+को = २ को$ ततः $\frac{\frac{भु^2}{इ}—इ}{२} = को$। इस कोटि में इष्ट जोड़ने से $\frac{\frac{भु^2}{इ}—इ}{२} + इ = \frac{\frac{भु^2}{इ}—इ+२ इ}{२} = \frac{\frac{भु^2}{२}+इ}{२} = $कर्ण इससे आचार्योक्त

सूत्र उपपन्न होता है। लीलावती में 'इष्टोभुजस्तत्कृति रिष्ट भक्ता' इत्यादि भास्कराचार्योक्त आचार्योक्त के अनुरूप ही है ॥ ३५ ॥

इदानीं समान लम्ब चतुर्भुजानयनाय सूत्रमाह ।

आयतकर्णौ बाहू भुजकृतिरिष्टेन भाजितेष्टोना ।
द्विहृता कोटयधिका भूर्मुखमूना द्विसम चतुरस्रे ॥ ३६ ॥

सु. भा.—द्विसमचतुरस्रं समानलम्बचतुर्भुज यत्र भुजौ समौ तस्मिन् कस्याप्यायतस्य कर्णौ बाहू कल्प्यौ। आयतभुजस्य कृतिरिष्टेन भक्तेष्टोना च कर्त्तव्या ततो द्विहृता कार्या। साऽऽयतकोटयधिका समानलम्बचतुर्भुजस्य भूर्भवति सैवायतकोटयूना समानलम्बचतुर्भुजस्य मुख भवति।

अत्रोपपत्तिः ।

यत्रायते घाता=जागा कोटिः ।

आता=काजा भुजः। आघा=कागा कर्णः। तद्वशेन समानलम्बे कर्णमितौ भुजौ जातौ। अत्र आगा—गाता=इ।

आगाताजात्ये आता=आयतस्य भुज एव भुजः ततो 'भुजाद्वर्गितात् कोटिकर्णान्तराप्तम्'—इत्यादिना गाता प्रमाणं भवति ततः गाता+घाता=गाघा। गाता—जागा=ताजा=आका। अत उपपन्नम् ॥३६॥

वि. भा.—द्विसमचतुरस्रशब्देन समानलम्ब चतुर्भुजं बोध्यं यस्मिन् भुजद्वयं समं तस्मिन् कस्याप्यायतचतुर्भुजस्य बाहू (भुजौ) प्रकल्प्यौ, आयतचतुर्भुजभुजकृति-रिष्टेन भक्ता-इष्टेन हीना च कार्या, द्विहृता (द्वाभ्यां भक्ता) साऽऽयत कोटयधिका कार्या तदा समलम्ब चतुर्भुजस्य भू (आधारः) र्भवति, तत्रैवायत कोटयूना तदा समलम्ब चतुर्भुजस्य मुखं भवतीति ॥ ३६ ॥

अत्रोपपत्तिः ।

यस्मिन्नायते क्षेत्रे घत=कोटिः=नग, तथा कत=भुजः=खन, तदा कघ कर्णः=खग कर्ण, तदायतक्षेत्र भुजकोटिवशेन कघ, खन-कर्णतुल्यौ समानलम्ब चतुर्भुजे भुजौ जातौ, कग-तग=इष्टं कल्पितम्। कतग त्रिभुजे कत=भुजः। तग=कोटिः। कग=कर्णः, तदा

$\frac{\text{कत}^2}{\text{कग}-\text{तग}} = \frac{\text{भु}^2}{\text{कर्ण}-\text{कोटि}} = \text{क}+\text{को} = \frac{\text{भु}^2}{\text{इ}}$ ततः संक्रमणेन $\frac{\frac{\text{भु}^2}{\text{इ}}-\text{इ}}{2}$
=कोटिः=तग, अत्र कोटावायतक्षेत्रस्य कोटियोजनेन तग+तघ=गघ=समान-लम्ब चतुर्भुजस्य भूः । तथा तस्यामेव कोटावायत क्षेत्रस्य कोटिर्हीना तदा तग—नग=नत=समान लम्बस्य मुखम् ॥ एतावताऽऽचार्योक्तमुपपद्यते इति ॥ ३६ ॥

अब समान लम्ब चतुर्भुज के आनयन के लिये कहते है ।

हि. भा.—जिस समान लम्बचतुर्भुज में दो भुज बराबर है वे किसी आयत क्षेत्र के दो भुजो के बराबर होते हैं । आयत चतुर्भुज के भुजवर्ग को इष्ट से भाग दे कर जो फल हो उसमें से इष्ट को घटा कर दो से भाग देने से जो लब्धि हो उसमें आयत की कोटिको जोडने से समलम्ब चतुर्भुज की भू (आधार) होती है, उसी लब्धि में आयत की कोटि को घटाने से समलम्ब चतुर्भुज का मुख होता है ॥३६॥

उपपति ।

यहाँ संस्कृतोपपति में लिखित (१) क्षेत्र को देखिये । जिस आयत क्षेत्र में घत=नग =कोटि, है तथा कत=खन=भुज, है तब कघ कर्ण=खग कर्ण, उस आयतक्षेत्र के भुज और कोटि वश से कघ; खन कर्णों के बराबर समान लम्ब गतुर्भुज में दो भुज हो गये, कतग त्रिभुज में कत=भुज, तग=कोटि, कग=कर्ण, कग—तग=कर्ण—कोटि=इष्ट कल्पना की तब $\frac{\text{कत}^2}{\text{कग}-\text{तग}} = \frac{\text{भु}^2}{\text{कर्ण}-\text{कोटि}} = \text{क}+\text{को} = \frac{\text{भू}^2}{\text{इ}}$ अब सक्रमण गणित से

$$\frac{\frac{\text{भु}^2}{\text{इ}}-\text{इ}}{2}$$ =कोटि=तग, इसमें आयत क्षेत्र की कोटि को जोड़ने से तग+तघ=गघ=समानलम्ब चतुर्भुज की भू=आधार, तथा उसी कोटि में आयत क्षेत्र की घटा देने से तग—नग=नत समान लम्ब चतुर्भुज का मुख, इससे आचार्योक्त उपपन्न हुआ ॥३६॥

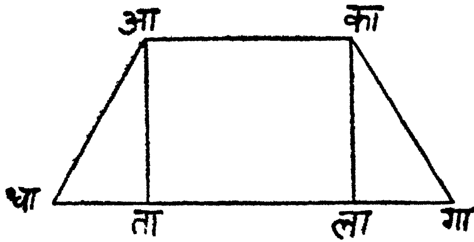
इदानीमायतेन त्रिसमभुज चतुर्भुजानयनार्थमाह ।

कर्णकृतिस्त्रिसमभुजास्त्रयश्चतुर्थो विशोध्यकोटि कृतिम् ।
बाहुकृतेस्त्रिगुणाया यद्यधिकोभूर्मुखं हीनः ॥३७॥

सु. भा.—यत्र समानलम्बचतुर्भुजे द्वौ भुजौ भूमिर्वा मुखमिति त्रयं मिथः समं तत् त्रिसमभुजचतुर्भुजमुच्यते । तत्राभीष्टायतकर्णकृतिरेव त्रिसमभुजा भवन्ति ।

त्रिगुणाया आयतभुजकृतेरायतकोटिकृतिं विशोध्य शेषसमश्चतुर्थो बाहुर्ज्ञेयः । सच त्रिसमभुजाधिकस्तदा भूर्हीनस्तदा मुखं भवतीति स्फुटम् ।

अत्रोपपत्तिः ।



आचार्येणैकजात्यस्य भुजकोटी इष्टौ प्रकल्प्य ३३ सूत्रेण साधितमन्यजात्यम् ।

तद्वशेनेह समलम्बचतुर्भुजं विरच्यते ।

तत्र आघा = आका = कागा = भु^{२} + को^{२} = क^{२}
घाता = लागा = भु^{२} — को^{२} ।

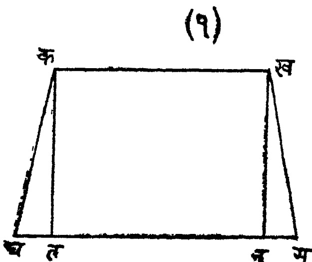
अतः घागा = घाता + ताला + लागा = ताला + २घाता = आका + २ घाता = भु^{२} + को^{२} + २ (भु^{२} — को^{२}) = भु^{२} + को^{२} + २ भु^{२} — २ को^{२} = ३ भु^{२} — को^{२} । अत्र यदि ३ भु^{२} — को^{२} > क^{२} तदा ३ भु^{२} — को^{२} भूरन्यथा मुखं कल्प्यम् ।।

अथ यदा ३ भु^{२} — को^{२} > क^{२}
> भु^{२} + को^{२}
वा २ भु^{२} > २ को^{२}
वा भु^{२} > को^{२}

अतो यदा भु > को तदा घागा भू मानमन्यथा मुखं ज्ञेयमिति ।।

वि. भा.—यस्मिन् समानलम्बचतुर्भुजे भुजद्वयं भूमिर्वा मुखमिति त्रयं परस्परं तुल्यं तत् त्रिसमभुजचतुर्भुजं कथ्यते । तस्मिन् अभीष्टायत क्षेत्रस्य कर्णवर्ग एव त्रिसम भुजा भवन्ति, त्रिगुणितायत भुजवर्गादायत कोटिवर्गं विशोध्य शेषतुल्यश्चतुर्थो भुजो बोध्यः । सो हि यदि त्रिसम भुजाधिकस्तदा भूर्भवति, यदि हीन स्तदा मुखं भवतीति ।।३७।।

अत्रोपपत्तिः ।



अत्राऽऽचार्येण 'कृतियुतिरसदृशराश्यो रित्यादि ३३ सूत्रेण' क जातस्य भुजकोटी इष्टौ प्रकल्प्यान्य जात्यं साधितम् । तद्वशादिह समलम्ब चतुर्भुजस्य रचना क्रियते । तत्र कघ = कख = खग = भु^{२} + को^{२} = क^{२} तथा घत = नग = भु^{२} — को^{२} तदा घग = घत + तन + नग = तन + २ घत

=कख +२ घत =भु^{२}+को^{२} +२ (भु^{२}—को^{२}) =भु^{२}+को^{२}+२ भू^{२}—२ को^{२}=३ भू^{२}—को^{२}, यदि ३ भू^{२}—को^{२}>क^{२} तदा ३ भू^{२}—को^{२} भूरन्यथा मुखं कल्पनीयम् ।

यदि ३ भु^{२}—को^{२}>क^{२} वा>भु^{२} +को^{२} तदा २भु^{२}>२ को^{२} वा भु>को एतेन सिद्धं यद्यदा भु>को तदा घग भूमान मन्यथा मुखं वोध्यमिति ॥३७॥

अब आयत क्षेत्र से त्रिसमभुज चतुर्भुज के आनयन के लिये कहते हैं ।

हि. भा.— जिस समानलम्ब चतुर्भुज में दो भुज और भूमि अथवा मुख ये तीनों परस्पर तुल्य हो वह त्रिसमभुज चतुर्भुज कहलाता है । उसमें अभीष्ट आयत क्षेत्र का कर्णवर्ग ही त्रिसम भुज होता है । त्रिगुणित आयत क्षेत्र के भुजवर्ग में आयत कोटिवर्ग को घटा कर शेष जो रहे उसको चतुर्थभुज समझना चाहिये । वह यदि त्रिसमभुज से अधिक हो तब भूमि प्रमाण होता है, यदि हीन (अल्प) हो तो मुख होता है ॥३७॥

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित (१) क्षेत्र को देखिये । यहां आचार्य ने 'कृतियुतिरसदृशराश्योः' इत्यादि ३३ सूत्र से एक जात्य त्रिभुज के भुज और कोटि को इष्ट मान कर अन्य जात्य त्रिभुज का साधन किया है उसके वश से समलम्ब चतुर्भुज की रचना करते हैं ।

यहां कघ=कख=खग=भु^{२}+को^{२}=क^{२}, तथा घत=नग=भु^{२}—को^{२}

तब घग=घत+तन+नग=तन+२ घत=कख+२ घत=भु^{२}+को^{२}+२ (भु^{२}—को^{२})=भु^{२}+को^{२}+२ भु^{२}—२ को^{२}=३ भु^{२}—को^{२}, यदि ३ भु^{२}—को^{२}>क^{२} तब ३ भु^{२}— को^{२} इसको भूमि समझना चाहिये, अन्यथा मुख मानना चाहिये । यदि ३ भु^{२}—को^{२}>क^{२} वा>भु^{२}+को^{२} तब २ भु^{२}>२ को^{२} वा भु>को इससे सिद्ध होता है कि जब भु> को तब घग भू मान होगा, अन्यथा मुख होगा इति ॥ ३७ ॥

इदानीं जात्यद्वयतो विषमचतुर्भुजानयनार्थमाह ।

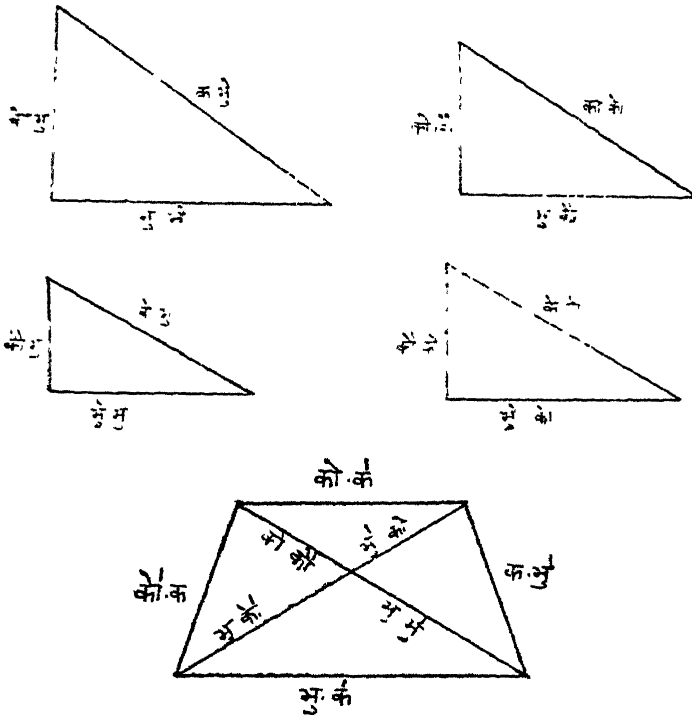
जात्यद्वयकोटिभुजाः पर कर्ण गुणा भुजाश्चतुर्विषमे ।
अधिको भूर्मुखहीनो बाहुद्वितयं भुजावन्यौ ॥ ३८ ॥

सु. भा.— स्पष्टार्थम् । 'अभीष्टजात्यद्वय बाहुकोटयः परस्परं कर्णहता भुजा इति' इत्यादि सर्व भास्करोक्तमेतदनुरूपमेव । यत्र विषमचतुर्भुजे कर्णौ परस्परं लम्बरूपौ तस्यैव जात्यद्वयतो भुजा भवन्तीति क्षेत्रयुक्त्या स्फुटम् ॥३८॥

वि. भा.—जात्यद्वयस्य कोटि भुजाः परस्परकर्णगुणितास्तदा विषम चतुर्भुजे भुजा भवन्ति, तेष्वधिको भूर्भवत्यल्पश्च मुखं, अन्यौ द्वौ भुजौ भुजद्वयं भवतीति ॥ ३८ ॥

अत्रोपपत्तिः ।

अत्र कल्प्यते ऽभीष्टजात्य त्रिभुज द्वयं यत्र प्रथमस्य भुजः=भु, कोटिः=को, कर्णः=क, द्वितीयस्य भुजः=भु' कोटिः=को', कर्णः=क', प्रथमस्य भु, को, क पृथक् पृथक् द्वितीयस्य भु'. को' आभ्यां गुणनेन ये जात्यत्रिभुज द्वये भवतस्ते प्रथमस्य सजातीये. एवं द्वितीयस्य भु', को'. क' (भुजकोटि कर्णः) पृथक् पृथक् भु, को आभ्यां गुणनेन ये जात्य त्रिभुजद्वये भवतस्ते द्वितीयजात्यस्य सजातीये भवतः, एतावता त्रिभुजचतुष्टयं जायते ।



चतुर्णां जात्यत्रिभुजानां संयोगेन विषम चतुर्भुजं जायते ।

एतत्स्वरूपदर्शनेन सिद्ध्यति यदस्मिन् विषमचतुर्भुजे कर्णौ परस्परं लम्बरूपौ भवतस्तस्यैव चतुर्भुजस्याचार्योक्तप्रकारेण भुजा भवन्ति, तत्र तत्कल्पिता भीष्टजात्यद्वयत एव कर्णज्ञानं भवति, सिद्धान्त शेखरे "जात्ययोः श्रुतिहताः परस्परं क्षेत्रयोरिह हि बाहुकोटयः । तेषु भूमिरधिको ऽल्पको मुखं शेषकं तु विषमस्य दोर्द्वयम्" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवास्ति, लीलावत्यां

'अभीष्टजात्यद्वयबाहुकोटयः परस्परं कर्णहता भुजा इति' भास्करोक्तमिदमप्याचार्योक्तानुरूपमेव, तस्मिन् चतुर्भुजे कर्णद्वयमानं किं भवति तदाचार्येण श्रीपतिना च नोक्तं भास्कराचार्येण तत्कथितमिति।। ३८ ।।

अब दो जात्य त्रिभुज से विषम चतुर्भुजानयन को कहते हैं ।

हि. भा.—अभीष्ट दो जात्य त्रिभुज के भुज और कोटि को परस्पर कर्ण से गुणा करने से विषम चतुर्भुज के भुज होते है उनमें अधिक भू होती है, लघु मुख होता है, और अन्य दोनों भुज होते है ।

उपपत्ति ।

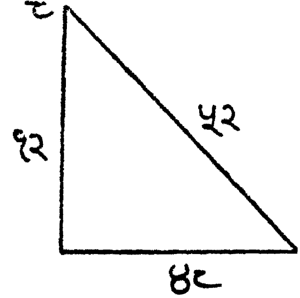
कल्पना करते है इष्ट दो जात्य त्रिभुज, जिनमें प्रथम का भुज=भु, कोटि=को, कर्ण=क, एवं द्वितीय का भुज=भु', कोटि=को', कर्ण=क', । भु, को, क इनको भु', को' इनसे गुणा करने से जो दो जात्य त्रिभुज बनेंगे वे प्रथम जात्य त्रिभुज के सजातीय होंगे । एवं भु' को', क' इनको पृथक्-पृथक् भु, को इनसे गुणा करने से जो दो जात्य त्रिभुज बनेंगे वे द्वितीयजात्य त्रिभुज के सजातीय होंगे । इस तरह से चार त्रिभुज होते है, सस्कृतोपपत्ति में चारो त्रिभुजों के (स्वरूप को देखिये, इन चारों त्रिभुजो के संयोग से विषम चतुर्भुज बनता है उसका स्वरूप संस्कृतोपपत्ति में देखिये । विषम चतुर्भुज का स्वरूप देखने से सिद्ध होता है कि जिस विषम चतुर्भुज में दोनों कर्ण परस्पर लम्बरूप हों उसी चतुर्भुज के आचार्योक्त प्रकार से भुज होते है, उसमें कल्पित इष्ट जात्य त्रिभुजद्वय से ही कर्ण का ज्ञान होता है, सिद्धान्त शेखर में 'जात्ययोः श्रुतिहताः परस्पर' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से । श्रीपतिने आचार्योक्त के अनुरूप ही कहा है । लीलावतीं में 'अभीष्ट जात्यद्वय वाहुकोटयः' इत्यादि भास्करोक्त भी आचार्योक्त के अनुरूप ही है, लेकिन उक्त चतुर्भुज मे दोनो कर्णो का मान क्या होता है सो आचार्य और श्रीपतिने भी नहीं कहा है, भास्कराचार्य 'वाह्वोर्वधः कोटिवधेन युक्' इत्यादि से कहे है ।। ३८ ।।

इदानीं कोटचेक देशेन युते कर्णे भुजे च दृष्टे कोटि कर्ण ज्ञानार्थमाह ।

इष्ट गुणाकारगुणितो गिर्युच्छ्रायः पुरान्तरमनष्टम् ।
द्वियुत गुणकार भाजितमुत्पातोऽन्यस्य समगत्योः ।। ३९ ।।

सु. भा.—अत्र चतुर्वेदाचार्यः । 'इहोदाहरणम् । कस्यापि पर्वतस्याग्रे तपस्विनौ द्वौ प्रतिवसतस्तत्र कः सिद्धः खगामी । सकिल पर्वताग्रादुत्प्लुत्य कियत्यपि दूरे गतः कर्णगत्या नगरमासादयति । द्वितीयः पर्वताग्रादवतीर्य पद्भ्यां नगरमासादयति तुल्याश्च गतयस्तयोः । तदिच्छामि ज्ञातुं पर्वतनगरान्तरं कियद्दूरे सिद्धस्योत्पतनं चेत्येवं स्थिते सूत्रं व्याख्यायते । इष्ट एव कश्चिद्गिरेरुच्छ्रायः कल्प्यते स श्चाभीष्टगुणकारगुणितोऽध्वा गिरिनगरान्तरे भवति (तदेव पुरान्तरं) । ततस्तमनष्टं द्वियुतगुणकारेण विभजेद्यत्फलं तत्सिद्धस्योत्पातयोजनानि भवन्ति । ततोगिर्युच्छ्रायोत्पातयोगः कोटिः । गिरिनगरान्तरं भुजा । तद्वर्गयोगमूलं कर्णः

पुरोत्पाताग्रयोरन्तरं तिर्यगिति । तद्यथा । द्वादशको गिर्युच्छ्रायः १२ । एष इष्टगुणाकारेण चतुष्केणानेन ४ गुणितो जातः ४८ । एतत् पर्वतनगरान्तरम् । एतदेव द्वियुतगुणकारेणानेन ६ भाजितम् ८ । एतावानुत्पातः । अत्र कोटिर्जाता २० । अस्या वर्गः ४०० । भुजा ४८ । अस्यावर्गः २३०४ । अनयोर्योगः २७०४ । अतो मूलं कर्णः ५२ । सिद्धमायतनार्द्धम् । अत्रैकसिद्धस्य कोट्यधस्तनखण्डभुजयोगेऽध्वा ६० । द्वितीयसिद्धस्योपरितनखण्डकर्णयोगेऽध्वा ६० । एवमनया दिशा क्षेत्रोत्पादनमूह्यम् ।



एवं 'वृक्षाद्धस्तशतोच्छ्रयात्'– इत्यादि भास्करोक्तोदाहरण मेतदनुरूपमेव । अतो गिउ=ताउ । इ.गिउ=पुअं=मअं । ततो 'द्विनिघ्नतालोच्छ्रितिसंयुतं यत् सरोऽन्तरम्' इत्यादिना ।

$$\text{उत्पातः}=\text{उड्डीनम्}=\frac{\text{ताउ}\times\text{मअं}}{२\,\text{ताउ}\times\text{मअं}}=\frac{\text{गिउ}\times\text{पुअं}}{२\,\text{गिउ}+\text{इ.गिउ}}=\frac{\text{पुअं}}{२+\text{इ}}$$ अत

उपपद्यते । भास्करप्रकारोपपत्त्यर्थम् मग=ताउ+मअं । अत्र तालोच्छ्रितियोजनेन कोटिकर्णयोगः=२ ताउ+मअं । ततः कोटिकर्णान्तरम्= $\frac{\text{मअं}^२}{२\,\text{ताउ}+\text{मअं}}$ ।

$$\text{कोटिः}=\frac{(\text{ताउ}+\text{मअं})^२-\text{मअं}^२}{२\,(२\text{ताउ}+\text{मअं})}\quad \text{उड्डीनम्}=\text{कोटि}-\text{ताउ}$$

$$=\frac{४\,\text{ताउ}^२+४\,\text{ताउ मअं}}{२\,(२\,\text{ताउ}+\text{मअं})}-\text{ताउ}=\frac{\text{ताउ. मअं}}{२\,\text{ताउ}+\text{मअं}}\ ।$$

अत उपपद्यते भास्करोक्तम् ॥३९॥

वि. भा.—अत्र चतुर्वेदाचार्यः, इहोदाहरणम्, कस्यापि पर्वतस्याग्रे तपस्विनौ द्वौ प्रतिवसतस्तत्रैकः सिद्धः खगामी । स किल पर्वताग्रादुत्प्लुत्य कियत्यपि दूरे गतः कर्णगत्या नगरमासादयति, द्वितीयः पर्वताग्रादवतीर्य पद्भ्यां नगरमासादयति, तुल्याश्च गतयस्तयोः । तदिच्छामि ज्ञातुं पर्वतनगरान्तरं कियद्दूरे सिद्धस्योत्पतनं चेति–एवं स्थिते सूत्रं व्याख्यायते । इष्ट एव कस्यचिद् गिरेरुच्छ्रायः कल्प्यते स एवाभीष्टगुणाकारगुणितो ऽध्वा गिरिनगरान्तरे भवति तदेव पुरान्तरम् । ततस्तमनष्टं द्वियुत गुणाकारेण विभजेद्यत्फलं तत्सिद्धस्योत्पातयोजनानि भवन्ति, ततो गिर्युच्छ्रायोत्पातयोगः कोटिः, गिरिनगरान्तरं भुजः, तद्वर्गयोगमूलं कर्णः पुरोत्पाताग्रयोरन्तरं तिर्यगिति । तद्यथा द्वादशको गिर्युच्छ्रायः=१२ एष इष्टगुणकारेण चतुष्केणा ४ नेन गुणितो जातः ४८ एतत्पर्वतनगरान्तरम् । एतदेव द्वियुतगुणकारेणानेन ६ भाजितम् ८ एतावानुत्पातः । अत्र कोटिर्जाता २०, अस्या वर्गः ४००, भुजवर्गः=(४८)^२=२३०४ अनयोर्योगः=२७०४ अतो मूलं कर्णः=५२ ।

अत्रैकसिद्धस्य कोटयधस्तनखण्डभुजयोगेऽध्वा = ६०, द्वितीय सिद्धस्योपरितन-खण्ड कर्णयोगेऽध्वा=६०, 'वृक्षाद्धस्तशतोच्छ्रयाच्छत युगे' इत्यादि भास्करोक्तमुदा-हरणमप्येतदनुरूपमेवास्ति, गिरेरूच्छ्रितिः=गिउ, इयमभीष्टगुणाकारगुणिता तदा पुरान्तरं (गिरिनगरान्तरं) भवति, गिउ. इ=पुरान्तरं=पुअ्र=सरोऽन्तरम्=सअ्रं, ततो 'द्विनिघ्नतालोच्छ्रितिसयुतं यत्सरोऽन्तरं' इत्यादिना उत्पातः=

$$\text{उड्डीनमानम्} = \frac{\text{ताउ. सअ्रं}}{\text{२ ताउ} + \text{सअ्रं}} = \frac{\text{गिउ. पुअ्रं}}{\text{२ गिउ} + \text{इ. गिउ}} = \frac{\text{पुअ्रं}}{\text{२} + \text{इ}}$$

एतावता ऽऽचार्योक्त-मुपपद्यते ।

भास्कर प्रकारोपपत्त्यर्थ समगतिः=ताउ+सअ्रं =कर्ण+उड्डीनमान=कर्ण+उ | ताउ=तालोच्छ्रितिः उ=उड्डीनमानं

तालोच्छ्रितियोजनेन ताउ + सअ्रं+ताउ=२ ताउ+सअ्रं=कर्ण+उ+ताउ =कर्ण+कोटि ततो 'भुजाद्वर्गितात्कोटिकर्णान्तराप्तमित्यादिना' $\frac{\text{भुज}^2}{\text{कर्ण}+\text{को}}$

$$= \text{क} - \text{को} = \frac{\text{सअ्रं}^2}{\text{२ ताउ}+\text{सअ्रं}} \quad \text{ततः कोटिः} = \frac{(\text{२ ताउ}+\text{सअ्रं})^2 - \text{सअ्रं}^2}{\text{२ (२ ताउ}+\text{सअ्रं})} \quad \text{अत्र}$$

$$\text{अत्र तालोच्छ्रिति विशोधनेनोड्डीन मानम्} = \frac{(\text{२ ताउ}+\text{सअ्रं})^2 - \text{सअ्रं}^2}{\text{२ (ताउ}+\text{सअ्रं})} - \text{ताउ} =$$

$$\frac{\text{४ ताउ}^2 + \text{४ ताउ. सअ्रं} + \text{सअ्रं}^2 - \text{सअ्रं}^2}{\text{२ (२ ताउ}+\text{सअ्रं})} - \text{ताउ} = \frac{\text{२ ताउ}^2 + \text{२ ताउ. सअ्रं}}{\text{२ ताउ}+\text{सअ्रं}} - \text{ताउ}$$

$$= \frac{\text{२ ताउ}^2 + \text{२ ताउ. सअ्रं} - \text{२ ताउ}^2 - \text{ताउ. सअ्रं}}{\text{२ ताउ}+\text{सअ्रं}} = \frac{\text{ताउ. सअ्रं}}{\text{२ ताउ}+\text{सअ्रं}} = \text{उ}, \text{एतावता}$$

'द्विनिघ्नतालोच्छ्रिति संयुतं यत्सरोऽन्तरमित्यादि' भास्करोक्तमुपपद्यते ॥३९॥

अब कोटि के एक प्रदेश से युत कर्ण तथा भुज के ज्ञान से कोटि और कर्ण के ज्ञान के लिये कहते हैं ।

हि. भा.—पर्वत की ऊंचाई को इष्ट गुणक से गुणा करने से पुरान्तर (पर्वत और नगर का अन्तर) होता है दोनों की गति बराबर होने के कारण उस पुरान्तर को गुण-कार में दो जोड़कर भाग देने से दूसरे का उत्पात (उड्डीनमान) होता है, अर्थात् किसी पर्वत के अग्र पर दो तपस्वी रहते थे, उन में सिद्ध पुरुष आकाश गामी थे। वे पर्वत के अग्र से ऊपर कुछ दूर जाकर कर्णमार्ग से नगर में गये, द्वितीय सिद्ध-पर्वत के अग्र से नीचे आकर पैदल ही नगर मे गये, दोनों की गति बराबर थी तब पर्वत के अग्र से प्रथम सिद्ध का कितना उत्पतन हुआ यह ज्ञातव्य है। किसी पर्वत के उच्छ्राय=पउ इसको इष्ट गुणाकार से गुणने से पर्वत और नगर का अन्तर होता है इसी को पुरान्तर 'पुअ्रं' कहते है, इसको इष्ट गुण-कार में दो जोड़कर भाग देने से जो फल हो वही उन सिद्ध पुरुषों के उत्पात योजन होते हैं। पर्वत की उच्छ्रिति में इस उत्पात को जोड़ने से कोटि होती है। पर्वत और नगर का अन्तर (पुरान्तर) भुज है, इन दोनों का वर्गयोग मूल कर्ण (पुर और उत्पाताग्र के तिर्यक्

अन्तर) होता है। जैसे पर्वत की उच्छ्रिति=१२ है, इसको इष्ट गुणकार ४ से गुणा करने से ४८=पर्वत और नगर का अन्तर हुआ, इसी को गुणकार में दो जोडकर ४+२=६ से भाग देने से $\frac{४८}{६}$=८=उत्पात हुआ। पर्वत की उच्छ्रिति मे इसको जोडने से १२+८=२० कोटि हुई। कोटि^{२}+भुज^२ =कर्ण^२ =(२०)^२+(४८)^२ =४००+२३०४ =२७०४, इसका मूल=५२=कर्ण, कोटि के नीचे वाला खण्ड और भुज का योग=१२+४८=६०=एक सिद्ध का चलन मार्ग प्रमाण, कोटि के ऊपर के खण्ड (उत्पात) और कर्ण का योग=५२+८=६०=द्वितीय सिद्ध का चलन मार्गप्रमाण. लीलावती मे 'वृक्षाद्धस्तशतोच्छ्रयात्' इत्यादि भास्करोक्त उदाहरण भी इसी के अनुरूप है ॥ ३९ ॥

उपपत्ति।

पर्वत की उच्छ्रिति=पउ, इसको इष्ट गुण कारसे गुणा करनेसे पुरान्तर होता है पउ.इ=पुरान्तर पुअ=सरोऽन्तर=सअ, तब 'द्विनिघ्न तालोच्छ्रिति संयुत यत्' इत्यादि भास्करोक्त सूत्र से उत्पात =उड्डीनमान$=\frac{ताउ. सअं}{२ ताउ+सअ}=\frac{पउ\ पुअ}{२ पउ+इ. पउ}=\frac{पुअ}{२+इ}$, ताउ=पउ कल्प्यते। इससे आचार्योक्त उपपन्न होता है।

भास्करोक्त प्रकार की उपपत्ति के लिये समगति=ताउ+स अ=कर्ण+उड्डीन मान=कर्ण+उ दोनों मे तालोच्छ्रिति (ताउ) जोडने से ताउ+सअं+ताउ=२ ताउ+सअ==कर्ण +उ+ताउ =कर्ण +को तब 'भुजाद्वर्गितात्कोटि कर्णान्तिराप्त' इत्यादि से

$$\frac{भु^२}{कर्ण+को}=क-को=\frac{सअ^२}{२ताउ+सअं}\therefore कोटि=\frac{(२ ताउ+सअ)^२-सअ^२}{२ (२ ताउ+सअ)}$$

$$=\frac{४ ताउ^२+४ ताउ. स अं+सअ^२-सअ^२}{२ (२ ताउ+सअ)}=\frac{४ ताउ^२+४ ताउ. सअ}{२ (२ ताउ+सअ)}$$

$\frac{२ ताउ^२+ताउ. सअं}{२ ताउ+सअ}$ इसमे से तालोच्छ्रिति को घटाने से $\frac{२ ताउ^२+२ ताउ. सअं}{२ ताउ+सअ}$

$$-ताउ=\frac{२ ताउ^२+२ ताउ. सअं-२ ताउ^२-ताउ, सअ}{२ ताउ+सअं}=\frac{ताउ. सअं}{२ ताउ+सअं}$$

=उ, इससे 'द्विनिघ्न तालोच्छ्रिति संयुत यत्' इत्यादि भास्करोक्त उपपन्न होता है इति ॥ ३९ ॥

इति क्षेत्रव्यवहारः।

अथ वृत्तक्षेत्रगणितम्

तत्र तावत् प्रथमं वृत्तपरिधिफलयोरानयनार्थमाह।

व्यासव्यासार्धकृती परिधिफले व्यावहारिके त्रिगुणे।
तद्वर्गाभ्यां दशभिः सङ्गुणिताभ्यां पदे सूक्ष्मे ॥४०॥

सु *भा.*—व्यासो व्यासार्धकृतिश्चैते त्रिगुणे तदा व्यावहारिके व्यवहारयोग्ये

क्रमेण परिधिफले भवतः। तद्वर्गाभ्यां व्यासव्यासार्धवर्गवर्गाभ्यां दशभिः संगुणिताभ्यां पदे ग्राह्ये ते सूक्ष्मे परिधिफले भवतः।

अत्रोपपत्तिः।

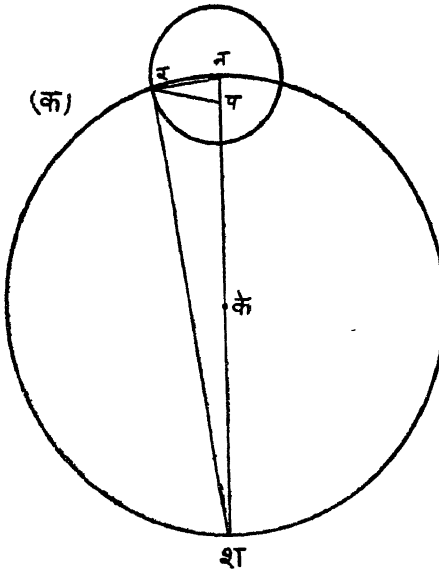
प्रथमप्रकारे व्यासत्रिगुणः परिधिः स्थूलः कल्पितः। द्वितीय प्रकारे व्यासवर्गो दशगुणः।

परिधिवर्गः कल्पितस्ततः परिधिव्यासघातचतुर्थांशफलमिति सुगमा वासना। वस्तुतः प्रकारद्वयं स्थूलमेव। सूक्ष्मार्थं 'व्यासे भनन्दाग्निहते विभक्ते'—इति भास्करप्रकारस्य लीलावत्यां मदीयोपपत्तिर्विचिन्त्येति ॥४०॥

वि. भा.—व्यासो व्यासार्धकृतिश्चैते त्रिगुणिते तदा व्यवहारयोग्ये (स्थूले) क्रमेण परिधिफले भवेताम्। तद्वर्गाभ्यां (व्यास-व्यासार्धवर्गवर्गाभ्यां) दशभिः सङ्गुणिताभ्यां पदे (मूले) ग्राह्ये तदा सूक्ष्मे परिधिफले भवतः ॥४०॥

अत्रोपपत्तिः।

अत्र वृत्त परिधिज्ञानार्थं प्रथम तद्व्यासानयनं क्रियते। वृत्तपरिधौ कोऽपि न बिन्दुर्गृहीतः। तद्बिन्दोरिष्टकर्कटकेनैकं वृत्तं कार्यं तद्वृत्तपरिधौ यत्र लग्नं तत्र र बिन्दुः। नश=वृत्तव्यासः के=वृत्तकेन्द्रम्। कर्कटकस्यैकाग्रतो द्वितीयाग्रं यावन्मापनेन विदितमस्ति, तेन नरचापं (कर्कटकाग्रद्वयान्तरं) विदितं तदा तच्चापस्य नरपूर्णज्या, रपजीवा, नपः उत्क्रमज्या इति सर्वा ज्योत्पत्त्या विदिताः सन्ति, शरन कोणः = ९०, तदा शरन, नरप त्रिभुजयोः साजात्यादनुपातः $\frac{\text{नर} \times \text{नर}}{\text{नप}}$



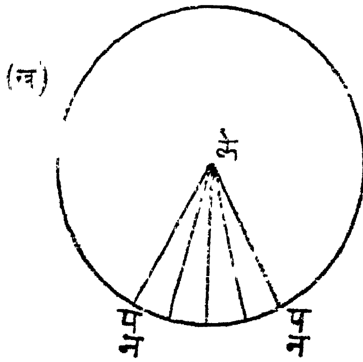
$= \frac{\text{नर}^2}{\text{नप}} = \frac{\text{पूर्णज्या}^2}{\text{रनचापोत्क्रमज्या}} = \text{नश}$ =वृत्तव्यासः। एतावताऽभीष्टवृत्तपरिधेर्व्यासज्ञानं जातं ततो 'व्यासे भनन्दाग्निहते विभक्ते खबाणसूर्यैरित्यादि' भास्करोक्त्या स्थूलो वृत्तपरिधिः= $\frac{\text{व्यास} \times ३९२७}{१२५०}$ =वृत्तपरिधिःसूक्ष्मः, तथा स्थूलो वृत्तपरिधिः= $\frac{\text{व्यास} \times २२}{७}$ अत्र $\frac{२२}{७}$=३ स्वल्पान्तरादाचार्येण गृहीतम् तदा व्यास×३=स्थूलवृत्त परिधिः। तथा 'वृत्तक्षेत्रे परिधिगुणितव्यासपादः फल'

मित्यादि भास्करोक्त्या वृत्तफलम् $= \frac{\text{परिधि. व्या}}{४}$ परन्तु परिधि = ३ व्या अतो वृत्तक्षेत्रफलम् $= \frac{\text{३ व्या. व्या}}{४} = \frac{\text{३. व्या}^२}{४} = \text{३.}\left(\frac{\text{व्या}}{२}\right)^२$ एतावताऽऽचार्योक्त पूर्वार्धमुपपन्नम् । अथ $\frac{\text{व्या. ३९२७}}{१२५०}$ = व्या × किञ्चिदधिकत्रय = सूक्ष्म वृत्तपरिधिः, एतयोर्वर्गकरणेन व्या^{२} किञ्चिदधिकत्रय^२ = व्या^{२} × १० = सूक्ष्मवृपरिधि^{२} मूल-ग्रहणेन $\sqrt{\text{व्या}^२ \times १०}$ = सूक्ष्मवृपरिधिः । अत्राचार्येण किञ्चिदधिकत्रय^२ = १० गृहीतम् । तथा च वृत्तफलम् $= \frac{\text{प. व्या}}{४}$ वर्गकरणेन $\frac{\text{प}^२\text{. व्या}^२}{१६}$ = वृत्तक्षेत्रफल^२, परन्तु प^२ = १० व्या^{२} $\therefore \frac{\text{१० व्या}^२\text{. व्या}^२}{१६} = \frac{\text{१०. व्या}^४}{१६} = १० \times \left(\frac{\text{व्या}}{२}\right)^४$ = सूक्ष्म वृत्तक्षेत्रफल^२, मूलेन सूक्ष्मवृत्तक्षेत्र फ $= \sqrt{\left(\frac{\text{व्या}}{२}\right)^४ \times १०}$ एतावता ऽऽचार्योक्तमुत्तरार्धमुपपन्नम् । सिद्धान्तशेखरे 'विष्कम्भवर्गे दशभि र्विनिघ्ने पदीकृते स्यात् परिधिः सुसूक्ष्मः । विष्कम्भवर्गस्य चतुर्थभागवर्गाद्दशघ्नाच्च पद फल स्यात्' श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव, व्यासात्परिध्यानयनमाचार्यस्य सूर्य सिद्धान्त-कारस्य श्रीधराचार्यस्य श्रीपतेश्चैकरूपमेवास्ति, 'तद्वर्गतोदश गुणात्पदं परिधिरिति सूर्यसिद्धान्त कारोक्तमेव कथ्यते । परमिति समीचीनं नास्ति, नवीनैस्तु 'तद्वर्गतो-ऽदशगुणात् पदं परिधिः' अर्थात् न दशेत्यदश किञ्चिन्न्यूना दश तैर्गुणात्पदं परिधिरितिव्याख्या क्रियतेऽर्थादशतः किञ्चिन्न्यून गुणकेन गुणित व्यासवर्गस्य पदं परिधिर्भवितुमर्हति, दशगुणित व्यासवर्गस्य पदं परिधिः समीचीनो न भवति । सौर वासनायां कमलाकरेण दशगुणक एव समीचीन इति युक्तिशून्यं प्रलपितम् स्वगूढ़ार्थ प्रकाशे रङ्गनाथेन दशगुणकः स्थूलः कथितः । सौरभाष्ये नृसिंहेनापि व्यासः किञ्चिदधिक त्रिभिर्गुणितः परिधिर्भवति, तत्र किञ्चिदधिकत्रयाणां वर्गो दशमितः कुतोऽतः 'व्यासवर्गाद्दश गुणात्पदं परिधिः' कथ्यते सर्वैः, दशग्रहणाद्-दोषावहमेव व्याख्यातं नव्यानां व्याख्यानमेव समीचीनमिति सूर्यसिद्धान्तस्य सुधावर्षिण्यां म. म. सुधाकर द्विवेदिनः कथयन्ति, व्यास-परिध्योः सम्बन्धस्या-स्थिरत्वाद् व्यासात्परिध्यानयनं परिधेर्व्यासानयनं वा कथमपि सूक्ष्मं न भवितु मर्हति, व्यासपरिध्योः सम्बन्धः कथं न स्थिर इत्येतदर्थं मल्लिखित 'वटेश्वर सिद्धान्तस्य' टीका विलोक्येति ।

वृत्तफलानयनार्थमुपपत्तिः ।

पूर्वमाचार्योक्त वृत्तफलानयनस्योपपन्नार्थं वृत्तक्षेत्रे परिधिगुणितव्यासपादः

फलमिति स्वीकृतं मया, परं परिधिगुणित व्यासपादो वृत्तक्षेत्रफलं कथं भवति तदर्थं युक्तिः प्रदर्श्यते ।



के=वृत्तकेन्द्रम् । न=अतीव महती संख्या, न संख्यया विभाजितो वृत्तपरिधिः फलमतीवाल्पं रेखारूपमर्थाद् वृत्तखण्डचापं-रेखारूप भवति, प्रत्येक चापप्रान्तद्वये वृत्त केन्द्राद्रेखा नेयास्तदाऽनेकानि त्रिभुजानि (अत्यल्प वृत्तखण्ड चाप प्रान्तद्वये केन्द्रादानीतरेखाद्वयेन रेखारूपात्यल्पवृत्तखण्ड-चापेन च जायमानानि) जायन्ते, सर्वाणि त्रिभुजानि तुल्यान्येव सन्ति, तत्रैकस्य त्रिभुजस्य फलं संसाध्य तत न संख्यया गुणितं सद्वृत्तक्षेत्रफलं भवेत् । अथैकक्षेत्र-(त्रिभुज) फलं साध्यते । 'लम्बगुणं भूम्यर्ध त्रिभुजे स्पष्टं फलमिति' भास्करोक्त्यैक त्रिभुज फलम् $= \frac{प}{२ न} \times \frac{व्या}{२} = \frac{प \times व्या}{४. न}$ अत्र भूमि $= \frac{प}{न}$, लम्बव्यासार्धयोरल्पान्तरत्वात् । एतत्त्रिभुज फलं न संख्यया गुणनेन वृत्तक्षेत्रफलम् $= \frac{प \times व्या}{४}$ एतावता 'वृत्तक्षेत्रे परिधिगुणितव्यासपादः फलं' भास्करोक्तमिदमुपपद्यते एतद्बलेनैवाऽऽचार्योक्तपद्यस्योपपत्तिः पूर्वं प्रदर्शिता, 'तद्वर्गाभ्यां दशभि: सङ्गुणिताभ्यां पदे सूक्ष्मे' इत्याचार्योक्तमपि समीचीनं नास्ति, यत एतत्प्रकारेण साधिते परिधिवृत्तफले सूक्ष्मे न भवतः यद्व्यास बलेन परिधिः साधितः स व्यासः सूक्ष्मो नास्त्यत आचार्यकथितसूक्ष्मपरिधिः सूक्ष्मो न, तथोपरि लिखितवृत्तफलं सूक्ष्मं नास्त्यतस्तत्सम्बन्धेन साधितमाचार्योक्तं वृत्तफलमपि सूक्ष्मं नेति सिद्धान्तितम् ॥४०॥

अब वृत्तक्षेत्र गणित प्रारम्भ किया जाता है ।

वृत्तक्षेत्र के परिधि और वृत्तफल के आनयन को कहते हैं ।

हि. भा.— व्यास को तीन से गुणा करने से व्यवहारोपयुक्त (स्थूल) परिधि होती है, तथा वृत्तव्यासार्ध वर्ग को तीन से गुणा करने से वृत्तक्षेत्र का स्थूल फल होता है । व्यासवर्ग को दस से गुणा कर मूल लेने से सूक्ष्म परिधि होती है, तथा व्यासार्ध वर्ग के वर्ग को दस से गुणा कर मूल लेने से सूक्ष्म वृत्तक्षेत्र फल होता है ॥४०॥

उपपत्ति

यहाँ संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । वृत्तपरिधिज्ञान के लिये पहले वृत्तव्यास का आनयन करते हैं । वृत्तपरिधि में कोई न बिन्दु लेकर उस बिन्दुको केन्द्रमान

कर इष्ट कर्कट से एकवृत्त बनाए, वह वृत्तवृत्तपरिधि में जहां लगा वह र बिन्दु है। नश=वृत्तव्यास, के वृत्तकेन्द्र कर्कट के दोनों अग्रों का अन्तर मापन करने से विदित है, इसलिये नर चाप विदित है, उस चाप की पूर्णज्या (नर), रप= ज्या, नप=उत्क्रमज्या, ये सब ज्योत्पत्ति विधि से विदित है, <नरश=९०, नरश नरप दोनों त्रिभुजों के सजातीयत्व के कारण अनुपात करते हैं $\frac{नर \times नर}{नप} = \frac{नर^2}{नप} = \frac{पूर्णज्या^2}{रन चापोत्क्रमज्या}$ =नश=वृत्तव्यास, इस से इष्टवृत्तपरिधि का व्यास ज्ञात हो गया, इससे 'व्यासे इत्यादि' इत्यादि भास्करोक्त प्रकार से स्थूल वृत्तपरिधि$=\frac{22 \times व्या}{7}$ यहां $\frac{22}{7}$=३ स्वल्पान्तर से लेते हैं तब ३ × व्या=स्थूलवृत्त परिधि, तथा 'वृत्तक्षेत्रे परिधि गुणित व्यास पादः फलं' इस भास्करोक्त प्रकार से वृत्तफल$=\frac{परिधि. व्या}{4}$, परन्तु परिधि=३ व्या इसलिये वृत्तक्षेत्रफल$=\frac{3 व्या व्या}{4}$ $=\frac{3 व्या^2}{4} = 3\left(\frac{व्या}{2}\right)^2$ इससे आचार्योक्त पूर्वार्ध उपपन्न हुआ। 'व्यासे भनन्दाग्नि हते विभक्ते खबाणसूर्यैः' इस भास्करोक्त प्रकार से सूक्ष्मवृत्तपरिधि$=\frac{व्या \times 3927}{1250}$=व्या ×तीन से कुछ अधिक, वर्ग करने से सूक्ष्म वृत्तपरिधि^{2}=व्या^{2} × (तीन से कुछ अधिक)^2 =व्या^{2} × १०, मूल लेने से सूक्ष्मवृत्तपरिधि$=\sqrt{व्या^2 \cdot 10}$ यहां आचार्य ने (तीन से कुछ अधिक)^2=१०, ग्रहण किया है। तथा वृत्तफल$=\frac{प. व्या}{4}$ वर्ग करने से $\frac{प^2. व्या^2}{16}$ = सूक्ष्म वृत्तक्षेत्रफल^2 परन्तु प^2= १० व्या^{2} ∴ $\frac{10 व्या^2. व्या^2}{16} = \frac{10 व्या^4}{16}$ =सूक्ष्म वृत्त क्षेत्र फ^2 मूल लेने से सूक्ष्म वृत्तक्षेत्रफल$=\sqrt{\left(\frac{व्या}{2}\right)^4 \times 10}$ इससे आचार्योक्त सूक्ष्म वृत्त क्षेत्र फलानयन उपपन्न हुआ ।। सिद्धान्त शेखर में 'विष्कम्भ वर्गे दशभिर्विनिघ्ने' इत्यादि सस्कृतोपपत्ति में लिखित श्रीपत्युक्त सूक्ष्मवृत्त परिध्यानयन तथा सूक्ष्मवृत्त क्षेत्रफलानयन आचार्योक्त के अनुरूप ही है। व्यास से परिधि के आनयन में आचार्य (ब्रह्मगुप्त), सूर्य सिद्धान्तकार, श्रीधराचार्य और श्रीपति का एक रूप ही है, सब कोई वृत्तव्यास वर्ग को दस से गुणा कर मूल लेने से सूक्ष्म परिधि कहते है। लेकिन नवीन लोग कहते है कि व्यास वर्ग को दस से कुछ कम ही गुणकाङ्क से गुणा कर मूल लेने से सूक्ष्म परिधि होती है और वासना में दस गुणक ही ठीक है यह कमलाकर का कथन युक्ति शून्य है। अपने गूढार्थ प्रकाश में रङ्गनाथ ने दश गुणकाङ्क को स्थूल कहा हैं। सौरभाष्य में नृसिंह द्वारा भी व्यास को तीन से कुछ अधिक से गुणा करने से वृत्त परिधि होती है, वहाँ तीन से कुछ अधिक का वर्ग दस लिया हैं। सभी प्राचीनाचार्यों ने 'व्यास वर्ग को दस से गुणा कर मूल लेने से सूक्ष्म वृत्त परिधि होती

है कहा है। नवीन लोगों का कहना है कि दस गुणकाङ्क नहीं लेना चाहिए। दस से अल्प ही गुणकाङ्क लेना उचित है, ये बाते सूर्य सिद्धान्त की सुधावर्षिणी टीका में म. म. सुधाकर द्विवेदी कहते है। व्यास और परिधि के सम्बन्ध स्थिर नही है। इसलिये व्यास से परिधि का आनयन वा परिधि से व्यास का आनयन किसी तरह ठीक नहीं हो सकता है, व्यास और परिधि के सम्बन्ध स्थिर क्यों नहीं है इसके लिये हमारी 'वटेश्वर सिद्धान्त की' टीका देखनी चाहिए।

वृत्त क्षेत्र फलानयन के लिये उपपत्ति।

यहाँ संस्कृतोपपत्ति मे लिखित (ख) क्षेत्र को देखिये। पहले आचार्योक्त वृत्तक्षेत्र-फलानयन के लिये, 'वृत्तक्षेत्रे परिधि गुणित व्यास पादः फलं' इस भास्करोक्त प्रकार की सहायता ली गयी है, लेकिन भास्करोक्त प्रकार की क्या युक्ति है यह दिखलाते हैं।

के=वृत्तकेन्द्र, न=अत्यन्त छोटी संख्या, वृत्तपरिधि को न संख्या से भाग देने से फल अत्यन्त ही छोटा होगा अर्थात् वृत्त का जो अत्यन्त छोटा खण्ड होगा वह रेखारूप ही होगा, उन अत्यन्त अल्प वृत्त खण्डों के दोनो प्रान्तों में वृत्तकेन्द्र से रेखाये लाने से अनेक त्रिभुज (न संख्यक) एक ही तरह (समान) के बनते है उनमें एक त्रिभुज के फल साधन करके न सख्या से गुणा कर देने से सब त्रिभुजों का (वृत्त क्षेत्र फल) हो जायगा, इसलिये एक त्रिभुज का फल साधन करते है। 'लम्ब गुण भूम्यर्ध त्रिभुजे स्पष्टं फलं भवति' इस भास्क-रोक्त प्रकार से एक त्रिभुज का फल $=\frac{\quad}{२ न}\times\frac{व्या}{२}=\frac{प.\ व्या}{४ न}$ यहाँ $\frac{प}{न}$ =भूमि, $\frac{व्या}{२}$= लम्ब, इस त्रिभुज फल को न संख्या से गुणा करने से वृत्त क्षेत्र फल $=\frac{प.\ व्या}{४}$ इससे भास्क-रोक्त वृत्त क्षेत्र फलानयन उपपन्न होता है, इसी की सहायता से पहले वृत्तक्षेत्रफलानयन किया गया है, पहले जो सूक्ष्म वृत्त परिधि और सूक्ष्म वृत्त क्षेत्र फल दिखलाया गया है जिनको आचार्य सूक्ष्म कहते हैं वे सूक्ष्म नही है। क्योकि जिन साधनों से साधित है वे साधन ठीक नहीं है ॥ ४० ॥

इदानी जीवा व्यासयोरानयनार्थमाह।

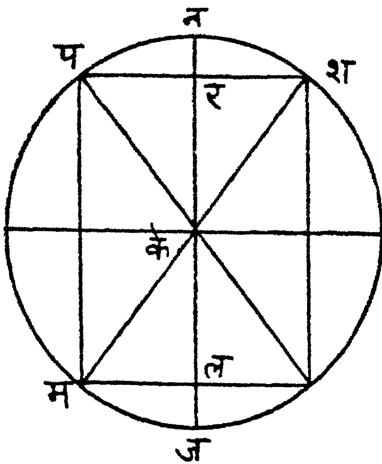
वृत्ते शरोन गुणिताद् व्यासाच्चतुराहतात् पदं जीवा।
ज्यावर्गश्चतुराहतशरभक्तः शरयुतो व्यासः ॥ ४१ ॥

सु. भा.—स्पष्टार्थम्। 'ज्याव्यासयोगान्तरघातमूलम्'—इत्यादि भास्क-रोक्तमेतदनुरूपमेव ॥४१॥

वि. भा.—वृत्ते शरेण ऊनो गुणितश्चव्यासस्तस्मात्पुनश्चतुराहतात्

(चतुर्भिर्गुणितात्) पदं (मूलं) जीवा भवति। ज्या (जीवा) वर्गश्चतुर्गुणित शरभक्तः शरयुतस्तदा व्यासो भवेदिति ॥ ८१ ॥

अत्रोपपत्तिः ।



पश = इष्टचापम्, एतच्चापस्य पूर्णज्या = पश ज्या, अत्र ज्याशब्देन पूर्णज्याबोध्या, नज = वृत्तव्यासः। नर = शर = लज, केन = व्यासार्धम् = केज, पर = ज्यार्धम्, केर = $\frac{\text{व्या}}{२}$ — शर केपर त्रिभुजे केर² = केप² — पर² वर्गान्तरस्य योगान्तरघात-समत्वात् (केप + केर)(केप — केर) = (केज + केर)(केन — केर) = पर² = रज·नर = (नज — नर) नर = (व्यास — शर) शर = $\left(\frac{\text{ज्या}}{२}\right)^2$ = (व्यास — शर). शर = $\frac{\text{ज्या}}{४}$,

∴ (व्यास — शर). शर × ४ = ज्या² मूलग्रहणेन $\sqrt{(\text{व्यास} - \text{शर}).\ \text{शर} \times ४}$ = ज्या अथवा रेखागणितेन नर. रज = पर. रप = शर. (व्यास — शर) = $\left(\frac{\text{ज्या}}{२}\right)^2 = \frac{\text{ज्या}^2}{४}$ ततः शर (व्यास — शर) × ४ = ज्या² मूलेन $\sqrt{\text{शर}\ (\text{व्यास} - \text{शर}) \times ४}$ = ज्या ।

अथ शर (व्यास — शर) × ४ = ज्या² पक्षौ ४ शर भक्तौ तदा $\frac{\text{ज्या}^2}{४\ \text{शर}}$ = व्यास — शर पक्षौ शर युक्तौ तदा $\frac{\text{ज्या}^2}{४\ \text{शर}}$ + शर = व्यास. । एतेनाचार्योक्तमुपपद्यते, सिद्धान्तशेखरे 'वृत्तव्यासादिष्टबाणेन निघ्नाद् वेदैः क्षुण्णाद् यत्पदं ज्या भवेत्तत्। जीवार्धवर्गे शरवर्गयुक्ते शरोद्धृते व्यासमुशन्ति वृत्ते' श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव। लीलावत्यां 'व्यासाच्छरोनाच्छरसङ्गुणाच्च मूलं द्विनिघ्नं भवतीह जीवा। जीवार्धवर्गे शरभक्तयुक्ते व्यासप्रमाणं भवतीह वृत्ते' भास्कराचार्योक्तमपीदमाचार्योक्तानुरूपमेवास्तीति ॥ ८१ ॥

अब जीवा और व्यास के आनयन के लिये कहते हैं।

हि. भा.—वृत्त में व्यास में से शर को घटाकर और शर से गुणाकर जो हो उसको

नाग से गुणाकर मूल लेने से जीवा होती है। ज्यावर्ग को चतुर्गुणित शर से भाग देने से जो लब्धि हो उसमें शर जोड़ने से व्यास होता है ॥ ४१ ॥

उपपत्ति ।

यहां संस्कृतोपपत्ति मे लिखित (१) क्षेत्र को देखिये । यश = इष्टचाप है, इस चाप की पूर्णज्या = पश = ज्या यहां ज्या से पूर्णज्या समझनी चाहिये, नज = वृत्तव्यास, नर = शर = लज. केप = व्यासार्ध = केज, पर = ज्यार्ध, केर = $\frac{\text{व्या}}{२}$ — शर; केपर त्रिभुज मे केप^2 — केर^2 = पर^2 वर्गान्तर योगान्तर घात के बराबर होता है ।

$$\text{इसलिये (केप + केर). (केप − केर)} = \text{(केज + केर). (केन − केर)} = \text{पर}^2$$

$$= \text{रज. नर} = \text{(नज − नर). नर} = \text{(व्यास − शर). शर} = \left(\frac{\text{ज्या}}{२}\right)^2$$

$$= \text{(व्यास − शर). शर} = \frac{\text{ज्या}^2}{४}$$

$$\therefore \text{(व्यास − शर). शर} \times ४ = \text{ज्या}^2$$

$$\text{मूल लेने से } \sqrt{\text{(व्यास − शर). शर} \times ४} = \text{ज्या. ।}$$

$$\text{अथवा रेखागणित से नर. रज} = \text{पर. रश} = \text{शर (व्यास − शर)}$$

$$= \left(\frac{\text{ज्या}}{२}\right)^2 = \frac{\text{ज्या}^2}{४} \text{ । पर} = \text{रश.}$$

$$\therefore \text{शर (व्यास − शर)} \times ४ = \text{ज्या}^2$$

$$\text{मूल लेने से } \sqrt{\text{शर (व्यास − शर)} \times ४} = \text{ज्या ।}$$

$$\text{शर (व्यास − शर)} \times ४ = \text{ज्या}^2$$

$$\text{दोनों पक्षों को ४ शर से भाग देने से व्यास − शर} = \frac{\text{ज्या}^2}{\text{४ शर}}$$

दोनों पक्षों में शर जोड़ने से व्यास = $\frac{\text{ज्या}^2}{\text{४ शर}}$ + शर इससे आचार्योक्त उत्पन्न होता है ।

सिद्धान्त शेखर में 'वृत्तव्यासादिष्ट बाणेन निघ्नान्' इत्यादि संस्कृतोपपत्ति में लिखित' श्रीपत्युक्त आनयन आचार्योक्त के अनुरूप ही है। लीलावती में 'व्यासाच्छरोनाच्छरसङ्गुणात्' इत्यादि संस्कृतोपपत्ति में लिखित भास्कराचार्योक्त भी आचार्योक्त के अनुरूप ही है ॥ ४१ ॥

इदानीं ज्याव्यासाभ्यां शरानयनार्थमाह ।

ज्याव्यासकृति विशेषान्मूल व्यासान्तरार्धमिषुरल्पः ।
व्यासौ ग्रासोनगुणौ ग्रासोनैक्योद्धृतौ बाणौ ॥ ४२ ॥

सु. भा. – पूर्वार्धे 'ज्याव्यासयोगान्तरघातमूलं व्यासस्तदूनो दलितः शरः स्यात्'—इत्यादि भास्करोक्तानुरूपमेव । उत्तरार्धव्याख्यायां चतुर्वेदाचार्यः । 'उद्दिष्टवृत्तयोर्यावान् परस्परमनुप्रवेशः स इह ग्रासशब्देनोच्यते । तेनायमर्थः । व्यासौ पृथक् संस्थाप्य ग्रासप्रमाणेनोनौ कर्तव्यौ ततस्तावनष्टौ कृत्वा पृथग्-ग्रासेनैव गुणनीयौ ततो ग्रासोनव्यासयोर्योगेन विभजेदुभयतोऽपि लब्धे फले शरौ लघू भवतः । तयोश्च योऽल्पः स महति वृत्ते यश्च महान् स लघुनि वृत्त इति ।

अत्रोपपत्तिः ।

लघुवृत्तकेन्द्रम् के, । व्यासार्धम् = के, घ । ग्रास प्रमाणम् = गघ । घत = शरमानम् । तत्प्रमाणम् = या । ततो गत = ग्रा - या = बृहद्वृत्तस्य शरः । ततः पूर्वविधिना शरद्वयतोऽर्धज्यावर्ग. = $\text{तत}^2 = (२\ \text{के}_१\text{घ} - \text{या})\ \text{या}$

$= (२\ \text{के}_२\text{ग} - \text{ग्रा} + \text{या})(\text{ग्रा} - \text{या})$

$\text{व्या}_१\ \text{या} - \text{या}^2 = \text{व्या}_२\ \text{ग्रा} - \text{व्या}_२\ \text{या} - \text{ग्रा}^2 + \text{ग्रा या} + \text{ग्रा या} - \text{या}^2$

$= \text{व्या}_२\ \text{ग्रा} - \text{व्या}_२\ \text{या} + २\ \text{ग्रा या} - \text{ग्रा}^2 - \text{या}^2$

यदि $२\ \text{के}_१\ \text{घ} = \text{व्या}_१$ । $२\ \text{के}_२\ \text{ग} = \text{व्या}_२$ ।

ततः समशोधनादिना

$\text{या}\ (\text{व्या}_१ + \text{व्या}_२ - २\ \text{ग्रा}) = \text{ग्रा}\ (\text{व्या}_२ - \text{ग्रा})$

$\text{या} = \dfrac{\text{ग्रा}\ (\text{व्या}_२ - \text{ग्रा})}{\text{व्या}_१ - \text{ग्रा} + \text{व्या}_२ - \text{ग्रा}}$ एतद्गुणं ग्रासमानं जातो गत समोऽन्यशरः

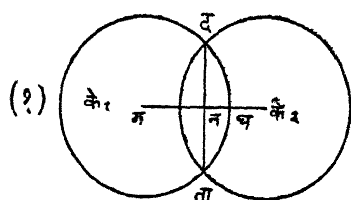
$= \dfrac{\text{ग्रा}\ (\text{व्या}_२ - \text{ग्रा})}{\text{व्या}_१ - \text{ग्रा} + \text{व्या}_२ - \text{ग्रा}}$ । अत उपपन्नम् । केन्द्रगामि के, के, रेखात धृतपूर्णज्या रेखागणित युक्तितो द्विभक्ता भवतीति स्फुटम् ॥४२॥

वि. भा.—ज्याव्यासयोर्यद्वर्गान्तरमूलं तेन हीनो व्यासः कार्यस्तदर्धं शरः (अल्पः) स्यात् । उत्तरार्धस्य व्याख्यायां चतुर्वेदाचार्यः—'उद्दिष्टवृत्तयोर्यावान् परास्परमनुप्रवेशः स इह ग्रासशब्देनोच्यते । तेनायमर्थः । व्यासौ पृथक् संस्थाप्य ग्रासप्रमाणेनोनौ कर्त्तव्यौ ततस्तावनष्टौ कृत्वा पृथग्ग्रासेनैव गुणनीयौ ततो ग्रासोनव्यासयोर्योगेन विभजेदुभयतोऽपि लब्धे फले शरौ लघू भवतः । तयोश्च योऽल्पः स महति वृत्ते यश्च महान् स लघुनि वृत्त इति ॥४२॥

अत्रोपपत्तिः ।

पूर्वार्धोपपत्त्यर्थं ४१ श्लोकोपपत्तौ लिखितं क्षेत्रं द्रष्टव्यम् । मश=व्यासः । पश=ज्या, नर=शर=लज < मपश=९०, तदा मपशत्रिभुजे $मश^2 - पश^2 = पम^2 =$ $व्यास^2 - ज्या^2 = रल^2$, मूलग्रहणेन $\sqrt{व्यास^2 - ज्या^2} = रल$, नज—रल=व्यास— $\sqrt{व्यास^2 - ज्या^2}$ = नर+लज = २×शर $\therefore \frac{व्यास - \sqrt{व्यास^2 - ज्या^2}}{२} = शर$, एनेनाचार्योक्तं पूर्वार्धमुपपन्नम् । सिद्धान्तशेखरे 'वृत्ते जीवा व्यासकृत्योर्विशेषान्मूलं प्रोह्य व्यासतोऽर्धं शरः स्यात्' श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवास्ति । लीलावत्यां 'ज्याव्यासयोगान्तरघातमूलं व्यासस्तदूनो दलितः शरः स्यात्' भास्कराचार्योक्तमपीदमाचार्योक्तानुरूपमेवेति ॥

अथोत्तरार्धोपपत्तिः ।



लघुवृत्तकेन्द्रम् = $के_1$, व्यासार्धम् = $क_1घ$, ग्रासप्रमाणम् = गघ, शरमानम् = घन । तत्प्रमाणम् = य, ततो गन = ग्रा — य = बृहद्वृत्तशरः । ततः पूर्वविधिना शरद्वयतोऽर्धज्यावर्गः = $नत^2$ = (२ $के_1घ$ — य). य = (२$के_2$ग — ग्रा + य) (ग्रा — य)

वा, $व्या_1$ य — $य^2$ = $व्या_2$. ग्रा — $व्या_2$. य — $य^2$ + ग्रा . य + ग्रा. य — $य^2$ = $व्या_2$. ग्रा — $व्या_2$. य + २ ग्रा. य — $ग्रा^2$ — $य^2$

यदि २ $के_1$घ = $व्या_1$, २$के_2$ग = $व्या_2$, ततः समशोधनादिना य ($व्या_1$ + $व्या_2$ — २ग्रा) = ग्रा ($व्या_2$ — ग्रा) $\therefore \frac{ग्रा\ (व्या_2 - ग्रा)}{व्या_1 - ग्रा + व्या_2 - ग्रा} = य$, एतदूनं ग्रासमानं जातो गन समोऽन्य शरः = $\frac{ग्रा\ (व्या_1 - ग्रा)}{व्या_1 - ग्रा + व्या_2 - ग्रा}$ अत उपपन्नम् । केन्द्रगामि $क_1$, $के_2$ रेखातोदतपूर्णज्या रेखागणित युक्त्याऽर्धिता भवतीति ॥४२॥

अब ज्या और व्यास से शर के आनयन के लिये कहते हैं ।

हि. भा.— ज्या और व्यास के वर्गान्तर का मूल जो हो उसको व्यास में से घटाकर आधा करने से शर होता है । दो वृत्तों में से एक वृत्त में दूसरा वृत्त जितना घुसता हैं वह ग्रास कहलाता है । दोनों वृत्तों के व्यासो को पृथक् रखकर ग्रासमान घटा देना चाहिये, इन दोनों

को पृथक् पृथक् व्यास ही में घटा कर देना चाहिये, तब दोनों व्यास के [illegible] ग्रास से घटा कर जो शेष उनके योग से भाग देने से दोनों [illegible] शर होते हैं। इन दोनों में जो छोटा है वह बड़े वृत्त में होता है और जो बड़ा है वह छोटे वृत्त में होता है ॥४२॥

उपपत्ति

यहां पूर्वार्द्ध की उपपत्ति के लिये (१) वें श्लोक की उपपत्ति में लिखित क्षेत्र को देखिये। [illegible] = [illegible], [illegible] = [illegible] = [illegible], [illegible] = ९०, तब [illegible] त्रिभुज से [illegible] मूल लेने से [illegible]

[illegible] ∴ [illegible]

= शर. इससे पूर्वार्द्ध उपपन्न हुआ। सिद्धान्त शेखर में 'वृत्तेऽम्भसा [illegible]' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है, तथा लीलावती में '[illegible]' इत्यादि से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है।

उत्तरार्ध की उपपत्ति।

यहां संस्कृतोपपत्ति में लिखित (२) क्षेत्र को देखिये। लघुवृत्त केन्द्र = के$_1$, व्यासार्ध = के$_2$ घ, ग्रासप्रमाण = गय, शरमान = घन. इसका प्रमाण य मानते हैं। तब गन = ग्रा — य = बृहद्वृत्तशर। तब पूर्व विधि के अनुसार दोनों शरों से अर्धज्यावर्ग = नन^2 = (२ के$_1$घ — य)य = (२ के$_2$ग — ग्रा + य)(ग्रा — य) वा व्या$_1$य — य^2 = व्या$_2$. ग्रा — व्या$_2$. य — ग्रा^{2} + ग्रा . य + ग्रा . य — य^2 = व्या$_2$. ग्रा — व्या$_2$. य + २ ग्रा . य — ग्रा^{2} — य^2

यदि २ के$_1$घ = व्या$_1$, २ के$_2$ग = व्या$_2$ तब समशोधन आदि करने से

य (व्या$_1$ + व्या$_2$ — २ ग्रा) = ग्रा (व्या$_2$ — ग्रा) ∴ $\frac{\text{ग्रा (व्या}_2\text{ — ग्रा)}}{\text{व्या}_1\text{ — ग्रा + व्या}_2\text{ — ग्रा}}$ = य

इसको ग्रासमान में से घटाने से गन के बराबर अन्य शर = $\frac{\text{ग्रा (व्या}_1\text{ — ग्रा)}}{\text{व्या}_1\text{ — ग्रा + व्या}_2\text{ — ग्रा}}$

इससे आचार्योक्त उत्तरार्ध उपपन्न होता है। केन्द्रगामिनी के$_1$ के$_2$ रेखा में दन पूर्णज्या अधिक होती है ॥४२॥

इदानीं वृत्तयोः सम्पर्के (संयोगे) जीवाशराभ्यां व्यासयोरानयनार्थमाह।

इष्टशरद्वयभक्ते ज्यार्धकृती शरयुते फले व्यासौ।
शरयोः फलयोरैक्यं ग्रासो ग्रासोनमैक्यं तत् ॥४३॥

सु. भा.—वृत्तसम्पर्के जीवा पूर्वसूत्रस्थ क्षेत्रे दत मिता । ततो 'जीवार्धवर्गे शरभक्तयुक्ते' इत्यादिभास्कर विधिना स्वस्वशरतो व्यासानयनं सुगमम् । पूर्वोक्त क्षेत्रत: शरयोरैक्यं ग्रासः स्फुट एव । फलयोरैक्यं च ग्रासोनमैक्यं व्यास योगमानं तद्भवति ।

अत्रोपपत्तिः ।

पूर्वप्रदर्शितक्षेत्रतः स्पष्टा ॥४३॥

वि. भा.—वृत्तयोः सम्पर्के तयोर्ज्यार्धकृती (ज्यार्धवर्गौ) वृत्तद्वयस्य शराभ्यां पृथक् भक्ते स्वस्वशरयुते तदा वृत्तयोर्व्यासौ भवतः । शरयोरैक्यं (शरयोर्योगः) ग्रासो भवति, फलयोरैक्यं ग्रासोनं तदा व्यासयोर्योगो भवतीति ॥४३॥

अत्रोपपत्तिः ।

वृत्तयोः सम्पर्के ४२ श्लोकस्य क्षेत्रे जीवा = दत, लघुमहद्वृत्तयोः क्रमशः शरौ नघ, गन आभ्यां 'जीवार्धवर्गे शरभक्त युक्ते व्यासप्रमाणमिति' भास्करोक्तेन वृत्तयोर्व्यासानयनं स्पष्टमेव, तथा नघ, गन शरयोर्योगो गघ ग्रासमानं प्रत्यक्ष-मेव दृश्यते । तथा वृत्तयोर्व्यासयोगे ग्रासोन व्यासयोगमानमपि क्षेत्रदर्शनेन स्पष्ट मेवास्तीति ॥४३॥

इति क्षेत्र व्यवहारः समाप्तः ।

अब दो वृत्तों के सम्पर्क (संयोग) में जीवा और शर से दोनों वृत्त
के व्यासानयन के लिये कहते हैं ।

हि. भा.—वृत्तद्वय के सम्पर्क में दोनों वृत्तों के ज्यार्ध वर्ग को दोनों वृत्तों के शर से पृथक् भाग देने से जो हो उसमें अपना अपना शर जोडने से दोनों फल दोनों वृत्तों के व्यास होते हैं । दोनों शरों का योग ग्रासमान होता है । दोनों फलों के योग में से ग्रास को घटाने से दोनों व्यासों का योग मान होता है ।।४३।।

उपपत्ति ।

४२ वें श्लोकस्थ क्षेत्र में जीवा = दत, लघुवृत्तकाशर = नघ, महद्वृत्त का शर = गन, इन दोनों से 'जीवार्ध वर्गे शरभक्तयुक्ते' इत्यादि भास्करोक्त प्रकार से दोनों वृत्तों का व्यासानयन स्पष्ट ही है । तथा नघ, गन दोनों शरों का योग गघ ग्रासमान प्रत्यक्ष ही दिखाई देता हैं । तथा दोनों वृत्तों के व्यास योग में से ग्रासमान घटाने से व्यासयोग मान भी क्षेत्रदर्शन से स्पष्ट है इति ।।४३।।

क्षेत्र व्यवहार समाप्त हुआ ।

अथ खातव्यवहारः प्रारभ्यते

तत्र प्रथमं खात फलानयनार्थमाह ।

क्षेत्रफलं वेधगुणमसमखात फलं हृतं त्रिभिः सूच्याः ।
मुखतलतुल्यभुजैक्या येकाग्रहृतानि समरज्जुः ।। ४४ ।।

सु. भा.—क्षेत्रफलं वेधेन गर्भखातेन हतं समखातस्य घनफलं भवेत् । तद् घनफलं त्रिभिर्हृतं सूच्या घनफलं भवेत् ।

अत्रोपपत्त्यर्थं मच्छोधिता भास्करलीलावती द्रष्टव्या ।

इतरार्थं चतुर्वेदाचार्यः । 'एकस्यैव खातस्य मुखतलतुल्यभुजस्य मध्ये यदा कतिचिद्धस्ता भिन्नवेधा भवन्ति तथा पृथुत्वभुजस्तावदेक एव सर्वेषां लघुखा-तकानां दैर्घ्यस्वभुजखण्डस्य स्ववेधस्य च यो घातस्तस्य मुखतलतुल्यभुजैक्यमिति संज्ञा । एवं बहूनां लघुखातानां वाहनामैक्यानि भवन्ति तानि पृथगेकाग्रहृतानि समरज्जुर्भवति । दीर्घभुजा या खण्डिता सा सकलैकाग्रशब्देनोच्यते' एवमस्य सूत्रस्य तथैवार्थो यथा च भास्करेण 'गणयित्वा विस्तारं बहुषु स्थानेषु'—इत्यादौ वर्णितः ।

अत्र चतुर्वेदाचार्यस्योद्देशकः—

त्रिंशद्धस्ता तु या वापी दैर्घ्येणाष्टौ पृथुत्वतः ।
तत्रान्तः पञ्च खातानि वेदाद्यैर्भुजखण्डकैः ।।
वेधश्च नवसप्तागत्रिद्विसंख्यो यथाक्रमम् ।
खातकानां समा रज्जुर्याऽत्र स्याच्छीघ्रमुच्यताम् ।।

न्यास. ।

	३०				
	वे	वे	वे	वे	वे
८	९	७	८	३	२
	४	५	६	७	८

अत्र मुखतलभुजैक्यानि क्रमशः ३६ । ३५ । ४८ । २१ । १६ । एतान्येकाग्रेणानेन ३० भाजितानि एकत्रीकृतानि $\frac{१५६}{३०}$ =५ इयं समा रज्जुः । अनया क्षेत्रफलं २४० गुणितं जातं सकलस्यैव खातस्य घनफलम्=१२०० ।

अत्र पुनश्चतुर्वेदाचार्यः—

सूत्राक्षराणां प्रायेणेदृगेवार्थो यतः फलेन संवाद इति ।।४४।।

वि. भा.—यस्मिन् खाते विस्तारे बहुषु स्थानेषु वैषम्यं भवेत्तदा तेषां

विस्ताराणां योगो विषमविस्तारस्थानसंख्यया भक्तो विस्तारसाम्यं भवति। एवं बहुषु स्थानेषु दैर्घ्ये वैषम्यं भवेत्तदा तद्विषमतानां योगस्तत्स्थानसंख्यया भक्तस्तदा दैर्घ्यसाम्यं भवति। वेधसाम्यमप्येवम्। अनया रीत्या समागतयोः समविस्तारदैर्घ्ययोर्घातः क्षेत्रफलं भवति। एतत्क्षेत्रफलं वेधगुणं तदा समखातफलं भवति, तत् त्रिभिर्भक्तं तदा तस्य खातस्य सूच्याः फलं भवति। यस्मिन् खाते मुखे तले च दैर्घ्यादिकं समानं तत्समखातं तद्घनफलं त्रिभिर्भक्तं तदा सूच्याकारे तस्मिन्नेव खाते घनफलं स्यादिति।

उत्तरार्धे चतुर्वेदाचार्यः—'एकस्यैव खातस्य मुखतलतुल्यभुजस्य मध्ये यदा कतिचिद्धस्ता भिन्नवेधा भवन्ति तथा पृथुत्वभुजस्तावदेक एव सर्वेषां लघुखातकानां दैर्घ्यं स्वभुजखण्डस्यस्ववेधस्य च यो घातस्तस्य मुखतलतुल्यभुजैक्यमिति संज्ञा। एवं बहूनां लघुखातानां बाहूनामैक्यानि भवन्ति तानि पृथगेकाग्रहृतानि समरज्जुर्भवति, दीर्घभुजा या खण्डिता सा सकलैकाग्रशब्देनोच्यते।

चतुर्वेदाचार्यमुदाहरणम्।

त्रिंशद्धस्ता तु या वापी दैर्घ्येणाष्टौ पृथुत्वतः।
तत्रान्तः पञ्च खातानि वेदाद्यैर्भुजखण्डकैः॥
वेधश्च नवसप्ताग त्रिद्विसंख्यो यथाक्रमम्।
खातकानां समा रज्जुर्याऽत्र स्याच्छीघ्रमुच्यताम्॥

(१) न्यासः (दैर्घ्यम् ३०, पृथुत्वम् ८)

वे	वे	वे	वे	वे
९	७	७	३	२
४	५	६	७	८

अत्र मुखतल भुजैक्यानि क्रमशः ३६।३५। ४२। २१। १६। एतान्येकाग्रेणानेन ३० भाजितानि एकत्रीकृतानि $\frac{१५०}{३०}$ =५ इयं समारज्जुः। अनया क्षेत्रफलं २४० गुणितं जातं सकलस्यैव खातस्य घनफलम् = १२०० अत्र पुनश्चतुर्वेदाचार्यः 'सूत्राक्षराणां प्रायेणेदृगेवार्थो यतः फले न संवाद इति'। सिद्धान्तशेखरे "स्यात् खातं विषमस्य चेत्पृथुतया दैर्घ्येण वेधेन वा साम्यार्थं विषमैः पदैर्विषमतायोगं तदा संभजेत्। वेधक्षेत्र फलाहति निगदितं विख्यात खातश्रमैर्धीरैः खातफलं समं त्रिविहृतं स्यात्तस्य सूचीफलम्" श्रीपतिनैवमुच्यते। लीलावत्यां "गणयित्वा विस्तारं बहुषु स्थानेषु तद्युतिर्भाज्या। स्थानकमित्या सममिति रेवं दैर्घ्ये च वेधे च॥ क्षेत्रफलं वेधगुणं खाते घनहस्तसंख्या स्यात्। समखातफलत्र्यंशः सूचीखाते फलं भवति।" भास्कराचार्येण श्रीपत्युक्तमेव स्पष्टतयोक्तम्।

त्रिष्वपि विस्तार दैर्घ्यवेधेषु विषमतायां भास्करोक्तमुदाहरणम्।

भुजवक्रतया दैर्घ्यं दशेशार्क करैर्मितम्।
त्रिषु स्थानेषु षट्पञ्चसप्तहस्ता च विस्तृतिः॥

यस्य खातस्य वेधोऽपि द्विचतुस्त्रिमितः सखे ।
तत्र खाते कियन्तः स्युर्घनहस्ताः प्रचक्ष्व मे ॥

न्यासः विस्तृतयः ६ । ९ । ३ हस्ताः, एतेषां योगः = ६ + ९ + ३ = १८ स्थानमितिः = ३, अनया भक्तस्तदा विस्तार समभितिः = $\frac{१८}{३}$ = ६ । दैर्घ्यम् १० । ११ । १२ हस्तात्मकम् । एतेषां योगः = १० + ११ + १२ = ३३ स्थान मित्या ३ भजनेन $\frac{३३}{३}$ = ११ दैर्घ्य समभितिः । वेधः २ । ४ । ३ हस्ताः, तत्र वेधसमभितिः = ३

विस्तारदैर्घ्यवेधघातः = ६ × ३३ = १९८ = क्षेत्रफलम् ।

त्रिषु स्थानेषु[1] केवलमेकस्थाने वैषम्यमस्थानत्वे वैषम्यं न तत्र विमतिस्तथापि अधस्तनमेवोक्तमुदाहरणम् ; द्वित्रिचतुष्कवेधः षोडशदैर्घ्यः पञ्च-हस्त विस्तारः । षोडशहस्ता दैर्घ्ये खातफलं कथयस्व मे । न्यासः वेधः २ । ३ । ४ हस्ताः, विस्तारः = ५ हस्ताः । दैर्घ्यम् = १६ ह, अत्र वेधस्य समभितिः = $\frac{२ + ३ + ४}{३}$ = $\frac{९}{३}$ = ३ । क्षेत्रफलम् = विस्तार × दैर्घ्यं = ५ × १६ = ८० क्षेत्रफलं वेधगुणितमद्या-दिना ८० × ३ = २४० = खातफलम् ।

अन्यदप्युदाहरणम् ।

त्रिचतुः पंचक हस्ता पृथुता विषमास्तु यस्य खातस्य ।
अष्टौ हस्ता वेधो द्वादश दैर्घ्ये कथय फलम् ॥

न्यासः विस्तृतयः = ३ । ४ । ५ हस्ताः । दैर्घ्यं हस्ताः = १२ । वेधः = ८ हस्ताः ।

विस्तृति समभितिः = $\frac{३ + ४ + ५}{३}$ = $\frac{१२}{३}$ = ४ । क्षेत्रफलम् = दैर्घ्य × विस्तार = १२ × ४ = ४८ क्षेत्र फल वेध गुणं ४८ × ८ = ३८४ = खातफलम् ।

गणित सार संग्रहे महावीराचार्योक्त सूत्रम् ।
"क्षेत्रफलं वेधगुणं समखाते व्यावहारिकं गणितम् ।
मुखतल युति दलमथ तत्संख्याप्त स्यात्समीकरणम् ॥"

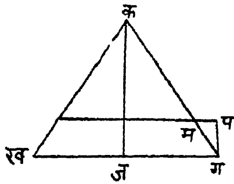
एतादृशमेवास्ति, तदुक्तान्युदाहरणानि च

समचतुरस्रस्याष्टौ बाहुः प्रतिबाहुकश्च वेधश्च ।
क्षेत्रस्य खातगणितं समखाते किं भवेदत्र ॥
त्रिभुजस्य क्षेत्रस्य द्वात्रिंशद्बाहुकस्य वेधे तु ।
षट्त्रिंशद् दृष्टास्ते षडङ्गुलान्यस्य किं गणितम् ॥

(१) त्रिषु विस्तार दैर्घ्यवेधेषु केवलमेकत्र वैषम्यं तत्स्थलीयमुदाहरणम्

साष्टशतव्यासस्य क्षेत्रस्य हि पंचषष्टि सहितशतम् ।
वेधो वृत्तस्य त्वं समखाते किं फलं कथय ।।
इत्यादीनि बहूनि सन्ति ।। ४४ ।।

अत्रोपपत्तिः ।



कखग सूची घनफल साधनार्थं तद्वेध (कज) स्य र संख्यक विभाग करणेन प्रथम खण्डप्रमाणम्$=\frac{वे}{र}$, द्वितीय खण्ड प्रमाणम्$=\frac{२\, वे}{र}$, तृतीय खण्ड प्रमाणम्$=\frac{३\, वे}{र}$ इत्यादि ।

सर्वेषां खण्डितक्षेत्राणां विस्तृतिदैर्घ्ययोः साधनेन जातानि क्षेत्रफलानि प्रथम क्षेत्रफ$=\frac{मुफ}{र}$, द्वितीय क्षेत्रफ$=\frac{४\, मुफ}{र^२}$, एवं सर्वत्र ततः क्षेत्र फलं वेध गुण मित्यादिना $\frac{वे}{र}$ वेधे क्षेत्राणां घनफलानि प्रथमक्षेत्रघनफ$=\frac{मुफ.\, वे}{र^३}$, द्वितीय क्षेत्र-घनफ $=\frac{मुफ.\, वे.\, ४}{र^३}$ एवमग्रेऽपि, सर्वेषां घनफलानां योग करणेन$\frac{वे.\, मुफ}{र^३}(१+४+९+\cdots\cdots र^२)$ द्विघ्नपदं कुयुतमित्यादिना '१+४+९+$\cdots\cdots$र^२'स्य स्वरूपमानीयोत्थापनेन $\frac{मुफ.\, वे}{र^३}\times\frac{(२\, र+१)\,(र+१)\, र}{६}=\frac{मुफ.\, वे}{र^२}\times\frac{२\, र^२+३\, र+१}{६}=$मुफ. वे$\left(\frac{१}{३}+\frac{१}{२\, र}+\frac{१}{६\, र^२}\right)$ अत्र र मानं यथा यथा वर्धते तथा तथा मपग क्षेत्रं हीयते तथैतदानीतं घनफलं वास्तवसूचीघनफलनिकटं भवेत् । रमानस्य परमाधिवच्चेऽनन्त समत्वे तत्फलमपि वास्तवं सूचीघनफलं भवेत् । अनन्त समे र माने $\frac{१}{२\, र}+\frac{१}{६\, इ^२}=०$ ततः सूचीघनफलम् $=\frac{मुफ.\, वे}{३}$ एतेनाचार्योक्त मुपपन्नम् लीलावत्यां 'क्षेत्र फलं वेध गुणं खाते घनहस्तसंख्या स्यात् । समखात फलत्र्यंशः सूची खाते फलं भवति' भास्करोक्तमिदमाचार्योक्तानु-रूपमेवास्तीति ।। ४४ ।।

अब खात व्यवहार प्रारम्भ किया जाता है ।

उसमें पहले खात फलानयन के लिये कहते हैं ।

हि. भा.—क्षेत्रफल को वेध से गुणा करने से समखातफल होता है, उसको तीन से

भाग देने से सूची घन फल होता है अर्थात् जिस खात के मुख में जितने दैर्घ्यादि है उतने तल में रहने से वह समखात कह लाता है उसके घन फल को तीन से भाग देने से सूच्य कार खात का घनफल होता है ।।

यहाँ चतुर्वेदाचार्योक्त उदाहरण है ।

किसी वापी (वावली) की दीर्घता (लम्बाई) तीस हाथ है, विस्तार आठ हाथ उस वापी के भीतर चार, पांच छः सात, आठ भुज खण्डो से पाँच खात (खत्ता) है, खातों के क्रम से वेध ६, ७,७,३,२, है तब उन खातों के समरज्जु प्रमाण कहो ।

यहाँ विज्ञान भाष्य में लिखित (१) चित्र को देखिये । यहाँ मुखतल भुजैक्य से ३६ । ३५ । ४२ । २१ । १६ । है इन सबों के योग को एकाग्र ३० से भाग देने $\frac{१५०}{३०}$=५=समरज्जु, क्षेत्रफल=विस्तार×दैर्घ्य=८×३०=२४० इस क्षेत्रफल समरज्जु से गुणा करने से सम्पूर्ण खात का घनफल १२०० हुआ ।।

विस्तार दैर्घ्य वेधों (तीनों) में केवल एक में वैषम्य रहने पर त्रिशतिका में धराचार्य का उदाहरण । किसी पुष्करिणी की लम्बाई १६ हाथ है, विस्तार=५ हाथ वेध, २, ३, ४ हाथ है तब उसका फल क्या होगा । न्यास २।३।४ वेध, वेधों की सममि $=\frac{२+३+४}{३}=\frac{९}{३}=३$, यहाँ स्थान संख्या=३ है, विस्तार×दैर्घ्य=५×१६=८ =क्षेत्रफल, इसको वेध से गुणा करने से ८०×३=२४०=खातफल ।

दूसरा उदाहरण

जिस खात का दैर्घ्य=१२ हाथ है, वेध=८ हाथ है, विस्तार ३ । ४ । ५ हाथ उस खात का फल कहो । विस्तृति सममिति$=\frac{३+४+५}{३}=\frac{१२}{३}=४$ । विस्तार×दै =४×१२=४८ इसको बेध से गुणा करने से ४८×८=३८४=खात फल हुआ ।।

विस्तार दैर्घ्य वेध इन तीनों में वैषम्य रहने पर भास्करोक्त उदाहरण है ।

जिस खात की विस्तृति=६ । ५ ।७ हाथ है, दैर्घ्य=१० । ११ । १२ हाथ वेध=२ ।४। ३ हाथ है, उस खात के घनहस्तमान क्या होगा । यहां स्थान संख्या=३ विस्तृतियोग=६+५+७=१८ इसको स्थान संख्या से भाग देने से $\frac{१८}{३}$=६=विस्त सममिति, दैर्घ्ययोग=१०+११+१२=३३ इसको स्थान संख्या से भाग देने से $\frac{३३}{३}$=१ =दैर्घ्य सममिति, वेधयोग=२+४+३=९ स्थान संख्या से भाग देने से $\frac{९}{३}$= बेधसममिति ।

विस्तार × दैर्घ्य = ६ × ११ = ६६ = क्षेत्रफल, इसको वेध से गुणा करने से ६६ × ३ = १९८ = खात की घन हस्त संख्या खात व्यवहार में गणित सार संग्रह में महावीराचार्य ने बहुत विस्तार के साथ कहा है इति ॥४४॥

उपपत्ति ।

संस्कृतोपपत्ति में लिखित (१) क्षेत्र को देखिये। कखग सूची घनफल साधन के लिये उसके वेध (कज) को र संख्यक विभाग करने से प्रथम खण्ड का मान $= \frac{वे}{र}$, द्वितीय खण्डमान $= \frac{२ वे}{र}$, इत्यादि सब खण्डित क्षेत्रों के विस्तार और दैर्घ्य साधन कर क्रम से क्षेत्रफल होते हैं।

प्रथम क्षेत्र फ $= \frac{मुफ}{र}$, द्वितीय क्षेत्र फ $= \frac{४ मुफ}{र}$ इसी तरह आगे भी, तब 'क्षेत्रफलं वेध गुणं' इससे $\frac{वे}{र}$ वेध में क्षेत्रों के घनफल होते हैं, प्रथम क्षेत्र घनफ $= \frac{मुफ. वे}{र^२}$, द्वितीय क्षेत्र घफ $= \frac{मुफ. वे. ४}{र^२}$ इसी तरह आगे भी, सब घनफलो का योग करने से $\frac{वे. मुफ}{र^२}(१+४+९+\cdots र^२)$' 'द्विघ्नपदं कुयुतं त्रिविभक्त' इत्यादि से $१+४+९+\cdots र^२$ इसका स्वरूप लेकर उत्थापन देने से $\frac{मुफ. वे}{र^२} \times \frac{(२र+१)(र+१)र}{६} = \frac{मुफ. वे}{र^२} \times \frac{२र^२+३र+१}{६} = मुफ.वे\left(\frac{१}{३}+\frac{१}{२र}+\frac{१}{६र^२}\right)$ यहां र का मान ज्यों-ज्यों बढ़ेगा त्यों-त्यों मपग क्षेत्र छोटा होता जायगा, और आनीत घनफल वास्तव सूचीघनफल के आसन्न होगा, र मान आदि परमाधिक अर्थात् अनन्त के बराबर होगा तब वह फल भी वास्तव सूची घनफल ही होगा।

र मान के अनन्त रहने से $\frac{१}{२र} + \frac{१}{६र^२} = ०$, इसलिये सूची घनफल $= \frac{मुफ. वे}{३}$ इससे आचार्योक्त उपपन्न हुआ। लीलावती में 'क्षेत्रफल वेधगुणं' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से भास्कराचार्य ने आचार्योक्त के अनुरूप ही कहा है ॥ ४४ ॥

खातान्तरे करणसूत्रे आह।

मुखतलयुतिदलगणितं वेधगुणं व्यावहारिकं गणितम्।
मुखतलगणितैक्यार्धं वेधगुणं स्याद् गणितमौत्रम् ॥४५॥

औत्रगणिताद्विशोध्य व्यवहारफलं भजेत् त्रिभिः शेषम् ।
लब्धं व्यवहारफले प्रक्षिप्य भवति फलं सूक्ष्मम् ॥४६॥

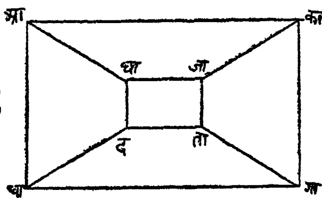
सु. भा.—यस्मिन्खाते मुखबाहवोऽन्यादृशास्तल बाहवश्चान्यादृशास्तत्र मुखतलबाह्वोर्युतिदलं ग्राह्यमेवमन्यस्यां दिशि ततस्तयोर्दलयोर्घातो गणितं क्षेत्रफलं वेधहतं व्यावहारिकं खातफलं भवति। अथ मुखभुजतः फलं तलभुजतोऽपि यत् फलं तयोरैक्यार्धं वेधगुणमौत्रसंज्ञं खातफलं भवति।

व्यवहार फलमौत्रगणितादौत्रफलाद्विशोध्यशेषं त्रिभिर्भजेल्लब्धं व्यवहारफले प्रक्षिप्य संयोज्य सूक्ष्मं खातफलं भवति।

अत्र चतुर्वेदोक्तोद्देशकः—

चतुरस्रा समा वापी दशहस्ता मुखे तु या।
तले षड्ढस्तिका सैव त्रिंशद्वेधा विनिर्मिता॥
व्यवहारौत्रसूक्ष्माणि तत्र ब्रूहि फलानि मे।
अत्र मुखबाहुः १०। तलबाहुः ६। अनयोर्युतिदलं ८।

अन्यस्यां दिश्यप्येवम् ८। आभ्यां गणितं ६४। वेधहतं व्यवहारफलं = १९२०।



अत्र वाप्यां यदि आघा = अ, धादा = क, गाघा = ग, दाता = घ,। वे = वेधः। तदाऽऽचार्यप्रकारेण व्यवहारफलम् = $\frac{अ+क}{२}\frac{ग\times घ}{२}$. वे,

औत्रफलम् = $\frac{अ.ग+क.घ}{२}$ · वे सूक्ष्मफलम् = व्यफ + $\frac{औफ - व्यफ}{३}$

$$= \frac{वे}{२}\left\{\frac{(अ+क)\,(ग+घ)}{२} + \frac{२(अ.ग+क.घ)-(अ+क)\,(ग+घ)}{२\times३}\right\}$$

$$= \frac{वे}{६}\left\{(अ+क)\,(ग+घ)+अ.ग+क.घ\right\}$$

एवं 'मुखजतलज तद्युतिजक्षेत्रफलैक्यं हृतं षड्भिः'—इत्यादि भास्करोक्तमेवाचार्यप्रकारेण घनफलं सूक्ष्ममेव भवति। भास्करप्रकारोपपत्त्यर्थं मच्छोधिता तल्लीलावती द्रष्टव्या ॥४५-४६॥

वि. भा.—यस्मिन् खाते मुखबाहवोऽन्यादृशास्तलबाहवश्चान्यादृशास्तत्र मुखतलबाह्वोर्युतिदलं ग्राह्यमेवमन्यस्यां दिशि ततस्तयोर्दलयोर्घातो गणितं क्षेत्रफलं वेधहतं व्यावहारिकं खातफलं भवति। अथ मुखभुजतः फलं तलभुजतोऽपि

यत्फलं तयोरैक्यार्धं वेधगुणमौत्र संज्ञं खातफलं भवति । व्यवहारफलमौत्रगणितादौत्रफलाद्विशोध्य शेषं त्रिभिर्भजेल्लब्धं व्यवहारफले प्रक्षिप्य संयोज्य सूक्ष्मं खातफलं भवति ॥

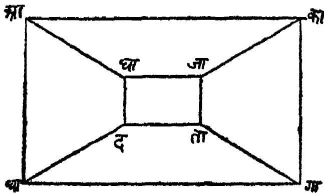
अत्र चतुर्वेदोक्तमुदाहरणम् ।

चतुरस्रा समावापी दशहस्ता मुखे तु या ।
तले षड्ढस्तिका सैव त्रिंशद्वेधा विनिर्मिता ।
व्यवहारौत्र सूक्ष्माणि तत्रब्रूहि फलानि मे ।

अत्र मुखबाहुः=१०, तलबाहुः=६ । अनयोर्युतिदलम्=८ । अन्यस्यां दिश्यप्येवम् ८। आभ्यां गणितम्=६४ वेधहतं व्यवहारफलम्=१९२० ।

मुखफलम्+१००, तलफलम्=३६ अनयोर्योगार्धम्=६८ वेधहतमौत्रफलम्=२०४०, औफ—व्यफ=१२० । त्रिभिर्हृतं लब्धं=४० इदं व्यवहार फले प्रक्षिप्य जातं सूक्ष्मं वापीघनफलम्=१९६० ।

अत्रोपपत्तिः



अत्र वाप्यां यदि आघा=अ, घादा=क, गाघा=ग, दाता=घ, वेधः=वे, तदाऽऽचार्य प्रकारेण व्यवहारफलम्=

$\frac{अ+क}{२} \times \frac{ग+घ}{२} \times$ वे औत्रफलम्

$= \frac{अ.ग+क.घ}{२} \times$ वे सूक्ष्मफलम्=व्यफ

$+ \frac{औफ—व्यफ}{३} = \frac{वे}{२} \left\{ \frac{(अ+क)\ (ग+घ)}{२} + \frac{२(अ.ग+क.घ)—(अ+क)\ (ग+घ)}{२\times३} \right\} = \frac{वे}{६}$ {(अ+क) (ग+घ)+अ.ग+क. घ} एतेन भास्करोक्तमुपपन्नम् ।

अथ लीलावत्यां भास्करप्रकारः

मुखज तलज तद्युतिज क्षेत्र फलैक्यं हृतं षड्भिः ।
क्षेत्रफलं सममेवं वेधहतं घनफलं स्पष्टम् ॥

तदुदाहरणं च ।

मुखे दश द्वादश हस्ततुल्यं विस्तार दैर्घ्यं तु तले तदर्धम् ।
यस्याः सखे सप्तकरश्च वेधः का खात संख्या वद तत्र वाप्याम् ॥

न्यासः मुखे विस्तृति दैर्घ्ये १० । १२ हस्तात्मके, तले विस्तृतिदैर्घ्ये ५ । ६ हस्तात्मके, वेधः=७ मुखजं क्षेत्रफलम्=१२० । तलजं क्षेत्रफलम्=३०, युतिजं क्षेत्रफलं=२७० एषामैक्यम्=४२० षड्भिर्भक्तं जातं समफलम्=७०, वेधेन गुणितं जातं घनफलं हस्ताः=४९० ।

अत्रोपपत्तिः ।

यस्मिन् खाते मुखविस्तृतिदैर्घ्यमानाभ्यां तलविस्तृतिदैर्घ्यमानेऽधिके तत्र तलदैर्घ्यविस्तृतिभ्यां स्वस्वसंमुखधरातलद्वयस्य समानान्तरधरातलेनैका चतुर्भुजाधारा सूची जायते । तत्पार्श्वद्वये त्रिभुजरूपे खातक्षेत्रे, तलचतुर्भुजाधारे समखातक्षेत्रं चेति चत्वारि क्षेत्राणि जायन्ते, सर्वेषां क्षेत्राणां घनफलानां योगकरणेन खातस्य वास्तवं घनफलं भवति ।

मुखविस्तारः=अ । तलविस्तारः=क । मुखदैर्घ्यम्=ग । तलदैर्घ्यम्=घ । वेधः=वे, तदा चतुर्भुजाधार सूची घनफलम् $= \frac{(\text{अ} - \text{क})\ (\text{ग} - \text{घ})}{३} \times$ वे; त्रिभुजरूपखातक्षेत्रयोर्घनफले $\frac{(\text{अ} - \text{क}).\ \text{घ}.\ \text{वे}}{२}$, $\frac{(\text{ग} - \text{घ})\ \text{क}.\ \text{वे}}{२}$ । तलक्षेत्राधारसमखातफलम् = क. घ. वे, सर्वेषां योगकरणेन वास्तवं खातघनफलम्

$$= \frac{(\text{अ} - \text{क})\ (\text{ग} - \text{घ}).\ \text{वे}}{३} + \frac{(\text{अ} - \text{क}).\ \text{घ}.\ \text{वे}}{२} + \frac{(\text{ग} - \text{घ}).\text{क}.\text{वे}}{२} + \text{क}.\ \text{घ}.\ \text{वे}$$

$$= \frac{\text{वे}}{६}\{२\ (\text{अ} - \text{क})\ (\text{ग} - \text{घ}) + ३\ (\text{अ} - \text{क}) + ३\ (\text{ग} - \text{घ}) + ६\ \text{क}.\ \text{घ}\}$$

$$= \frac{\text{वे}}{६}(२\ \text{अ}.\ \text{ग} + २\ \text{क}.\ \text{घ} + \text{क}.\ \text{ग} + \text{अ}.\ \text{घ})$$

$$= \frac{\text{वे}}{६}(\text{मुखक्षेफ} + \text{तलक्षेत्रफल} + \text{अ}.\ \text{ग} + \text{क}.\ \text{घ} + \text{क}.\ \text{ग} + \text{अ}.\ \text{घ})$$

$$= \frac{\text{वे}}{६}\{\text{मुखक्षफ} + \text{तलक्षत्रफ} + \text{ग}\ (\text{अ} + \text{क}) + \text{घ}\ (\text{अ} + \text{क})\}$$

$$= \frac{\text{वे}}{६}\{\text{मुखक्षेफ} + \text{तलक्षेत्रफ} + (\text{अ} + \text{क})\ (\text{ग} + \text{घ})\}$$

$= \frac{१}{६}$ (मुखक्षेत्रफ+तलक्षेत्रफ+युतिजक्षेत्रफ) एतावता भास्करोक्तमुपपद्यते।

अत्राऽऽचार्यापेक्षया भास्करोक्तं स्पष्ट मस्ति, आचार्योक्तौ स्फुटता नास्ति। सिद्धान्तशेखरे "खातस्य तद्योग भुवां स्फुटानां क्षेत्रोद्भवानां च युतिः फलम्। षड्‌धृता वेधसमाहता स्याद्घनाभि धानं गणितं सुसूक्ष्मम्" श्रीपत्युक्तमिदमेव भास्करोक्तस्य बीजमिति ॥४५-४६॥

इति खात व्यवहारः समाप्तः

अब खातान्तर के लिये कहते हैं ।

हि. भा.—जिस खात में मुखबाहु सब भिन्न तरह के है तथा तलबाहु सब भी भिन्न तरह के हैं वहां मुखबाहु और तलबाहु का योगार्ध करना, दूसरी तरफ भी इसी तरह करना, तब दोनो योगार्ध का घात करने से क्षेत्रफल होता है, उसको वेध से गुणा करने से व्यावहारिक खातफल होता है। मुखभुज से जो फल होता है और तलभुज से भी जो फल हो उन दोनों के योगार्ध को वेध से गुणा करने से औत्र सञ्ज्ञक खातफल होता है। औत्रफल में से व्यवहारफल को घटाकर तीन से भाग देने से जो लब्धि हो उसको व्यवहार फल में जोड़ने से सूक्ष्म वापी घनफल होता है ॥४५-४६॥

चतुर्वेदोक्त उदाहरण ।

चतुर्भुजाकार समान वापी (वावली) के मुखबाहु १० हाथ है, तलबाहु ६ है, और वेध=३० तब उस वापी में व्यवहारफल, औत्रफल और सूक्ष्म खातफल कहो ।
सूत्रोक्ति के अनुसार गणित करते हैं। यहां मुखबाहु=१०, तलबाहु=६ । दोनों का योगार्ध $= \frac{१६}{२} = ८$ । दूसरी तरफ भी ८ इनदोनों का घात करनेसे $८ \times ८ = ६४$ = क्षेत्रफल ।

इसको वेध से गुणा करने से १९२० = व्यवहार फल हुआ। मुखफल = १००, तलफल = ३६, दोनों का योगार्ध $= \frac{१०० + ३६}{२} = \frac{१३६}{२} = ६८$, इसको वेध से गुणा करने से २०४ = औत्रफल हुआ। औत्रफ—व्यवहारफ = १२० इसको तीन से भाग देने से लब्धि = ४० इसको व्यवहार फल में जोड़ने से १९६० = सूक्ष्मवापी घनफल हुआ इति ।

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित (१) क्षेत्र को देखिये। इस वापी में आघा=अ, घाता=क, गाघा=ग, दाता=घ, वेध=वे, तब आचार्य प्रकार से व्यवहार फल $= \frac{अ + क}{२} \times \frac{ग + घ}{२}$, वे औत्रफल $= \frac{अ. ग + क. घ}{२} \times$ वे, सूक्ष्मफल = व्यफ + $\frac{औफ - व्यफ}{२}$ सूक्ष्मफल = व्यफ + $\frac{औफ - व्यफ}{२} = \frac{वे}{३} \left\{ \frac{(अ + क)(ग + घ)}{२} \right.$ $\left. + \frac{२ (अ. ग + क. घ) - (अ + क)(ग + घ)}{२ \times ३} \right\} = \frac{वे}{६} \{(अ + क)(ग + घ) +$ अ. ग + क. घ} इससे भास्करोक्त प्रकार उपपन्न हुआ ।

लीलावती में

'मुखज तलज तद्युतिज क्षेत्र फलैक्य' इत्यादि संस्कृतोपपत्ति में लिखित भास्करोक्त पद्य है ।

उनके उदाहरण भी हैं।

मुख में विस्तार=१० हाथ, दैर्घ्य=१२हाथ। तल मे उसका आधा अर्थात् विस्तार =५ हाथ, दैर्घ्य=६ हाथ, वेध=७ हाथ, मुखज क्षेत्रफल=१२०, तलज क्षेत्रफल=३०, युतिजक्षेत्रफल=२७०, इन सवों का योग=४२०, इसको छः से भाग देने से समफल=७० इसको वेध से गुणा करने से घनफल ४९० हुआ।

भास्करोक्त प्रकार की उपपत्ति।

जिस खात में मुख का विस्तार और दैर्घ्य से तल का विस्तार और दैर्घ्य अधिक है वहां तल के दैर्घ्य और विस्तार से अपने अपने संमुख धरातल द्वय के समानान्तर धरातल करने से एक चतुर्भुजाधार सूची होती है, उसके दोनों बगल में त्रिभुजरूप दो खातक्षेत्र होते हैं। तलचतुर्भुजाधार में सम खात क्षेत्र होता है, ये चार क्षेत्र बनते है। इन सब क्षेत्रों के घनफलों का योग करने से वास्तवखात घनफल होता है।

कल्पना करते हैं मुखविस्तार=अ, तलविस्तार=क, मुखदैर्घ्य=ग, तलदैर्घ्य=घ वेध=वे, तव चतुर्भुजाधार सूची घनफल $=\frac{(अ-क)\ (ग-घ)}{३}\times$वे, त्रिभुजरूप दोनों खातक्षेत्रों का घनफल $\frac{(अ-क).\ घ.\ वे}{२}$, $\frac{(ग-घ)\ क\cdot वे.}{२}$, तलक्षेत्राधार समखातफल =क. घ. वे इन सब फलों का योग करने से वास्तवखातघनफल =

$$\frac{(अ-क)\ (ग-घ).\ वे}{३}+\frac{(अ-क).\ घ.\ वे}{२}+\frac{(ग-घ).\ क.\ वे}{२}+क.\ घ.\ वे$$

$$=\frac{वे}{६}\{२\ (अ-क)\ (ग-घ)+३\ (अ-क)+३\ (ग-घ)+६\ क.\ घ\}$$

$$=\frac{वे}{६}(२\ अ.ग+२\ क.घ+क.ग+अ.घ)$$

$$=\frac{वे}{६}(मुखक्षेफ+तलक्षेफ+अ.ग+क.घ+क.ग+अ.घ)$$

$$=\frac{वे}{६}\{मुखक्षेत्रफ+तलक्षेफ+ग\ (अ+क)+घ\ (अ+क)\}$$

$$=\frac{वे}{६}\{मुखक्षेत्रफ+तलक्षेफ+(अ+क)\ (ग+घ)\}$$

$$=\frac{वे}{६}(मुखक्षेत्रफ+तलक्षेत्रफ+युतिजक्षेत्रफ)$$ इससे भास्करोक्त उपपन्न हुआ।

सिद्धान्त शेखर में 'खातस्य तद्योगभुवां स्फुटानां' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति भास्करोक्त के अनुसार ही कहा है लेकिन भास्कराचार्य ने श्रीपत्युक्त ही का अनुकरण किया है इति ।।४५-४६।।

खात व्यवहार समाप्त हुआ।

अथ चितिव्यवहारः प्रारभ्यते ।
तत्रादौ चितौकरणसूत्रम् ।

आकृतिफलमौच्याहतमग्रतलैक्यार्धमौच्य दैर्घ्यं गुणम् ।
घनगणितमिष्टकाघनफलेन हृतमिष्टकागणितम् ।।४७।।

सु. भा.—अग्रे तले च यत् पृथुत्वं तदैक्यार्धमौच्च्याहतमाकृतिफलं भवेत् पुनस्तदौच्च्यदैर्घ्याहतमौच्च्यसम्बन्धि यद्दैर्घ्यं तेन गुणं चितिघनफलं घनगणिताख्यं भवेत् । तदिष्टकाघनफलेन हृतमिष्टकागणितमिष्टकाप्रमाणं भवति । 'उच्छ्रयेण गुणितं चितेः किल'—इत्यादि भास्करोक्तमेतदनुरूपमेव ।

अत्रोपपत्तिः ।

अग्रतल पृथुत्वैक्यार्ध मध्यममानेन चितेः पृथुत्वं प्रकल्प्य चितेर्घनफलं साधितं तदिष्टकाघनफलहृतमिष्टका परिमितिर्भवतीति सुगमा वासना ।।४७।।

अत्र चतुर्वेदोक्तोद्देशक :—

शतहस्ता तु दैर्घ्येण मूले पञ्चत्रयोमुखे ।
पृथुत्वेनोच्छ्रितिः सप्तचितेरस्याः फलं वद ।।
उक्तवच्चितेर्घनफलम्=२८०० ।
इति चितिव्यवहारः

वि. भा.—अग्रतलैक्यार्धं (चितेरग्रेतले च या पृथुता तद्योगार्धं) औच्य गुणितं तदाऽकृति फलं भवेत् । तदौच्यसम्बन्धि दैर्घ्येण गुणितं तदा चितेर्घन फलं (घनगणितं) भवेत् । तदिष्टकाघनफलेन भक्तं तदेष्टकानां संख्या स्यात् । इष्टकानां चयनं चितिः । भास्कराचार्यलीलावत्यां श्रीधराचार्य त्रिशतिकायां महावीराचार्यगणितसारसंग्रहे चितिव्यवहार एकरूप एवास्ति, सिद्धान्तशेखरे ऽपि "चितेर्घनाख्यं फलमिष्टकायाः फलेन भक्तं फलमिष्टकानाम् । संख्येष्टकानामुदयेन भक्ताः स्तरा भवन्त्युच्छ्रितयश्चितेश्च" श्रीपत्युक्तमिदं चितिव्यवहार स्वरूपं तादृशमेवास्ति, ।।४७।।

चतुर्वेदोक्तमुदाहरणम् ।

शतहस्ता तु दैर्घ्येण मूले पंच त्रयो मुखे ।
पृथुत्वेनोच्छ्रितिः सप्त चितेरस्याः फलं वद ।।

न्यासः तले ५ हस्ताः । मुखे ३ हस्ताः । दैर्घ्यम्=१००, सस्ताः वेधः=७ हस्ता, अस्याश्चितेर्घन फलमानीयते मुखतलयोर्योगार्धं $\frac{५+३}{२}=\frac{८}{२}=४$,

दैर्घ्यं गुणितम् ४००, वेध गुणितम् ४००×७=२८००=चितेर्घनफलम् ॥

लीलावत्यां भास्करोक्तमुदाहरणम् ।

अष्टादशाङ्गुलं दैर्घ्यं विस्तारो द्वादशाङ्गुलः ।
उच्छ्रिति स्त्र्यङ्गुला यासामिष्टकास्ताश्चितौ किल ॥

यद्विस्तृतिः पंचकराष्टहस्तं दैर्घ्यं च यस्यां त्रिकरोच्छ्रितिश्च ।
तस्यां चितौ कि फलमिष्टकानां संख्या च का ब्रूहि कति स्तराश्च ।

न्यासः इष्टकाया दैर्घ्यमङ्गुलात्मकम् =१८, हस्तात्मकम् $=\frac{१८}{२४}=\frac{३}{४}$, विस्तारोऽङ्गुलात्मकः =१२, हस्तात्मकः $=\frac{१२}{२४}=\frac{१}{२}$, वेधोङ्गुलात्मकः = ३, हस्तात्मकः $=\frac{३}{२४}=\frac{१}{८}$, इष्टकायाः क्षेत्रफलम् $=\frac{३}{४}\times\frac{१}{२}=\frac{३}{८}$ क्षेत्रफलं वेधगुणं $=\frac{३}{८}\times\frac{१}{८}=\frac{३}{६४}$=इष्टकाया घनहस्तमानम् । चितेः क्षेत्रफलम् =५×८=४०, वेधेन गुणितं ४० × ३ = १२० = चितेर्घनफलम् । चितेर्घनफलमिष्टकाघनफलेन भक्तं $\frac{१२०}{\frac{३}{६४}}=\frac{१२०\times ६४}{३}$ =४०×६४=२५६०=इष्टकासंख्या । स्तरसंख्या=२४ ।

अन्यस्याप्युदाहरणम् ।

चतुस्रायतवेदी चितेष्टकाभिः षड़ङ्गुलोन्नतिभिः ।
हस्तार्धविस्तराभिः करदैर्घ्याभिर्भवेत्तस्याः ॥
विस्तारे हस्तत्रयमायामे षट् समुच्छ्रये त्वर्धम् ।
किं घनगणितं विद्वन् प्रकथय का चेष्टका संख्या ॥

चतुर्विंशत्यङ्गुलदीर्घाणां द्वादशाङ्गुल विस्ताराणां षडङ्गुलोच्छ्रयाणामिष्टकानां षड्हस्तदीर्घायां हस्तत्रयविस्तारायां, अर्धहस्तोच्छ्रितायां चितौ—पूर्ववत्क्रिया करणेन वेदी घनहस्ताः=९, इष्टकानां घनफलम् $=\frac{१}{८}$, इष्टका संख्या =७२ । एव त्रिभुजवृत्तादिचयनेष्वपि घनफलमिष्टकाश्च साधयेदिति ॥४७॥

अत्रोपपत्तिः ।

अग्रे तले च यत्पृथुत्वं तद्योगार्ध मध्यममानेन चितेः पृथुत्वं भवति तद्वशतश्चितेर्घनफलं साध्यं । तथेष्टकायाश्च घनफलं साध्यं ततोऽनुपातो यद्येष्टका घनफले नैकेष्टका लभ्यते तदा चितेर्घनफलेन किं समागच्छन्तीष्टका संख्याः, इति ॥४७॥

इति चिति व्यवहारः

अब चिति व्यवहार प्रारम्भ किया जाता है। पहले चिति (भाठा) के लिये कहते हैं।

हि. भा.—चिति (भाठा) के अग्र में और तल में जो पृथुत्व (मोटाई) है उन दोनों के योगार्ध को औच्य (ऊंचाई) वेध से गुणा करने से आकृतिफल होता है, फिर उसको औच्य सम्बन्धी दीर्घता से गुणा करने से चिति का घनफल होता है। इस चिति घनफल को इष्टका के घनफल से भाग देने से इष्ट का प्रमाण होता है। आचार्योक्त चिति व्यवहार के सदृश ही "लीलावती में भास्करोक्त त्रिशतिका में श्रीधराचार्योक्त गणित सार संग्रह में महावीराचार्योक्त सिद्धान्तशेखर में श्रीपत्युक्त चिति व्यवहार है ॥ ४७ ॥

यहां चतुर्वेदाचार्योक्त उदाहरण है।

किसी चिति के तल में ५ हाथ है, मुख में तीन ३ हाथ है, सो १०० हाथ लम्बाई है, सात हाथ वेध है तब उस चिति का घनफल क्या होगा ?

न्यास तल में ५ हाथ, मुख में ३ हाथ, १०० हाथ=लम्बाई=दैर्घ्य, ७ हाथ=वेध आचार्योक्त सूत्र के अनुसार मुख और तल के योगार्ध $\frac{५+३}{२}=\frac{८}{२}=४$ इसको दैर्घ्य से गुणा करने से ४×१००=४००, इसको वेध से गुणा करने से ४००×७=२८००= चिति का घनफल।

लीलावती में भास्करोक्त उदाहरण स्पष्ट है।

इष्टका का दैर्घ्य १८ अंगुल है, विस्तार १२ अंगुल, वेध ३ अङ्गुल, इसका घनफल क्या होगा ? चिति का विस्तार ५ हाथ है, दैर्घ्य ८ हाथ है, ऊंचाई (वेध) तीन ३ हाथ है, इस चिति का घनफल क्या होगा ?

न्यास इष्टका का अंगुलात्मक दैर्घ्य=१८, हस्तात्मक दै० $=\frac{१८}{२४}=\frac{३}{४}$, अंगुलात्मक विस्तार=१२ हस्तात्मक वि० $=\frac{१२}{२४}=\frac{१}{२}$, अंगुलात्मकवेध=३, हस्तात्मकवे० $=\frac{३}{२४}=\frac{१}{८}$,। इष्ट का क्षेत्रफल $=\frac{३}{४}\times\frac{१}{२}=\frac{३}{८}$ इसको वेधसे गुणा करने से $\frac{३}{८}\times\frac{१}{८}=\frac{३}{६४}$=इष्टका घन फल, चितिका क्षेत्रफल=५×८=४० इसको वेधसे गुणा करनेसे ४०×३=१२०चितिका घनफल, चिति के घन फल को इष्टका के घनफल से भाग ःने से $\frac{१२०}{\frac{३}{६४}}=\frac{१२०\times६४}{३}$ =४०×६४=२५६०=इष्टका संख्या, स्तर संख्या=२४॥

यहां दूसरे का भी उदाहरण है।

इष्टका का दैर्घ्य चौबीस अंगुल है, विस्तार बारह अंगुल है, उच्छ्राय (वेध) छः अंगुल

है चिति का दैर्घ्य छः हाथ है, तीन हाथ विस्तार है, आधा हाथ वेध है, तब इष्टका का घनफल, इष्टका संख्या, वेदी घन हस्तमान क्या होगा ?

पूर्ववत् क्रिया करने से वेदी घन हस्तमान = ९, इष्टका घनफल = $\frac{१}{८}$, इष्टका संख्या = ७२॥

उपपत्ति

चिति के अग्र में और तल मे जो पृथुत्व है, उनका योगार्ध मध्यममान (मोटा मोटी) से चिति का पृथुत्व होता है, इसके वशसे चिति का घनफल तथा इष्टका का घनफल साधन करके अनुपात करते हैं यदि इष्टका घनफल में एक इष्टका पाते है। तो चिति के घनफल में क्या इससे इष्टका की सख्या आजायगी इति ॥४७॥

चिति व्यवहार समाप्त हुआ

अथ क्राकचिक व्यवहारे करणसूत्रे ।

विस्तारायामाङ्गुलघातो मार्गाहतो द्विवेदहृतः ।
किष्क्वङ्गुलानि लब्धं तत् षण्णवतिर्भवति कर्म ॥ ४८ ॥

शाकादिषु शाल्मल्यां शतद्वयं बीजके शतं विंशम् ।
शालसरलादिषु शतमथाविदारुषु चतुः षष्टिः ॥ ४९ ॥

सु. भा.—विस्तारः काष्ठस्य घनत्वमर्थात् पिण्ड उच्यते । आयामो दैर्घ्यं तेनायमर्थः । काष्ठविस्तारायामयोर्वध एकपट्टस्यांगुलात्मकं फलं तन्मार्गाहतं दारुदारणपथैराहतं सकलपट्टफलं तद् द्विवेद ४२ हृतं फलं किष्क्वङ्गुलानि भवन्ति । 'किष्कुर्हस्ते वितस्तौ च'—इति अ. को. नानार्थवर्गः । अग्रमूलयोः पिण्ड-साम्यं कल्प्यते तदा 'पिण्डयोगदलमग्रमूलयोः'—इत्यादि भास्करोक्तमेतदनुरूपमेव । भास्करेण वर्गाङ्गुल फले हस्तवर्गाङ्गुलैः षट्स्वरेषु ५७६ भिर्भक्ते करात्मकं फलं प्रकल्पतमिहाचार्येण काष्ठमृदुत्वकठिनत्ववशेन भिन्नं भिन्नं करात्मकं फलं साध्यते । तत्र शाकादिषु हस्तवर्गाङ्गुलानि = ४२ × ९६ । शाल्मल्यां = ४२ × २०० । बीजके = ४२ × १२० । शालसरलादिषु = ४२ × १०० । अविदारुषु खदिरादिषु च = ४२ × ६४ कल्पितानि । तत्राङ्गुलात्मकं फलं सर्वत्र द्विवेदैर्विभज्य फलं किष्क्व-ङ्गुलानि जातानि तानि काष्ठविशेषे स्वस्वहारेण विभज्य कर्मार्थात् कर्मकाराणां सम्बन्धि हस्तकर्म भवति तत एकस्य हस्तकर्मणो यन्मूल्यं तेन गुण्यं सर्वहस्तकर्म भवतीति सर्वं त्रैराशिकेन स्फुटम् ।

अत्र चतुर्वेदोक्तोदेशकः—

'दशहस्तास्तु दैर्घ्येण विस्तारेण षडङ्गुलम् मार्गश्च सप्तभिर्जीर्णं बीजवृक्षस्य काष्ठकम् । पणैर्यत्राष्टभिः कर्म तत्र मूल्यं निगद्यताम् ।

न्यासः । पतिताङ्ग विस्ताराङ्गुलानि ६ । आयामाङ्गुलानि २४० । अनयोर्घातः १४४० मार्गाहतः १००८० द्विवेदैरेतै ४२ हृतः २४० । एतानि किष्कुवङ्गुलानि बीजवृक्षत्वाद्विशत्यधिकशतेन भागे हृते लब्धं कर्म सङ्ख्येयम् २। कर्ममूल्येनानेन ८ गुणिता पणसङ्ख्या जाता १६ । एतावन्तः पणाः शिल्पिने देया। इति ॥४८-४९॥

वि. भा.—काष्ठादिविदारणोपयुक्तस्य शस्त्रस्य नाम क्रकचस्तत्सम्बन्धी व्यवहारः क्राकचिकव्यवहारः कथ्यते । विस्तारायामांगुलघातः (विस्तृति दैर्घ्याङ्गुलघातः) मार्गाहतः (काष्ठस्यैकरूपेण यन्मितस्थानेषु स्फाटनमभीष्टं तत्संख्याभिर्गुणितः) द्विवेदै ४२ र्भक्तस्तदा किष्ववङ्गुलानि भवन्ति, तत्र शाकादिषु हस्तवर्गाङ्गुलानि=४२×९६, शाल्मल्याम्=४२×२००, बीजके =४२×१२०, शालसरलादिषु=४२×१००, अविदारुषु खदिरादिषु च=४२×६४ कल्पितानि, तत्राङ्गुलात्मकं फलं सर्वत्र द्विवेदैर्विभज्य तदा किष्ववङ्गुलानि भवन्ति तानि काष्ठविशेषे स्वस्वहरेण विभज्य कर्मकारसम्बन्धि हस्तकर्म भवति, तत्रैकस्य यन्मूल्यं तेन कर्मणो गुणनीयं तदा सर्वहस्तकर्म भवतीति ॥ ४८-४९ ॥

अत्र चतुर्वेदाचार्योक्तमुदाहरणम् ।

दश हस्तास्तु दैर्घ्येण विस्तारेण षडङ्गुलम् ।
मार्गश्च सप्तभिर्जीर्णं बीजवृक्षस्य काष्ठकम् ॥
पणैर्यत्राष्टभिः कर्म तत्र मूल्यं निगद्यताम् ।

न्यासः पतितांग विस्तारांगुलानि=६ । दैर्घ्यांगुलानि=२४०, अनयोर्घातः =२४०×६=१४४० मार्गगुणितः १४४०,×७=१००८०, द्विवेदै ४२ र्भक्तः फलम् =२४० एतानि किष्ववङ्गुलानि, बीजवृक्षत्व-द्विशत्यधिकशतेन भक्ते जाता कर्मसंख्या=२ । कर्ममूल्येनानेन ८ गुणिता जाता पणसंख्या=१६ । एतावन्तः पणाः शिल्पिने देयाः । सिद्धान्तशेखरे 'आयामपिण्डाङ्गुलघातराशौ काष्ठस्य मार्गैर्गुणिते विभक्ते । द्वितांडितद्वादशवर्गमित्या छेदे खलूर्ध्वे गणितं कराः स्युः ॥ यदङ्गुलैः क्षेत्रफलं हि दारोः प्रजायते तद्गुणयेच्च मार्गैः । करात्मकं स्याद् गणितं हि तिर्यक् छेदे चतुर्विंशतिवर्गभक्ते' श्रीपतेरयं क्राकचिक व्यवहारः । त्रिशतिकायां श्रीधराचार्यस्य गणितसारसंग्रहे महावीराचार्यस्य लीलावत्यां भास्कराचार्यस्याप्येतदनुरूप एव । भास्करेण मूल्यनियमं स्थिरी-करणार्थं "इष्टकाचिति-

दृषच्चिति खात क्राकच व्यवहृतौ खलु मूल्यम्। कर्मकारजनसंप्रतिपत्त्या तन्मृदुत्व-कठिनत्व वशेन" इति विशेषः कथितः। भास्कराचार्येण वर्गांगुलफले हस्तवर्गा-गुलैः षट्स्वरेषुभिः ५७६ भक्ते हस्तात्मकं फलं कल्पितम्। अत्राचार्येण काष्ठानां मृदुत्वकठिनत्ववशेन भिन्नं भिन्नं हस्तात्मकं फलं साधितम्।

अन्यस्योदाहरणम्।

द्वादशहस्तायामे खादिरकाष्ठे करार्धदलपिण्डे।
मार्गेषु पञ्चसु भवेदूर्ध्वच्छेदे कियद् गणितम्॥

न्यासः आयामः (दैर्ध्यम्)=१२, पिण्डः=$\frac{१}{४}$, दारणमार्गः=५ तदा सूत्रोक्त्या आयामपिण्ड=१२×$\frac{१}{४}$=३ दारणमार्गेण गुणिते ३×५=१५=हस्तात्मकं काष्ठ गणितम्।

अन्यदपि।

वृत्तस्य खदिरदारोः करविस्तारस्य दशसु मार्गेषु।
तिर्यक् छेदे गणितं करात्मकं किं भवेत् कथय॥

क्षेत्रफलम्=४५५$\frac{६}{७}$ एतन्मार्गगुणितं चतुर्विंशतिवर्गेण ५७६ विभक्तं लब्धम्=७ $\frac{१६३}{१८०}$ हस्ताः। अनुपातेनैकस्य करपत्रस्य (काष्ठ विदारणोप युक्त-शस्त्रस्य) पाटने रूपभागाः=$\frac{१४२३}{३०००}$।

अन्यदप्युदाहरणम्।

पिण्डेनैको हस्तः प्रपद्यते करशतं तु दैर्ध्येण।
षड्भिः खादिरदारोः पञ्च त्रिगुणाः कराः कियता॥

पिण्डः=१ हस्तः; । दैर्ध्यम् =१०० हस्ताः, तदा क्रकच फलम्=१००, ततः खादिरकाष्ठशतं षड्भी रूपैः प्रपद्यते तदा पंचदश कराः कियता प्रपद्यंते $\frac{६\times१५}{१००}=\frac{९०}{१००}=\frac{९}{१०}$=रूपभागाः॥ ४८-४९॥

अत्रोपपत्तिः

कस्यापि काष्ठस्याग्रमूलयोः पिण्डे वैषम्यं भवेत्तदाऽग्रमूलयोः पिण्डयोर्योगार्ध-समं मध्यममानेन पिण्डमानं भवति। बहुषु स्थानेषु पिण्डेषु वैषम्यं चेत्तदा तत्स्था-

नीयपिण्डानां योगः स्थानमित्या भक्तस्तदा मध्यममानेन पिण्डमानं भवेत्। एतत्पिण्डस्य दैर्घ्यस्य च घातः फलं भवति। काष्ठविदारणसमये कर्मकारः सूत्रपातेन तद्द्वारा मार्ग सम्पाद्य तत्प्रतिचिन्हितमार्गेण काष्ठं विदारयति। पूर्वागतं फलं काष्ठस्यैक पट्टस्यांगुलात्मकम्। तत्काष्ठदारणमार्गैर्गुणितं सत्सकल पट्टफलं भवेत्।

इति क्राकचिक व्यवहारः समाप्तः

अब क्राकचिक व्यवहार प्रारम्भ किया जाता है।

हि. भा.—काष्ठादि विदारण (चीरना) के लिये उपयुक्त शस्त्र (आरा) को क्रकच कहते हैं तत्सम्बन्धी व्यवहार को क्राकचिक व्यवहार कहते है। काष्ठ के विस्ताराङ्गुल और दैर्घ्याङ्गुल के घात को दारणमार्ग (जितने स्थान मे एक रूप से चीरना अभीष्ट हो उसकी सख्या) से गुणाकर ४२ (बयालीस) से भाग देने से फल किष्क्वङ्गुल होता है। काष्ठ की मृदुता और कठिनता वश से आचार्य भिन्न भिन्न हरतात्मक फल साधन करते है। शाकादियों में हस्तवर्गाङ्गुल = ४२ × ९६, शाल्मली (सेमर) में = ४२ × २००, बीजक में = ४२ × १२०, शाल सरलादियों मे = ४२ × १००, खदिरादियो में = ६४ × ४२ सब जगह अङ्गुलात्मक फल को ४२ (बयालीस) से भाग देने से फल किष्क्वङ्गुल होते हैं उनको काष्ठ विशेष में अपने अपने हर से भाग देने से कर्म कार सम्बन्धी हस्तकर्म होता है। एक हस्तकर्म का जो मूल्य होता है उससे गुणा करने से सब हस्तकर्मों का होता है॥

यहाँ चतुर्वेदाचार्य का उदाहरण है।

किसी बीज वृक्ष काष्ठ का दैर्घ्य १० हाथ है, विस्तार ६ अङ्गुल हैं, दारण मार्ग = ७ है, कर्ममूल्य ८ पण है तब पण संख्या (अर्थात् शिल्पी को कितने पैसे दिये गये) कहो ?

न्यास-काष्ठ विस्ताराङ्गुल = ६, दैर्घ्य = १० हाथ = २४० अङ्गुल, इन दोनों का घात करने से १४४०, इसको मार्ग संख्या से गुणा करने से १००८०, इसको बयालीस से भाग देने से फल = २४०, इतने किष्क्वकङ्गुल हुए। बीज वृक्ष है इसलिए इन किष्क्वङ्गुलों को एक सौ वीस १२० से भाग देने से लब्धि = २ कर्म संख्या हुई, इसको कर्म मूल्य ८ से गुणा करने से पण संख्या १६ हुई, इतने पण शिल्पी को दिये गए॥

दूसरे का उदाहरण।

किसी खादिर (खैर) काष्ठ का दैर्घ्य बारह हाथ है। एक हाथ की चौथाई $\frac{१}{४}$ पिण्ड है। दारण मार्ग = ५ है तब उसका गणित (फल) कहो।

दैर्घ्य × पिण्ड = १२ × $\frac{१}{४}$ = $\frac{१२}{४}$ = ३। इसको दारण मार्ग से गुणा करने से ३ × ५ = १५ हस्तात्मक काष्ठ गणित हुआ॥ सिद्धान्त शेखर में 'आयाम पिण्डाङ्गुल घात राशौ

काष्ठस्य मार्गैः' इत्यादि संस्कृत विज्ञान भाष्य में लिखित पद्यों से श्रीपति का क्राकचिक व्यवहार त्रिशतिका में श्रीधराचार्य का—गणितसारसंग्रह में महावीरा चार्य का—लीलावतीमें भास्कराचार्य का आचार्योक्त क्राकचिक व्यवहार के अनुरूप ही है। भास्कराचार्य ने मूल्य नियम के लिए 'इष्टकाचिति दृषच्चिति' इत्यादि संस्कृत विज्ञान भाष्य में लिखित श्लोक से विशेष कहा है ।। ४८-४६ ।।

उपपत्ति ।

यदि किसी काष्ठ के अग्र और मूल के पिण्ड में वैषम्य हो तो दोनों पिण्डों के योगार्ध के बराबर मध्यम मान से उसका पिण्ड मान होता है। बहुत स्थानों के पिण्डों में वैषम्य रहने से सब स्थानों के पिण्डों के योग को स्थान संख्या से भाग देने से मध्यममान से पिण्ड मान होता है। इस पिण्ड और दैर्घ्य का घात करने से फल होता है। काष्ठ चीरने के समय सूत्र गिरा कर दारण मार्ग ठीक कर उस प्रति चिन्हित मार्ग से काष्ठ को कर्मकार चीरता है । पूर्वागत फल काष्ठ के एक पट्ट का अङ्गुलात्मक है। उसको काष्ठ के दारण मार्ग से गुणा करने से सब पट्टों का फल होगा ।। ४८-४६ ।।

इति क्राकचिक व्यवहार समाप्त हुआ ।।

अथ राशि व्यवहारः प्रारभ्यते ।

नवमः शूकिषु दशमः स्थूलेष्वेकादशो भवत्यणुषु ।
परिधेर्वेधः परिधेः षड़ंश वर्गाहतो गणितम् ।।५०।।

सु. भा.—स्पष्टार्थम् । 'अनणुषु दशमांशो ऽणुष्वथैकादशांशः'—इत्यादि भास्करोक्तमेतदनुरूपमेव ।

अत्रोपपत्तिः ।

धान्यस्थितिवशेन वृत्ताधारा सूची भवति। तत्राधारपरिधिनवमभागाधिको धान्यविशेषे वेध उपलब्ध्या स्थिरीकृतः। सूचीघनफलं चाधारफलं वेधत्र्यंशगुणम् । तत्र स्थूलत्वात् परिधितृतीयांशो व्यासः कल्पितः । ततो वृत्तफलं $= \frac{प \times प}{३ \times ४}$। वेधत्र्यंशहतं घनफलं $= \frac{प^२ . वे}{३६} = \left(\frac{प}{६}\right)$ वे, अत उपपन्नम् ।।५०।।

वि. भा.—शूकिषु (शूकधान्य राशिषु) परिधेर्नवमांशो वेधो भवति, स्थूलेषु (स्थूल धान्य राशिषु) परिधेर्दशमांशो वेधो भवति। अणुषु (सूक्ष्मधान्यराशिषु) परिधेरेकादशांशो वेधो भवति। वेधः परिधेः षष्टांशवर्गेण गुणितस्तदा तद्घन फलं भवतीति। सिद्धान्तशेखरे 'समावती संस्थित धान्यराशेः षड़ंशजा या परिधेः

कृतिश्च। समुच्छ्रयेणाभिहता फलं स्यात् घने स्थितं मागध खारिकायाः' इति सूत्रेणानीतं घनफलं मागध खारिकाया भवति "धान्यादिके यद्घनहस्तमानं शास्त्रोदिता मागधखारिका सा" इति भास्करोक्तेः। पूर्वैः प्रमाणीकृतमस्ति यस्मान्मयोदितं मागधमानमेव" इति गणेशोक्तेश्च मगधदेशीयमानस्यैव प्रसिद्धेः किन्त्वाचार्येणैतद्विषये न किमपि कथ्यते। राशिव्यवहारो यादृश आचार्य (ब्रह्मगुप्त) स्य तादृश एव श्रीधराचार्य श्रीपत्याचार्य भास्कराचार्याणामप्यस्ति।

लीलावत्यां भास्करोक्तमुदाहरणम्।

"समभुवि किल राशिर्यः स्थितः स्थूलधान्यः परिधिपरिमितिः स्याद्धस्तषष्टिर्यदीया प्रवद गणक खार्यः किं मिताः सन्ति तस्मिन्नथ पृथगणुधान्यैः शूकधान्यैश्च शीघ्रम्।

स्थूलधान्यराशिमानज्ञानार्थं

न्यासः स्थूलधान्यराशि परिधिः=६०, परिधेर्दशमांशः $\frac{६०}{१०}$=६=वेधः। तदा सूत्रानुसारेण परिधेः षष्टांशः=१०, वर्जितः=१०० वेधगुणितः=१००×६ =६००=स्थूलधान्यराशि घनफलम्।

शूक धान्यराशिमानज्ञानार्थं

न्यासः परिधिः=६०, परिधिः नवमांशो वेधः=$\frac{६०}{९}$=$\frac{२०}{३}$ तदा सूत्रोत्तया परिधेः षष्टांशः=१०, वर्गितः १०० वेधगुणितः=१००×$\frac{२०}{३}$=$\frac{२०००}{३}$=६६६$\frac{२}{३}$= शूकधान्यराशि घनफलम्।

अणुधान्यराशिमानज्ञानार्थं

न्यासः अणुधान्यराशि परिधिः=६०, वेधः=$\frac{६०}{११}$ तदा सूत्रोत्तया परिधेः षष्ठांशः=$\frac{६०}{६}$=१०, वर्गितः=१०० वेधगुणितः=१००×$\frac{६०}{११}$=$\frac{६०००}{११}$=५४५$\frac{५}{११}$ =अणुधान्यराशिघनफलम्।

अन्यस्योदाहरणम्।

षट्त्रिशंन्मित परिधौ राशौ धान्यस्य किं भवेद् गणितम्।
हस्त चतुष्काभ्युदये यदि वेत्सि तदुच्यतामाशु॥

न्यासः धान्यराशि परिधिः=३६, वेधः=४, तदा पूर्ववत् परिधेः षष्टांशः =$\frac{३६}{६}$=६ वर्गितः=३६ वेधगुणितः=३६×४=१४४=घनफलम्॥५०॥

अत्रोपपत्तिः।

धान्य स्थितिवशेन धान्यराशिः सूच्याकारो भवति तदाधारपरिधेर्नवमांशादिभागस्तद्वेधो भवतीति प्रत्यक्षोपलब्ध्या स्थिरीकृतः। वृत्तक्षेत्रे परिधिगुणितव्यास-

पाद फलमिति भास्करोक्त्या वृत्तक्षेत्रफलम् $= \frac{प \times व्या}{४}$ द्वाविंशतिघ्ने विहृते ऽथ शैलैरिति व्यासात्परिध्यानयन विलोमेन व्यासः $= \frac{७ प}{२२} = \frac{प}{३}$ स्वल्पान्तरतः तदोत्थापनाद्वृत्तक्षेत्रफलम् $= \frac{प \times व्या}{४} = \frac{प . प}{४ \times ३} = \frac{प^२}{१२}$ ततः क्षेत्रफलं वेध-गुणमित्यादिना समखात फलत्र्यंशः सूचो खातंफलमित्यनेन च सूच्याकारधान्य-राशेः फलम् $= \frac{प^२}{१२} \times \frac{वेध}{३} = \frac{प^२}{३६} \times वे = \left(\frac{प}{६}\right)^२ वे$, एतावताऽऽचार्योक्त-मुपपन्नम् 'समावनी संस्थित धान्यराशेः षड़ंशजा या परिधेः कृतिश्च । समुच्छ्रे-येणाभि हृता फलं' श्रीपत्युक्तमिदं 'परिधि षष्ठे वर्गिते वेधनिघ्ने घनगणितकराः स्युः' इति भास्करोक्तं चाप्युपपद्यते इति ॥५०॥

अब राशि व्यवहार आरम्भ किया जाता है ।

हि. भा.—शूक धान्य राशि मे परिधि का नवमांश वेध होता है। स्थूल (मोटा) धान्य राशि में परिधि का दशमांश वेध होता है। अणु (सूक्ष्म) धान्य राशि में परिधि का एकादशांश (ग्यारहवां भाग) वेध होता है। वेध को परिधि के षष्ठांश के वर्ग से गुणा करने से धान्य राशि का घनफल होता है । शिद्धान्तशेखर में 'समावनी संस्थित धान्यराशेः' इत्यादि संस्कृत भाष्य में लिखित श्लोक से समानीत धान्य राशि घनफल को मगध देशीय खारी कहते हैं। 'धान्यादिके यद्घनहस्तमानं शास्त्रोदिता मागधखारिका सा' इससे भास्कराचार्य भी 'पूर्वैः प्रमाणी कृतमस्ति यस्मात्' इत्यादि संस्कृत भाष्य में लिखित पद्य से गणेश ने भी उसको मगध देशीय खारी ही कहा है। किन्तु आचार्य (ब्रह्मगुप्त) ने इस विषय में कुछ नहीं कहा है। राशिव्यवहार आचार्योक्त राशि व्यवहार के अनुरूप ही श्रीधराचार्य श्रीपति भास्कराचार्य का राशि व्यवहार है ।

लीलावती में भास्करोक्त उदाहरण है ।

स्थूल धान्य राशि परिधि $=$ ६० $=$ अणुधान्य राशि परिधि $=$ शूकधान्य राशि परिधि, स्थूल धान्यराशि का वेध $= \frac{परिधि}{१०}$, शूकधान्य राशि का वेध $= \frac{परिधि}{९}$, अणुधान्य राशि का वेध $= \frac{परिधि}{११}$ तब इन धान्य राशियों का घनफल क्या होगा ?

स्थूल धान्य राशिमान ज्ञान के लिये न्यास—धान्य राशि परिधि $=$ ६०, वेध $= \frac{परिधि}{१०} =$ ६ तब सूत्र के अनुसार परिधि का षष्ठांश $= \frac{६०}{६} =$ १०, इसके वर्ग १०० को वेध ६ से गुणा करने से १०० $\times$ ६ $=$ ६०० $=$ स्थूलधान्य राशि का घनफल हुआ ।

शूक धान्य राशि मान ज्ञान के लिये—न्यास. धान्य राशि परिधि=६०, वेध $=\frac{\text{परिधि}}{९}=\frac{६०}{९}=\frac{२०}{३}$ तब सूत्र के अनुसार परिधि ६० षष्ठांश १० के वर्ग को वेध से गुणा करने से $१००\times\frac{२०}{३}=\frac{२०००}{३}=६६६\frac{२}{३}$=शूकधान्यराशिघनफल।

अणुधान्य राशिमान ज्ञान के लिये न्यास – धान्यराशि परिधि=६०, वेध$=\frac{\text{परिधि}}{११}$ $=\frac{६०}{११}$ तब सूत्र के अनुसार परिधि षष्ठांश १० वर्ग को वेध से गुणा करने से $१००\times\frac{६०}{११}$ $=\frac{६०००}{११}=५४५\frac{५}{११}$=अणुधान्यराशि घनफल।

दूसरे का भी उदाहरण है।

धान्यराशि की परिधि=३६ है, वेध ४ चार है तब उसका घनफल क्या होगा? पूर्ववत् परिधि षष्ठांश के वर्ग को वेध से गुणा करने से ३६×४=१४४=घनफल हुआ ॥५०॥

उपपत्ति।

धान्य स्थिति वश से धान्य राशि सूच्याकार होती है। उसके आधार वृत्त परिधि के नवमांशादि भाग उनके वेध होते है यह प्रत्यक्ष उपलब्धि से निश्चय किया गया। 'वृत्तक्षेत्रे परिधि गुणित व्यासपादः फलं' इस भास्करोक्त से वृत्तक्षेत्र फल$=\frac{\text{प. व्या}}{४}$, 'द्वाविंशतिघ्ने विहृतेऽथशैलैः' इस व्यास से परिध्यानयन के विलोम से व्यास$=\frac{७\ \text{प}}{२२}=\frac{\text{प}}{३}$ स्वल्पान्तर से इससे उत्थापन करने से वृत्तक्षेत्रफल$=\frac{\text{प. व्या}}{४}=\frac{\text{प. प}}{४\times३}=\frac{\text{प}^२}{१२}$. 'क्षेत्रफलं वेधगुणं' इत्यादि से तथा 'समखातफलत्र्यंशः' इत्यादि से सूच्याकार धान्यराशिका फल $=\frac{\text{प}^२}{१२}\times\frac{\text{वेध}}{३}=\frac{\text{प}^२}{३६}\times\text{वे}=\left(\frac{\text{प}}{६}\right)^२$. वे इससे आचार्योक्त उपपन्न हुआ। तथा 'समावनी संस्थित धान्यराशेः' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपति श्लोक, 'परिधिषष्टे वर्गिते वेधनिघ्ने' यह भास्करोक्त भी उपपन्न हुआ इति ॥५०॥

इदानीं भित्यन्तर्बाह्यकोण संलग्नधान्यराशिप्रमाणानयनार्थमाह।

द्विचतुः सत्र्यंशगुणो भित्त्यन्तर्बाह्यकोणगः परिधिः।
प्राग्वत् कृत्वा गणितं तद्गणितं स्वगुणकारहृतम् ॥५१॥

सु. भा.—सत्र्यंशः सैकत्रिभागः। गणितं घनफलं। शेषं स्पष्टार्थम्।

'द्विवेदसत्रिभागैकनिघ्नात् तु परिधेः फलम्' – इत्यादि भास्करोक्तमेतदनुरूपमेव ॥५१॥

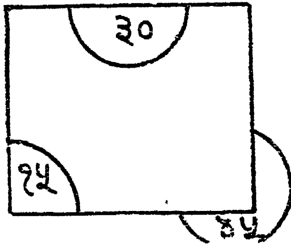
इति राशिव्यवहारः ।

वि. भा.—भित्त्यन्तर्बाह्यकोणगः परिधिः द्विचतुः सत्र्यंशगुणः प्राग्वत् गणितं कृत्वा स्वगुणकारभक्तं तदा तद् गणितं भवति । अर्थात् भित्तिपार्श्वसंलग्नस्य धान्यराशेः परिधिमानं द्वाभ्यां संगुण्य तस्मात्पूर्ववद्यत्फलं तद्द्वाभ्यां भक्तं तदा तद्राशेर्घनफलं भवति । भित्त्योरन्तः कोणस्थितधान्यराशेः परिधिं चतुर्गुणं कृत्वा ततः पूर्ववत्फलमानीय तच्चतुर्भक्तं तदा तद्धान्यराशेर्घनफलं भवति । भित्त्योर्बहिः कोणस्थितधान्यराशेः परिधिं सत्रिभागैकेन संगुण्य ततः पूर्ववत्फलमानीय तत्फलं सत्रिभागैकेन भक्तं तदा तस्य धान्यराशेर्घनफलं भवेदिति ॥

भास्करीय लीलावत्यामुदाहरणम् ।

परिधिर्भित्ति लग्नस्य राशेस्त्रिंशत्करः किल ।
अन्तः कोणस्थितस्यापि तिथितुल्यकरः सखे ॥
बहिः कोणस्थितस्यापि पञ्चघ्ननवसंमितः ।
तेषामाचक्ष्व मे क्षिप्रं घनहस्तान् पृथक् पृथक् ॥

अस्य गणितं प्रदर्श्यते ।



अत्र प्रथमस्य परिधिः ३० द्विनिघ्नः $=३०\times२=६०$ अन्तः कोणस्थितपरिधिः १५ चतुर्गुणितः $=१५\times४=६०$ बाह्यकोणस्थितपरिधिः ४५ सत्रिभागैक गुणितः $=४५\times\frac{४}{३}=६०$ एषांवेधः $=६$

एभ्यः फलं तुल्यमेतावत्य एव खार्यः $=६००$, एतत् स्व स्व गुणेन भक्तं जातं पृथक् पृथक् फलम् ३०० । १५० । ४५० एवं स्थूल धान्यस्य मानं जातम् ।

अथाणु धान्यराशिमानानयनाय पूर्ववत् क्षेत्रत्रयस्य स्वस्वगुणगुणितपरिधिः $=६०$, वेधः $=\frac{६०}{११}$ फलानि २७२$\frac{८}{११}$, १३६$\frac{४}{११}$, १०९$\frac{१}{११}$ ।

शूक धान्य राशिमानानयनाय ।

पूर्ववत् क्षेत्रत्रयस्य स्वस्वगुणगुणितपरिधिः $=६०$ । वेधः $=\frac{२०}{३}$, फलानि ३३३$\frac{१}{३}$, १६६$\frac{२}{३}$, ५०० सिद्धान्तशेखरे "द्विचतुः सत्रिभागघ्ने भित्त्यन्तर्बाह्यकोणगे ।

परिधौ क्रमश: प्राग्वत् स्वगुणाप्तं भवेत् फलं" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवास्ति। एतदानयनस्य सर्वथैकरूपमेव त्रिशतिकायां श्रीधराचार्यस्य, लीलावत्यां भास्कराचार्यस्यास्ति। यथा भास्कराचार्योक्तमानयनम्। द्विवेद सत्रिभागैकनिघ्नात् तु परिधे: फलम्। भित्त्यन्तर्बाह्यकोणस्थराशे: स्वगुणभाजितम् ॥५१॥

अत्रोपपत्ति:

भित्त्यन्त: संलग्न धान्यराशे: परिधिर्वास्तव परिधेरर्धतुल्य:। अन्त: कोण स्थितस्य धान्यराशे: परिधिर्वास्तवपरिधि चतुर्थांशतुल्य:। वाह्यकोणसंलग्न धान्यराशे: परिधिर्वास्तव परिधे: पादोनैक तुल्यस्तेनोक्तपरिधित्रयमानं द्विवेदसत्रिभागैकेनक्रमशो गुणितं सद्वास्तव: परिधिर्भवेत्। तत: पूर्ववद्यत्फलं तत् द्विवेद सत्रिभागैकेन क्रमशो भक्तं तदा वास्तवं तत्फलं भवतीत्येतावताऽऽचार्योक्तमुपपन्नम् ॥५१॥

इति राशि व्यवहार:

अब भित्ति के अन्तर्गत भित्ति के अन्त: कोणस्थ तथा बाह्यकोणस्थ धान्यराशि प्रमाणानयन के लिये कहते हैं।

हि. भा.—भित्ति के पार्श्व संलग्न धान्यराशि परिधि को दो से गुणा करने से वास्तव परिधिमान होता है इससे पूर्ववत् जो फल हो उसको दो से भाग देने से उस धान्य राशि का घनफल होता है। भित्ति के अन्त: कोणस्थित धान्य राशि परिधि को चार से गुणा करने से वास्तव परिधि मान होता है। इससे पूर्ववत् जो फल हो उसको चार से भाग देने से उस धान्य राशि का घनफल होता है। भित्ति के वाह्यकोणस्थ धान्यराशिपरिधि को $\frac{4}{3}$ इससे गुणा करने से वास्तव परिधि मान होता है, इससे पूर्ववत् जो फल हो उसको $\frac{4}{3}$ इससे भाग देने से उस धान्य राशि का घनफल होता है। ॥५१॥

भास्करीय लीलावती में इसका उदाहरण है।

भित्ति संलग्न धान्यराशि परिधि = ३०, अन्त:कोणस्थित धान्यराशिपरिधि = १५, बहि:कोणस्थित धान्यराशिपरिधि = ४५, तब इन सबों के घन हस्तमान पृथक् पृथक् कहो ॥

गणित दिखलाते हैं।

भित्ति संलग्नधान्यराशि परिधि = ३० इसको दो से गुणा करने से ६० = वास्तव परिधि, अन्त: कोणस्थित धान्यराशि परिधि = १५, इसको चार से गुणा करने से ६० = वास्तवप, बाह्यकोणस्थ धान्यराशि परिधि = ४५ इसको $\frac{4}{3}$ इससे गुणा करने से ६० =

वास्तव परिधि। इन सबों का वेध = ६ इन सबों से फल तुल्य ही ६०० खारी, आता है, इसको अपने अपने गुणकों से भाग देने से क्रम से पृथक् पृथक् घनफल हुआ ३०० । १५० । ४५०॥

अणुधान्यराशि मानानयन के लिये ।

पूर्ववत् क्षेत्रत्रय के अपने अपने गुणक से गुणित परिधि = ६०, वेध = $\frac{६०}{११}$ इससे फल = २७२$\frac{८}{११}$, १३६$\frac{४}{११}$, १०९$\frac{१}{११}$ ॥

शूक धान्य राशिमानानयन के लिये ।

पूर्ववत् क्षेत्र त्रय के अपने गुणक से गुणित परिधि = ६० । वेध = $\frac{परिधि}{९} = \frac{६०}{९}$ = $\frac{२०}{३}$ इन से फल ३३३$\frac{१}{३}$, १६६$\frac{२}{३}$, ५०० ॥ सिद्धान्त शेखर में 'द्विचतुः सत्रिभागघ्ने भित्त्यन्तर्बाह्यकोणगे' इत्यादि संस्कृत विज्ञान भाष्य में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है। त्रिशतिका मे श्री धराचार्य ने और लीलावती में भास्कराचार्य ने भी सर्वथा आचार्योक्त के अनुरूप ही कहा है ॥ ५१ ॥

उपपत्ति ।

भित्ति के अन्तः संलग्न धान्यराशि के परिधिमान वास्तव परिधि के आधे के बराबर होता है। अन्तः कोणस्थित धान्यराशि परिधि के चतुर्थांश तुल्य होती है । बाह्यकोण संलग्न धान्यराशि परिधि वास्तव परिधि के $\frac{३}{४}$ भाग के बराबर होती है। अतः उक्त परिधि त्रय मानों को क्रम से दो, चार, $\frac{४}{३}$ इन अंकों से गुणा करने से वास्तव परिधि मान होता है, इस परिधि से पूर्ववत् जो फल हो उन फलों को क्रम से दो चार और $\frac{४}{३}$ इन अङ्कों से भाग देने से उन धान्यराशियों का वास्तव घनफल होता है इससे आचार्योक्त उपपन्न हुआ ॥ ५१ ॥

इति राशि व्यवहार समाप्त हुआ

अथ छायाव्यवहारः प्रारभ्यते ।

तत्रादौ छायात इष्टकालज्ञानार्थमिष्टकालतश्छायानयनार्थं चाह ।

छायानरसैकहृतं द्युदलं प्रागपरयोर्द्युगतशेषम् ।
दिनगतशेषांशहृतं द्युदलं छाया नरव्येकम् ॥ ५२ ॥

सु. *भा.*—नरः शङ्कुरभीष्टः । छायाया यो नरः शङ्कुभागः स सैको यस्तेन द्युदलं हृतं लब्धं प्राक् कपाले द्युगतं पश्चिमकपाले द्युशेषं भवति । एवमेतद्विपरीते-

न द्युदलं दिनगतावयवेन वा दिनशेषांशेन हृतं लब्धं व्येकं नरं नरगुणं च पूर्वापर कपालयोः क्रमेण छाया भवति। एवमस्य श्लोकस्य व्याख्या पञ्चासिद्धान्तिका संमता यदि तत्र मध्यछाया शून्यमिता कल्प्यते।

(द्रष्टव्या पंचसिद्धान्तिका प्रकाशिका पृ० २६ वा मच्छोधितमुद्रिता त्रिशतिका पृ० ४६)।

$$\text{तत्रदिनगतशेषा नाड्यः} = \frac{१२\frac{\text{दि}}{२}}{१२+\text{इच्छा}} = \frac{\frac{\text{दि}}{२}}{१+\frac{\text{इच्छा}}{१२}}$$

अत्र द्वादशांगुलशङ्कु तच्छाययोर्या निष्पत्तिः सैवेष्टशङ्कु तच्छाययो र्निष्पत्ति र्भवतीति छायाक्षेत्रेण स्फुटम्।

अत्र चतुर्वेदाचार्यः। 'इयमार्या निष्प्रयोजना तेन नोदाहृता। निरक्षदेशेऽपि छायानयनं कालानयनं वा न सिद्ध्यति। मनुस्मरेण नात्राचार्येणोपनिबद्धेति। वराहमिहिरादीनां रीतिबुमद्ध्वाऽऽचार्यगूढार्थमविज्ञायैवं चतुर्वेदस्य यत्प्रकथनं तद्बुद्धिमद्भि र्नादरणीय मिति।

अत्रोपपत्त्यर्थं पंचसिद्धान्तिकायां पंचासिद्धान्तिकाप्रकाशिका विलोक्या, किमत्र ग्रन्थगौरवेण ॥५२॥

वि. भा.—नरोऽभीष्ट शंकुः। छायाया नरः शंकुभागो यः स सैकस्तेन द्युदलं (दिनार्ध) भक्तं तदा लब्धं पूर्वकपाले द्युगतं (दिनगतं) पश्चिमकपाले द्युशेषं भवति। तथैतद्विपरीतेन द्युदलं (दिनार्ध) दिनगतावयवेन वा दिनशेषांशेन भक्तं लब्धं व्येकं (एकहीनं) नर गुणं (शंकु गुणितं तदा छाया भवतीति ॥ अत्र चतुर्वेदाचार्यः—इयमार्या निष्प्रयोजना तेन नोदाहृता। निरक्ष देशेऽपि छायानयनं कालानयनं वा न सिध्यति, मनुस्मरेणात्राचार्येणोपनिबद्धेति'। चतुर्वेदाचार्यकथन मिदं न समीचीनं यत आचार्योक्तप्रकारेण छायात इष्टकालानयनं भवत्येव यद्यपि तत्र किञ्चित्स्थौल्यमस्ति तेन 'इयमार्या निष्प्रयोजनेत्यादि' चतुर्वेदोक्तं कथमादरणीयं भवेदिति विज्ञैर्विवेचनीयम् ॥ त्रिशतिकायां श्री धराचार्येण "द्विगुण सशङ्कुच्छायाभक्ते शङ्कौ भवेद्द्युगत-शेषम्। छाया तु शङ्कुहीने दिनगतशेषैर्हृते च शङ्कुदले ॥" वमानयनं कथितम्। सिद्धान्तशेखरे 'द्विनिघ्न शङ्कुवन्वितभा विभक्ते शङ्कौ भवेद्वासरयाततयेयम्। दिनस्य शेषेण गतेन भक्ते शङ्कूनिते शङ्कुदले प्रभा स्यात्" अनेन श्रीपतिना श्रीधराचार्योक्तानुरूपमेवाभिहितम्। तत्रत्यमुदाहरणम्।

"द्वादशाङ्गुल दैर्घ्यस्य शङ्कोरष्टाङ्गुलस्य वा ।
छाया पश्चिमतो दृष्टा त्रिगुणान्हः कियद् गतम् ॥"

अत्र शङ्कू १२ । ८ एतयोः क्रमेण छाये ३६।२४ तदा सूत्रोक्तया समागतं दिनगतशेषम्=$\frac{१}{८}$ पूर्वापरच्छायायामेव दिन सिद्धिरिति ॥

उत्तरार्धोदाहरणम् ।

अष्टभाग दिनस्यैते शेषे चापि निगद्यताम् ।
शङ्कोः पूर्वोक्तयोरेव छायां पूर्वापरां वद ॥

न्यासः शङ्कू = १२ । ८ सूत्रोक्तया क्रियाकरणेन दिनगतशेषे $\frac{१}{८}$ छाया यथा क्रमं ३६ । २४ ॥

आचार्योक्तेष्टच्छायानयन सदृशमेव गणितसारसंग्रहे

"द्विगुणित दिनभागहृताशङ्कु मिति शङ्कुमानोना । द्युदलच्छाया युक्ता छाया तत्स्वेष्ट-कालिका भवति" अनेन महावीराचार्येण कृतमस्ति, तत्र 'गणित सारसंग्रहे' विषुवच्छायायुक्ते देशे इष्टच्छायातः कालानयनाय 'शङ्कु युतेष्टच्छाया मध्यच्छायोनिता द्विगुणा । तदवाप्ता शङ्कुमितिः पूर्वापरयोर्दिनांश. स्यात्' प्रकारोऽयमस्तीति ॥ वराहमिहिराचार्येण छायात इष्टकालानयनार्थं 'दिनं खरामैरधिकं यदल्पं रसेन पंक्त्या निहतं शराप्तम् । हीनं धनं देशपलप्रभायां छाया च सा स्याद्दिनमध्यभागे ॥ छाया निजेष्टा दिनमध्यभागच्छायोनिता दिक् सहिता तयाप्ते दिने शरघ्ने गत गम्यनाड़ी श्रीमान् वराहो वदतीह युक्तया ॥' मयं प्रकारोऽभिहितः ॥ ५२ ॥

अत्रोपपत्तिः ।

'षड्घ्नेऽथवा द्युमाने छिन्ने सद्वादशैर्विमध्यान्हैः ।
छायाङ्गुलैर्गतास्तानाड्यस्ताः पृष्ठतः शेषाः ॥'

इति पञ्चसिद्धान्तिकायां वराह मिहिरोक्त सूत्रेण दिनगत शेषाः घटिकाः $= \frac{६ \text{ दि}}{१२ + \text{इच्छा} - \text{मछा.}}$, अत्र इछा = इष्टच्छाया, मछा = मध्यच्छाया, दि=दिनमानम् । १२=द्वादशाङ्गुलशङ्कुः । अत्र यदि मध्यच्छाया शून्य मिता तदा दिनगत शेषाः घटिकाः $= \frac{६ \text{ दि}}{१२ + \text{इछा}}$ हरभाज्यौ द्वाभ्यां गुणितौ तदा $\frac{१२ \text{ दि}}{२(१२ + \text{इछा})}$ =दिनगत शेषाः घटिकाः, हरभाज्यौ १२ भक्तौ तदा

$\frac{\text{दि}}{२\left(१+\frac{\text{इछा}}{१२}\right)}$ अत्र इच्छा=द्वादशाङ्गुल शंकुच्छायास्ति। परन्तु

$$\frac{\text{द्वादशाङ्गुलशंकुच्छा}}{१२} = \frac{\text{इष्टशंकुच्छाया}}{\text{इष्टशं}}$$

$\therefore \frac{\text{दि}}{२\left(१+\frac{\text{इछा}}{\text{इ श}}\right)}$ दिनगत शेषाः घटिकाः। एतेनाचार्योक्तेष्ट काला-

नयनमुपपन्नम्।

अथ $\frac{\text{दि}}{२\left(१+\frac{\text{इछा}}{\text{इशं}}\right)}$ दिनगत शेष, छेदगमेन $\frac{\text{दि}}{२}$ – दिनगत शेषांश $\left(१+\frac{\text{इछा}}{\text{इशं}}\right)$

$\therefore \frac{\frac{\text{दि}}{२}}{\text{दिनगत शेषांश}} = १+\frac{\text{इछा}}{\text{इशं}}$ पक्षौ रूपहीनौ तदा $\frac{\frac{\text{दि}}{२}}{\text{दिनगतशेषांश}} - १$

$=\frac{\text{इछा}}{\text{इश}}$ पक्षौ इशं गुणितौ तदा $\left(\frac{\frac{\text{दि}}{२}}{\text{दिनगतशेषांश}} - १\right) \times \text{इशं}$

=इछा।

अत्र १२=इशं कल्पनीयः। एतावतेष्टकालतश्छायानयनमुपपन्नम्॥

(१) अस्योपपत्तिः।

यदि मध्यच्छायया हीनो द्वादशेष्टच्छाया योगो द्वादश तुल्यस्तदा दिनार्ध तुल्या इष्ट घटिका भवन्ति, मध्यच्छाया हीन द्वादशेष्टच्छाया योगो यदि केनचिदिष्टाङ्केन समस्तदा का इष्टघटिकाः।

इति व्यस्तानुपातेनेष्ट घटिकाः $=\frac{१२\times\frac{\text{दि}}{२}}{१२+\text{इछा}-\text{मछा}} = \frac{६\ \text{दि}}{१२+\text{इछा}-\text{मछा}}$

एतेनोपपन्नम्। परमिदमिष्ट घटिकानयनं न समीचीनमित्यनुपात स्वरूप दर्शनेनैव स्फुटं भवति। एतद्बलेन साधितमाचार्योक्तेष्टकालानयनमपि सुतरां स्थूलमिति विज्ञैर्ज्ञेयम्॥ ५२॥

अब छायाधिकार प्रारम्भ किया जाता है।

छाया से इष्टकाल ज्ञान के लिये तथा इष्टकाल से छाया ज्ञान के लिये कहते है।

हि. भा.—छाया के शङ्कुभाग (छाया को शङ्कु से भाग देने से जो फल हो) में एक जोड़कर जो हो उससे दिनार्ध में भाग देने से फल पूर्वकपाल में दिनगत और पश्चिम-कपाल में दिन शेष होता है। तथा इससे विपरीत (उल्टा) दिनार्ध को दिनगतावयव से वा दिनशेषाश से भाग देने से जो लब्धि हो उसमे से एक घटाकर शङ्कु से गुणा करने से छाया होती है॥

यहां चतुर्वेदाचार्य कहते हैं यह आचार्योक्त निष्प्रयोजन (निरर्थक) है निरक्ष देश में भी छायानयन वा कालानयन नहीं सिद्ध होता है। चतुर्वेदाचार्य का यह कथन ठीक नही है क्योंकि आचार्योक्त प्रकार से इष्ट कालानयन वा छायानयन होता ही है, यद्यपि उनके आनयन में स्थूलता है तथापि व्यवहारोपयुक्त है। इसलिये आचार्योक्तानयन निष्प्रयोजन (निरर्थक) है यह चतुर्वेदाचार्य का कथन अनादरणीय है। त्रिशतिका मे श्रीधराचार्य ने इसी तरह आनयन किया है। सिद्धान्त शेखर में 'द्विनिघ्नशङ्क्वन्वित भा विभक्ते' इत्यादि संस्कृत भाषा में लिखित पद्य से, श्रीपति ने श्रीधराचार्योक्त के अनुरूप ही कहा है।

वराहमिहिराचार्य ने छाया से इष्टकालानयन के लिये 'दिनं खरामैरधिकं यदल्पं रसेन पंक्त्या निहत शराप्तम्' इत्यादि संस्कृत भाष्य मे लिखित पद्यों से) नियम बतलाया है॥

उपपत्ति

(क) 'षड्घ्नेऽथवा द्युमाने छिन्ने सद्वादशैः' इत्यादि संस्कृतोपपत्ति में लिखित पञ्चसिद्धान्तिकास्थ वराहमिहिरोक्त सूत्र से दिनगत शेष घटी $= \frac{६ \text{ दि}}{१२ + \text{इछा} - \text{मछा}}$

यहां दि = दिनमान, इछा = इष्टच्छाया, मछा = मध्यच्छाया, १२ = द्वादशाङ्गुल-शङ्कु। यदि मध्यच्छाया शून्य मानी जाय तो दिनगत

शेष घटी $= \frac{६ \text{ दि}}{१२ + \text{इछा}}$ हरभाज्य को दो से गुणा करने से

$\frac{१२ \text{ दि}}{२ (१२ + \text{इछा})}$ = दिगशेष हर और भाज्य को बारह १२ से भाग देने से

$\frac{\text{दि}}{२ \frac{(१ + \text{इछा})}{१२}}$ = दिनगत शेष घ, यहां १२ = इष्टशङ्कु

$\therefore \frac{\frac{\text{दि}}{२}}{१ + \frac{\text{इछा}}{\text{इशं}}}$ = दिनगत शेष, इससे आचार्योक्त इष्ट कालानयन उपपन्न हुआ।

अब $\frac{\frac{दि}{२}}{१+\frac{इछा}{इशं}}$ दिनगत शेष, छेदगम से $\frac{दि}{२}$ = दिनगत शेषांश

$\left(१+\frac{इछा}{इशं}\right)$ $\therefore \frac{\frac{दि}{२}}{दिनगतशेषांश}$ $१+\frac{इछा}{इशं}$ दोनों पक्षों मे रूप घटाकर

इष्टशङ्कु से गुणा करने से $\left(\frac{\frac{दि}{२}}{दिनगत शेषांश}-१\right)$ शङ्कु = इछा; इससे इष्टकाल से छायानयन उपपन्न हुआ ।

(क) इसकी उपपत्ति ।

यदि मध्यच्छाया रहित द्वादश और इष्टच्छाया योग बारह के बराबर होता है। तो दिनार्धतुल्य इष्टघटी होती है। मध्यच्छाया रहित द्वादश और इष्टच्छाया योग जब किसी इष्टाङ्क के बराबर होगा तब इष्ट घटी क्या होगी ? इस व्यस्तानुपात से $\frac{\frac{१२\times दि}{२}}{१२+इछा-मछा}$ $=\frac{६ दि}{१२+इछा-मछा}$ = इष्टघटी, इससे उत्पन्न हुआ। लेकिन यह इष्ट घट्यानयन ठीक नहीं है यह बात अनुपात स्वरूप देखने ही से स्पष्ट है। इसके बल से साधित आचार्योक्त इष्टकालानयन अत्यन्त स्थूल समझना चाहिये इति ॥ ५२ ॥

इदानीं छायानयनार्थमाह ।

दीपतल शङ्कुतलयोरन्तरमिष्ट प्रमाणशङ्कुगुणम् ।
दीपशिखौच्च्याच्छङ्कुं विशोध्य शेषोद्धृतं छाया ॥ ५३ ॥

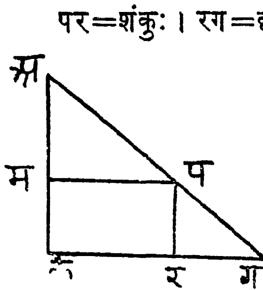
सु. भा.—दीपशिखौच्च्याच्छङ्कु विशोध्य यच्छेषं तेन शेषेणोद्धृतं छाया भवति। शेषं स्पष्टार्थम्। 'शङ्कुप्रदीपतलशङ्कुतलान्तरघ्नः' इत्यादि भास्करोक्तमेतदनुरूपमेव ।

अत्रोपपत्तिस्त्रैराशिकेन सुगमा ॥५३॥

वि. भा.—दीपतलशंकुतलयोरन्तरं शंकुगुणं शंकुहीनदीपशिखौच्च्येन भक्तं तदा छाया भवतीति ॥

अत्रोपपत्तिः ।

पर=शंकुः । रग=छाया, अक=दीपशिखौच्च्यम्=दीउ. प बिन्दुतः कग रेखायाः समान्तरा पम रेखा कार्या तदा



पम=कर=दीपशंकुतलान्तरम्, तदा अमप, परग त्रिभुजयोः साजात्यादनुपातः $\frac{\text{मप. पर}}{\text{अम}}$ $=\frac{\text{कर. पर}}{\text{अम}}=\frac{\text{दीपशंकुतलान्तर} \times \text{शंकु}}{\text{दीपौच्च्य}-\text{शंकु}}$ =रग=छाया । एतनोपपन्नमाचार्योक्तम् । सिद्धान्तशेखरे 'विशंकुना दीपशिखोच्छ्रयेण शंकावभीष्टाङ्गुलकेविभक्ते । प्रदीपशंक्वन्तर मान निघ्ने प्रभा प्रमाणं प्रवदन्ति सन्तः' श्रीपत्युक्तमिदं, लीलावत्यां 'शंकुः प्रदीपतल शंकुतलान्तरघ्नच्छाया भवेद्विनरदीपशिखौच्च्य भक्तः' भास्करोक्तमिदं चाचार्योक्तानुरूपमेवेति ॥ ५३ ॥

अब छायानयन के लिये कहते हैं ।

हि. भा.—दीपतल और शङ्कुतल के अन्तर को शङ्कु से गुणाकर शंङ्कु हीन दीप शिखौच्च्य से भाग देने से छाया होती है ॥ ५३ ॥

उपपत्ति

यहां संस्कृतोपपत्ति में लिखित (१) क्षेत्र को देखिये । पर=शंकु । रग=छाया, अक=दीपशिखौच्च्य, प बिन्दु से कग रेखा की समानान्तर पम रेखा करने से पम=कर=दीप और शंङ्कु का तलान्तर । तब अमप, परग दोनों त्रिभुजों का सजातीयत्व से अनुपात करते हैं $\frac{\text{मप. पर}}{\text{अम}}=\frac{\text{कर. पर}}{\text{अम}}=\frac{\text{दीपशंकुतलान्तर.शंकु}}{\text{दीपौच्च्य}-\text{शंकु}}$ =रग=छाया इससे आचार्योक्त उपपन्न हुआ । सिद्धान्त शेखर में 'विशंकुना दीपशिखोच्छ्रयेण इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने तथा लीलावती में 'शंकुः प्रदीपतल शंकुतलान्तरघ्नच्छाया' इत्यादि संस्कृतोपपत्ति में लिखित पद्य से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है इति ॥५३॥

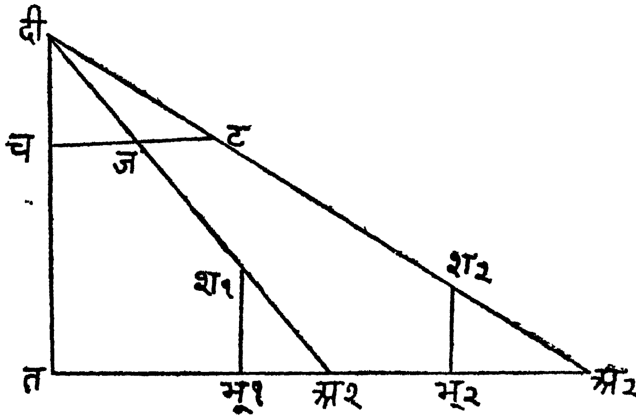
इदानीं छायाप्रदीपान्तरदीपौच्च्यानयनार्थमाह ।

छायाग्रान्तरगुणिता छाया छायान्तरेण भक्ता भूः ।
भूः शङ्कु गुणा छाया विभाजिता दीप शिखयौच्च्यम् ॥५४॥

सु. भा.—दीपशिखया उच्चनर्था द्दीपशिखौच्च्यम् । शेषं स्पष्टार्थम् । 'छाया-ग्रयोरन्तर सङ्ग णा भा छाया प्रमाणान्तर हृद्भवेद्भ :'—इत्यादि भास्करोक्तमेत-दनुरूपमेव ।

अत्रोपपत्तिः ।

साजात्यक्षेत्रतोऽनुपातेन स्फुटा । सा यथा—



तदी=दीपशिखौच्च्यम् । $श_1$ $भू_1$=$श_2$ $भू_2$=शङ्कुः । $भू_1$ $अ_1$=प्रथमच्छाया । $भू_2$ $अ_2$=द्वितीयच्छाया । त, अ१=प्रथमभूः । $तअ_2$=द्वितीयभूः । $अ_1$ $अ_2$ =छायाग्रयोरन्तरम् । दीच=१ । चजटरेखा त $भू_1$ $अ_1$ $भू_2$ $अ_2$ रेखासमानान्तरा। ततः सजातीय क्षेत्रानुपातेन $चज=\frac{प्रछा}{शं}$ । $चट=\frac{द्विछा}{शं}$ । जट=चट—चज $=\frac{द्विछा—प्रछा}{शं}$ । $दीत=\frac{१\times अ_1\, अ_2}{जट}=\frac{अ_1\, अ_2 .\, शं}{द्विधा—प्रछा}$ ।

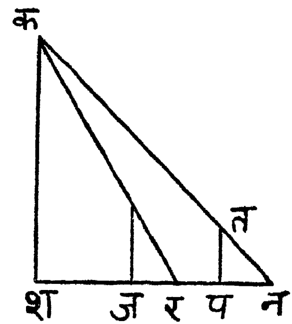
$$ततः\ प्रथमभूः=तअ_1=\frac{दीत.\ भू_1 .\ अ_1}{श_1\ भू_1}=\frac{दीत.\ प्रछा}{शं}=\frac{अ_1\ अ_2 .\ प्रछा}{द्विछा+प्रछा}$$

एवं द्वितीय भूः=$तअ२=\frac{अ_1\ अ_2 \cdot द्विछा}{द्विछा—प्रछा}$ । अत उपपद्यते सर्वमिह भास्करोक्त' चेति ॥५४॥

वि. भा.—छाया छायाग्रान्तरेण गुणिता, छायान्तरेण भक्ता तदा भूर्भवेत् भूः शङ्कु गुणा छायया भक्ता तदा दीपशिखौच्च्यं भवेत् ॥५४॥

अत्रोपपत्तिः ।

मज=शङ्कुः=१२ । जर=छाया, शर=भूः । तप=शङ्कुः=१२ । पन



$=\text{छाया}'$, शन $=\text{भू}'$ः। कश = दीपौच्च्यम्। कशर, मजर त्रिभुजयोः साजात्यादनुपातः $\frac{\text{छाया. दीउ}}{\text{१२}}=\text{भूः}$।

दीउ=दीपौच्च्यम् तथा कशन, तपन त्रिभुजयोः साजात्यादनुपातः $\frac{\text{छाया}'\text{. दीउ}}{\text{१२}}=\text{भू}'$, अनयोरन्तरम्

$=\text{भू}'-\text{भू}=\text{रन}=\text{छायाग्रान्तरं}$

$$=\frac{\text{छाया}'\text{. दिउ}-\text{छाया. दीउ}}{\text{१२}}=\frac{\text{दीउ (छाया}'-\text{छाया)}}{\text{१२}}=\frac{\text{दीउ.छायान्तर}}{\text{१२}}$$

छेदगमेन छायाग्रान्तर . १२ = दीउ . छायान्तर, पक्षौ छायान्तर भक्तौ तदा $\frac{\text{छायाग्रान्तर. १२}}{\text{छायान्तर}}=\text{दीउ}$. अनेन भू स्वरूपे उत्थापनेन भू= $\frac{\text{छाया. दीउ}}{\text{१२}}$

$$=\frac{\text{छाया. छायाग्रान्तर. १२}}{\text{१२. छायान्तर}}=\frac{\text{छाया. छायाग्रान्तर}}{\text{छायान्तर}}$$ । तथा $\text{भू}'\text{ः}=\frac{\text{छाया}'\text{. दीउ}}{\text{१२}}$

$$=\frac{\text{छाया}'\text{. छायाग्रान्तर.१२}}{\text{छायान्तर. १२}}=\frac{\text{छाया}'\text{. छायाग्रान्तर}}{\text{छायान्तर}}$$, तथा च मजर, कशर त्रिभुजयोः साजात्यात् $\frac{\text{१२. भू}}{\text{छाया}}=\text{दीपौच्च्यम्}$। एवं तपन, कशन त्रिभुजयोः साजात्यादनुपातेन $\frac{\text{१२. भु}'}{\text{छाया}'}=\text{दीपौच्च्यम्}$ । एतावताऽऽचार्योक्तमुपपन्नम् । लीलावत्यां "छायाग्रयोरन्तरसङ्गुणा भा छाया प्रमाणान्तरहृद् भवेद् भूः। भूशङ्कुघातः प्रभया विभक्तः प्रजायते दीपशिखौच्च्यमेवमिति" भास्करोक्तमाचार्योक्तानुरूपमेवेति विद्वद्भिर्ज्ञेयम् ॥५४॥

अब छाया प्रदीपान्तर तथा दीपौच्च्यानयन के लिये कहते हैं।

हि. भा.—छाया को छायाग्रान्तर से गुणा कर छायान्तर से भाग देने से भू प्रमाण होता है, भू और शङ्कु के घात को छायान्तर से भाग देने से दीपौच्च्य होता हैं ॥ ५४ ॥

उपपत्ति।

यहां संस्कृतोपपत्ति में लिखित (१) क्षेत्र को देखिये । मज=शङ्कु=१२ । जर =छाया, शर=भूः, तप=शङ्कु= १२ । पन=छाया' । शन=भू'ः। कश=दीपौच्च्य।

कशर, मजर दोनों त्रिभुजों के सजातीयत्व से अनुपात करते है $\frac{\text{छाया. दीउ}}{\text{१२}}$ =भूः। तथा कशन, तपन दानो त्रिभुजो के सजातीयत्व से अनुपात करते है $\frac{\text{छाया}'\text{. दीउ}}{\text{१२}}$ =भू'ः। दीउ= दीपौच्च्य। दोनो भू के अन्तर करने से भू'—भू=रन = छायाग्रान्तर=

$\frac{\text{छाया}'\text{. दीउ—छाया. दीउ}}{\text{१२}} = \frac{\text{दीउ. (छाया}'\text{—छाया)}}{\text{१२}} = \frac{\text{दीउ. छायान्तर.}}{\text{१२}}$ छेदगम से

छायाग्रान्तर. १२=दीउ. छायान्तर $\therefore$ $\frac{\text{छायाग्रान्तर. १२}}{\text{छायान्तर}}$ =दीउ इससे भू स्वरूप में उत्थापन से भू $= \frac{\text{छाया. छायाग्रान्तर. १२}}{\text{१२. छायान्तर}} = \frac{\text{छाया. छायाग्रान्तर}}{\text{छायान्तर}}$ । तथा

भू' $= \frac{\text{छाया}'\text{. छायाग्रान्तर. १२}}{\text{छायान्तर. १२}} = \frac{\text{छाया}'\text{. छायाग्रान्तर}}{\text{छायान्तर}}$ । तथा नजर, कशर दोनो त्रिभुजों के सजातीयत्व से अनुपात करते हैं $\frac{\text{१२. भू}}{\text{छाया}}$ =दीपौच्च्य। एव तपन, कशन त्रिभुजों के सजातीयत्व से अनुपात करते हैं $\frac{\text{भू}'\text{. १२}}{\text{छाया}'}$ =दीपौच्च्य। इससे आचार्योक्त उपपन्न हुआ। लीलावती में 'छायाग्रयोरन्तर सङ्गुणा भा' इत्यादि सस्कृतोपपति में लिखित पद्यों से भास्कराचार्य ने आचार्योक्त के अनुरूप ही कहा है इति ॥५४॥

इदानीं प्रत्युत्पन्नादौ विशेषमाह

गुणकार खण्ड तुल्य गुण्यो गोमुत्रिकाकृतो गुणितः।
सहितः प्रत्युत्पन्नो गुणकारक भेदतुल्यो वा ॥५५॥

सु. भा.—गुणकारस्यैकदशादिस्थानीयखण्डतुल्यो गुण्यः स्थाप्य स्ततस्तैः खण्डैर्गोमूत्रिकाकृतो गुणितः सहितः प्रत्युत्पन्नो गुणनफलं भवति। अर्थात् तैः खण्डैः पृथग्गुण्या गुणितो यथास्थानकं सहितो गुणनफलं भवति। वा गुणकार भेदतुल्यो गुणकारखण्डतुल्यो गुण्योऽधोऽधः स्थाप्यस्तैः खण्डकैर्गुणितः सहितः प्रत्युत्पन्नो भवति। अत्र गुणकारस्य यथेच्छरूपविभागात्मकः खण्डो ज्ञेय इति। 'गुण्यस्त्वधोऽधो गुणखण्डतुल्यः' इत्यादि भास्करोक्तमेतदनुरूपमेव॥ ५५ ॥

वि. भा.—गुणयितुं योग्यो गुण्यः। येनाङ्केन गुण्यते स गुणकः। गुणकस्य यन्मितानि खण्डानि क्रियन्ते तन्मितेषु स्थानेषु गुण्यः स्थाप्यः, तैः खण्डकैः पृथक् गुण्यो गुणितः सर्वेषां योगश्च कार्यस्तदा प्रत्युत्पन्नो गुणनफलं भवति।

अत्रोपपत्तिः ।

गुणनफलं हि योग विशेषोऽर्थाद् गुणकस्य संख्यकस्थानेषु गुण्यं स्थापयित्वा सर्वेषां योगकरणेन तद्गुणंनफलं भवति । यथा गुण्यः=८ । गुणकः=५ अत्र गुणकसंख्यकस्थानेषु गुण्यस्य स्थापनेन ८+८+८+८+८=८ (१+१+१+१+१)=८×५=४० । अत्र गुण्यः=गु । गुणकः गुणक तदा गुणन फलम्=गु×गुणक, यदि गुणकः=य+र+ल तदा गुणनफलम्=गुण्य-गुणक=गु (य+र+ल)=गु×य+गु. र+गु. ल, अथवा यदि गुण्य=य+र+ल तदा गुणनफ=गुण्य.गुणक=गुणक (य+र+ल)=गुणक. य+गुणक. र+गुणक. ल एतेनाऽऽचार्योक्तमुपपन्नम् । गुण्यस्त्वधोऽधो गुणखण्डतुल्यस्तैः खण्डकैः संगुणितो युतो वेति' लीलावत्या भास्करोक्तानुरूपमेवोपपद्यते च । आचार्येण साधारणगुणनप्रकारः कथं नोक्त इति त एव ज्ञातु शक्नुवन्ति, श्रीपति भास्करादिभिः स्वस्वग्रन्थे प्रथमं स एव प्रकारोऽभिहितः । यथा सिद्धान्तशेखरे "विन्यस्य गुण्यं गुणकाख्यराशेरधः कपाटद्वयसन्धियुक्त्या । उत्सार्य हन्यात् क्रमतोऽनुलोमं विलोममाहो उत तत्स्थमेव" इति श्रीपत्युक्तप्रकारः । गुणकस्योत्सारणतः कपाटसन्धिवदस्य रूपं लक्ष्यतेऽतः प्राचीनैरिद कपाटसन्धिगुणनं कथ्यते । लीलावत्यां 'गुण्यान्त्यमङ्कं गुणकेन हन्यादुत्सारितेनैवमुपान्त्यमादी' नित्यनेन भास्करेण प्रथममयमेव गुणनविधिः कथितः । भास्करोक्त मुदाहरणं च । 'बाले बालकुरङ्गलोलनयने लीलावति प्रोच्यतां पञ्चत्र्येकमिता दिवाकरगुणा अङ्काः कति स्युर्यदि । रूपस्थानविभागखण्डगुणने कल्यासि कल्याणिनीति' मुनीश्वरोक्तमुदाहरणम् । 'यस्यास्तिमुद्राः शरसप्तदस्रा धनं हि यत्तत्त्वगुणं कृतं तत् । व्यापारतस्तेन कतीत्यवैहि चेद् गौणमार्गे दृढ़ता तवास्ते । न्यासः—गुण्यः=२७५, गुणकः =२५ कपाटसन्धिना गुणिते तिर्यग् मार्गेण योगे कृते जातं गुणनफलम् =६८७५

गणित सारे महावीराचार्योक्त मुदाहरणम् ।

नन्दाद्यृतुशरचतुस्त्रिद्वन्द्वैकं स्थाप्यमत्र नवगुणितम् । आचार्यमहावीरैः कथितं नरपाल कण्ठिकाभरणम्, न्यासः गुण्यः=१२३४५६७९, गुणकः=९ गुणिते जातम्=१११११११११ इद कण्ठाभरण सदृशं कथ्यते ॥५५॥

अब प्रत्युत्पन्नादि में विशेष कहते हैं ।

हि. भा.—जो अङ्क गुणे जाते है वे गुण्य कहलाते हैं, जिन अङ्कों से गुणे जाते है वे गुणक कहलाते हैं । गुणक के जितने खण्ड किये जाय उतने स्थानों में गुण्य को रख कर उन खण्डों से गुणा कर योग करने से गुणन फल होता है ।

उपपत्ति ।

गुणक की संख्या तुल्य स्थानों में रख कर योग करने से गुणनफल होता है जैसे गुण्य =८, गुणक=५ यहां गुणक संख्यक स्थानों में गुण्य को स्थापन करने से ८+८+८+८

+८=८×१+८×१+८×१+८×१+८×१ तुल्य गुणक को पृथक् करने से ८ (१+१+१+१+१)=८×५=४०, यहां गुण्य=गु। गुणक=गुणक तब गुणनफल=गुण्य×गुणक। यदि गुणक=य+र+ल तब गुणनफल=गुणक.गु=गु (य+र+ल)=गु×य+गु×र+गु×ल, इससे आचार्योक्त सूत्र उपपन्न होता है। आचार्य ने साधारण गुणनप्रकार क्यों नही लिखा नही कह सकते है। श्रीपति--भास्कर आदि आचार्यो ने अपने अपने ग्रन्थ में उसी प्रकार को कहा है। जैसे सिद्धान्त शेखर मे 'विन्यस्य गुण्य गुणकाख्य राशेः' इत्यादि श्रीपति प्रकार है, लीलावती में 'गुण्यान्त्यमङ्क गुणकेन हन्यात्' इत्यादि से भास्कराचार्य ने भी उसी प्रकार को कहा है। भास्करोक्त उदाहरण भी 'बाले बाल कुरङ्ग लोलनयने लीलावति' इत्यादि सस्कृतोपपत्ति मे लिखित पद्यो से है। मुनीश्वरोक्त उदाहरण भी है जैसे 'यस्यास्तिमुद्राः शर सप्तदस्रा' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक इसके अनुसार न्यास गुण्य=२७५, गुणक=२५ गुणा करने मे गुणनफल=६८७५।

गणित सार में महावीराचार्योक्त उदाहरण।

'नन्दाद्यृतुशरचतुः' इत्यादि सस्कृतोपपत्ति में लिखित श्लोक के अनुसार गुण्य=१ २ ३ ४ ५ ६ ७ ९, गुणक=९, गुणा करने से गुणनफल=१ १ १ १ १ १ १ १ १ इति ॥५५॥

इदानीं प्रकारान्तरेणाह।

गुण्यो राशिर्गुणकार राशिनेष्टाधिकोनकेन गुणः।
गुण्येष्टवधोनयुतो गुणकेऽभ्यधिकोनके कार्यः ॥ ५६ ॥

सु. भा.—स्पष्टार्थम्। 'इष्टोनयुक्तेन गुणेन निघ्नः' इत्यादि भास्करोक्तमेमेतदनुरूपमेव ॥५६॥

वि. भा.--इष्टेन युतेन हीनेन गुणकेन गुणितो गुण्य इष्ट गुणित गुण्येन हीनो युतश्च कार्यस्तदा गुणनफलं भवतीति।

अत्रोपपत्तिः।

गुण्य×गुणक=गुणनफलम्। अथ गुणक ± इ ∓ इ=गुण। इ=इष्टम्

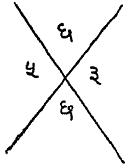
तदा गुणनफलम्=गुण्य (गुणक ± इ ∓ इ)

=गुण्य (गुणक ± इ) ∓ गुण्य × इ

एतावताऽऽचार्योक्तमुपपन्नम्। लीलावत्यां 'इष्टोनयुक्तेन गुणेन निघ्नोऽभीष्टघ्न गुण्यान्वित वर्जितोवेति' भास्करोक्तमेतदनुरूपमेव।

गुण्यगुणकयोर्घातेन यद्गुणनफलं तच्छुद्धं न वेत्येतदर्थ शोधनप्रकारः। रेखयोः संयोगेन यद्रूपं भवति तत्र वामभागे गुण्याङ्कानां योगो नवभक्तो यो शेषः

स्थाप्य गुणकाङ्कानां योगो नवभक्तः शेषो दक्षिण भागे स्थाप्यः । गुणनफलाङ्कानां योगो नवभक्तः शेषोऽधो भागे स्थाप्यः । वामभागे दक्षिणभागे च स्थापितयोरङ्कयोर्घातो नवभक्तः शेषोर्ध्वभागे स्थाप्य एवं सति यद्यूर्ध्वाधोभागस्थापितयोरङ्कयोः साम्यं भवेत्तदा गुणनफलं शुद्धमेवास्तीति बोध्यम् । यथा गुण्यः=२४८, गुणकः=४८, गुणनफलम्=११९०४



गुण्याङ्कानां योगो १४ नवभक्तः शेषम्=५
गुणकाङ्कानां योगो १२ नवभक्तः शेषम्=३
गुणनफलाङ्कानां योगो १५ नवभक्तः शेषम्=६
वाम भागे दक्षिणभागे च स्थापितयोरङ्कयोर्घातो

१५ नवभक्तः शेषम् =६,

अत ऊर्ध्वाधो भागस्थयोरङ्कयोः साम्ये जाते गुणनफलं शुद्धमेवेति ॥५६॥

अब प्रकारान्तर से गुणन विधि को कहते हैं ।

हि. भा.—इष्टयुत और इष्ट रहित गुणक से गुण्य को गुणा करना उसमें इष्ट गुणित गुण्य को क्रमशः हीन और युत करने से गुणन फल होता है ॥

उपपत्ति

गुण्य × गुणक = गुणनफल । गुणक ± इ ∓ इ = गुणक, तब गुणनफ = गुण्य (गुणक ± इ ∓ इ), यहाँ इ = इष्ट है = गुण्य (गुणक ± इ) ± गुण्य × इ, इससे आचार्योक्त उपपन्न हुआ । लीलावती में 'इष्टोनयुक्तेन गुणेन निघ्नोऽभीष्टघ्न गुण्यान्वित वर्जिवा' यह भास्करोक्त आचार्योक्त के अनुरूप ही है ॥

गुण्य और गुणक के घात करने से जो गुणनफल होता है
वह शुद्ध है या नहीं इसका शोधन प्रकार ।

दो रेखाओं के सयोग से जैसा आकार बनता है उसमें वाम भाग में गुण्य के अङ्कों के योग को नौ से भाग देकर जो शेष रहे उसको स्थापन करना । गुणक के अङ्को के योग को नौ से भाग देकर जो शेष रहे उसको दक्षिण भाग में स्थापित करना, गुणनफल के अङ्कों के योग को नौ से भाग देकर शेष को अधो भाग में स्थापित करना, वाम भाग में स्थापित अङ्क और दक्षिण भाग में स्थापित अङ्कों के घात को नौ से भाग देकर शेष को ऊर्ध्व भाग में स्थापित करना । यदि ऊर्ध्व भाग में स्थापित अङ्क और अधो भाग में स्थापित बराबर हो तब गुणनफल को शुद्ध समझना चाहिए अन्यथा नहीं । जैसे यहाँ संस्कृतोपपत्ति में लिखित चित्र को देखिए । गुण्य=२४८, गुणक = ४८, गुणनफल = ११९०४, गुण्य के अङ्कों के योग १४ को नौ से भाग देने से शेष=५, गुणाकाङ्कों के योग १२ को

नौ से भाग देने से शेष=३ । गुणनफलाङ्कों के अङ्कों के योग १५ को नौ से भाग देने से शेष=६, वामभाग और दक्षिण भाग में स्थापित अङ्कों के घात १५ को नौ से भाग देने से शेष=६, अतः ऊर्ध्वभाग और अधोभाग के अङ्को मे तुल्यत्व होने के कारण गुणनफल-शुद्ध है ॥ ५६ ॥

इदानीं भागहारे विशेपमाह ।

छेदेनेष्टयुतोनेनाप्तं भाज्यादनष्टमिष्टगुणम् ।
प्रकृतिस्थच्छेदहृतं लब्ध्या युत हीनकमनष्टम् ॥ ५७ ॥

सु. भा.—भाज्यादिष्टयुतोनेन छेदेन हरेण यदाप्त तदनष्टं स्थाप्यमेकत्रेष्टगुणं प्रकृतिस्थच्छेदहृतमुदाहरणे यः स्वाभीष्टश्छेदस्तेन हृतम् । अत्र या लब्धिस्तयाऽनष्टं क्रमेण युतं हीनं च वास्तवा लब्धिः स्यात् । इष्टाधिके छेदे युतमिष्टोने छेदे हीनमनष्टं कार्यमित्यर्थः ।

अत्रोपपतिः ।

कल्प्यते । भाज्य=भा । छेदः=हा । इष्टम्=ई । तदा वास्तवा लब्धिः= $\frac{\text{भा}}{\text{हा}}$ । इष्टयुतोनेन हारेण लब्धिः $=\frac{\text{भा}}{\text{हा}+\text{इ}}$ द्वयोरन्तरम्$=\frac{\text{भा}}{\text{हा}\pm\text{इ}}-\frac{\text{भा}}{\text{हा}}$

$$=\text{भा}\left(\frac{1}{\text{हा}+\text{इ}}-\frac{1}{\text{हा}}\right)=\frac{\pm\ \text{भाइ}}{\text{हा}\ (\text{हा}\pm\text{इ})}=\pm\frac{\text{आ. इ}}{\text{हा}}$$

अत्र $\frac{\text{भा}}{\text{हा}\pm\text{इ}}$ अस्याप्तसंज्ञा कृता । अत इष्टाधिके छेदे $\frac{\text{भा}}{\text{हा}+\text{इ}}-\frac{\text{भा}}{\text{हा}}$

$$=\text{आ}-\frac{\text{भा}}{\text{हा}}=-\frac{\text{आ. इ}}{\text{हा}}\ ।$$

$\therefore\ \frac{\text{भा}}{\text{हा}}=\text{आ}+\frac{\text{आ. इ}}{\text{वा}}$ । इष्टोने छेदे $\text{आ}-\frac{\text{भा}}{\text{हा}}=+\frac{\text{आ. इ}}{\text{हा}}$

$\therefore\frac{\text{भा}}{\text{हा}}=\text{आ}-\frac{\text{आ. इ}}{\text{हा}}$ अत्र उपपद्यते ॥५७॥

वि. भा.- भाज्यात् इष्टयुतोनेन च्छेदेन (हरेण) भक्ताद्यल्लब्धं तदनष्टं स्थाप्यमेकत्रेष्टगुणं प्रकृतस्थच्छेदहृतं (येन हारेण भाज्यो विभाज्यस्तेन भक्तं) या लब्धिस्तयाऽनष्टं क्रमेण युतं हीनं च कार्यं तदा वास्तवा लब्धिः स्यात् (इष्टाधिके हरे युतमिष्टोने हरे हीनं कार्यमिति) ॥ ५७ ॥

अत्रोपपत्तिः ।

कल्प्यते भाज्यः=भा, हारः=हा, इष्टम्=इ, तदा $\frac{\text{भाज्य}}{\text{हार}}=\frac{\text{भा}}{\text{हा}}$ वास्तवलब्धिः ।

इष्टयुतोनेन हारेण भाज्ये भक्ते $\frac{\text{भा}}{\text{हा} \pm \text{इ}}$ =लब्धिः । अस्याप्तसंज्ञा कृता, अत इष्टाधिके हरे $\frac{\text{भा}}{\text{हा}+\text{इ}} - \frac{\text{भा}}{\text{हा}}$ = आप्त$-\frac{\text{भा}}{\text{हा}} = \frac{-\text{आप्त. इ}}{\text{हा}}$ अतः समशोधनेन $\frac{\text{भा}}{\text{हा}}$ =आप्त$+\frac{\text{आप्त.इ}}{\text{हा}}$ इष्टोने हरे आप्त$-\frac{\text{भा}}{\text{हा}} = \frac{\text{आप्त. इ}}{\text{हा}}$ $\therefore$ $\frac{\text{भा}}{\text{हा}}$ = आप्त$-\frac{\text{आप्त. इ}}{\text{हा}}$ एतावताऽऽचार्योक्तमुपपन्नम् ।। सिद्धान्त शेखरे 'भाज्यस्याधः स्थापयेत् भाजकं च येन क्षुण्णं भाज्यराशेरपैति । लब्धिः सा स्यादेवमन्त्याद्विलोमं भागादाने ह्याक्षयाद् भाज्यराशेः' अत्रोदाहरणं गणेशदैवज्ञोक्तम् । तत्त्वशीतकिरणाः शरनेत्रै र्भाजिता कति भवन्ति वदाशु । बाण पाणि कु गुणा अपि तत्त्वैर्भाजिता कति च चारू विचारे ।। न्यासः भाज्यः=३१२५, भाजकः=२५ तदा सूत्रोक्तया भागफलम्=११५ अथवा भाज्यः=१२५, भाजकः=२५ तदा सूत्रोक्तया भागफलम्=५ ।। लीलावत्यां 'भाज्याद्धरः शुद्धयति यद् गुणः स्यादन्त्यात्फलं तत् खलु भागहारे' भास्करोक्तमिदं श्रीपत्युक्तानुरूपमेव, एतयो (श्रीपतिभास्करयोः) राचार्ययोः कथनमतीवस्पष्टमस्ति, आचार्येण तु गुणनविधौ 'इष्टोनयुक्तेन गुणेन निघ्नोऽभीष्टघ्नगुण्यान्वितवर्जितो वा' यादृशो विधि-स्तादृश एव भागहरणेऽपि प्रदर्शितः, एतावता किमपि वैशिष्ट्यं न जातं साधारणभागहारविधिर्नोक्त इति ।। ५७ ।।

अब भाग हरण में विशेष कहते है ।

हि. भा.—भाज्य मे इष्ट युत और इष्ट रहित भाजक से भाग देकर जो लब्ध हो उसको अनष्ट स्थापन करना, एक जगह इष्ट से गुणा कर हर से (भाज्य को जिस हर से भाग देना है) भाग देने से जो लब्धि हो उसको पूर्वोक्त अनष्ट स्थापित लब्धि में क्रम से युत और हीन करने से वास्तव लब्धि होती है; (हर के इष्ट से अधिक रहने से युत करना, अल्प रहने से हीन करना) इति ।। ५७ ।।

उपपत्ति ।

भाज्यः=भा, हारः=हा, इष्टम्=इ, तब $\frac{\text{भाज्य}}{\text{हार}} = \frac{\text{भा}}{\text{हा}}$ =वास्तव लब्धि, इष्टयुतोन हार से भाज्य को भाग देने से लब्धि=$\frac{\text{भा}}{\text{हा} \pm \text{इ}}$ इसकी आप्त संज्ञा है, इसलिये इष्टाधिक हर में $\frac{\text{भा}}{\text{हा} \pm \text{इ}} - \frac{\text{भा}}{\text{हा}}$ = आप्त$-\frac{\text{भा}}{\text{हा}} = \frac{-\text{आप्त. इ}}{\text{हा}}$ समशोधन करने से $\frac{\text{भा}}{\text{हा}}$ =आप्त$+\frac{\text{आप्त. इ}}{\text{हा}}$ हर के इष्ट से अल्प रहने से आप्त$-\frac{\text{भा}}{\text{हा}} = \frac{\text{आप्त. इ}}{\text{हा}}$

$\therefore$ $\frac{\text{भा}}{\text{हा}}$ =आप्त$-\frac{\text{आप्त. इ}}{\text{हा}}$ इससे आचार्योक्त उपपन्न हुआ । सिद्धान्तशेखर में

'भाज्यस्याधः स्थापयेत् भाजक च' इत्यादि सस्कृतोपपत्ति मे लिखित श्लोक से श्रीपति ने तथा लीलावती में 'भाज्याद्धरः शुद्धयति यद्गुणः स्यात्' इत्यादि से भास्कराचार्य ने भी जिस तरह स्पष्टी करण किया है उस तरह आचार्योक्त नही है भास्कराचार्योक्त श्रीपत्युक्त के अनुरूप ही है । भागहरण के लिए आचार्य ने साधारण विधि न कह कर विशेष विधि ही कही है । उदाहरण गणेश दैवज्ञोक्त है जैसे—

'तत्त्वगीत किरणाः शरनेत्रैः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक है । न्यास भाज्य=१२५ भाजक=२५ तब श्रीपत्युक्त सूत्र के अनुसार क्रिया करने से लब्धि=५ । अथवा भाज्य=३१२५, भाजक=२५ तब पूर्ववत् क्रिया करने से लब्धि=११५, आचार्योक्त विधि में कुछ विशिष्टता नही है केवल क्रिया बाहुल्य है इति ।।५७।।

इदानी गुणने पुनर्विशेषमाह ।

गुण्यश्छेदफलवधो गुणकहृतो गुण्यभाजितो गुणकः ।
छेदोद्धृतः फलं गुण्यगुणवधः फलहृतश्छेदः ।। ५८ ।।

सु. भा.—गुणनफलं केनचिदभीष्टेन छेदेन हृतं लब्धं फलसंज्ञं ज्ञेयम् । अतश्छेदफलवधो गुणनफलं भवत्येवातः स वधो गुणकहृतो गुण्यो गुण्यभाजितो गुणकश्च भवति । एवं गुण्यगुणवधो गुणनफलं स छेदोद्धृतः फलं फलहृतश्छेदो भवतीति सर्वं स्फुटम् ।।५८।।

वि. भा.—गुणनफलं केनचिदिष्टेन छेदेन (हरेण) भक्तं लब्धं फलसंज्ञम् । अतो हरफलयोर्वधो गुणनफलं भवेदेव वधः (गुण्य गुणक घातः) गुणक हृतस्तदा गुण्यो भवति, वधो गुण्यभाजितस्तदा गुणको भवति, तथा गुण्यगुणवधः (गुणनफलं) छेदोद्धृतः (हारभक्तः) फलं भवति, फलेन भक्तस्तदा छेदो (हरो) भवतीति ।।५८।।

अत्रोपपत्तिस्तु व्याख्ययैव स्फुटेति ।।५८।।

अब फिर गुणन में विशेष कहते हैं ।

हि. भा.—गुणन फल को किसी इष्ट छेद से भाग देने से जो लब्धि हो वह फल संज्ञक है । अतः छेद और फल का वध गुणन फल होगा ही, वध (गुण्य और गुणक के घात) को गुणक से भाग देने से गुण्य होता है, और गुण्य से भाग देने से गुणक होता है, तथा गुण्य और गुणश के वध (गुणनफल) को छेद से भाग देने से फल होता है, और फल से भाग देने से छेद होता है । इन बातों को कहने की कोई आवश्यकता नहीं थी, इन सबों को हम निरर्थक समझते है ।।५८।।

उपपत्ति भी हि. भा. से स्पष्ट ही है ।।५८।।

इदानीं पुनर्विशेषमाह।

गुण्य गुणकारयोश्छेदलब्धयोर्यदि द्वयोर्द्वयोर्नाशः।
तेषां दृश्यौ व्यस्तौ कृत्वा तत्स्थानयोश्चेष्टौ ॥५६॥

सु. भा.—यदि गुण्यगुणकारयोर्वा छेदलब्धयोर्द्वयोर्द्वयोर्नाशो भवति तदा तेषां मध्ये यौ दृश्यौ तौ व्यस्तौ कृत्वा तत्स्थानयोश्चेष्टौ प्रकल्प्यौ। एतदुक्तं भवति। यौ दृश्यौ तावदृश्यौ कल्प्यौ दृष्टस्थानयोश्चेष्टावन्यौ राशी कर्त्तव्यौ। करणं च यथा। छेदफलयोर्नाशे गुण्यगुणकौ छेदफले कल्प्ये। ततश्छेदफलवध इष्टेन गुण्यकल्पितेन गुणककल्पितेन वा विभजनीयं फलं द्वितीयो भवत्येवमवशेषयोरपि। इयं व्याख्या चतुर्वेदोक्ता ॥५९॥

वि. भा.—अस्य व्याख्या चतुर्वेदोक्ता यथा यदि गुण्य गुणकारयोर्वा छेदलब्धयोर्द्वयोर्द्वयोर्नाशो भवति तदा तेषां मध्ये यौ दृश्यो तौ व्यस्तौ कृत्वा तत्स्थानयोश्चेश्टौ प्रकल्प्यौ। एतदुक्तं भवति। यौ दृश्यौ तावदृश्यौ कल्प्यौ दृष्टस्थानयोश्चेष्टा वन्यौ राशी कर्त्तव्यौ। करणं च यथा। छेदफलयोर्नाशे गुण्यगुणकौ छेदफले कल्प्ये। ततश्छेदफलवध इष्टेन गुण्यकल्पितेन गुणकल्पितेन वा बिभजनीयं फलं द्वितीयो भवत्येवमवशेषयोरपि भवतीति ॥५९॥

अब पुनः विशेष कहते हैं।

हि. भा.—यदि गुण्य और गुणकार में वा छेद और लब्धि में दो दो का नाश हो तब उन सबों में जो दृश्य है उनको उलटा कर उनके स्थान में इष्टद्वय कल्पना करना, जो दृश्यद्वय है उनको अदृश्यद्वय कल्पना करना दृष्टस्थानद्वय में इष्ट अन्य राशिद्वय करना चाहिये। छेद और फल के नाश में गुण्य और गुणक को छेद और फल कल्पना करनी चाहिये। तब छेद और फल के बध को गुण्य कल्पित इष्ट से भाग देने से फल द्वितीय होता है अर्थात् गुण्य कल्पित इष्ट से भाग देने से गुणक कल्पित इष्ट होता है और गुणक कल्पित इष्ट से भाग देने से गुण्य कल्पित इष्ट होता है इति ॥५६॥

इदानीं पुनर्विशेषमाह।

गुण्यं गुणकारं वा गुणयेच्छेदेन भागहारस्य।
गुण्यगुणकारराश्योश्छेदगुणो भागहारश्च ॥६०॥

सु. भा.—यदा कोऽपि गुण्यो वा गुणको भवेत् तदा तं भागहारस्य छेदेन गुणयेत् फलं गुण्यो वा गुणकः कल्प्यः। एवं गुण्यगुणकारराश्योर्यश्छेदस्तेन भागहारश्च गुणो भागहारो भवति। एतदुक्तं भवति यदि कस्यापि भिन्नो गुण्यो

वा गुणकस्तस्य भागहारश्च भिन्नस्तदा गुण्यस्य गुणकस्य वा लवो गुण्यो वा गुणकसञ्ज्ञः । एवं भागहारस्य लवो भागहारसञ्ज्ञः कल्प्यस्तदाऽयं विधिर्भिन्नभागहारविधिनोत्पद्यते । अत एवात्र चतुर्वेदाचार्यः । 'परिवर्त्त्य भागहारच्छेदांशावित्यनेनार्यासूत्रेण गतार्थेयमार्याऽतो न व्याख्यात मिति' ॥६०॥

वि. भा.—यदि गुण्यो गुणकारो वा भवेत्तदा त भागहारस्य च्छेदेन गुणयेत् फलं गुण्यो गुणकारो वा कल्प्यः तथा गुण्यगुणकराश्योर्यश्छेदस्तेन भागहारो गुणो भागहारो भवति । एतदुक्तं भवति । यदि कस्यापि भिन्नो गुण्यो वा गुणको भवेत्तस्य भागहारश्च भिन्नस्तदा गुण्यस्य गुणकस्य वा लवो गुण्यो वा गुणसंज्ञः । भागहारस्य लवो भागहारसंज्ञः कल्प्यस्तदाऽयं विधिर्भिन्नभागहारविधिनोत्पद्यते । अत एवात्र चतुर्वेदाचार्यः—'परिवर्त्त्य भागहार च्छेदांशावित्यनेनार्या सूत्रेण गतार्थेयमार्याऽतो न व्याख्यातमिति' ॥६०॥

अब पुनः विशेष कहते हैं ।

हि. भा.—यदि कोई गुण्य या गुणक हो तो उसको भागहार के छेद से गुणाकर फल को गुण्य या गुणक कल्पना करना । तथा गुण्य और गुणक राशि के छेद से भागहार को गुणा करनेसे भागहार को गुणा करनेसे भागहार होता है । यदि किसी का गुण्य वा गुणक भिन्न हो उसका भागहार भी भिन्न हो तो गुण्य वा गुणक का लव (अंश) गुण्य संज्ञक वा गुणक संज्ञक होता है । भागहार का लव भागहार संज्ञक होता हैं तब यह विधि भिन्न भागहार विधि से होती है इति ॥६०॥

इदानीं पुनर्विशेषमाहः ।

अच्छेदस्य च्छेदं रूपं कृत्वाऽन्यदुक्तवत्सर्वम् ।
अपवर्त्त्यौ छेदगुणौ तुल्येनेष्टेन गुण्यौ वा ॥ ६१ ॥

सु. भा.—अच्छेदस्याभिन्नस्य रूपं छेदं कृत्वाऽन्यत् सर्वमुक्तवत् कार्यम् । एवं छेदगुणौ केनापि तुल्येनेष्टेन संभवे सत्यपवर्त्त्यौ वा गुण्यौ ततस्ताभ्यां कर्मणि न कश्चिद्विकार इति सर्व स्फुटम् ॥६१॥

वि. भा.—अच्छेदस्य (अभिन्नराशेः) रूपमेकं छेदं (हरं) कृत्वाऽन्यत्सर्व पूर्ववत् कार्यम् । तथा छेद गुणौ केनापि तुल्येनेष्टे नापवर्त्त्यौ वा गुणनीयौ ततोऽग्रे क्रियाकरणे न कोऽपि दोष आगच्छति, भास्करार्येणापि लीलावत्यां 'समेन केनाप्यपवर्त्त्य हारभाज्यौ भजेद्वा सति सम्भवे तु' कथ्यते इति ॥ ६१ ॥

अव पुनः विशेष कहते हैं ।

हि. भा.—अभिन्नराशि (पूर्णाङ्क) में एक हर देकर पूर्ववत् अन्य सब कुछ करना

चाहिये। तथा छेद और गुणक को किसी तुल्य इष्टाङ्क से अपवर्त्तन देकर वा गुणा कर आगे कर्म करने में किसी तरह विकार नही आता है। लीलावती मे 'समेन केनाप्यपवर्त्य हार-भाज्यौ' इत्यादि से भास्कराचार्य इसी बात को कहते है इति ॥ ६१ ॥

इदानीं सकल विकलावर्गानयनार्थमाह ।

स्वविकलषष्ट्यंशगुणः सकलस्त्रिशोद्धृतो विकलवर्गः ।

प्रक्षेप्यः सकलकृतौ वर्गघनौ द्वित्रितुल्यवधौ ॥ ६२ ॥

सु. *भा.*—यत्र राशौकला विकला चेति द्वयं वर्त्तते तस्य वर्गार्थं कलाराशिः सकलसंज्ञो विकलाराशिश्च स्वविकलस्तत्कलाषष्ट्यंशश्च कथ्यते । अथ सकलो राशिः स्वविकल एव षष्ट्यंशः स्वविकलषष्ट्यंशस्तेन गुणस्त्रिशोद्धृतः फलं विकलवर्गसंज्ञो भवति स सकलस्य कृतौ वर्गे प्रक्षेप्यो योज्यस्तदा राशेर्वर्गो भवेत् । अथ वर्गघनलक्षणमाह । द्वित्रितुल्यवधौ क्रमेण वर्गघनौ भवत इति प्रसिद्धौ ।

अत्रोपपतिः ।

कल्प्यते कस्मिन्नपि राशौ कलाः = क । विकलाः = वि । तदा कलात्मकः स राशिः $= क + \frac{वि}{६०}$ ।

अस्य बीजगणितरीत्या वर्गः $= क^{२} + \frac{२ क वि}{६०^{२}} + \frac{वि^{२}}{६०^{२}} = क^{२} + \frac{क. वि}{३०}$ $+ \frac{वि^{२}}{६०}$ -आचार्येणान्तिमं खण्डं रूपाल्पत्वात् त्यक्तम्। ततो जातो वर्गः $= क^{२} + \frac{क. वि}{३०}$ । अत उपपन्नं मूलोक्तम् ॥६२॥

वि. *भा.*—यस्मिन् राशौ कला-विकला चेति द्वयं वर्त्तते तस्य वर्गकरणार्थं कलाराशिः सकल संज्ञो विकलाराशिश्च स्वविकलस्तत्कलाषष्ट्यंशश्च कथ्यते। अथ सकलो राशिः स्वविकल एव षष्ट्यंशः स्वविकलषष्ट्यंशस्तेन गुणस्त्रिशोद्धृतः फलं विकलवर्गसंज्ञो भवति स सकलस्य वर्गे योज्यस्तदा राशेर्वर्गो भवेत् ॥ अथ वर्गघनयोर्लक्षणमाह । समानाङ्कयोर्घातस्तद्वर्गः समानाङ्कत्रयस्य घातस्तद्घन इति, सिद्धान्तशेखरे 'वर्गोऽभिघातः सदृशद्विराश्योर्घनः समानत्रितयस्य घातः' ऽनेन श्रीपतिना, लीलावत्यां 'समद्विघातः कृतिरुच्यते' 'समत्रिघातश्च घनः प्रदिष्टः' आभ्यां भास्करेण चा चार्योक्त वर्गघनलक्षणयोरनुरूपमेव कथ्यते ॥ ६२ ॥

अत्रोपपत्तिः ।

कल्प्यते कस्मिन्नपि राशौ कला $=$ क, विकला $=$ वि, तदा कलात्मकः स राशिः $=$ क $+\frac{\text{वि}}{६०}$, (विकलानां कला षष्ट्या इत्युक्तेर्विकलानां षष्ट्या एका कला) । तदा स्थाप्योऽन्त्यवर्गो द्विगुणान्त्यनिघ्ना इत्यादि भास्करोक्त्या कलात्मकराशिवर्गः $=\left(\text{क}+\frac{\text{वि}}{६०}\right)^{२}=\text{क}^{२}+\frac{२\,\text{क}.\,\text{वि}}{६०}+\left(\frac{\text{वि}}{६०}\right)^{२}=\text{क}^{२}+\frac{\text{क}.\,\text{वि}}{६०}+\left(\frac{\text{वि}}{६०}\right)^{२}$ अत्र $\left(\frac{\text{वि}}{६०}\right)^{२}<१$ तस्मादाचार्येण तत्त्यक्तम् । तदा कलात्मकराशिवर्गः $=\text{क}^{२}+\frac{\text{क}.\,\text{वि}}{३०}$, एतावताऽऽचार्योक्तमुपपन्नम् ॥ ६२ ॥

अब कला सहित विकला के वर्गानयन के लिये कहते हैं ।

हि. भा.—जिस राशि में कला और विकला दोनों हैं उसका वर्ग करने के लिये कला राशि सकल सज्ञक और विकला राशि स्वविकल संज्ञक है । सकल राशि को स्वविकल से गुणा कर तीस से भाग देकर जो फल होता है वह विकलवर्गसंज्ञक होता है इसको सकल के वर्ग में जोड़ देने से राशि का वर्ग होता है ॥ वर्ग और घन के लक्षणों को कहते है । समान दो अङ्कों का घात उस अङ्क का वर्ग कहलाता है । एवं समान तीन अङ्कों का घात उस अङ्क का घन कहलाता है । सिद्धान्त शेखर में 'वर्गोऽभिघातः सदृश द्विराश्योः' इत्यादि से श्री पति, तथा लीलावती में 'समद्विघातः कृतिरुच्यते-समत्रिघातश्च घनः प्रदिष्टः' इससे भास्कराचार्य भी आचार्योक्त के अनुरूप ही कहा है इति ॥

उपपत्ति ।

किसी राशि में कला $=$ क । विकला $=$ वि, तब कलात्मक वह राशि $=$ क $+\frac{\text{वि}}{६०}$ (साठ विकला की एक कला होती है इस नियम से) तब 'स्थाप्योऽन्त्यवर्गो द्विगुणान्त्यनिघ्ना इत्यादि भास्करोक्त सूत्र से कलात्मकराशि वर्ग $=\left(\text{क}+\frac{\text{वि}}{६०}\right)^{२}=\text{क}^{२}+\frac{२\,\text{क}.\,\text{वि}}{६०}+\left(\frac{\text{वि}}{६०}\right)^{२}=\text{क}^{२}+\frac{\text{क}.\,\text{वि}}{३०}+\left(\frac{\text{वि}}{६०}\right)^{२}$ यहां $\left(\frac{\text{वि}}{६०}\right)^{२}<१$ इसलिये आचार्य ने इसको छोड़ दिया, तब कलात्मक राशि वर्ग $=\text{क}^{२}+\frac{\text{क}.\,\text{वि}}{३०}$ इससे आचार्योक्त उपपन्न हुआ ॥ ६२ ॥

इदानीं वर्गार्थमाह ।

राशेरूनं द्विगुणं बहुतरगुणमूनकृतियुतं वर्गः ।
राशेरिष्टयुतोनाद्वधः कृतिर्वेष्टकृतियुक्तः ॥ ६३ ॥

सु. भा.—राशेरूनमूनस्थानीयाङ्कमर्थादेकस्थानीयमङ्कद्विगुणं बहुतरगुणं बहुतरस्थानीयैरङ्कैर्गुणमूनकृतियुतं च यथास्थानकमेवं वर्गो भवेत्। एतदुक्तं भवति। आदिवर्गः स्थाप्यः परेऽङ्का द्विगुणादिनिघ्नाश्च स्थाप्यास्तत आदिं त्यक्त्वा पुनस्तथैव क्रिया कार्या। एवं वर्गो भवेत्। 'स्थाप्योऽन्त्यवर्गो द्विगुणान्त्यनिघ्नाः' इत्यादिभास्करोक्तमेतदनुरूपमेव। भास्करेणान्त्यतः क्रिया कृतेहाचार्येणादित एवेत्येव विशेषः। राशेरिष्टयुतोनाद्वध इत्यादि स्पष्टार्थम्। 'इष्टोनयुग्राशिवधः कृतिः स्यात्' इत्यादि भास्करोक्तमेतदनुरूपमेव ॥६३॥

वि. भा.—राशेरूनमूनस्थानीयाङ्कमर्थादेकस्थानीयमङ्कं द्विगुणं बहुतरगुणं बहुतरस्थानीयैरङ्कैर्गुणमून वर्गयुतं यथास्थानकं तदा वर्गो भवेत्। अर्थादादिवर्गः स्थाप्योऽपरे ऽङ्काद्विगुणादिगुणिताः कार्यास्तत आदि व्यक्त्वा पुनस्तथैव क्रिया कार्या तदा वर्गो भवेत्। इष्टयुतोनाद्राशेर्वध इष्टवर्गयुक्तो वा कृति (वर्गः) र्भवेदिति ॥

अत्रोपपत्तिः।

कल्प्यते राशिः=क=ग+घ तदा वर्ग परिभाषया क. क=क^2=(ग+घ). (ग+घ)=ग^2+ग.घ+ग. घ+घ^2=ग^2+२ ग. घ+घ^2, यदि क=ग+घ+च, तदाप्येवमेव, एतावताऽऽचार्योक्त पूर्वार्धमुपपन्नम्। लीलावत्यां 'स्थाप्योऽन्त्यवर्गो द्विगुणान्त्यनिघ्ना' इत्यादि भास्करोक्तमेतदनुरूपमेवास्ति, किन्तु भास्करेणान्त्यतः क्रिया कृता, आचार्येणादितः क्रियाकृतेत्येतावानेव भेदः।

परार्धोपपत्तिः।

राशिः=क, इष्टम्=इ, इष्टयुत राशिः=क+इ, इष्टरहित राशिः=क−इ, अनयोर्घातः (क+इ) (क−इ) योगान्तर घातस्य वर्गान्तर समत्वात् (क+इ). (क−इ)=क^2−इ^2 पक्षौ इ^2 युतौ तदा (क+इ).(क−इ)+इ^2=क^2 एतेनोपपन्नमाचार्योक्तम्। लीलावत्यां 'इष्टोनयुग्राशिवधः कृतिःस्यादित्यादि' भास्करोक्तमेतदनुरूपमेवास्तीति ॥ ६३ ॥

अब वर्ग के लिए कहते हैं।

हि. भा.—जिन अङ्कों (राशि) का वर्ग करना है उनके दो या तीन आदि खण्ड करना चाहिये तब आदि का वर्ग स्थापन करना पर अङ्को को द्विगुणित आदि से गुणा देना, आदि को छोड़कर पुनः इसी तरह क्रिया करने से राशि वर्ग होता है। वा राशि में इष्ट को जोडकर और राशि में इष्ट को घटाकर जो हो उन दोनों के घात में इष्टवर्ग जोड़ने से राशिवर्ग होता है ॥ ६३ ॥

पूर्वार्ध की उपपत्ति ।

यदि राशि=क=ग+घ तब वर्ग की परिभाषा में क.क=क^{२}=(ग+घ).(ग+घ)=ग^{२}+ग. घ+ग. घ+घ^{२}=ग^{२}+२ग. घ+घ^{२}, यदि क=ग+घ+च, तो भी इसी तरह होता है इससे आचार्योक्त उपपन्न हुआ । लीलावती में 'स्थाप्योऽन्त्यवर्गो द्विगुणान्त्य निघ्ना' इत्यादि भास्करोक्त भी आचार्योक्ति के अनुरूप ही है, किन्तु भास्कराचार्य ने अन्त्याङ्क से क्रिया की है, आचार्य ने आदि से क्रिया की है, इतना ही भेद है ।।

परार्ध की उपपत्ति ।

राशि=क । इष्ट=इ, इष्टयुतराशि=क+इ, इष्ट रहित राशि=क—इ, इन दोनों का घात करने से (क+इ).(क—इ) योगान्तर घात वर्गान्तर के बराबर होता है इसलिये (क+इ).(क—इ)=क^{२}—इ^{२} दोनों पक्षों में इ^{२} जोड़ने से (क+इ). (क—इ)+इ^{२} =क^{२}=राशि^{२} इससे आचार्योक्त उपपन्न हुआ । लीलावती मे 'इष्टोनयुग्राशिवधः कृतिः स्यात्' इत्यादि भास्करोक्त भी इसी के अनुरूप है इति ।। ६३ ।।

इदानीं द्वयो राश्योर्वर्गयोगस्य वर्गान्तरस्य च पदानयनार्थमाह ।

इष्टाल्पराशिवर्गौ युक्तोनावितरविकलवर्गाभ्याम् ।
द्विगुणेतरराशिभ्यां भक्तौ तेनाधिकोनाभ्याम् ।। ६४ ।।

स्थानान्तरेषु लब्धं येन समं फलयुतोनकच्छेदः ।
दलितः कृतियोगान्तरपदमितरो वा फलयुतोनः ।। ६५ ।।

सु. *भा*.—यत्रैक इष्टराशिरल्पोऽन्यश्चेतरः सविकलस्तत्र यदि तयोर्वर्गयोगपदमपेक्षितं तदाऽल्पराशिवर्ग इतरविकलवर्गेण ६२ सूत्रागतेन युक्तः कार्यः । एवं योगो भवति । द्विगुणेतरराशिना भक्तोऽल्पराशिवर्गो यल्लब्धं तेन युतेन द्विगुणेतरराशिना स योगः स्थानान्तरेषु स्थापितो भक्तः कार्यः । लब्धं येन पूर्वफलेन समं भवति तदा छेदो लब्धयुतगुणेतरराशिरयं फलेन युतो दलितो वर्गयोगपदं भवेत् । एवं वर्गान्तरपदेऽपेक्षिते पूर्वोक्त विधौ योगस्थान ऊनं ग्राह्यम् ।

यथा १४ । १५ । ४० राशी । अत्राल्पराशिवर्गः १९६ । ६२ सूत्रागतेनेतरविकलवर्गेण= $\frac{१५\times२\times४०}{६०}$=२० अनेन सहितो जातो योगः १९६+२० =२१६ । अल्पराशिवर्गो द्विगुणेतरराशिना भक्तो लब्धं निरग्रम्=६ अनेन युतो द्विगुणेतरराशिः ३६ । अनेन पूर्वयोगोऽयं २१६ भक्तो लब्धं पूर्वागतनिरग्रलब्ध सममेव । तेन युतश्छेदः ३६ जातः ४२ । अयं दलितो जातं वर्गयोगपदं २१ वा लब्ध

६ मितरराशि १५ युतं जातं तदेव वर्गयोगपदम् २१। एवमन्तरवर्गपदानयनं च कार्यम्।

अत्रोपपत्तिः।

कल्प्यते लघुराशिः=अ। सविकलेतरराशिः कलात्मकः=$इ+\frac{वि}{६०}$। तदैतयोर्वर्ग योगो वा वर्गान्तरम्=$इ^2+\frac{२इ.वि}{६०}\pm अ^2$ स्वल्पान्तरात्।

वा=$इ^2\pm अ^2+वि^2=इ^2\pm(अ^2\pm वि^2)$ अस्य मूलम्।

$इ\pm\frac{अ^2}{२इ}=इ\pm ल$। इदं तदैव स्याद्यदि $२इ\pm ल$ इदं ल गुणं $(२इ\pm ल)$ ल, $अ^2+वि^2$ अनेन समं स्यात् तदा ल=$\frac{अ^2\pm वि^2}{२इ}$। अतस्तदा $२इ\pm२ल$ एतदर्थं वा $इ\pm ल$ इदमासन्नपदं भवेदिति ॥६४-६५॥

वि. भा.—यत्रैक इष्टराशिरल्पो ऽन्यश्चेतरः सविकलस्तत्र यदि तयोर्वर्गयोगमूलमपेक्षितं तदाऽल्पराशिवर्ग इतरविकलवर्गेण ६२ सूत्रागतेन युक्तः कार्यः। एवं योगो भवति। अल्पराशिवर्गो द्विगुणेतरराशिना भक्तो यल्लब्धं तेन युतेन द्विगुणेतरराशिना स योगः स्थानान्तरेषु स्थापितो भक्तो लब्धं येन पूर्वफलेन समं भवति तदा छेदो लब्धयुतद्विगुणेतरराशिरयं फलेन युतो दलितो वर्गयोग पदं भवेत्। एवं वर्गान्तरपदेऽपेक्षिते पूर्वोक्तविधौ योगस्थान ऊनं ग्राह्यम्।

यथा १४ ॥ १५ ॥ ४० राशी। अत्राल्पराशिवर्गः=$(१४)^2=१९६$, ६२ सूत्रागतेनेतरविकलवर्गेण = $\frac{१५\times२\times४०}{६०}=२०$ अनेन सहितो जातो योगः =$१९६+२०=२१६$। अल्पराशिवर्गो द्विगुणोत्तरराशिना भक्तो लब्धं निरग्रम् =६। अनेन युतो द्विगुणोत्तरराशिः=३६ अनेन पूर्वयोगोऽयं २१६ भक्तो लब्धं पूर्वागतनिरग्रलब्धसममेव। तेन युतश्छेदः ३६ जातः ४२ अस्यार्धं जातं वर्गयोगमूलम्=२१ वा लब्ध ६ मितरराशि १५ युतं तदा तदेव वर्गयोग मूलम्=२१। एव मन्तर वर्गपदानयनं च कार्यम्॥

अत्रोपपत्तिः।

कल्प्यते लघुराशिः=अ। सविकलेतर राशिः कलात्मकः=$इ+\frac{वि}{६०}$

तदैतयोर्वर्गयोगो वा वर्गान्तरम्=$इ^2+\frac{२इ.वि}{६०}\pm अ^2$ स्वल्पान्तरात्।

वा $इ^2 \pm अ^2 + वि^2 = इ^2 \pm (अ^2 \pm वि^2)$ अस्य मूलम् $= इ \pm \frac{अ^2}{२इ} = इ \pm ल$ इदं तदैव स्याद्यदि २ इ ± ल इदं ल गुणं (२ इ ± ल) ल $अ^2 \pm वि^2$ अनेन मम स्यात्तदा ल $= \frac{अ^2 \pm वि^2}{२ इ \pm ल}$, अतस्तदा २ इ ± २ ल एतदर्ध वा इ ± ल इदमासन्नमूलं भवेदिति ॥६४–६५॥

अब दो राशियों के वर्गयोग और वर्गान्तर के पदानयन के लिये कहते है।

हि. भा.—जहां एक राशि अल्प हो और अन्य सविकल हो वहां यदि उन दोनों का वर्गयोग पदानयन अपेक्षित हो तो अल्पराशि वर्ग में ६२ सूत्र से आये हुए इतर विकल वर्ग को जोड़ देना योग होता है, अल्प राशि वर्ग को द्विगुणेतर राशि से भाग देने से जो लब्ध हो उसको द्विगुणेतर राशि मे जोड़ कर उस योग में भाग देना लब्ध जैसे पूर्व फल के बराबर हो, तब छेद लब्ध युत द्विगुणेतर राशि होती है इसमे फल जोड़ कर आधा करने से वर्गयोग पद होता है इसी तरह वर्गान्तर पदानयन के लिये पूर्वोक्त विधि मे योग स्थान मे ऊन ग्रहण करना चाहिये।

जैसे दो राशि १४ ॥ १५ ॥ ४० है, यहां अल्प राशि १४ वर्ग १९६ मे ६२ सूत्रागत इतर विकलवर्ग $= \frac{१५ \times २ \times ४०}{६०} = २०$ जोड़ने से $१९६ + २० = २१६ =$ योग। अल्पराशि वर्ग में द्विगुणेतर राशि से भाग देने से निरग्रलब्धि $= ६$ इसको द्विगुणेतर राशि में जोड़ने से ३६ हुआ, इससे पूर्वागत योग २१६ मे भाग देने से लब्ध पूर्वागत निरग्र-लब्ध के बराबर ही हुआ। उससे छेद को जोड़ने से $३६ + ६ = ४२$ इसका आधा $= २१ =$ वर्गयोगपद वा लब्ध ६ में इतर राशि १५ जोड़ने से वही वर्ग योग पद २१ होता है इसी तरह वर्गान्तर पदानयन करना चाहिये।

उपपत्ति।

कल्पना करते है लघुराशि $=$ अ। सविकलेतर राशि कलात्मक $= इ + \frac{वि}{६०}$ तब इन दोनों का वर्गयोग वा वर्गान्तर $= इ^2 + \frac{२ इ. वि}{६०} \pm अ^2$ स्वल्पान्तर से वा $इ^2 \pm अ^2 + वि^2 = इ^2 \pm (अ^2 \pm वि^2)$ इसका मूल $= इ \pm \frac{अ^2}{२ इ} = इ \pm ल$, यह तब ही हो सकता है यदि २ इ ± ल इसको ल से गुणा करने से (२ इ ± ल). ल, से $अ^2 \pm वि^2$ इसके बराबरहो। तब ल $= \frac{अ^2 \pm वि^2}{२ इ \pm ल}$, अतः तब २इ ± २ल इसका आधा इ ± ल यह आसन्न पद होता है इति ॥६४–६५॥

इदानीमध्यायोपसंहारमाह ।

दिङ्मात्रमेतदन्यज्ज्योत्पत्तौ कुट्टके च कथयिष्ये ।
सङ्कलितादिष्वार्या षट्षष्टिर्द्वादशोऽध्यायः ।। ६६ ।।

सु. भा.—स्पष्टार्थम् ।

मधुसूदनसूनुनोदितो यस्तिलकः श्री पृथुनेह जिष्णुजोक्ते ।
हृदि तं विनिधाय नूनतोऽयं रचितो व्यक्तिविधौ सुधाकरेण ।।

इति श्री कृपालु दत्तसुतसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धांतनूतनतिलके गणिताध्यायो नाम द्वादशोऽध्यायः ।। १२ ।।

वि. भा.—सङ्कलितादिषु गणितेष्वेतत्पूर्वोक्तं सर्वं दिग्दर्शनमात्रमेव मया प्रदर्शितम् । अन्यत् ज्योत्पत्तौ कुट्टके च कथयिष्यते । आर्या षट्षष्टिः (षट्षष्टिसंख्यकार्या श्लोकात्मको) द्वादशोध्यायः समाप्त इति ।।६६।।

इति श्री ब्राह्मस्फुटसिद्धान्ते द्वादशोध्यायः

अब अध्याय के उपसंहार को कहते है ।

हि. भा—**सङ्कलित आदि गणितों में पूर्वोक्त सब कुछ दिग्दर्शन मात्र कहा गया है । अन्य (अवशिष्ट) ज्योत्पत्ति में और कुट्टक मे कहेगे । छयासठ आर्या श्लोकों का यह बारहवां अध्याय समाप्त हुआ इति ।।६६।।**

इति श्री ब्राह्मस्फुटसिद्धान्त में बारहवां अध्याय समाप्त हुआ ।

•

ब्राह्मस्फुटसिद्धान्तः

७

प्रश्नाध्यायाः

तत्र तावन्मध्यगत्युत्तराध्यायः

अत्रादौ तदारम्भप्रयोजनमाह ।

प्रश्नाध्यायान् वक्ष्यामि सोत्तरान् गणकबुद्धिवृद्धिकरान् ।
यैर्ज्ञातैस्तन्त्रविदामाचार्यो भवति बुद्धिमताम् ॥ १ ॥

सु. भा.—यैः प्रश्नैर्ज्ञातैर्बुद्धिमतां तन्त्रविदां मध्ये गणक आचार्यो भवति । शेषं स्पष्टार्थम् ॥१॥

वि. भा.—गणक बुद्धि वर्धकान्—उत्तर सहितान् प्रश्नाध्यायानहं वक्ष्यामि यैः (प्रश्नै) ज्ञातैर्बुद्धिमतां तन्त्रविदां मध्ये गणक आचार्यो भवति ॥१॥

अब प्रश्नाध्याय आरम्भ किया जाता है ।

उनमें पहले मध्यगत्युत्तराध्याय है, प्रश्नाध्याय के आरम्भ करने के प्रयोजन को कहते हैं ।

हि. *भा*—ज्योतिषियों की बुद्धि को बढाने वाले उत्तर सहित प्रश्नाध्याय को मैं कहता हूं, जिन प्रश्नों की समझ से ज्योतिषी लोग बुद्धिमान् तन्त्रज्ञों के बीच मे आचार्य होते है ॥१॥

इदानीं प्रश्नानाह ।

अधिमासकैः सविकलैर्दृष्टै र्युगयातमवमरात्रैर्वा ।
युगगणेन वा युगगतं यो वेत्ति स कालतन्त्रज्ञः ॥२॥

सु० *भा०*—सविकलैः साधिशेषकैरधिमासकैर्दृष्टैर्यो युगगतं वेत्ति । वा

सविकलैः सावमशेषैरवमगात्रैरूनाहैर्दृष्टैर्यो युगगतं वेत्ति । वा द्युगणेनाहर्गणेन दृष्टेन यो युगगतं वेत्ति स कालतन्त्रज्ञः सिद्धान्तविदिति । एवमत्र प्रश्नत्रयम् ॥२॥

वि. भा.—सविकलैः सशेषैः (अधिशेष सहितैः) अधिमासकैर्दृष्टैर्यो युगगतं- वेत्ति, वा सशेषैः (अवमशेषसहितैः) अवमरात्रै (क्षयाहैः) दृष्टैर्यो युगगत वेत्ति। वा द्युगणेन (अहर्गणेन) दृष्टेन यो युगगतं वेत्ति स कालतन्त्रज्ञः (ज्योतिः सिद्धान्त- पण्डितः) अस्तीति । अत्र प्रश्नत्रयमस्ति ।

प्रथमप्रश्नोत्तरार्थं युक्तिः ।

गतसौर दिनेभ्यः साधिशेषा गताधिमासाः $= \dfrac{\text{युगाधिमास. गतसौरदिन}}{\text{युसौरदि}}$

$= \text{गताधिमास} + \dfrac{\text{अधिशे}}{\text{युसौदि}}$ पक्षौ 'युसौदि' गुणितौ तदा युगाधिमास . गतसौदि

$=$ युसौदि . गताधिमा $+$ अधिशे, पक्षौ 'युगाधिमा' भक्तौ तदा गतसौदि

$= \dfrac{\text{युसौदि. गताधिमास} + \text{अधिशे}}{\text{युगाधिमास}}$ अत्र युगशब्देन सर्वत्र कल्पो ग्राह्यः । एतावता

युगरवि दिवसैर्गुणिता गताधिमासाः स्वशेषसंयुक्ताः ।
भक्ता युगाधिमासैः फलं युगादेर्गता दिवसाः ॥ ११ ॥[1]

इत्युपपद्यत इति ।

अब प्रश्नों को कहते हैं ।

हि. भा.—अधिशेष सहित अधिमास को जानकर जो युगगत को जानते है, वा अवमशेष सहित क्षयाह को जानकर युगगत को जानते हैं, वा अहर्गण जानकर जो युगगत को जानते है वे ज्योतिः सिद्धान्त के पण्डित है । यहां तीन प्रश्न हैं ।

प्रथम प्रश्न के उत्तर के लिये युक्ति ।

गतसौर दिन से अधिशेष सहित गताधिमास $= \dfrac{\text{युगाधिमा. गतसौदि}}{\text{युसौदि}} =$

गताधिमा $+ \dfrac{\text{अधिशे}}{\text{युसौदि}}$ दोनों पक्षों को 'युसौदि' गुणा करने से युगाधिमा . गतसौदि

$=$ युसौदि . गताधिमा $+$ अधिशे, दोनों पक्षों को 'युगाधिमा' भाग देने से गतसौदि

$= \dfrac{\text{युसौदि. गताधिमा} + \text{अधिशे}}{\text{युगाधिमा}}$ यहाँ युग से सब जगह कल्प ग्रहण करना चाहिये । इससे 'युगरवि दिवसैर्गुणिता ॥ ११ ॥' इत्यादि संस्कृतोपपत्ति में लिखित पद्य उपपन्न होता है ॥

१. अस्य सुधाकरभाष्यं ९३३ तमे पृष्ठे द्रष्टव्यम् ।

अथ द्वितीय प्रश्नस्योत्तरार्थं युक्तिः ।

सशेषगतावमतोऽनुपातेन गतचान्द्रदिनानयनं स्पष्टमेव । अधिमासस्य सौरत्वे चान्द्रत्वे चाधिशेषं तुल्यमेव स्यादिति 'सौरेभ्यः साधितास्ते चेदधिमासा' इत्यादि वासना भाष्ये भास्करोक्तेः सौरदिनेभ्यश्चान्द्रदिनेभ्यश्च गताधिमासाः समा एव भवन्ति तच्छेषमपि सममेव । एकत्र युगसौरदिनहरोऽन्यत्र युगचान्द्र-दिनहरः। ततश्चान्द्रदिनेभ्यः समा गतैर्गताधिमासैर्दिनीकृतैश्चान्द्रदिवसा रहिता-स्तदा गतसौरदिनानि भवन्ति येभ्यः पुनर्गताधिमासाहर्गणेष्टग्रहाद्यं सुखेन ज्ञायते ।

गतसौरदिनेभ्यः साधिशेषा गताधिमासाः $= \frac{\text{युगाधिमास. गतसौदि}}{\text{युसौदि}}$

$= \text{गताधिमा} + \frac{\text{अधिशे}}{\text{युसौदि}}$ छेदगमेन युगाधिमा. गसौदि=युसौदि . गताधिमा+ अधिशे; पक्षयोः '३० युगाधिमा . गताधिमा' योजनेन युगाधिमा . गसौदि+३० युगाधिमा . गताधिमा = युसौदि . गताधिमा+अधिशे+३० युगाधिमा . गताधिमा = युगाधिमा (गतसौदि+गताधिमादि)=गताधिमा (युसौदि+युगधिमादि)+ अधिशे=युगाधिमा . गचांदि =गताधिमा . युचांदि+अधिशे (१)

एतेन 'अधिमासस्य चान्द्रत्वे सौरत्वे चाधिशेषं तुल्यमेव स्यात्' भास्करोक्त-मिदमुपपद्यते । तथा (१) अत्र समीकरणे युगाधिमासगताधिमासाधिशेषेषु स्थानेषु युगावमगतावमावमावशेष ग्रहणं क्रियेत तदा—

गुणितानि चान्द्र दिवसैर्गतावमानि स्वशेषसहितानि ।
विभजेद्युगावमैः फलमनष्टमधिमासकैर्गुणितम् ॥ १२ ॥

हृतमिन्दुदिनैर्लब्धाधिमासदिवसैर्विहीनकमनष्टम् ।
युगयातदिनाद्यधिमास दिनगणेष्टग्रहाद्यमतः ॥ १३ ॥[१]

आचार्योक्तं चोपपद्यते ।

अब द्वितीय प्रश्न के उत्तर के लिये युक्ति ।

हि. भा.—सशेषगतावम से अनुपात से गत चन्द्र दिनानयन स्पष्ट ही है । गत सौर दिन से साधिशेषगताधिमास $= \frac{\text{युगाधिमा. गसौदि}}{\text{युसौदि}} = \text{गताधिमा} + \frac{\text{अधिशे}}{\text{युसौदि}}$ छेदगम से युगाधिमा . गसौदि = युसौदि . गताधिमा + अधिशे, दोनो पक्षों में ३० युगाधिमा . गताधिमा जोड़ने से युगाधिमा . गसौदि + ३० युगाधिमा . गताधिमा = युसौदि . गताधिमा + ३० युगाधिमा . गताधिमा + अधिशे = युगाधिमा (गसौदि +

१. अनयोः सुधाकरभाष्यं ६३४ तमे पृष्ठे द्रष्टव्यम् ।

गताधिमादि) = गताधिमा (युसौदि + युगाधिमादि) + अधिशे = युगाधिमा . गचांदि = गताधिमा . युचांदि + अधिशे . (क)

अतः यहां सौर और चान्द्र से गताधिमास तुल्य ही आते है और अधिशेष भी समान ही आता है; इससे भास्करोक्त 'अधिमासस्य चान्द्रत्वे सौरत्वे चाधिशेष तुल्यमेव स्यात्' उपपन्न होता है। तथा (क) समीकरण में यदि युगाधिमास के स्थान मे युगावम, गताधिमास के स्थान मे गतावम, और अधिशेष स्थान मे क्षय शेष ग्रहण किया जाय तो 'गुणितानि चान्द्र दिवसैः' इत्यादि संस्कृतोपपत्ति मे लिखित आचार्योक्त पद्य उपपन्न होते है ।।१२-१३।।

अथ तृतीय प्रश्नस्योत्तरार्थं युक्तिः ।

यदि युगकुदिनैर्युगचान्द्रदिनानि लभ्यन्ते तदाऽहर्गणेन किं समागच्छन्ति गतचान्द्रदिनानि, पुनरनुपातो यदि युगचान्द्रदिनैर्युगाधिमासा लभ्यन्ते तदा गतचान्द्रदिनैः किं फलं गताधिमासास्तत्स्वरूपम् = $\frac{\text{युगाधिमा गचांदि}}{\text{युचांदि}}$ = गताधिमा, एतद्दिनीकृतं गतचान्द्रदिने विहीनं तदा युगगतसौरदिनानि भवन्तीति—अहर्गणानयनविलोमेन कल्पगतानयनमस्तीति, एतेन

युगणेन्दु दिवसघातात् कुदिनाप्तमथोयुगाधिमासगुणम् ।
शशिदिनभक्तं फलमासदिनोनं युगगतदिनानि ।। १४ ।।[1]

आचार्योक्तमिदमुपपद्यते ।

अब तृतीय प्रश्न के उत्तर के लिये युक्ति ।

यदि युग कुदिन में युगचान्द्रदिन पाते हैं तो अहर्गण में क्या इस अनुपात से गतचान्द्र दिन आते हैं $\frac{\text{युचांदि. अहर्गण}}{\text{युगकु}}$ = गतचांदि, पुनः अनुपात करते हैं, यदि युगचान्द्रदिन में युगाधिमास पाते हैं। तो गतचान्द्रदिन में क्या इससे गताधिमास आते है $\frac{\text{युगाधिमा गचांदि}}{\text{युचादि}}$ = गताधिमा, इस को दिन बना कर अर्थात् तीस से गुणा कर गतचान्द्र दिन में से घटाने से युगगत सौर दिन होते हैं। इससे 'द्युगणेन्दुदिवसघातात् ।।१४।।' इत्यादि संस्कृतोपपत्ति में लिखित आचार्योक्त पद्य उपपन्न होता है अहर्गणानयन का विलोम कल्पगतानयन है इति ।

इदानीमन्यान् प्रश्नानाह ।

अवमानि यः सविकलैरधिमासैरधिकमासकानवमैः ।
ग्रहमिष्टं वा ताभ्यां यो वेत्ति स कालतन्त्रज्ञः ।।३।।

१. अस्य सुधाकरभाष्यं १३४ तमे पृष्ठे द्रष्टव्यम् ।

सु. भा.—यः सविकलैः साधिशेषैरधिमासैरवमानि गतावमानि वेत्ति। वा यः सावमशेषैरवमैर्गताधिमासकान् वेत्ति। वा ताभ्यामधिशेषावमशेषाभ्यामिष्टं मध्यग्रहं वेत्ति, स एव कालतन्त्रज्ञः। एवमत्र प्रश्नत्रयम् ॥ ३ ॥

वि. भा.—यः सविकलैः (अधिशेष सहितैः) अधिमासैरवमानि(गतावमानि) वेत्ति वा योऽवमशेषसहितैरवमैर्गताधिमासान् वेत्ति, वा ताभ्यामधिशेषावमशेषाभ्यामिष्टं ग्रहं (मध्यमग्रहं) वेत्ति, स सिद्धान्तविदस्ति अत्र प्रश्नत्रयमस्ति ॥

प्रथम द्वितीयप्रश्नयोरुत्तरार्थ युक्तिः।

यदि युगाधिमासै र्युगावमानि लभ्यन्ते तदा सशेषगताधिमासैः किं समागच्छन्त्यवमानि। एवमेव सशेषावमेभ्यो गताधिमासानयनं चेति ॥

तृतीय प्रश्नोत्तरार्थ युक्तिः।

कल्प्यते-अहर्गरण प्रमाणम्=य, तदाऽनुपातेन गतावमानि$=\frac{\text{य.युअव}-\text{क्षशे}}{\text{युकु}}$

अहर्गणे सयोजनेन जातानि गतचान्द्रदिनानि$=\frac{\text{य (युकु+युअव)}-\text{क्षशे}}{\text{युकु}}$

$=\frac{\text{य. युचांदि}-\text{क्षशे}}{\text{युकु}}$ एभ्योऽनुपातेन सशेषा गताधिमासाः$=\frac{\text{युगाधिमा.गतचांदि}}{\text{युचांदि}}$

$=\frac{\text{युगाधिमा. युचांदि· य}-\text{युगाधिमा. क्षशे}}{\text{युचांदि. युकु}}$ $=$गताधिमा$+\frac{\text{अधिशे}}{\text{युचांदि}}$ छेदगमेन

युगाधिमा. युचांदि. य—युगाधिमा . क्षशे=गताधिमा . युचांदि-युकु+अधिशेयुकु, समयोजनेन युगाधिमा. युचांदि . य=गताधिमा . युचांदि . युकु+अधिशे . युकु+युगाधिमा . क्षशे, पक्षौ युचांदि भक्तौ तदा युगाधिमा. य=गताधिमा. युकु+$\frac{\text{अधिशे. युकु+युगाधिमा. क्षशे}}{\text{युचादि}}$=गताधिमा. युकु+स्पष्टाधिशे,

$\therefore$ य$=\frac{\text{गताधिमा. युकु+स्पष्टाधिशे}}{\text{युगाधिमा}}$, अत्र$\frac{\text{अधिशे.युकु+युगाधिमा.क्षशे}}{\text{युचांदि}}$ =स्पष्टाधिशे।

अहर्गणज्ञानेन मध्यमाधिकारोक्त 'अहर्गणान्मध्यग्रहानयनं विधिनेष्ट मध्यमग्रहाः सुखेनैव समागच्छन्तीति। एतावता

गुणमधिमासक शेषं युगकुदिनै रवमशेषमधिमासैः।
तद्युतिरिन्दुदिनहृताधिमास शेषं स्फुटं भवति ॥ १५ ॥'

१. अस्य सुधाकरभाष्यं ९३५ तमे पृष्ठे द्रष्टव्यम्।

भूदिनगताधिमासकघातः स्पष्टाधिमासशेषयुतः ।
भक्तो युगाधिमासैरहर्गणः पूर्ववन्मध्याः ॥ १६ ॥[1]

अधिमासशेषयुग कुदिनैरवमशेष च युगाधिमासैर्गुणनीयं तयोर्युतिर्युग-चान्द्रदिनैर्भक्ता फल स्फुटाधिशेषसज्ञक भवति, युगकुदिन गताधिमासघातः स्फुटाधिशेषयुतो युगाधिमासैर्भक्तो लब्धमहर्गणो भवेत् । ततोमध्यमाधिकारोक्त-वदिष्टमध्यमग्रहा भवन्ति' आचार्योक्तमुपपद्यते ।

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—जो व्यक्ति शेष सहित अधिमास से अवम को जानते हैं । वा अवमशेष सहित अवमों से गताधिमास को जानते हैं । वा उन दोनो से (अधिशेष और अवमशेष) इष्टग्रह (मध्यमग्रह) को जानते हैं वे ज्योतिःसिद्धान्तवेत्ता है । यहां तीन प्रश्न है । प्रथम और द्वितीय प्रश्न के उत्तर के लिये उपपत्ति । यहां अनुपात करते है । यदि युगाधिमास मे युगावम पाते है तो शेष सहित गताधिमास मे क्या इससे गतावम आते है । इसी तरह अनुपात से शेष सहित अवम से गताधिमासानयन होता है ॥

तृतीय प्रश्न के उत्तर के लिये उपपत्ति ।

कल्पना करते हैं अहर्गण प्रमाण=य, तब अनुपात से गतावम $=\frac{\text{य. यु अव}-\text{क्षशे}}{\text{युकु}}$

इसको अहर्गण में जोड़ने से गत चान्द्र दिन $=\frac{\text{य (युकु+यु अव)}-\text{क्षशे}}{\text{युकु.}}=\frac{\text{य. युचांदि}-\text{क्षशे}}{\text{युकु}}$

इससे अनुपात से गताधिमास $=\frac{\text{युगाधिमास. गचांदि}}{\text{युचादि}}=\frac{\text{युगाधिमा. युचादि. य}-\text{युगाधिमा.क्षशे}}{\text{युचांदि. युकु}}$

$=\text{गताधिमा}+\frac{\text{अधिशे}}{\text{युचांदि}}$ छेदगम से युगाधिमा. युचांदि. य—युगाधिमा. क्षशे = गताधिमा. युचांदि. युकु+अधिशे. युकु, दोनों पक्षो मे युगाधिमा. क्षशे जोड़ने से युगाधिमा. युचादि. य= गताधिमा. युचांदि. युकु+अधिशे. युकु+युगाधिमा. क्षशे, दोनों पक्षों को युचादि से भाग देने से युगाधिमास. य=गताधिमा. युकु+ $\frac{\text{अधिशे. युकु+युगाधिमा. क्षशे}}{\text{युचादि}}$ =गताधिमा. युकु+ स्पष्टाधिशे । यहां $\frac{\text{अधिशे. युकु+ युगाधिमा. क्षशे}}{\text{युचांदि}}$ =स्पष्टाधिशेष ।

$\therefore$ य $=\frac{\text{गताधिमा. युकु+स्पष्टाधिशे}}{\text{युगाधिमा}}$ अहर्गण ज्ञान से मध्यमाधिकारोक्त 'अहर्गणा-न्मध्य ग्रहानयनं' विधि द्वारा सुगमता से मध्यम ग्रह ज्ञान हो जायगा । इससे 'गुणमधिमासक-

१. अस्य सुधाकरभाष्यं ९३५ तमे पृष्ठे द्रष्टव्यम् ।

शेषम् ॥ १५-१६ ॥' इत्यादि संस्कृतोपपत्ति में लिखित आचार्योक्त पद्य उपपन्न हुआ। आचार्योक्त पद्यों का अभिप्राय है कि अधिमास शेष को युग कुदिन से और अवम शेष को युगाधिमास से गुणाकर दोनों के योग को युगचान्द्रदिन से भाग देने से लब्ध स्फुटाधिशेषसंज्ञक होता है। युगकुदिन और गताधिमास के घात में स्फुटाधिशेष जोडकर युगाधिमास से भाग देने से लब्ध अहर्गण होता है। उससे मध्यमाधिकारोक्तवत् मध्यमग्रह ज्ञान होता है इति।

इदानीमन्यान् प्रश्नानाह।

द्युगणं विना ऽधिमासावमैर्विना दिनगणेन चन्द्रार्कौ।
ताभ्यां विना स्फुटतिथिं यो वेत्ति स कालतन्त्रज्ञः ॥ ४ ॥

सु. भा.—योऽधिमासावमैर्विनाऽहर्गणं वेत्ति। वा दिनगणेन विना चन्द्रार्कौ वेत्ति। वा ताभ्यां चन्द्रार्काभ्यां विना स्फुटतिथिं वेत्ति स कालतन्त्रज्ञः। एवमत्र प्रश्नत्रयम् ॥४॥

वि. भा—योऽधिमासावमैर्विना द्युगणं (अहर्गणं) जानाति, वा दिनगणेन (अहर्गणेन) विना चन्द्रार्कौ (चन्द्रसूर्यौ) जानाति, वा ताभ्यां (चन्द्रार्काभ्यां) विना स्फुटतिथिं जानाति स सिद्धान्तविदिति। अत्र प्रश्नत्रयमस्ति ॥

प्रथम प्रश्नोत्तरार्थमुपपत्तिः।

यदि युगसौरमासैर्युगचान्द्रमासा लभ्यन्ते तदा गतचान्द्रमासतुल्यैः सौरमासैः किं लब्धा निरग्रा अमान्ते गतचान्द्रमासास्ते त्रिंशद्गुणिता अमान्तादग्रे यावन्ति चान्द्र दिनानि तैर्युता तदेष्टदिने गतचान्द्रदिनानि जातानि, ततो यदि युग चान्द्रमासैर्युगकुदिनतुल्योऽहर्गणस्तदागतचान्द्रदिनैः कि लब्धं तिथ्यन्ते सावयवः सावनाहर्गणो भवति। शेषत्यागेन सूर्योदये निरग्रः सावनाहर्गणो भवेत्। अभीष्टवारार्थ 'अभीष्टवारार्थमहर्गणश्चे दित्यादि' भास्करोक्त्याऽहर्गणः सैको वा निरेकः स्फुटतिथिदिनार्थं कार्य इति। एतेन

युगगतशशिमासवधाद्रविमासाप्तं दिनीकृतं सदिनम्।
भूदिनगुणितं शशिदिनहृतमाप्नमहर्गणः सैकः ॥ १८ ॥[1]

आचार्योक्तमिदमुपपद्यते। युगचान्द्रमासानां गतचान्द्रमासानां च वधाद्युगसौरमासै र्भक्ताद्यल्लब्धं निरग्रं तद्दिनीकृतममान्तादग्रे यस्मिन् दिनेऽहर्गणज्ञानमभीष्टं तद्दिनसंख्यायुतं ततो युगकुदिनैर्गुणितं युगचान्द्रदिनैर्भक्तं लब्धमहर्गणो भवेत्। स वारार्थं सैकोवा निरेकः कार्य इति सिद्धान्त शेखरे 'कल्पातीत पतङ्गमासनिवहे कल्पेन्दुमासाहते तैः सौरैर्विहृतैकवासरगता मासा भवन्त्यैन्दवाः। पश्चात्ते

१. अस्य सुधाकरभाष्यं ९३७ तमे पृष्ठे द्रष्टव्यम्।

दिवसीकृताः सतिथयः कल्पैर्हता भूदिनैर्भक्ता कल्प समुत्थचान्द्रदिवसैः सैको-ऽथवाऽहर्गणः" श्रीपतेरयं प्रकारो वर्त्तते ।

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.— जो व्यक्ति अधिमास और अवम के बिना अहर्गण को जानता है। वा अहर्गण के बिना चन्द्र और सूर्य को जानता है। वा चन्द्र और सूर्य के बिना स्फुट तिथि को जानता है वह सिद्धान्तवेत्ता है, यहां तीन प्रश्न है ॥ ४ ॥

प्रथम प्रश्न के उत्तर के लिये उपपत्ति ।

यदि युगसौर मास में युगचान्द्रमास पाते हैं तो गत चान्द्रमास तुल्य सौर मास में क्या इस अनुपात से लब्ध निरग्र अमान्त में गत चान्द्रमास आते है । उनको तीस से गुणाकर अमान्त से आगे जितने चान्द्रदिन है वे उसमें जोड देना तब इष्ट दिन मे गत चान्द्र दिन होते है । तब अनुपात करते है । यदि युग चान्द्रमास मे युग कुदिन तुल्य अहर्गण पाते है तो गत चान्द्र दिन में क्या इससे लब्ध तिथ्यन्त में सावयव सावनाहर्गण होना है । शेष के त्याग करने से सूर्योदय काल में निरग्र अहर्गण होता है। अभीष्ट वार के लिये अहर्गण में सैक वा निरेक करना चाहिये । इससे 'युगगतशशिमासवधात् ॥ १८ ॥' इत्यादि सस्कृतोपपत्ति में लिखित आचार्योक्त पद्य उपपन्न होता है। आचार्योक्त पद्यों का अभिप्राय यह है कि युगचान्द्रमास और गतचान्द्रमास के घात में युगसौर मास से भाग देने से जो निरग्र लब्ध हो उसके दिन बनाना अमान्त से आगे जिस दिन में अहर्गण ज्ञान अभीष्ट हो उसकी दिनसंख्या उसमें जोड़ देना तव युग कुदिन से गुणा कर युगचान्द्रदिन से भाग देने से लब्ध अहर्गण होता है । अभीष्ट वार के लिये उसको सैक वा निरेक करना चाहिये ॥ सिद्धान्त शेखर में "कल्पातीत पतङ्ग मास निवहे' इत्यादि संस्कृतोपपत्ति में लिखित पद्य से, श्रीपति प्रकार है ॥ ४ ॥

इदानीमन्यान् प्रश्नानाह ।

त्रिगुणः शनिरिन्दूनोऽन्य भगणलब्धैर्गृहादिभिः सहितः ।
भौमो हीनोऽर्को गुरुरिन्दूच्चं वा ऽन्यभगणाः के ॥५॥

सु. भा.—राश्यादिकः शनिस्त्रिगुण इन्दुराश्याद्यूनोऽन्यभगणलब्धैर्गृहादिभिः सहितो भौमो भवति । तैरन्यभगण गृहादिभिर्हीनोऽर्को वा गुरुर्वेन्दूच्चं भवति तदाऽन्यभगणाः के सन्तीति प्रश्नः ।

अत्र चतुर्वेदाचार्यः । अत्र सप्तभिर्ग्रहैः पञ्चभिः शीघ्रैः षड्भिः पातैः सप्तभिर्मन्दैश्च विकल्पमाने सहस्त्रमधिकं प्रश्नानां समपद्यत इति ॥ ५ ॥

वि. भा.—राश्यादिकः शनिस्त्रिगुण इन्दु राश्याद्यूनोऽन्यभगणलब्धैर्गृहादिभिः सहितो भौमो भवति । तैरन्यभगणगृहादिभिर्हीनोऽर्को वा गुरुर्वेन्दूच्चं भवति तदाऽन्य भगणाः के सन्तीति प्रश्नः ।

अत्र चतुर्वेदाचार्यः—अत्र सप्तभिर्ग्रहैः पञ्चभिः शीघ्रैः षड्भिः पातैः सप्तभिर्मन्दैश्च विकल्पमाने सहस्रमधिकं प्रश्नानां सम्पद्यत इति ॥५॥

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—राश्यादिक शनि को तीन से गुणाकर देते हैं उसमें से चन्द्र राश्यादि को घटाकर अन्य ग्रहभगण राश्यादि से भाग देने से लब्ध राशियों को जोडने से मङ्गल होते हैं । उन्हीं अन्य भगण राश्यादियों को रवि में वा गुरु (बृहस्पति) में से घटाने से चन्द्रोच्च होता है तब अन्यभगण क्या हैं ॥ ५ ॥

इदानीमन्यौ प्रश्नावाह ।

द्वित्रिगुणयो रवीन्द्वोर्युतिः कुजोनाऽन्यभगणलब्धेन ।
राश्यादिनाऽधिका गुरुरूना शनिरन्यभगणाः के ॥ ६ ॥

सु. भा.—द्विगुणो रविस्त्रिगुणश्चन्द्रो ऽनयोर्युतिः कुजेनोना ऽन्यभगणलब्धेन राश्यादिनाऽधिका तदा गुरुर्भवति । अथ तेनैव राश्यादिनोना तदा शनिर्भवति । एवमन्यभगणाः के सन्तीति प्रश्नद्वयम् ॥६॥

वि. भा.—द्विगुणो रविस्त्रिगुणश्चन्द्रोऽनयोर्युतिः कुजेनोनाऽन्यभगण लब्धेन राश्यादिनाऽधिका तदा गुरुर्भवति । अथ तेनैव राश्यादिनोना तदा शनिर्भवति तदाऽन्य भगणाः के सन्तीति प्रश्नद्वयम् ।

एषां प्रश्नानामुत्तरार्थमुपपत्तिः ।

यदि युग ग्रहभगणा इष्ट गुणकुदिनैर्युता वा हीनास्तदा तेभ्योपि राश्यादिको ग्रहः स एव भवति यतस्तेऽहर्गणगुणाः कुदिनैर्हृता इष्टसमभगणाधिकोनाः पूर्वभगणा भवन्ति भगणशेषं तु पूर्वसममेव । अतोऽत्रेष्टगुणा गुणानां ग्रहभगणानामैक्यान्तरं कुदिनाधिकं तदा कुदिनैस्तक्ष्यं शेषमेव ग्रहभगणाः कल्प्या येभ्यो राश्यादिर्ग्रहोऽभीष्ट गुण गुणग्रह योगान्तरसम एवोत्पद्यते । अथान्यभगणग्रहो यदा स्वं तदाऽन्यभगणयुतः शेष इष्टग्रहभगणसमोऽतस्तदा शे+अभ=इभ

∴ अभ=इभ−शे=इभ+युकुदि−शे । एवं यदाऽन्यभगणभवः खेटश्चर्णं तदा शे−अभ=इभ ∴ अभ=शे−इभ=शे+युकुदि−इभ, एतेन पूर्वोक्त

प्रश्नानामुत्तरं जातम् ।(¹) सिद्धान्त शेखरे

"त्रिघ्नः पतङ्गतनयो विधुना विहीनश्चक्रादिनाऽन्य भगणोत्थफलेन युक्तः। भौमः फलेन रहितः सवितृा गुरुर्वा चन्द्रोच्चमन्यभगणा वद के भवन्ति ॥ द्वाभ्यां त्रिभिर्गुणितयो रविशीतरश्म्योर्योगः कुजेन रहितोऽपरचक्रलब्ध्या । राश्याद्यया समधिको गुरुरूनितः स्यात् पातङ्गिरन्यभगणा गणितज्ञ के ते ॥" श्लोकद्वयेन श्रीपतिनाऽऽचार्योक्तं 'त्रिगुणः शनिरिन्दून' इत्यादि तथा 'द्वित्रि गुणयो रवीन्द्वोर्युतिरित्यादि' आर्याद्वयमेवोक्तमिति । पूर्वोक्तोपपत्त्या "अभिमतगुणकारै स्ताड़ितानां ग्रहाणां भगणयुतिवियुक्ती प्रश्नवन् सविधाय अवनिदिनविभक्ते शेषहीनाधिकाँस्तान् कुरुत कुदिवसांश्चेदन्यलब्धं धनर्णम् ॥ स्वं क्षयो भवति चान्यफलं चेदिष्ट खेटभगणास्तु धनर्णम् । तत्र तान्त्रिक विधाय यथावत् ज्ञायतेऽन्य भगणप्रमितिः सा" सिद्धान्त शेखरस्थ श्रीपत्युक्त श्लोक द्वयमुपपद्यत इति ॥ श्रीपत्युक्तं 'इष्ट गुणाकारगुणितग्रहभगणैक्यान्तरमित्यादि' आचार्योक्तानुरूपमेवेति ॥

अब दो और प्रश्नों को कहते है ।

हि. भा.—रविको दो से गुणाकर और चन्द्र को तीन से गुणाकर जो हो उन दोनों की युति में मङ्गल को घटा देते है और अन्य भगण लब्ध फल को जोड देने से गुरु होते हैं। उसी युति में अन्यभगण से लब्धराश्यादि को घटाने से शनि होते है तो अन्यभगण क्या है ॥

इन प्रश्नों के उत्तर के लिए उपपत्ति ।

यदि युगग्रह भगण में इष्ट गुणित कुदिन को जोडते है वा घटाते है तो उनसे राश्यादिक ग्रह वही होते हैं क्योंकि उनको अहर्गण से गुणा कर कुदिन से भाग देने तथा इष्ट सम भगण को जोड़ने वा घटाने से पूर्वभगण होते हैं भगणशेष पूर्व के समान ही है। इसीलिये यहाँ इष्ट गुण गुणित ग्रह भगणों का योग और अन्तर कुदिन से अधिक हो तो कुदिन से भाग देना, शेष को ग्रहभगण कल्पना करना जिनसे राश्यादिक ग्रह अभीष्ट गुण गुणित ग्रह योगान्तर के समान ही हो । अन्य भगण ग्रह यदि धन है तब शेष में अन्य भगण जोड़ने से इष्टग्रहभगण के समान होता है । इसलिये तब शे+अभ=इभ

∴ अभ=इभ—शे=इभ+युकुदि—शे । एव जब अन्यभगणोत्पन्न ग्रह ऋण है तब शे—अभ=इभ ∴ अभ=शे—इभ=शे+युकुयि—इभ. यही उत्तर हुआ ।

सिद्धान्त शेखर में "त्रिघ्नः पतङ्गतनयो विधुना विहीनः" इत्यादि संस्कृतोपपत्ति में लिखित पद्यों से श्रीपति ने आचार्योक्त 'त्रिगुणः शनिरिदून इत्यादि' तथा 'द्वित्रि गुणयोरवी-

(१) एतेन "इष्टगुणाकार गुणित ग्रहभगणैक्यान्तरं यथाऽभिहितम् ।
कृत्वा कुदिनैं विभजेत् शेषोन युतानि कुदिनानि ॥
यद्यन्यभगणलब्धं धनर्णमिष्टग्रहस्य युगभगणैः ।
अन्यफलमृण धनं चेदूनयुतान्यन्य युग भगणाः ॥" आचार्योक्तमित्युपपद्यते ।

न्द्वोर्युतिः' इत्यादि श्लोक द्वयोक्त विषय को ही कहा है । तथा पूर्वोपपत्ति से 'अभिमत गुणकारै स्ताड़ितानां ग्रहाणां' इत्यादि सस्कृतोपपत्ति मे लिखित श्रीपत्युक्त पद्य उपपन्न होता है यह आचार्योक्त के अनुरूपही है ।। ६ ।।

इदानीमन्यान् प्रश्नानाह ।

इष्टौदयिकानश्विन्यौदयिकान् वा करोति यो मध्यान् ।
मध्यार्क गुणकैर्गुणमिष्टं मध्यं स तन्त्रज्ञः ।। ७ ।।

सु. भा.—य इष्टौदयिकान् इष्टग्रहोदयकालिकान् मध्यान् ग्रहान् करोति । वाऽश्विन्यौदयिकान् अश्विन्युदयकालिकान् मध्यान् ग्रहान् करोति । वा मध्यार्क कैरपि गुणकैर्गुणमिष्टं मध्यं ग्रहं करोति स तन्त्रज्ञः । एवमत्र प्रश्नत्रयम् ।। ७ ।।

वि. भा.—य इष्टग्रहोदयकालिकान् मध्यान् ग्रहान् करोति, वा अश्विन्युदय कालिकान् मध्यान् ग्रहान् करोति वा कैरपि गुणकै र्मध्यार्क गुणमिष्टं मध्यं ग्रहं करोति स तन्त्रज्ञः (ज्योतिः सिद्धान्तविदस्ति), अत्र प्रश्नत्रयमस्ति ।। ७ ।।

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—जो व्यक्ति इष्ट ग्रहोदय कालिक मध्यग्रह को साधन करते हैं । वा अश्विनी नक्षत्रोदय कालिक ग्रह साधन करते है वा मध्यम रवि को किसी गुणकाङ्क से गुणा कर इष्ट मध्यम ग्रहानयन करते है वे ज्योतिः सिद्धान्त वेत्ता हैं ।। ७ ।।

इदानीमन्यान् प्रश्नानाह ।

यातानननुलोमगतीन् प्रतिलोमगतीन् ग्रहान् दिवसवारम् ।
विपरीतैः शन्याद्यैर्यो वेत्ति स कालतन्त्रज्ञः ।। ८ ।।

सु. भा.—योऽननुलोमगतीन् पातान् वेत्ति, वा रव्यादिग्रहान् प्रतिलोमगतीन् वेत्ति । अर्थाद्विपरीतगतयः पातादयस्तथा साध्या यथाऽनुलोमगतयः स्युरनुलोमगतयो रव्यादयश्च तथा साध्या यथा विलोमगतयः स्युरिति । एवं यः शन्याद्यैर्विपरीतैर्दिवसवारं वेत्ति अर्थाद्विपरीतगणनया यो दिवसवारं वेत्ति स कालतन्त्रज्ञः । एवमत्रप्रश्नत्रयम् ।। ८ ।।

वि. भा.—योऽननुलोमगतीन् (विपरीतगतीन्) पातान् वेत्ति । वा ग्रहान् विपरीतगतीन् वेत्ति । अर्थाद्विलोमगतयः पातास्तथा साध्या यथाऽनुलोमगतयः स्युरनुलोमगतयश्च ग्रहास्तथा साध्या यथा विपरीतगतयः स्युः । तथा 'शन्याद्यैर्विलोमै (विलोम गणनया) दिवस वारं वेत्ति स ज्योतिः सिद्धान्तविदस्ति । अत्र प्रश्नत्रयमस्ति ।

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—जो व्यक्ति विपरीनगनिक पातो को जानने है। वा गृहों को विलोमगतिक जानते है। अर्थात् विलोमगतिक पातों को उम तरह साधन करना चाहिये जिस से वे अनुलोमगतिक हो और अनुलोमगतिक गृहो को उम तरह साधन करना चाहिये जिस से वे विलोमगतिक हो। तथा शनि आदि गृहो की विलोमगणना मे जो व्यक्ति दिवस वार को जानते हैं वे कालतन्त्रज्ञ है। यहा तीन प्रश्न है ॥ ८ ॥

इदानी मन्यान् प्रश्नानाह।

व्यतिपातवैधृतिबृहस्पतिवर्षस्योच्चनीचपरिवर्त्तान्।
द्विग्रहयोगांश्च युगे यो वेत्ति स कालतन्त्रज्ञः ॥ ९ ॥

सु. भा.—यो व्यतिपातं वेत्ति। वैधृतं वेत्ति बृहस्पतिवर्षं वेत्ति। स्वोच्चनीचपरिवर्त्तान् स्वोच्चनीचभगणान् वेत्ति। युगे द्विग्रहयोगान् द्वयोर्द्वयोर्ग्रहयोर्युगे कियती युतिर्भवतीति वेत्ति स कालतन्त्रज्ञ.। एवमत्र पञ्च प्रश्नाः सन्ति ॥९॥

वि. भा.—यो व्यतिपातं वेत्ति, वैधृतिं वेत्ति, बृहस्पतिवर्षं वेत्ति, स्वोच्चनीच भगणान् वेत्ति, युगे द्वयो र्द्वयोर्ग्रहयोर्युतिः कियती भवति वेत्ति स कालतन्त्रज्ञः। अत्र पञ्च प्रश्नाः सन्ति।

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—जो व्यक्ति व्यतिपात को जानते हैं। वैधृत को जानते हैं, बृहस्पति वर्ष को जानते, स्वोच्चनीच भगण को जानते हैं, दो दो ग्रहों की युतियुग में कितनी होती है इसको जानते हैं वे काल तन्त्रज्ञ है, यहां पांच प्रश्न है ॥ ९ ॥

इदानीमन्यान् प्रश्नानाह।

सावनमासाब्दाधिपहोरेशानिष्टमध्यसंयोगान्।
इष्टैर्गुणैर्युतोनानिष्टान् यो वेत्ति गणकः सः ॥ १० ॥

सु. भा.—सावनमानेन मासपतिमब्दपतिं च यो वेत्ति। इष्टकाले होरेशं यो वेत्ति। इष्टानामभीष्टानां मध्यानां ग्रहाणां संयोगान् किं विशिष्टान् इष्टान् मध्यग्रहान् इष्टैर्गुणैर्युतोनान् दृष्ट्वा तान् यो वेत्ति स एव गणक इति। एवमत्र प्रश्नचतुष्टयम् ॥१०॥

वि. भा.—यः सावनमानेन मासपतिं वर्षपतिं च वेत्ति, इष्टकाले होरेशं च यो वेत्ति। अभीष्टानां मध्यानां ग्रहाणां संयोगान् किं विशिष्टान् इष्टान् मध्यग्रहान इष्टैर्गुणैर्युतोनान् दृष्ट्वा तान् यो वेत्ति स एव गणक इति॥ अत्र प्रश्नचतुष्टयमस्ति॥ १०॥

अब अन्य प्रश्नो को कहते हैं।

हि. भा.—जो व्यक्ति सावन मान से मासपति और वर्षपति को जानते हैं। इष्टकाल में होरेश को जानते है। इष्ट मध्यम ग्रहों के संयोग को किं विशिष्ट को इष्ट गुणक से युत और ऊन इष्ट मध्यम ग्रह को देखकर उनको जो जानते है वे गणक (ज्यौतिषिक) है॥ यहां चार प्रश्न हैं॥ १०॥

अथोक्तानां प्रश्नानामुत्तराणि विवक्षुस्तत्रादौ साधिशेषैर्गताधिमासैर्दृष्टैर्युगयातं वेत्तीत्यस्योत्तरमाह—

युगरविदिवसैर्गुणिता गताधिमासाः स्वशेषसंयुक्ताः।
भक्ता युगाधिमासैः फलं युगादेर्गता दिवसाः॥ ११॥

सु. भा.—गताधिमासा युगरविदिवसैर्गुणाः स्वशेष संयुक्ता अधिशेषयुताः युगाधिमासैर्भक्ताः फलं युगादेर्गता दिवसाः स्युरिति।

अत्रोपपत्तिः।

त्रैराशिकेन सुगमा तद्यथाऽहर्गणानयने गतसौरदिनेभ्यो गताधिमासाः साधिशेषाः $= \text{गअमा} + \frac{\text{अधिशे}}{\text{युसौदि}} = \frac{\text{गसौदि. युअधिमा}}{\text{युसौदि}}$। छेदगमादिना गसौदि $= \frac{\text{युसौदि. गअमा} + \text{अधिशे}}{\text{युअधिमा}}$ अत उपपद्यते मूलोक्तम्। अत्र सर्वत्र युगशब्देन कल्पो ग्राह्य इति।११॥

इदानीं द्वितीय प्रश्नोत्तरमाह।

गुणितानि चान्द्रदिवसैर्गतावमानि स्वशेषसहितानि।
विभजेद्युगावमैः फलमनष्टमधिमासकैर्गुणितम्॥ १२॥
हृतमिन्दुदिनैर्लब्धाधिमासदिवसैर्विहीनकमनष्टम्।
युगयातदिनाद्यधिमासदिनगणेष्टग्रहाद्यमतः॥ १३॥

सु. भा.—गतावमानि युगचान्द्रदिनैर्गुणानि स्वशेषसहितानि युगावमैः विभजेत् फलं गतचान्द्राहा इति स्फुटम् । तत् फलमनष्ट स्थाप्यमेकत्र युगाधिमासकैर्गुणं युगेन्दुदिनैर्हृत फलं गताधिमासास्तैर्दिनीकृतैरनष्टं स्थापितं गत चन्द्र दिनमानं विहीनं युगयातसौरदिनादि भवेत् । अतः सौर दिनेभ्यो गताधिमास—दिनगणेष्टग्रहाद्यं मध्यमाधिकारोक्तवत् साध्यम् ।

अत्रोपपत्तिः ।

गतावमस्तच्छेषाच्चानुपातेन गत चान्द्राहानयनस्य स्फुटा । सौरदिनेभ्यश्चान्द्रदिनेभ्यश्च गताधिमासाः समा एव लभ्यन्ते तच्छेषं च समं किन्त्वेकत्र युगसौरदिनहरोऽन्यत्र युगचान्द्रदिनहर इति सर्व 'सौरेभ्यः साधितास्ते चेदधिमासास्तदैन्दवाः'—इत्यादि भास्करोक्तेन स्फुटम् । ततश्चान्द्राहत आगतैर्गताधिमासैर्दिनीकृतैश्चन्द्राहा विहीना गतसौराहा भवन्ति येभ्यः पुनर्गताधिमासाहर्गणेष्टग्रहाद्यं सुखेन ज्ञायते । गतसौरेभ्यो गताधिमासशेपतः समीकरणम् ।

गसौदि . युअधिमा=युसौदि . ग अधिमा+अधिशे पक्षयोः ३० युअधिमा . गअधिमा योजनेन युअधिमा (गसौदि+'ग अधिमादि)=गचादि . युअधिमा=ग धिमा (युसौदि+युअधिमादि)+अधिशे=युचादि . गअधिमा+अधिशे

अतः सौरचान्द्रेभ्यः समा गताधिमासा लभ्यन्तेऽधिशेषं च समम् । अनेन भास्करोक्तमुपपद्यते ॥१२-१३॥

इदानीं द्युगणेन वा युगगतं वेत्तीत्यस्योत्तरमाह ।

द्युगणेन्दुदिवसघातात् कुदिनाप्तमधो युगाधिमासगुणम् ।
शशिदिनभक्तं फलमासदिनोनं युगगतदिनानि ॥ १४ ॥

सु. भा.—अहर्गणस्य युगचान्द्रदिनानां घातात् युगकुदिनैर्यदाप्तं तद्गतचान्द्राहमानमधः पृथक् स्थाप्यं युगाधिमासगुणं युगचान्द्रदिनभक्तं फलं गताधिमासास्तद्दिनैः पृथक्स्थं च गतचान्द्रदिनमानमूनं युगगतसौरदिनानि भवन्ति ।

अत्रोपपत्तिः ।

अहर्गणानयनविलोमेन कल्पगतानयनं त्रैराशिकेनेति सुगमा ।
एवं द्वितीयश्लोकस्थप्रश्नत्रयोत्तराणि सम्पन्नानि ।

तृतीयश्लोकस्थादि प्रश्नद्वयस्योत्तरं त्रैराशिकेनातिस्पष्टत्वादाचार्येण न

कृतम् । त्रैराशिकं च यदि युगाधिमासैर्युगावमानि तदा साग्रगताधिमासैः किम् । लब्धमवमानि । एवं साग्रावमेभ्यो गताधि मासानयनं च त्रैराशिकेन स्फुटम् ॥ १४ ॥

इदानीं ग्रहमिष्टं वा ताभ्यां यो वेत्तीत्यस्योत्तरमाह ।

गुणमधिमासकशेषं युगकुदिनैरवमशेषमधिमासैः ।
तद्युतिरिन्दुदिनहृताधिमासशेषं स्फुटं भवति ॥ १५ ॥

भूदिनगताधिमासकघातः स्पष्टाधिमासशेषयुतः ।
भक्तो युगाधिमासैरहर्गणः पूर्ववन्मध्याः ॥ १६ ॥

सु. भा.—अधिमासशेषं युगकुदिनैरवमशेपं च युगाधिमासैर्गुणम् । तयोर्युतिर्युगचन्द्रदिनैर्हृता लब्धं स्फुटाधिशेषसंज्ञं भवति । युगकुदिनानां गताधिमासानां च घातः पूर्वानीतस्फुटाधिमासशेषयुतो युगाधिमासैर्भक्तः फलमहर्गणो भवेत् । ततः पूर्ववन्मध्याधिकारोक्त वन्मध्या इष्टग्रहाः साध्याः ।

अत्रोपपत्तिः ।

अहर्गणप्रमाणं या । ततोऽनुपातेन गतावमानि $= \frac{\text{या. युअव}-\text{क्षशे}}{\text{युकुदि}}$

ऐतान्यहर्गणे संयोज्य जातानि गतचान्द्र दिनानि $= \frac{\text{या(युकुदि}+\text{युअव)}-\text{क्षशे}}{\text{युकुदि}}$

$= \frac{\text{युचादि. या}-\text{क्षशे}}{\text{युकुदि}}$। एभ्यो गताधिमासाः साग्रा $=$ गधिमा $+ \frac{\text{अधिशे}}{\text{युचादि}}$

$= \frac{\text{युधिमा. युचादि. या}-\text{युधिमा. क्षशे}}{\text{युचादि. युकुदि}}$ पक्षौ युगकु दिनैः सङ्गुण्य समशोधने न युकुदि. गधिमा $+ \frac{\text{युकुदि. अधिशे}+\text{युधिमा. क्षशे}}{\text{युचादि}}$ $=$ युधिमा . या $=$ युकुदि. गधिमा $+$ स्पधिशे

$\therefore$ या $= \frac{\text{युकुदि. गधिमा}+\text{स्पधिशे}}{\text{युधिमा}}$ अत उपपन्नं यथोक्तम् ॥१५-१६॥

इदानीं गतावमैरवमशेषेण चाहर्गणानयनमाह ।

भूदिन गतावमवधः स्वशेषयुक्तो युगावमविभक्तः ।
लब्धं भवति द्युगणो युगयातो मध्यमाः प्राग्वत् ॥ १७ ॥

सु. भा.—युगकुदिननानां गतावमानां च वधः स्वशेषेणावमावशेषेण युक्तो युगावमैर्विभक्तो लब्धमहर्गणो भवति ततः प्राग्वद्युगयातो मध्यमा ग्रहाश्च साध्याः।

अत्रोपपत्तिः।

त्रैराशिकेन यदि युगावमैर्युगकुदिनतुल्योऽहर्गणस्तदा साग्रगतावमैः किम्।

$$\text{लब्धोऽहर्गणः} = \frac{\text{युकुदि} + \dfrac{\text{युकुदि} + \text{क्षशें}}{\text{यु कुदि}}}{\text{यु क्ष}} = \frac{\text{यु कुदि. गक्ष} + \text{क्षशे}}{\text{यु क्ष}}$$ । अत उपपन्नम् ।।१७।।

वि. भा.—युगकुदिनगतावमघातः स्वशेष (अवमशेष) युक्तो युगावमैर्भक्तो लब्धं द्युगणो (अहर्गणः) भवति ततः प्राग्वद्युगयातो मध्यमा ग्रहाश्च साध्या इति ।। १७ ।।

अत्रोपपत्तिः।

यदि युगावमैर्युग कुदिन तुल्योहर्गणस्तदा सशेषगतावमैः किं लब्धोऽहर्गणः

$$= \frac{\text{युकुदि.}\left(\text{गतावम} + \dfrac{\text{अवममशे}}{\text{युकुदि}}\right)}{\text{यु अवम}} = \frac{\text{युकुदि. गतावम} + \text{अवशे}}{\text{यु अवम}}$$ एतेनाऽऽचार्योक्तमुपपन्नम्। सिद्धान्त शेखरे "विगतावमानि गुणयेत्कुदिनैरवमावशेषसहितानि भजेत्। युगजावमैरिह भवेद् द्युगणो युगयातमम्बरचराश्च ततः ।।" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति ।। १७ ।।

अब गतावम और अवमशेष से अहर्गणानयन को कहते हैं।

हि. भा.—युगकुदिन और गतावम के घात में अवम शेष को जोड़कर युगावम से भाग देने से लब्ध अहर्गण होता है ।। १७ ।।

उपपत्ति।

यदि युगावम में युगकुदिन तुल्य अहर्गण पाते हैं तो शेष सहित गतावम में क्या इस अनुपात से लब्ध अहर्गण $= \dfrac{\text{युकुदि}\left(\text{गतावम} + \dfrac{\text{अवशे}}{\text{युकुदि}}\right)}{\text{युगावम}} = \dfrac{\text{युकुदि. गतावम} + \text{अवशे}}{\text{युगावम}}$ इस से

आचार्योक्त उपपन्न हुआ। सिद्धान्त शेखर में 'विगतावमानि गुणयेत्' इत्यादि संस्कृतोपपत्ति में लिखित पद्य से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥ १७ ॥

इदानीं विनाऽधिमासावमैर्योऽहर्गणं वेत्तीत्यस्योत्तरमाह ।

युगगतशशिमासवधाद्रविमासाप्तं दिनीकृतं सदिनम् ।
भूदिनगुणितं शशिदिनहृतमाप्तमहर्गणः सैकः ॥ १८ ॥

सु. भा.—युगशशिमासानां गतशशिमासानां च वधाद्युगमसौरमासैर्यदाप्तं निरग्रं तद्दिनीकृतममान्तादग्रे यस्मिन् दिनेऽहर्गणोऽभीष्टस्तद्दिनसंख्यायुतं ततो युगकुदिनैर्गुणितं युगशशिदिनैर्हृतमाप्तमहर्गणो भवेत् । स च वारार्थं सैको वा निरेकः कार्य इत्यर्थादवगम्यते ।

अत्रोपपत्तिः ।

यदि युगसौरमासैर्युगशशिमासा लभ्यन्ते तदा गतचान्द्रसमैः सौरमासैः किं लब्धा निरग्रा अमान्ते गतचान्द्रमासास्ते त्रिंशद्गुणिता अमान्तादग्रे यावन्ति चान्द्रदिनानि तैर्युता अभीष्टे दिने गतचान्द्राहा जाताः। ततो यदि युगचान्द्रमासैर्युगकुदिन तुल्योऽहर्गणस्तदा गतचान्द्राहैः किम् । लब्धं तिथ्यन्ते सावनाहर्गणः सावयवो भवति। शेषत्यागेनोदये निरग्रोऽहर्गणोऽभीष्टवारार्थं सैको वा निरेकः स्फुटतिथिदिनार्थं कार्यं इति ज्योतिर्विदां सम्प्रदायो युक्तियुक्त एवेति ॥१८॥

इदानीं प्रकारान्तरेणाहर्गणानयनम् ।

गतदिवसाः पृथगधिमासकगुणिता रविदिनाप्तमासदिनैः ।
सहिताः पृथगवम गुणाः शशिदिवसाप्तोन का द्युगणः ॥ १९ ॥

सु. भा.— गतदिवसा गतचान्द्रदिनसमसौराहाः । शेषं स्पष्टार्थम् । अत्रोपपत्तिश्च भास्कराहर्गणानयनोक्तिवत् स्पष्टा ॥ १९ ॥

वि. भा.—गतदिवसाः (गतचान्द्रदिन तुल्य सौर दिवसाः) शेषं स्पष्टमेव।

अत्रोपपत्तिः ।

भास्करोक्ताहर्गणानयनवत्स्पष्टेति । यथा गताब्दा द्वादशगुणा वर्षादौ गताः सौरमासा जाताः, ते गत चान्द्रमासतुल्यैर्गतसौरमासैर्युक्ताः क्रियन्ते तर्हि दर्शाग्रतः संक्रान्त्यवयवः सौरा मासा जाताः। ततोऽनुपातेन लब्धाधिमासैः सशेषैः

सहितास्ते गतसौरमासास्तत्रत्याः सावयवाश्चान्द्रा मासा भवन्ति। तत्र चेद् दर्श-संक्रान्त्यन्तरमानमधिशेषसमं शोध्यते तदा दर्शान्ते चान्द्रा मासा भवन्ति। अतः केवलेन निरवयवाधिमासमानेन युक्तास्ते सौरा मासा दर्शान्ते चान्द्रा मासा भवन्ति ततस्ते त्रिशद्गुणा गततिथियुतास्तिथ्यन्ते गतचान्द्रदिवसा भवन्ति, ततो युगचान्द्रदिवसैर्युगावमानि लभ्यन्ते तदा गतचान्द्रदिवसैः किमित्यनुपातागतैः क्षयतिथिभिरूनिताश्चान्द्रदिवसास्तिथ्यन्ते सावनदिवसाः स्युः । ततस्तिथ्यन्त-सूर्योदयान्तर्वर्त्तिना ऽवमशेषेण युक्तास्तिथ्यन्तकालिकसावनदिवसाः सूर्योदये सावनाहर्गणो भवेदिति। इह स्थूलतिथ्यानयने यस्यां तिथौ यो वारः स चेदहर्गणेन न तदा सैको वा निरेकोऽहर्गणः कार्य इत्यनुक्तमपि बुधैर्ज्ञेयमिति ॥ सिद्धान्त शेखरे "कल्पातीतसमागणोऽर्क गुणितश्चैत्रादिमासान्वितः । खाग्निघ्नः सतिथिः पृथक् च पठितैः क्षुण्णोऽधिमासैर्हृतः । तिग्मांशोर्दिवसैः खरामगुणितैर्लब्धाधिमासैर्युतो द्विः कल्पावमताड़ितः शशिदिनैर्भक्तश्च कल्पोद्भवैः सम्प्राप्तावमवर्जितो दिनगणः" श्रीपत्युक्तमिदमहर्गणानयनमाचार्योक्तानुरूपमेव । आचार्येण युगसम्बन्धेन साधितं श्रीपतिना कल्पसम्बन्धेनैतावानेव भेद इति ॥ १९ ॥

अब प्रकारान्तर से अहर्गणानयन को कहते हैं ।

हि. भा.—गत दिवस (गत चान्द्र दिन तुल्य सौर दिन) को पठित अधिमास से गुणा कर पठित सौर दिन से भाग देकर लब्धाधिमास को सौरमास में जोडने से चान्द्रमास होते हैं। चान्द्रमास को तीस से गुणा कर गत चान्द्र दिन जोड़ देना चाहिये, उन चान्द्रदिनों को दो जगह स्थापन करना। एक जगह पठित अवम दिन से गुणा कर युग चान्द्र दिन से भाग देकर लब्ध क्षयतिथि को पूर्वस्थापित चान्द्रदिनों में से घटाने से सावनाहर्गण होता है ॥९१॥

उपपत्तिः ।

गत वर्ष को बारह से गुणा करने से वर्षादि में गतसौर मास होते हैं। उनमें गत चान्द्रमास तुल्य गत सौरमास को जोडने से दर्शाग्र से सक्रान्ति पर्यन्त सौरमास होते हैं। तब अनुपातागत सशेष अधिमास को गत सौर मास में जोड़ने से सावयव चान्द्रमास होते हैं। उनमें यदि दर्श (अमावास्या) और सक्रान्ति के अन्तर्गत अधिशेष को घटा देते हैं तो दर्शान्त में चान्द्रमास होते हैं। अतः उन सौर मास में केवल निरवयवाधिमास को जोड़ने से दर्शान्त मे चान्द्रमास होते है। इन चान्द्रमासों को तीस से गुणाकर गततिथि जोडने से तिथ्यन्त में चान्द्रदिन होते हैं, तब युग चान्द्रदिन में युगावम पाते है तो समागत चान्द्रदिन में क्या इस अनुपात से लब्धक्षयतिथि को चान्द्रदिनों मे से घटाने से तिथ्यन्त मे सावनाहर्गण होता है। तिथ्यन्त और सूर्योदय के अन्तर क्षय शेष को तिथ्यन्त कालिक सावनाहर्गण में जोडने से सूर्योदय कालिक सावनाहर्गण होता है ॥ सिद्धान्त शेखर मे 'कल्पातीत समागणोऽर्कगुणितः' इत्यादि पद्यों से श्रीपति ने भी इसी तरह अहर्गणानयन किया है इति ॥ १९ ॥

अथ द्वितीयप्रश्नस्योत्तरार्थमुपपत्तिः ।

अत्राधिमासावम शेषाभ्यां चन्द्रार्कानयनं क्रियते । परन्तु रविवर्षान्ताद्यावन्तोऽर्कदिवसा गतास्तावन्त एवार्कभागास्ते न ज्ञायन्ते रविवर्षान्तोऽपि न ज्ञायते । अतो यावन्तश्चैत्रशुक्लप्रतिपदादितिथयश्चान्द्रजातीयावमयुतास्तावन्त एव सौराहाः कल्पिताः, एवं कल्पिते सौरान्तादग्रे स्वरविशिष्टसौरान्ते रविः स्यात् । परञ्च तिथ्यन्तानन्तरं सूर्योदयस्तदनन्तरं सौरान्तस्तदनन्तर स्वरविशिष्टसौरान्तस्तेन स्वरविशिष्टसौरान्तकालिकार्के अवमशेषतुल्यसौरोने सौरान्तकालिकार्कः स्यात्, तस्मिन्नधिशेषसम्बन्धिसौरोने कृते तिथ्यन्तकालिकार्कः स्यात्, तस्मिन्नवमशेषसम्बन्धिसौरयुते सूर्योदयकालिकार्कः स्यात्, तस्य स्वरूपम् = सौअर−अशेसंसौ− अवशेतुसौ + अवशेसंसौ = चैति + $\frac{\text{अवशे}}{\text{ककु}}$ − अशेसंसौ − अवशेतुसौ + अवशेसंसौ = सूर्योदय कालिकरविः । अत्रावमशेषसम्बन्धि सौरानयनार्थमनुपातो यदि कल्पचान्द्रैः कल्प सौराहा लभ्यन्ते तदा ऽवमशेषैश्चान्द्रजातीयैः क इति जाता अवमशेषसम्बन्धि सौराहाः = $\frac{\text{वशे. कसौ}}{\text{ककु. कचां}}$ = अवशेसंसौ ; अस्मादवमशेषतुल्यसौरमानमिदं $\frac{\text{अवशे}}{\text{ककु}}$ अधिकं कल्पसौराधिक कल्पचान्द्रत्वात् । परञ्चात्रावमशेषसम्बन्धिसौरस्य सौरत्वं − अवमशेषतुल्यसौरस्य चान्द्रत्वमतस्तयोरन्तरमवमशेषसम्बन्ध्यधिशेषमृणात्मकं स्यादतोऽवमशेष - सम्बन्ध्यधिशेषस्याधिशेषसम्बन्धि सौरस्य च योग एवं यदि स्वर विशिष्टसौरान्त कालिकार्के विशोध्यते तदाऽपि सूर्योदयकालिकार्कः स्यात् अतोऽनुपातेनाधिशेषसम्बन्धिसौरस्वरूपम् = $\frac{\text{कसौ. अशे}}{\text{कचां.कसौ}}$ = $\frac{\text{अशे}}{\text{कचां}}$ = अशेसंसौ अनुपातेनैवावम शेष सम्बन्ध्यधिशेष स्वरूपम् = $\frac{\text{कअमा. अवशे}}{\text{कचां . ककु}}$ = अवशेसंअशे । एनयोर्योगः = $\frac{\text{अशे} + \frac{\text{क अमा. अवशे}}{\text{क कु}}}{\text{कचां}}$ = अशेसंसौ + अवशेसअशे

एतस्यैव मासादि फलसंज्ञा कृता, अनेनोनः स्वर विशिष्टसौरान्तकालिको रविरर्कोदयकालिकः स्यात् । परञ्च स्वरविशिट सौरान्तकालिकार्के द्वादशगुणितपूर्वकल्पितसौराहसमान्तरांशान्वितेतत्कालिकश्चन्द्रः स्यात्तस्मिन्नुक्तयुक्तया मासादिफलशोधनादर्कोदयकालीनश्चन्द्रः स्यात् ।

चैति + $\frac{\text{अशे}}{\text{ककु}}$ − माफ = सूर्योदयकालिकरविः । चैति + $\frac{\text{अशे}}{\text{ककु}}$ + १२

$\left(\text{चैति} + \frac{\text{अवशे}}{\text{ककु}}\right) - \text{माफ} = १३\left(\text{चैति} + \frac{\text{अवशे}}{\text{ककु}}\right) - \text{माफ} = \text{सूर्योदयकाचन्द्रः}$। एतेन

अधिमासावम शेषाभ्यां चन्द्रार्कानयनमाह। अर्थाद्दिनगणेन चन्द्रार्कौ योवेत्तीत्यस्योत्तरमाह।

गुणिताद्युगाधिमासैर्युगभूदिवसैर्हृतादवमशेषात्।
फलयुक्तमधिकमासक शेषं मध्यावतोऽर्केन्दू ॥ २० ॥

अधिमासावमशेषे युगशशिभूदिनहृते पृथक् लब्धेः।
मासदिनाद्ये स्थाप्ये गतमासदिनानि चैत्रादेः ॥ २१ ॥

अवमावशेषलब्ध्या सहितानि पृथक् त्रयोदश गुणानि।
अधिमासशेषलब्ध्या हीनानि पृथग्रवि-शशाङ्कौ ॥ २२ ॥

सु. *भा.*—अवमशेषाद्युगाधिमासैर्गुणिताद्युगकुदिनैर्हृताद्यत् फलं तेन फलेनाधिमासशेषं युक्तमधिशेषं कल्प्यम्। अतोऽस्मादधिशेषाद्वक्ष्यमाणविधिना ऽर्केन्दू ज्ञेयौ। अधिमासशेषं युगशशिदिनैर्हृतमवमशेषं च युगभूमिदिनैर्हृतम्। एवं पृथक् पृथक् ये लब्धे ते क्रमेण मासदिनाद्ये स्थाप्ये। अर्थादधिमासशेषतो लब्धिर्मासादिकाऽवमशेषतश्च दिनादिका ग्राह्या। चैत्रादेर्गतमासदिनानि यानि तानि पूर्वागतावमशेषलब्ध्या सहितानि कार्याणि तानि च पृथक् स्थाप्यानि। एकत्र त्रयोदश गुणानि। उभयत्राधिमासशेषलब्ध्या हीनानि क्रमेण मध्यौ रवि शशाङ्कौ भवतः।

अत्रोपपत्तिः।

चैत्रादेर्यावन्तश्चान्द्रमासा गतास्तावन्तः सौरमासा रविराशयो यावन्ति च चान्द्रदिनानि तावन्तो रविभागाः कल्पितास्तत्रावमशेषसावनावयवाद्यश्चान्द्राहावयवस्तत्समो रविभागश्चौदयिकार्थं योजितः। चान्द्राहावयवार्थमनुपातो यदि युगकुदिनैर्युगचन्द्रदिनानि तदा क्षयशेषावयवेन $\frac{\text{क्षशे}}{\text{युचादि}}$ अनेन किं लब्धश्चान्द्राहावयवः $= \frac{\text{क्षशे}}{\text{युकुदि}}$। अयं दिनादिश्चैत्रादिगतमासदिनादौ योजितः स रविः कल्पितः।

अयं रविश्च तत्स्थचान्द्रसौरान्तरेणाधिमासशेषोत्थरविराश्यादि चालनेनाधिको जातोऽतस्तच्छोधनेन वास्तवो मध्यमरविः स्यात्।

अथ गणितागतं चान्द्रमधिशेषमवमशेषोत्थचान्द्रदिनसमसौरदिनावयवोत्थेनाधिशेषेण युतं तदा वास्तवाधिशेषं भवति। तत्र पूर्वागतावमशेषसंबन्धी चान्द्राहावयवः $=\frac{\text{क्षशे}}{\text{युकुदि}}$। अयं युगाधिमासैर्गुणो युगसौरदिनैर्विभक्तो लब्धं तज्जमधिशेषम् $=\frac{\text{युधिमा क्षशे}}{\text{युसौदि.युकुदि}}=\frac{\frac{\text{युधिमा. क्षशे}}{\text{युकुदि}}}{\text{युसौदि}}=\frac{\text{फ}}{\text{युसौदि}}$। पूर्वगणितागतमधिशेषंच $=\frac{\text{अधिशे}}{\text{युसौदि}}$। द्वयोर्योगे वास्तवाधिशेषम् $=\frac{\text{अधिशे}+\text{फ}}{\text{युसौदि}}$। एतत्सम्बन्धिसौरं राश्यादि (यदि युग चान्द्रमासैर्युगसौराहास्तदेष्टाधिशेष समचान्द्रमासैः किं लब्धाः सौराहाः $=\frac{\text{अधिशे}+\text{फ}}{\text{युचामा}}$। एते त्रिंशद्धृता जातं राश्यादि $\frac{\text{अधिशे}+\text{फ}}{\text{३७ युचामा}}=\frac{\text{अफिशे}+\text{फ}}{\text{युचादि}}$)
$=\frac{\text{अधिशे}+\text{फ}}{\text{युचादि}}$ अधिशेफ। अनेन पूर्वकल्पितो रविर्हीन औदयिको रविर्भवति। स च तत्स्थचान्द्रावयवेन कल्पितरविसमेन द्वादशगुणेन सहितश्चन्द्रो भवति चान्द्राहे चान्द्राहे रविचन्द्रयोर्द्वादशभागान्तरत्वादित्युपपद्यत आचार्योक्तम्। अयमेव प्रकारः सिद्धान्तशेखरे श्रीपतिनाऽपि निबद्धस्तद्वाक्यं च।

कल्पाधिमासगुणितादवमावशेषात्।
क्ष्माहोद्धृतात् फलयुतं ह्यधिमासशेषम्॥
मासादिकं फलमतः शशिवासरैः स्यात्।
क्ष्माहैर्हृताच्च दिवसाद्यवमावशेषात्॥
चैत्रादितो विगतमासदिनैर्युतं तत्।
कृत्वा दिनाद्यथ पृथग्गुणितं च विश्वैः॥
मासादिना विरहिते विहिते क्रमेण।
यद्वा दिवाकरतुषार करौ भवेताम्॥

एतदनुकल्पमेव कोटयाहतैर्यंद्भवभैरवाप्तम्'—इत्यादि भास्करोक्तमस्तीति ज्योतिर्विदामतिरोहित मेवेति ॥२०-२२॥

वि. भा.—अर्थात् अवमशेषाद्युगाधिमासैर्गुणितात् युगकुदिनैर्भक्ताद्यत्फलं तेन फलेनाधिमासशेषं युक्तमधिशेषं कल्प्यम्। अतोऽस्मादधिशेषाद्वक्ष्यमाणविधिनाऽर्केन्दू ज्ञेयौ, अधिमासशेषं युगचान्द्रदिनैर्भक्तमवमशेषं च युगकुदिनैर्भक्तम्। एवं पृथक् पृथक् ये लब्धे ते क्रमेण मासदिनाद्ये स्थाप्ये। अर्थादधिमासशेषतो लब्धिर्मासादि-

काऽवमशेषनश्च दिनादिका ग्राह्या । चैत्रादेर्गतमासदिनानि यानि तानि पूर्वागतावमशेषलब्ध्या सहितानि कार्याणि तानि च पृथक् स्थाप्यानि, एकत्र त्रयोदश गुणानि । उभयत्राधिमासलब्ध्या हीनानि तदा क्रमेण मध्यौ रविचन्द्रौ भवतः" आचार्योक्तमुपपद्यते । सिद्धान्तशेखरे "कल्पाधिमासगुणितादवमावशेषात् क्ष्माहोद्धृतात् फलयुत ह्यधिमासशेषम् । मासादिक फलमतः शशिवासरैः स्यात् क्ष्माहैहृताच्च दिवसाद्यवमावशेषात् ॥ चैत्रादितो विगतमासदिनैर्युतं तत् कृत्वा दिनाद्यथ पृथग्गुणित च विश्वैः । मासादिना विरहिते विहिते क्रमेण यद्वा दिवाकरतुषार करौ भवेताम् ॥" श्रीपतेरय प्रकार आचार्योक्तप्रकारानुरूप एव, सिद्धान्तशिरोमणौ 'वोट्याहतैर्यद्भवभैर्वाप्तमित्यादि' भास्करोक्तमप्येतदनुकल्पमेवेति विद्वद्भिर्ज्ञेयम् ॥

अब अधिमासशेष और अवम शेष से चन्द्र और सूर्य का आनयन करते है ।

हि. भा.—चैत्रादि से जितने चान्द्रमास गत है उतने सौरमास (रविराशि) भी और जितने चान्द्र दिन है उतने रविभाग कल्पना की गयी, वहाँ अवमशेप सावनावयवादि से जो चान्द्र दिनावयव होता है उसके बराबर रविभाग औदयिक के लिये जोड़ दिया गया, चान्द्र दिनावयव के लिये अनुपात करते हैं । यदि कल्प सावन दिन में कल्प चान्द्र दिन पाते हैं तो क्षय शेषावयव $\frac{\text{क्षशे}}{\text{कचांदि}}$ में क्या इस अनुपात से आगया चान्द्र दिनावयव $=\frac{\text{क्षशे}}{\text{कसादि}}$ इस दिनादि को चैत्रादि गत मास दिनादि में जोड कर जो हो उसको रवि कल्पना करना । यह रवि तत्स्थित चान्द्र और सौर का अन्तर (अधिमास शेपोत्पन्न रविराश्यादि चालन तुल्य) अधिक हुआ अतः उसको घटाने से वास्तव मध्यम रवि होता है । गणितागत चान्द्राधिशेष में अवम शेषोत्पन्न चान्द्रदिनतुल्य सौरदिनावयवोत्पन्न अधिशेप को जोड़ने से वास्तवाधिशेष होता है । पूर्वागत अवमशेष सम्बन्धी चान्द्रदिनावयव $=\frac{\text{क्षशे}}{\text{कसादि}}$ इसको कल्पाधिमास से गुणा कर कल्पसौर दिन से भाग देने से लब्ध तज्जनित अधिशेष $=\frac{\text{कअमा. क्षशे}}{\text{कसौदि. कसादि}}$

$=\frac{\frac{\text{कअमा. क्षशे}}{\text{कसादि}}}{\text{कसौदि}}=\frac{\text{फ}}{\text{कसौदि}}$, पूर्व गणितागत अधिशेष $=\frac{\text{अधिशे}}{\text{कसौदि}}$ दोनों के योग करने से

वास्तवाधिशेष $=\frac{\text{अधिशे}+\text{फ}}{\text{कसौदि}}$ एतत् सम्बन्धी सौर राश्यादि (यदि कल्पचान्द्रमास में कल्प सौर दिन पाते हैं तो इष्टाधिमास तुल्य चान्द्रमास में क्या लब्ध सौर दिन $=\frac{\text{अधिशे}+\text{फ}}{\text{कचांमा}}$ इसको तीस से भाग देने से राश्यादि $=\frac{\text{अधिशे}+\text{फ}}{\text{३० कचांमा}}=\frac{\text{अधिशे}+\text{फ}}{\text{कचांदि}}=\frac{\text{अधिशे}+\text{फ}}{\text{कचांदि}}=$ अधिशेफ

कल्पितरवि में से इसको घटाने से औदयिक रवि होते हैं। इसमें तन् स्थित बारह गुणित कल्पित रवि के समान चान्द्रावयव को जोड़ने से चन्द्र होते हैं। इससे 'गुणितान्युगाधिमासैर्युग-भूदिवसैर्हृतात्' इत्यादि संस्कृतोपपत्ति में लिखित आचार्योक्त पद्य उपपन्न होता है, आचार्योक्त पद्यों का अभिप्राय यह है कि अवमशेष को युगाधिमास से गुणाकर युग कुदिन से भाग देने से जो फल हो उसको अधिमास शेष में जोड कर जो हो उसको अधिशेष कल्पना करना। इस अधिशेष से वक्ष्यमाण विधि से रवि और चन्द्र को जानना चाहिए। अधिमास शेष को युग चान्द्र दिन से भाग देना और अवम शेष को युग कुदिन से भाग देना, इस तरह पृथक् पृथक् जो लब्ध हो उनका क्रम से मास और दिनादि स्थापन करना अर्थात् अधिमास शेष से जो लब्धि हो उसका मासादिक ग्रहण करना चाहिए और अवमशेष से जो लब्धि हो उसका दिनादिक ग्रहण करना चाहिए। चैत्रादि से गतमास-दिन जो है उनमें पूर्वागत अवम शेष लब्धि को जोड कर पृथक् स्थापित करना चाहिए एक जगह तेरह से गुण देना चाहिए, दोनों जगहों में अधिमास लब्धि को घटा देने से क्रम से मध्यम रवि और चन्द्र होते हैं। सिद्धान्तशेखर में 'कल्पाधिमास गुणितादवमावशेषात्' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपति प्रकार भी आचार्योक्त के सदृश ही है ॥ २०-२१-२२ ॥

इदानीं तृतीय प्रश्न (रविचन्द्राभ्यां विना य. स्फुट तिथिं वेत्ति) स्योत्तरार्थमुपपत्तिः।

पूर्वोक्त रविचन्द्रानयनप्रकारेणाभीष्टदिने सूर्योदये चैत्रादितः सावयव-चान्द्रमासादिः=मा+दि+क्षशेल, रविः=मा+दि+क्षशेल—अधिमास, चन्द्रश्च =१३ (मा+दि+क्षशेल)–अधिमास, स्वस्व मन्दोच्चस्य विशोधनेन केन्द्रानयनं जायते, ततो रविं स्व फल संस्कृतं स्वफलसंस्कृताच्चन्द्राद्विशोध्य स्पष्टरवि-चन्द्रान्तरं जातम्। तत् द्वादशभक्तं स्पष्टं चान्द्रं मासादि स्यात्। एवं द्वादशभक्तं रविमन्दफल व्यस्तं द्वादशभक्तचन्द्रफलं च दिनादि यथागतं मध्यम चान्द्रसासा-दिकेऽस्मिन् मा+दि+क्षशेल संस्कृतं भवति। एव तिथेर्भुक्तं घट्यात्मकं लङ्कायां चान्द्रात्मकं जातम्। सावनघट्यर्थमेकस्मिन् सावनदिने रविचन्द्रगत्यन्तरं द्वादश भक्तं फलं चान्द्रं प्रसाध्यानुपाते यद्येतच्चान्द्रावयवेन सावनाः षष्टिघटिका लभ्यन्ते तदा तिथि विकलेन किं लब्धा लङ्कायां स्फुटाः सावनास्तिथिभुक्तघटिकास्तत्र देशान्तरभुजान्तरचरसंस्कारेण स्वदेशे स्फुटार्कोदये स्फुटा स्थितिभुक्तघटिका भवन्तीति ॥ एतेनाचार्योक्ताः २३, २४, २५ तमाः श्लोका उपपद्यन्ते।

अब तृतीय प्रश्न (रवि और चन्द्र के बिना स्फुट तिथिज्ञान) के उत्तर के लिये उपपत्ति।

हि. भा. - पूर्वोक्त रवि चन्द्रानयन प्रकार से अभीष्ट दिन में सूर्योदय काल में चैत्रादि से सावयव चान्द्रमासादि=मा+दि+क्षशेल। रवि=मा+दि+क्षशेल—अधिमास। तथा चान्द्र=१३ (मा+दि+क्षशेल)—अधिमास इन दोनों में से अपने अपने मन्दोच्च को घटाने

से केन्द्रानयन उपपन्न होता है। अपने फल से सस्कृत रवि को अपने फल से संस्कृत चन्द्र में से घटाकर स्फुट रवि और स्फुट चन्द्र के अन्तरांश साधन करना उसको बारह से भाग देने से स्फुट चान्द्र मासादि प्रमाण होता है। एव द्वादश भक्त रविमन्द फल को व्यस्त (उल्टा), द्वादश भक्त चन्द्रफल दिनादि यथागत मध्यम चान्द्रमासादि 'मा+दि+क्षशेल' में सस्कृत होता है। इस तरह तिथि का घटयात्मक भुक्त (भुक्तघटी) लङ्का में चान्द्रात्मक हुआ। सावन घटी के लिये एक सावन दिन में रवि और चन्द्र के गत्यन्तर को बारह से भाग दे कर चान्द्रात्मक फल साधन कर अनुपात करते है यदि इस चान्द्रावयव में सावन साठ घटी पाते है तब तिथि विकल (तिथिशेष) में क्या इस अनुपात से लब्ध लङ्का में स्फुट सावन तिथि भुक्त घटी प्रमाण आया। इसमे देशान्तर-भुजान्तर तथा चर के संस्कार करने से स्वदेश में स्फुटार्कोदयकाल मे स्फुट तिथिभुक्त घटी होती है। इससे 'गतमासदिनावमशेषलब्धियोगात् ॥ २३-२५ ॥' इत्यादि संस्कृतोपपत्ति में लिखित आचार्योक्त पद्य उपपन्न होते है।

इदानीं रविचन्द्राभ्यां विना यः स्फुटतिथिं वेत्तीत्यस्योत्तरमाह।

गतमासदिनावमशेष लब्धियोगात् त्रयोदशगुणाच्च।
अधिमासशेषलब्ध्या रविचन्द्रोच्चे युते शोध्ये॥ २३ ॥
केन्द्रे पृथक् फले द्वादशोद्धृते व्यस्तमृणधनं सौरम्।
अनुलोममैन्दवं मासदिनावमशेषलब्धियुतौ॥ २४ ।
तिथि विकलषष्टिघाताद्रविहृतभुक्तचन्तराप्तघटिकासु।
देशान्तरमनुलोमं भुजान्तरं चार्कं फलमसवः॥ २५ ॥

सु. भा.—गतमास दिनावमशेषलब्धियोगः पूर्वसाधितः कल्पितो रविस्तस्मात् पूर्वागतमासाद्यधिशेषलब्धियुतरविमंदोच्चं शोध्यम्। त्रयोदशगुणात् तस्मात् कल्पितरवेस्तदधिशेषलब्धियुतचन्द्रमन्दोच्चं शोध्यम्। एवं क्रमेण रविचन्द्रयोः केन्द्रे भवतस्ततः पृथक् स्पष्टाधिकारविधिना तयोरंशात्मके फले साध्ये। ते च द्वादशोद्धृते फले दिनादिके ग्राह्ये। मास दिनावमशेषलब्धियुतौ कल्पितरवौ सौरं दिनादिफलं व्यस्तं धनमृणं कार्यम्। फलं धनं तदा ऋणं चेदृणं तदा धनं कार्यमित्यर्थः। ऐन्दवं चान्द्रवं दिनादिफलं चानुलोमं यथागतं तथैव देयम्। एवं मासाश्चैत्रादयश्चान्द्रा दिनानि च तिथयो गताः। घटिकादिवर्तमानतिथेर्विकलं भुक्तघटी प्रमाणं तच्च षष्टिगुणं कार्यम्। तस्माद् द्वादशहृतरविचन्द्रगत्यन्तरेणाप्ता या घटिकास्तासु देशान्तरं घटयात्मकमनुलोमं यथागतं देयम्। आर्कफलमर्कमन्दफलसम्बन्धि कालात्मकं भुजान्तरं च यथागतं देयं तथाऽसवश्चरासवश्च गोलवशाद् धनमृणं च देयाः। एवं वर्त्तमानतिथेः स्फुटा सावना भुक्तघटिका भवन्तीति।

अत्रोपपत्तिः।

पूर्वोक्त रविचन्द्रानयनप्रकारेण सूर्योदयेऽभीष्टदिने चैत्रादितः सावयवं चान्द्रमासादि=मा+दि+क्षशेल। रविः=मा+दि+क्षशेल −अधिमास। चन्द्रः =१३ (मा+दि+क्षशेल)—अधिमास। स्वस्वमन्दोच्चं विशोध्य केन्द्रानयनमुपपद्यते। ततो रविं स्वफलसंस्कृतं स्वफलसंस्कृताच्चन्द्राद्विशोध्य स्पष्टरविचन्द्रान्तरं साधितं तद् द्वादशहृतं स्पष्टं चान्द्रं मासादि स्यात्। एवं द्वादशहृतं रविमन्दफलं व्यस्तं द्वादशहृतचन्द्रफलं च दिनादि यथागतं मध्यमचान्द्रमासादिकेऽस्मिन् मा +दि+क्षशेल संस्कृतं भवति। एवं तिथेर्भुक्तं घट्यात्मकं लङ्कायां चान्द्रात्मकं जातम्। सावनघट्यर्थमेकस्मिन् सावनदिने रविचन्द्रगत्यन्तरं द्वादशहृतं फलं चान्द्रं प्रसाध्यानुपातो यद्येतच्चान्द्रावयवेन सावनाः षष्टिघटिका लभ्यन्ते तदा तिथि विकलेन किं लब्धा लङ्कायां स्फुटाः सावनास्तिथिभुक्तघटिका स्तत्र देशान्तरभुजान्तरचरसंस्कारेण स्वदेशे स्फुटार्कोदये स्फुटास्तिथिभुक्ता घटिका भवन्तीति सर्वं स्फुटम् ॥२३-२५॥

वि. भा.—गतमासदिनावमशेषलब्धियोगः पूर्वं साधितः। कल्पितो रविस्तस्मात्पूर्वागतमासाद्यधिशेषलब्धियुतरविमन्दोच्चं शोध्यम्। त्रयोदशगुणात् तस्मात् कल्पितरवेस्तदधिशेषलब्धियुतचन्द्रमन्दोच्चं शोध्यम्। एवं क्रमेण रविचन्द्रयोः केन्द्रे भवतस्ततः पृथक् स्पष्टाधिकारोक्त विधिना तयोरंशात्मके फले साध्ये। ते च द्वादशोद्धृते फले दिनादिके ग्राह्ये। मासदिनावमशेषलब्धियुतौ कल्पितरवौ सौरं दिनादि फलं व्यस्तं धनमृणं कार्यम्। फल धनं तदा ऋणं चेदृणं तदा धनं कार्यम्। चान्द्रं दिनादि फलं चानुलोमं यथागतं तथैव देयम्। एवं मासाश्चैत्रादयश्चान्द्रा दिनानि च तिथयो गताः। घटिकादिवर्त्तमानतिथेर्विकलं भुक्तघटी प्रमाणं तच्च षष्टिगुणं कार्यम्। तस्मात् द्वादशहृतरविचन्द्रगत्यन्तरेणाप्ता या घटिकास्तासु देशान्तरं घट्यात्मकमनुलोमं (यथागतं) देयम्। अर्कमन्दफलसम्बन्धि कलात्मकं भुजान्तरं च यथागतं देयं तथा चरासवश्च गोलवशाद् धनमृणं च देयाः। एवं वर्त्तमानतिथेः स्फुटाः सावना भुक्त घटिका भवन्तीति ॥ २३-२५ ॥

अब रविचन्द्र के बिना स्फुटतिथि के ज्ञाता को इसका उत्तर।

हि. भा.—गतमास दिन अवमशेषलब्धियों के योग पहले साधित हैं, कल्पित रवि में से पूर्वागत मासाद्यधिशेष लब्धियुत रवि मन्दोच्च को घटा देना चाहिये। तेरह गुणित उस कल्पित रवि के अधिशेषलब्धियुत रविमन्दोच्चको घटाना इस क्रम से रवि और चन्द्र का केन्द्र उपपन्न होता है। केन्द्रवश से पृथक् स्पष्टाधिकारोक्त विधि से दोनों के अंशात्मक फल साधन करना। उन दोनों को बारह से भाग देकर दिनादि फल ग्रहण करना चाहिये। मास दिन अवमशेष लब्धि के योग (कल्पितरवि) में सौर दिनादि फल को व्यस्त (उल्टा) धनऋण करना चाहिये। फल धन रहने से ऋण करना और ऋण रहने से धन करना

चाहिए। चान्द्रदिनादिफल को अनुलोम (यथागत) देना चाहिये। इस तरह चैत्रादि चान्द्रमास और गत तिथि होती है। वर्त्तमान तिथि के जो भुक्त घटी प्रमाण है उस को साठ से गुणा करना, उसमें रवि और चन्द्र के गत्यन्तर को बारह से भाग देकर जो लब्ध घटी हो उसमे घटचात्मक देशान्तर को अनुलोम (यथागत) देना (संस्कार) चाहिये। रवि के मन्दफल सम्बन्धी कलात्मक भुजान्तर को भी यथागत देना चाहिये तथा चरासु को भी गोलवश से धन और ऋण करना चाहिये। तब वर्त्तमान तिथि की स्फुट सावन भुक्त घटी होती है।

इदानीं विशेषमाह।

अवम विकलं नु सावनमेभिः परिकल्पितं यतश्चान्द्रम्।
नार्यभटाद्यैः प्रश्नो मध्यान्यत्वात् ततो ज्ञातः॥ २६॥

सु. भा.—नु इति वितर्के निश्चये वा। अवमविकलमवमशेषं गणितयुक्त्या सावनमस्ति परन्तु एभिरार्यभटाद्यैर्यतस्तदवमशेषं चान्द्रं परिकल्पितं ततस्तस्मात् कारणादार्यभटाद्यैरयं प्रश्नो न ज्ञातो मध्यान्यत्वादवमशेषजात्यन्यत्वात् तद्वशाद्रविचन्द्रयोर्मध्ययोरन्यत्वात् स्थूलत्वादिति॥२६॥

वि. भा.—नु वितर्के निश्चये वा। अवमशेषं गणितयुक्त्या सावनात्मकमस्ति परन्त्वेभिरार्यभटाद्यैस्तदवमशेषं यतश्चान्द्रं परिकल्पितं ततः (तस्मात्कारणात्) आर्यभटाद्यैरयं प्रश्नो न ज्ञातो मध्यान्यत्वात् अवमशेषजात्यन्यत्वा त्तद्वशाद्रविचन्द्रयोरन्यत्वात् स्थूलत्वादिति॥ २६॥

अब विशेष कहते हैं।

हि. भा.—गणित युक्ति से अवमशेष सावनात्मक है परन्तु आर्य भटादि आचार्यों ने जिसलिये उस अवमशेष की चान्द्र कल्पना की है उस कारण से आर्य भटादि इस प्रश्न को नहीं समझे, अवमशेष के भिन्न जातिक होने से उस के वश से मध्यम रवि और चन्द्र में भी स्थूलता होगी, इसलिये आर्य भटादि नहीं समझ सके॥ २६॥

इदानीमिष्टादेकस्मान्मध्यग्रहादन्यान् मध्यान् यो वेत्तीत्यस्योत्तरमाह।

ज्ञातभगणादिभुक्तं सविकलमिष्टयुगभगणसङ्गुणितम्।
ज्ञातयुगभगणभक्तं मध्यो भगणादिफलमिष्टः॥ २७॥

सु. भा.—ज्ञातस्य ग्रहस्य भगणादि यद् भुक्तं सविकलं सशेषं तदिष्टयुगभग-

णसंगुणितं ज्ञातयुगभगणभक्तं भगणादिफलमिष्टो मध्यो ग्रहो भवेत्। 'साध्यस्य चक्रैर्गुणितः प्रसिद्धः' इत्यादि भास्करोक्तमेतदनुरूपमेव।

अत्रोपपत्तिः।

त्रैराशिकेन स्फुटा ॥२७॥

वि. भा.—ज्ञातग्रहस्य यत्सशेषं भगणादि भुक्तं तदिष्ट ग्रहयुगभगण सङ्गुणितं ज्ञातग्रहस्य युगभगणेन भक्तं तदा भगणादिफलमिष्टो मध्यग्रहो भवेदिति ॥ २७ ॥

अत्रोपपत्तिः।

यदि युगकुदिनैर्ज्ञातग्रहयुगभगणा लभ्यन्ते तदाऽहर्गणेन किं समागच्छति ज्ञातग्रहस्तत्स्वरूपम् $= \frac{\text{ज्ञातग्रह युगभगण.अहर्गण}}{\text{युकुदि}}$, एवं यदि युगकुदिनैरिष्टग्रह (साध्यग्रह) युगभगणा लभ्यन्ते तदाऽहर्गणेन कि समागच्छतोष्टग्रहस्तत्स्वरूपम् $= \frac{\text{इष्टग्रह युगभगण. अहर्गण}}{\text{युगकुदि}}$ अनयोः सम्बन्धः $= \frac{\text{ज्ञातग्रहयुगभगण}}{\text{इष्टग्रह युगभगण}}$

$= \frac{\text{ज्ञातग्रह}}{\text{इष्टग्रह}}$ छेदगमेन ज्ञातग्रयुगभगण . इष्टग्रह=इष्टग्रहयुभगण . ज्ञातग्रह,

$\therefore \frac{\text{इष्टग्रह युगभगण.ज्ञातग्रह}}{\text{ज्ञातग्रह युगभगण}} =$ इष्टग्रह एतावताऽऽचार्योक्त मुपपन्नम्।

सिद्धान्त शिरोमणौ 'साध्यस्य चक्रैर्गुणितः प्रसिद्धो भक्तो निजैः स्यादथवा प्रसाध्यः' भास्करोक्तमिदमाचार्योक्तानुरूपमेव, सिद्धान्तशेखरे 'अविदितग्रहपर्ययसङ्गुणे सभगणे विदिते कृतलिप्तिके। विदितकल्पजचक्रविभाजिते भवति वाऽविदितः स कलादिकः' 'श्रीपत्युक्तमिदमक्षरश आचार्योक्तानुरूपमेवेति विज्ञैश्चिन्त्यम् ॥ २७ ॥

अब एक मध्यम ग्रह से अन्य मध्यग्रहों के ज्ञान के लिये कहते हैं।

हि. भा.—ज्ञात ग्रह का भुक्त जो सशेष भगणादि है उसको इष्ट ग्रह (साध्यग्रह) के युगभगण से गुणा कर ज्ञात ग्रह के युगभगण से भाग देने से भगणादि फल इष्टमध्यम ग्रह होते है ॥ २७ ॥

उपपत्ति।

यदि युग कुदिन में ज्ञात ग्रह के युगभगण पाते हैं तो अहर्गण में क्या इस से ज्ञात ग्रह आते है ?

$\frac{\text{ज्ञातग्रयुगभगण. अहर्गण}}{\text{युकुदि}}$ = ज्ञातग्रह । एवं यदि युगकुदिन में इष्टग्रह (साध्यग्रह) का युगभगण पाते हैं तो अहर्गण में क्या इस से इष्ट ग्रह आते हैं $\frac{\text{इष्टग्र युगभगण. अहर्गण}}{\text{युकुदि}}$ = इष्टग्रह । इन दोनों के सम्बन्ध = $\frac{\text{ज्ञातग्र युगभगण}}{\text{इष्टग्र युगभगण}} = \frac{\text{ज्ञातग्रह}}{\text{इष्टग्रह}}$ छेदगम से ज्ञातग्रयुगभगण.इष्टग्र = इष्टग्रयुगभगण.ज्ञातग्रह $\therefore \frac{\text{इष्टग्र युगभगण ज्ञातग्रह}}{\text{ज्ञातग्र युगभगण}}$ = इष्टग्रह । इस से आचार्योक्त उपपन्न हुआ । सिद्धान्त शेखर मे 'अविदित ग्रह पर्यय सगुणे' इत्यादि संस्कृतोपपत्तिमें लिखित श्रीपति के इष्ट ग्रहानयन अक्षरशः आचार्योक्त के अनुरूप है सिद्धान्त शिरोमणि में 'साध्यस्य चक्रै र्गुणितः प्रसिद्धो भक्तो निजैः स्यादथवा प्रसाध्यः' यह भास्करोक्त भी आचार्योक्त के अनुरूप ही है इति ॥ २७ ॥

इदानीमनन्तरोक्त प्रश्ने विशेषमाह ।

इष्टाहतभक्तानां द्वयादीनां संयुतेर्द्वयोरथवा ।
इष्टगुणकारगुणयोर्विभक्तयोर्वाऽन्तरादथवा ॥ २८ ॥

सु० भा०—द्वयादीनां ग्रहाणामिष्टाहतानां भक्तानां वा संयुतेरथवा द्वयोर्ग्रहयोरिष्टगुणकारगुणयोर्वा भक्तयोः संयुतेरथवा तेषामिष्टाहतभक्तानां वा तयोरिष्टाहतभक्तयोरन्तराद्वा पूर्ववदिष्टो मध्यग्रहः साध्यः । यथेष्टाहतभक्तानां युतिरन्तरं वा दृष्टं भवेत् तथा तद्भगणानामिष्टाहतग्रहयोगान्तरं कृत्वा ततस्तेन योगान्तरेण दृष्टमिष्टाहत ग्रहयोगान्तरं लभ्यते तदेष्टग्रहभगणैः किं लब्धं भगणादिर्मध्य इष्टो भवेत् ॥२८॥

वि.भा.—द्वयादीनां ग्रहाणामिष्टाहतानां भक्तानां वा संयुतेरथवा द्वयोर्ग्रहयोरिष्टगुणकारगुणयोर्वा भक्तयोः संयुतेरथवा तेषामिष्टाहतभक्तानां वा तयोरिष्टाहतभक्तयोरन्तराद्वा पूर्ववदिष्टो मध्यग्रहः साध्यः यथेष्टाहतभक्तानां युतिरन्तरं वा दृष्टं भवेत् तथा तद्भगणानामिष्टाहतभक्तानां योगान्तरं कृत्वा ततस्तेन योगान्तरेण दृष्टमिष्टाहतग्रह योगान्तरं लभ्यते तदेष्टग्रहभगणैः किं लब्धं भगणादिर्मध्य इष्टो भवेदिति ॥ २८ ॥

अत्रोपपत्तिः ।

यद्यनेनेष्टगुणकारगुणितयोर्ग्रहभगणयोर्योगेनान्तरेण वा ज्ञेयग्रहयुगभगणा लभ्यन्ते तत्तथा गुणितयोर्मण्डलादि विलिप्तान्तयोगेनान्तरेण वा किमिति ज्ञेयग्रहो लभ्यते । एवं बहूनां योगे अन्तरेऽपि त्रैराशिकम् । तथा इष्टहारकभक्तयो–

ग्रहमध्यमयो र्योगोऽन्तरं वा इच्छाराशिः, ज्ञेयग्रहभगणाः फलराशिः तयोरेवेष्ट हारकभक्तभगणयोर्योगोऽन्तरं वा प्रमाणराशिः ज्ञेयग्रहमध्यमिच्छाफलम् । एवं बहूनामपि चिन्तनीयम् ॥

सिद्धान्तशेखरे "द्वित्र्यादयस्तत्वभिमतैर्गुणकैर्विनिघ्ना भक्ता हरैरथ खगा वियुता युता वा । योगेऽन्तरं तदभिवीक्ष्य करोत्यभीष्टान् खेटान् स तन्त्र विदुषां तिलकत्वमेति" श्रीपत्युक्त प्रश्नोत्तरं तेनैवा "इष्टाहतानामथवा हृतानां द्वयोर्बहूनां वियुते युते वा । अथैकतस्तद्भगणेषु तद्वत् कृत्वानुपातात् द्युचराः प्रसाध्याः" ऽनेन कृतं यच्चाऽऽचार्योक्त 'इष्टाहत भक्तानामित्यादेः' पुनरूक्तिमिवेति विद्वद्भिश्चिन्त्यम् ॥

अब अनन्तरोक्त प्रश्न में विशेष कहते हैं ।

हि. भा.—इष्ट से गुणित वा भक्त दो आदि ग्रहों की सयुति से अथवा इष्ट गुणकार से गुणित वा भक्त दो ग्रहों की संयुति से अथवा इष्ट गुणित वा भक्त उन सबों के अन्तर से वा इष्ट गुणित वा इष्ट भक्त उन दोनों के अन्तर से पूर्ववत् इष्टमध्यम ग्रह साधन करना ॥२८॥

उपपत्ति ।

यदि इष्ट गुणकार से गुणित दो ग्रहों के भगण योग वा अन्तर में ज्ञातव्य ग्रह के युगभगण पाते हैं तो उसी तरह गुणित मण्डलादि विलिप्तान्त योग में अन्तर में क्या इस अनुपात से ज्ञातव्य ग्रह (साध्यग्रह) आते है । बहुत ग्रहों के योग में वा अन्तर में इसी तरह त्रैराशिक होता है । सिद्धान्त शेखर में 'इष्टाहतानामथवा हृतानां' इत्यादि पद्य से श्रीपति ने आचार्योक्त 'इष्ट हत भक्ताना' इत्यादि के अनुरूप ही कहा है इति ॥ २८ ॥

इदानीमनन्तरोक्त प्रश्नस्य प्रकारान्तरेणोत्तरमाह ।

ज्ञातैक भगण भुक्तिस्तद्भगणाप्ता तदिष्ट भगणेभ्यः ।
भगणादि सविकलं सविकलेष्ट भगणादि गुणमिष्टः ॥ २९ ॥

सु. भा.—ज्ञातग्रहो यावता कालेनैकं भगणं भुङ्क्ते तावता कालेन तदिष्टभगणेभ्यो ज्ञेयग्रहभगणेभ्यो ज्ञेयग्रहो यद्भगणादि सविकलं भुङ्क्ते तज्ज्ञातैकभगणभुक्तिर्भवति । सा च भुक्तिस्तदिष्टभगणेभ्यस्तद्भगणाप्ता भवति । अर्थाद्यदि ज्ञात भगणैरिष्टग्रहभगणास्तदैकज्ञातभगणेन किमित्यनुपातेन ज्ञेयस्यैकभगणभुक्तिर्भगणादि सविकलं भवति । इदं भगणादि सविकलं भुक्तिमानं सविकलेष्टभगणादिगुणं ज्ञातग्रहस्याभीष्टदिने यद्भगणादि सविकलं मानं तेन गुणं तदेष्टो ज्ञेयो मध्यग्रहो भवेदित्यर्थः ।

अत्रोपपत्तिः ।

ज्ञातग्रहस्यैकेन भगणेन यद्येकभगणभुक्तिसमो ज्ञेयग्रहो भवति तदेष्टज्ञात ग्रहभगणादिभिः किमिति जातो भगणादिर्ज्ञेयग्रह इति ॥२९॥

वि. भा.—ज्ञातग्रहो यावता कालेनैकं भगणं भुङ्क्ते तावता कालेन ज्ञेयग्रहभगणेभ्यो ज्ञेयग्रहो यद्भगणादि सशेष भुङ्क्ते तज्ज्ञातैकभगणभुक्ति-र्भवति । सा च भुक्तिस्तदिष्टभगणेभ्यस्तद् भगणाप्ता भवति । तावता ज्ञेयग्रहस्यै-कभगणभुक्तिमानं सशेषेष्टभगणादिगुणितं तदेष्टो ज्ञेयो मध्यम ग्रहः स्यादिति ॥

अत्रोपपत्तिः ।

यदि ज्ञातग्रहयुगभगणैर्ज्ञेयग्रहयुगभगणा लभ्यन्ते तदैकेन भगणेन क इति ज्ञातस्यैक भगणभुक्तिः स्यात् । ततो यद्येकेन ज्ञातभगणेन एतावती गतिस्तदा तद्गत भगणैः सविकलैः (सशेषैः) केति ज्ञेयग्रहो भवेदिति । एतेनाचार्योक्तमुपपन्नं भवति । सिद्धान्त शेखरे "विज्ञात कल्पभगणैर्विहृतेषु साध्यचक्रेषु यद्भगणपूर्वक माप्यतेऽत्र । ज्ञातग्रहः सभगणो गुणितस्तु तेन साध्यग्रहो भवति वा भगणादिको-ऽसौ ॥" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति ॥ २९ ॥

अब अनन्तरोक्त प्रश्न के उत्तर को प्रकारान्तर से कहते हैं ।

हि. भा. - ज्ञात ग्रह जितने काल में एक भगण को भोग करते हैं उतने काल में ज्ञेय ग्रह भगणों से ज्ञेय ग्रह जो सशेष भगणादि भोग करते है वह ज्ञात ग्रह की एक भगण भुक्ति होती है, वह भुक्ति इष्ट (ज्ञेयग्रह) भगण से भक्त होती है, ज्ञेयग्रह के एक भगण भुक्तिमान को सशेष इष्ट भगणादि से गुणा करने से मध्यमज्ञेयग्रह होते हैं इति ॥ २९ ॥

उपपत्ति ।

यदि ज्ञातग्रह युगभगण में ज्ञेयग्रह युगभगण पाते हैं तो एक भगण में क्या इस अनुपात से ज्ञातग्रह की एक भगण भुक्ति होती है । पुनः अनुपात करते है यदि एक ज्ञात भगण में इतनी गति पाते हैं तो सशेष तद्गत भगण में क्या इससे ज्ञेय ग्रह आते हैं । इससे आचार्योक्त उपपन्न होता है । सिद्धान्त शेखर में 'विज्ञातकल्पभगणैर्विहृतेषु' इत्यादि संस्कृतोप-पत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥ २९ ॥

इदानीमिष्टान्मध्यग्रहाद्यो मध्यतिथिं वेत्तीत्यस्योत्तरमाह ।

शशिदिन गुणं सविकलं यद्भुक्तं मण्डलादि तद्भगणैः ।
विभजेत्फलं सविकलास्तिथयः प्राग्वत्स्फुटीकरणम् ॥ ३० ॥

सु० भा०—इष्टग्रहस्य मण्डलादि भगणादि सविकलं सशेषं यद्भुक्तं ज्ञातमस्ति। तद्युगशशिदिनगुणं तद्भगणैर्ज्ञातग्रहभगणैर्विभजेत् फलं मध्यमाः सविकलास्तिथयो भवन्ति ततः प्राग्वत् २३–२५ सूत्रयुक्त्या स्फुटीकरणं कार्यम्।

अत्रोपपत्तिः।

त्रैराशिकेन यदीष्टग्रहयुगभगणैर्युगचान्द्रदिनानि तदा तद्भुक्तभगणादिना किं लब्धा अभीष्टचान्द्राहाः सावयवा मध्यमास्तिथयस्ततः स्फुटीकरणं प्राग्वदित्यादि स्फुट मिति ॥३०॥

वि. भा.—इष्टग्रहस्य सशेषं मण्डलादि (भगणादि) यद्भुक्तं विदितमस्ति तद्युगचान्द्रदिनैर्गुणितं ज्ञातग्रहभगणैर्विभजेत्फलं सशेषा मध्यमास्तिथयो भवेयुस्ततः पूर्ववत् (२३-२५ सूत्रानुसारेण) स्फुटीकरणं कार्यमिति ॥ ३० ॥

अत्रोपपत्तिः।

यदीष्टग्रहयुगभगणैर्युगचान्द्रदिनानि लभ्यन्ते तद्भुक्तभगणा (ज्ञातग्रह भगणादिना) दिना किं लब्धाः सावयवा अभीष्ट चान्द्रदिवसा मध्यमास्तिथयस्ततः पूर्ववत् (२३-२५ सूत्रोक्तया) स्फुटीकरणं विधेयमिति। ३० ॥

अब इष्टमध्यमग्रह से मध्यम तिथ्यानयनार्थ प्रश्न के उत्तर को कहते हैं।

हि. भा.—इष्टग्रह का सशेष भगणादि भुक्त जो ज्ञात है उसको युगचान्द्र दिन से गुणाकर ज्ञात ग्रह भगण से भाग देने से लब्ध सशेष मध्यम तिथि होती है उससे पूर्ववत् (२३-२५ सूत्रोक्त युक्ति से) स्फुटीकरण करना चाहिये ॥ ३० ॥

उपपत्ति।

यदि इष्ट ग्रह युग भगण में युगचान्द्र दिन पाते हैं तो ज्ञात ग्रह भुक्त भगणादि में इस अनुपात से लब्ध अभीष्ट चान्द्र दिन (सावयव मध्यमतिथि) आया, इससे पूर्ववत् स्फुटीकरण करना चाहिये ॥ ३० ॥

इदानीमिष्टान्मध्याद्रवीन्दुपातैर्विना यश्चन्द्रग्रहणं वेत्तीत्यस्योत्तरमाह।

पातेन्दु योगलब्धौ कृत्वा देशान्तराद्यमनुलोमम्।
विक्षेपोऽस्माद् सूर्यादिभिर्विनेन्दुग्रहणमेवम् ॥ ३१ ॥

सु. भा.—पातेन्दु योगलब्धौ देशान्तराद्यमनुलोमं यथागतं कृत्वाऽस्माद्विक्षेपः साध्यः। अत्रैतदुक्तं भवति। युगे पातभगणानां चन्द्रभगणानां च योगं कृत्वा तेन भगणादि सविकलमिष्टग्रहं संगुण्येष्टग्रहयुगभगणैर्विभजेत् फलं भगणादिः

सपातचन्द्रो भवेत्। भगणानपास्य राश्यादौ मध्यमसपाते चन्द्रे देशान्तर-मन्दफला-दीन् यथागतान् संस्कृत्य स्पष्टः सपातचन्द्रो ज्ञेयस्ततो विक्षेपः साध्यः। एवं शरतो बिम्बादिज्ञानेन सूर्यादिभिः सूर्यचन्द्रपातैर्विना चन्द्रग्रहणं भवति।

अत्रोपपत्तिः।

त्रैराशिकेन सपातचन्द्रानयनस्याति सुगमेति ॥३१॥

वि. भा.—मध्यमसपातेचन्द्रे यथागतं देशान्तराद्यं कृत्वा (संस्कृत्य) ऽस्माद्विक्षेपः (शरः) साध्यः। युगे पातभगण चन्द्रभगणयोर्योगं विधाय तेन सशेषं भगणादिकमिष्टग्रह हत्वेष्टग्रहयुगभगणैर्विभजेत्फल भगणादिकः सपातचन्द्रो भवेत्। तत्र भगणान् त्यक्त्वा राश्यादिमध्यमसपातचन्द्रे देशान्तरमन्दफलादीन् यथागतान् दत्वा स्पष्ट सपातचन्द्रो ज्ञातव्यस्ततः शरः साध्यः। शरवशात् बिम्बादि ज्ञानेन सूर्यं चन्द्र पातैर्विना चन्द्रग्रहणं विदित भवति ॥ ३१ ॥

अत्रोपपत्तिः।

यदीष्ट ग्रहयुगभगणैः सशेष भगणादीष्टग्रहो लभ्यते तदा युगीयपातभगण-चन्द्रभगणयोर्योगे किं फलं भगणादिकः सपात चन्द्रो भवेत्। अत्र भगणान् विहाय राश्यादिमध्यमसपातचन्द्रे यथागतदेशान्तरादिसंस्कारेण स्पष्टसपातचन्द्रो ज्ञेयस्ततस्त्रिज्यया यदि चन्द्रस्य परमशरज्या लभ्यते तदा सपात चन्द्रभुजज्यया किमित्यनुपातेन चन्द्रस्येष्टशरज्या समागच्छति, अस्याश्चापं चन्द्रस्येष्टशरो भवेत्। शरवशाद्बिम्बादिज्ञानं सुगममेव, एतेन सूर्यचन्द्रपातैर्विना चन्द्रग्रहणज्ञानं भवेदेवेति ॥ ३१ ॥

अब रविचन्द्र और पात के बिना इष्ट मध्यम ग्रह से चन्द्र ग्रहण ज्ञान सम्बन्धी प्रश्न के उत्तर को कहते हैं।

हि. भा.—मध्यमसपातचन्द्र में यथागत देशान्तरादि संस्कार कर स्पष्ट सपात चन्द्र ज्ञान कर इससे शर साधन करना चाहिये, अर्थात् युग में पठित पातभगण और चद्रभगणों का योग कर उससे सशेष भगणादि इष्ट ग्रह को गुणा कर इष्टग्रह युगभगण से भाग देने से फल भगणादि सपात चन्द्र होते हैं। इसमें भगण को छोड़कर राश्यादि मध्यम सपातचन्द्र में यथागत देशान्तर मन्दफलादि को संस्कार कर स्पष्ट सपात चन्द्र का ज्ञान करना चाहिये उससे शर साधन करना चाहिये, शरवश से बिम्बादि ज्ञान सुलभ ही है। इस तरह सूर्य चन्द्र और पात के विना चन्द्रग्रहण ज्ञात होता है इति ॥ ३१ ॥

उपपत्ति।

यदि इष्ट ग्रह युगभगण में संशेष भगणादि इष्टग्रह पाते हैं तो युगपातभगण-चन्द्र-

भगण के योग में क्या इस अनुपात से भगणादिक सपातचन्द्र आते है। इसमें भगणों को छोड़कर राश्यादि मध्यम सपात चन्द्र में यथागत देशान्तरादि को संस्कार करने से स्पष्टस पातचन्द्रज्ञान होता है तब अनुपात करते है यदि त्रिज्या मे चन्द्र की परमशरज्या पाते है तो सपात चन्द्रभुजज्या में क्या इस अनुपात से चन्द्र की इष्टशरज्या आती है इसके चाप करने से चन्द्र के इष्टशर होते हैं। शरवश से बिम्बादि ज्ञान सुगम ही है। इससे सूर्य-चन्द्र और पात के विना ही चन्द्र ग्रहण ज्ञान होता है इति ॥ ३१ ॥

इदानीं मध्यम सूर्यादवमशेषाच्चमध्यमचन्द्रानयनमाह।

कुदिनहृतमवमशेषं द्वादशभिर्गुणितमाप्तमंशाद्यम्।
द्वादशगुणतिथ्यंशैर्युतं धनं भास्करे चन्द्रः ॥ ३२ ॥

सु. भा.—अवमशेषं द्वादशभिर्गुणितं युगकुदिनहृतमाप्तमंशाद्यं ग्राह्यम्। तद् द्वादशगुणतिथ्यंशैर्युतं यद्भवेत् तद्भास्करे मध्यमरवौ धनं कार्यमेवं मध्यश्चन्द्रो भवति।

अत्रोपपत्तिः।

२० सूत्रोपपत्त्याऽभीष्टदिने सूर्योदये सावयवाश्चान्द्राहाः $=$ इति $+\frac{\text{क्षश}}{\text{युकुदि}}$ एते द्वादशगुणा रविचन्द्रान्तरांशा भवन्ति ते रवौ क्षिप्यन्ते चन्द्रो भवतीत्युपपन्नम् ॥३२॥

वि. भा.—अवमशेषं द्वादशभिर्गुणितं युगकुदिनभक्तं लब्धमंशाद्यं यत्तद्-द्वादशगुणतिथ्यंशैर्युतं तद् भास्करे (मध्यम रवौ) धनं कार्यं तदा मध्यमश्चन्द्रो भवेदिति ॥ ३२ ॥

अत्रोपपत्तिः।

अभीष्ट दिने सूर्योदये सावयवाश्चान्द्रदिवसाः $=$ इति $+\frac{\text{अवमशे}}{\text{युकुदि}}$, एते द्वादश गुणितास्तदा रवि चन्द्रान्तरांशाः $=१२\left(\text{इति}+\frac{\text{अवमशे}}{\text{युकुदि}}\right)=१२\ \text{इति}+\frac{१२\ \text{अवमशे}}{\text{युकुदि}}$ $=$ चन्द्र $-$ रवि, $\therefore$ $१२\ \text{इति}+\frac{१२\ \text{अवमशे}}{\text{युकुदि}}+\text{रवि}=\text{चन्द्रः}$। एतावताऽऽचार्योक्तमुपपद्यते। सिद्धान्त शेखरे "महीदिनैर्युक्षयशेषतः फलंदिनादि तत्तत्तिथिभिः समन्वितम्।

तेनार्क निघ्नेन युतो रविः शशी हीनोऽनकेन्दुर्घ्योगादीधितिः ॥" श्रीपत्युक्त मिदमाचार्योक्तानुरूपमेवेति विज्ञेयम् ॥ ३२ ॥

अब मध्यम सूर्य और अवम शेष से मध्यम चन्द्रानयन को कहते हैं ।

हि. भा.—अवम शेष को बारह से गुणाकर युगकुदिन से भाग देने से लब्ध जो अंशादि हो उसमें बारह गुणित तिथ्यंश को जोड़ने से जो हो उसको मध्यम रवि में जोड़ने से मध्यम चन्द्र होते हैं ॥ ३२ ॥

उपपत्ति ।

इष्टदिन में सूर्योदय काल में सावयव चान्द्रदिन $=$ इति $+ \frac{\text{अवमशे}}{\text{युकुदि}}$ इसको बारह से गुणा करने से रवि और चन्द्र के अन्तरांश होते हैं $१२ \left(\text{इति} + \frac{\text{अवमशे}}{\text{युकुदि}}\right) = १२\ \text{इति} + \frac{१२\ \text{अवमशे}}{\text{युकुदि}} = \text{चन्द्र} - \text{रवि}$

$\therefore\ १२\ \text{इति} + \frac{१२\ \text{अवमशे}}{\text{युकुदि}} + \text{रवि} = \text{चन्द्र}$. इससे आचार्योक्त उत्पन्न हुआ । सिद्धान्त शेखर में 'महीदिनैर्घ्युक्षय शेषतः फलं' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपत्युक्त मध्यम चन्द्रानयन आचार्योक्त के अनुरूप ही है इति ॥ ३२ ॥

इदानीं प्रकारान्तरेण मध्यमचन्द्रानयनमाह ।

द्युगणं युगाधिमासैर्गुणितं युगभूदिनैर्भजेल्लब्धम् ।
भगणादिमध्यमार्कत्रयोदशगुणाधिकं चन्द्रः ॥३३॥

सु. भा.—अहर्गणं युगाधिमासैर्गुणितं युगकुदिनैर्भजेत् । लब्धं भगणादि-ग्राह्यम् । तन्मध्यमार्क त्रयोदशगुणाधिकमर्थात् त्रयोदशगुणमध्यार्कसहितं चन्द्रो भवेत् ।

अत्रोपपत्तिः ।

युगरविमासाः $= १२$ युरभ ।

युगाधिमासाः $=$ युचामा $-$ युरमा

$= \text{युचभ} - \text{युरभ} - १२\ \text{युरभ}$

$= \text{युचभ} - १३\ \text{युरभ}$

$\therefore$ युचभ $=$ युगाधिया $+ १३$ युरभ ।

एते चन्द्रभगणा अहर्गणगुणा युगकुदिनगुणा भगणादिश्चन्द्रो भवेत् । तत्र प्रथम खण्डे युगाधिमाससमयुगभगणोद्भवं भगणादि फल द्वितीयखण्डे त्रयोदशगुणार्कस्तयोर्योगे चन्द्रो भवतीत्युपपद्यते ॥३३॥

वि. भा.—अहर्गणं युगाधिमासैर्गुणितं युगकुदिनैर्भक्तं लब्धं भगणादिफलं यत्तत् त्रयोदश गुणितरवौ योजित तदा चन्द्रो भवेदिति ॥३३॥

अत्रोपपत्तिः ।

भवन्ति शशिनोमासाः सूर्येन्दुभगणान्तरमिति सूर्यसिद्धान्तोक्तेः युचांमा= युचंभ—युरभ, रविमासोनितास्तेतु शेषाः स्युरधिमासकाइत्युक्तेः युगाधिमास= युचांमा—युगरविमास=युचंभ—युरभ—युरविमास, परन्तु १२ युरभ=युरविमा ∴ युगाधिमास=युचंभ—युरभ—१२ युरभ=युचंभ—१३ युरभ, एतेन 'इन्दुमण्डलगुणेन्दुसङ्गुणाव्रध्नचक्र विवरेऽधिमासकाः, इतिभास्करोक्तमुप पन्नम् ।

∴ युगाधिमास+१३ युगरभ=युचंभ, ततः $\frac{\text{युचंभ} \times \text{अहर्गण}}{\text{युकुदि}}$=भगणादिचन्द्रः=

$=\frac{(\text{युगाधिमा}+१३\,\text{युरभ})\,\text{अहर्गण}}{\text{युकुदि}}=\frac{\text{युगाधिमा. अहर्गण}+१३\,\text{युरभ. अहर्गण}}{\text{युकुदि}}$

$=\frac{\text{युगाधिमा. अहर्गण}}{\text{युकुदि}}$+१३ भगणादिरवि=भगणादिचद्रः । एतावताऽऽचार्योक्तमुपपन्नम् ।

सिद्धान्तशेखरे "अहर्गणाच्चाधिकमासनिघ्नात् कुद्यूद्धृतान्मण्डल पूर्वकेण। विश्वाहतोऽर्कः सहितो विधुरिति" श्रीपत्युक्तमाचार्योक्तानुरूपमेवेति ॥ ३३ ॥

अब प्रकारान्तर से मध्यम चन्द्रानयन को कहते हैं।

हि. भा.—अहर्गण को युगाधिमास से गुणाकर युग कुदिन से भाग देने से जो लब्ध भगणादि हो उसको तेरह गुणित रवि में जोडने से चन्द्र होते हैं ॥ ३३ ॥

उपपत्ति ।

'भवन्ति शशिनोमासाः सूर्येन्दु भगणान्तरम्' इस सूर्य सिद्धान्तोक्ति से युचांमा=युचंभ—युरभ, 'रविमासोनिता स्तेतु शेषाः स्युरधिमासका' इस से युगाधिमास=युचांमा —युरविमास =युचंभ—युरभ—युरमिवास परन्तु १२ युरभ=युरविमा ∴ युगाधिमास=युचंभ—युरभ—१२ युरभ=युचंभ—१३ युरभ, इससे 'इन्दु मण्डल गुणेन्दु सङ्गुण' इत्यादि भास्करोक्त उपपन्न होता है। अतः युगाधिमा+१३ युरभ=युचंभ तब अनुपात करते है।

$$\frac{\text{युचंभ. अहर्गण}}{\text{युकुदि}} = \text{भगणादिचन्द्र} = \frac{(\text{युगाधिमा} + \text{१३ युरभ})\ \text{अहर्गण}}{\text{युकुदि}}$$

$$= \frac{\text{युगाधिमा.अहर्गण} + \text{१३ युरभ.अहर्गण}}{\text{युकुदि}} = \frac{\text{युगाधिमा.अहर्गण}}{\text{युकुदि}} + \text{१३ भगणादिरवि} =$$

भगणादिचन्द्र इससे आचार्योक्त उपपन्न होता है। सिद्धान्त शेखर में 'अहर्गणाच्चाधिकमास-निघ्नात्' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपति प्रकार आचार्योक्त के अनुरूप ही है इति ॥३३॥

इदानो त्रिगुणः शनिरिन्दून इत्यादि प्रश्नानामुत्तरमाह ।

इष्टगुणकारगुणितग्रहभगणैक्यान्तरं यथाऽभिहितम् ।
कृत्वाकुदिनैर्भजेत् शेषोनयुतानि कुदिनानि ॥३४॥
यद्यन्यभगणलब्धं धनर्णमिष्टग्रहस्य युगभगणैः ।
अन्यफलमृण धनं चेदूनयुतान्यन्य युगभगणाः ॥ ३५ ॥

सु. भा.—उद्देशकालापे यथेष्टगुणगुणानां ग्रहाणां योगान्तरमभिहितं भवेत् तथेष्टगुणगुणानां तेषां युगभगणानामैक्यान्तरं कार्यं। एवं स राशिर्यदि युग-कुदिनाधिक स्तदा तं युगकुदिनैर्विभजेदत्र फलं प्रयोजनाभावात् त्याज्यं शेषमेव ग्राह्यम्। अन्यभगणलब्धं राश्यादिफलं यदि धनं तदा युगकुदिनानि शेषोनानि यदि ऋणं तदा शेषयुतानि कार्याणि । एवं यानि तानि यद्यन्यभगणफलमृणं तदेष्टग्रहस्य इष्टग्रहस्य युगभगणैरूनानि यद्यन्यभगणफलं धनं तदा युतानि कार्याणि । एवमन्यभगणा भवन्ति । 'उद्देशकालापवदेव कार्यं योगान्तराद्यं ग्रहपर्ययाणाम्' इत्यादि भास्करोक्तमेतदनुरूपमेव ।

अत्रोपपत्तिः ।

यदि युगग्रहभगण इष्टगुणकुदिनैर्युता वा हीना स्तदा तेभ्योऽहर्गणगुणाः कुदिनैर्हृता इष्टसमभगणादिकोनाः पूर्वभगणा भवन्ति भगणशेषं तु पूर्वसममेव। अतोऽत्रेष्टगुणगुणानां ग्रहभगणानामैक्यांतरं कुदिनाधिकं तदा कुदिनैस्तक्ष्यं शेषमेव ग्रहभगणा कल्प्या येभ्यो राश्यादिग्रहोऽभीष्टगुणगुणग्रहयोगान्तरसम एवोत्पद्यते। अथान्यभगणग्रहो यदास्वं तदाऽन्य भगणयुतः शेषो इष्टग्रह भगणसमोऽस्तदा शे+अभ=इभ

∴ अभ=इभ—शे=इभ+युकुदि—शे। एवं यदाऽन्यभगणभवः खेटश्चर्णं तदा शे—अभ=इभ

∴ अभ=शे—इभ = शे + युकुदि — इभ । अत उपपद्यत आचार्योक्तम् ॥३४-३५॥

वि. भा.—उद्देशकालापे यथेष्ट गुणगुणानां ग्रहाणां योगान्तरमभिहितं भवेत्। तथेष्ट गुणगुणानां तेषांयुगभगणानामैकान्तरं कार्यम्। एवं स राशिर्यदि युगकुदिनाधिकस्तदा तं युगकुदिनैर्भिजेत् अत्र फलं प्रनोजनाभावत्त्याज्यं शेषमेव ग्राह्यम्। अन्यभगण लब्धराश्यादिफलं यदि धनं तदा युगकुदिनानि शेषोनानि यदि ऋणं तदाशेषयुतानि कार्याणि, एवं यानि तानि यद्यन्यभगणफलमृणं तदेष्टग्रहस्य दृष्टग्रहस्य युगभगणैरूनानि यद्यन्यभगणफलं धनं तदा युतानि कार्याणि एवमन्य-भगणाभवति 'उद्देश कालापवदेवकार्यं योगान्तराद्यं ग्रहपर्यायाणाम्' भास्करोक्त-मिदमेतदनुरूपमेवेति ॥३४-३५॥

अत्रोपपत्त्यर्थं त्रिगुणः शनिरिन्दूनोऽन्यभगणलब्धैरित्यादि पञ्चमश्लोकस्थले द्रष्टव्यमिति।

अब 'त्रिगुण शनिरिन्दून्' इत्यादि प्रश्नो का उत्तर कहते हैं।

हि. भा.—उद्देश कालाप में जिस प्रकार इष्टगुण से गुणित ग्रहों का योगान्तर कहा गया है, उसी प्रकार इष्टगुण से गुणित उन युगभगणों का ऐक्यान्तर करना चाहिए। इस प्रकार यदि वह राशि युगकुदिन से अधिक हों तो उसको युगकुदिन से भाग दें। प्रयोजन के न होने के कारण फल छोड़कर शेष को ही ग्रहण करना चाहिए। दूसरे भगण से प्राप्त राश्यादिफल यदि धन हो, तो युगकुदिन में से शेष को घटा दें। यदि राश्यादिफल ऋण हो, तो उसे युगकुदिन में जोड़ दे। इस प्रकार जो फल उपलब्ध हों उनको यदि अन्य भगणफल ऋण हो तो दृष्ट इष्टग्रह के युगभगण से घटादें, और यदि अन्यभगण फल धन हो तो युगभगण में जोड़ दें। इस प्रकार अन्यभगण होते है।

"उदेशकालापवदेव कार्य योगान्तराद्यं ग्रहपर्ययाणां" इत्यादि भास्करोक्त आचार्योक्त के अनुरूप ही है ॥ ३४-३५ ॥

इदानीं प्रथमद्वितीय प्रश्नयो (इष्टौदयिकानश्विन्यौदयिकान् वा मध्यान् यः करोति) रुत्तरमाह।

भदिनानि ग्रहभगणैरूनानि सावनदिनानि।
इष्टाश्विन्यौदयिकाः स्वसावनैः पूर्ववन्मध्याः ॥ ३६ ॥

सु. भा.—ग्रहभगणैरूनानि भदिनानि सावनदिनानि ग्रहसावनदिनानि भवन्ति। ततः स्वसावनैः पूर्ववदिष्टाश्विन्यौदयिका मध्या ग्रहा भवन्ति। अर्थाद्य-दीष्टग्रहौदयिका ग्रहाः साध्यास्तदेष्टग्रहग्रहसावनाहर्गणतो यद्यश्विन्यौदयिका स्तदेष्टभदिनतो मध्याग्रहाः पूर्ववत् साध्या इति। 'भभ्रमास्तु भगणैर्विवर्जिता यस्य कुदिनानि तानि वा—' इत्यादि भास्करोक्तमेतदनुरूपमेवेति ॥३६॥

वि. भा.—ग्रह भगणैरूनानि (रहितानि) भदिनानि ग्रहसावनदिनानि भवन्ति, ततः स्व सावने पूर्ववदिष्टाश्विन्योदयिका मध्या ग्रहाः स्युरर्थाद्यदीष्टग्रहोदयिका ग्रहा अपेक्षितास्तदेष्टग्रहसावनाहर्गणो यद्यश्विन्यौदयिका ग्रहा अपेक्षितास्तदेष्टभदिनतो मध्यग्रहा पूर्ववत्साध्या । यस्य भगणैर्यो ग्रह आनीयते स तत्स्वैदोदयकालिको भवति । नक्षत्रपरिवर्त्तगणितो नक्षत्रोदयिकालिको भवति तथा सत्यश्विनी नक्षत्रगणा प्रथमं तदुदयकालिको ग्रहो भवति । अस्मादश्विन्यौदयिकाद् भगणात् यस्योदयाः शोध्यन्ते शेषस्तस्यैव मध्यमो भवतीति ।

अत्रोपपत्तिः ।

यदि युगकुदिनै र्युग स्वोदया लभ्यन्ते तदाऽहर्गणेन किं जाता गत स्वोदयाप्तिः । ततो यदि युगकुदिनैर्युग नक्षत्रभगणोत्पन्ना ग्रहा लभ्यन्ते तदाऽहर्गणेन किमिति यातनक्षत्र परिवर्त्तोत्पन्नग्रह. । ततो यदि युगनक्षत्रभगणोत्पन्नग्रहे युगस्वोदयशोधनेन युगग्रहभगणा लभ्यन्ते तदिष्टनक्षत्रभगणोत्पन्नग्रहे इष्टग्रहस्वोदयशोधनेन क जात इष्टग्रह इति, सिद्धान्त शेखरे 'अहर्गणे स्वोदय संगुणे हृते क्वहर्गनाः स्युः स्वचरोदयाःफलम् । तदूनितो भभ्रमसम्भो ग्रह. प्रजायते मध्यम खेचरोऽथवा ऽयं श्रीपत्युक्तः प्रकारोऽस्तीति ॥ ३६ ॥

अब प्रथम और द्वितीय प्रश्न के उत्तर को कहते है ।

हि. भा.— भदिन में ग्रह भगग को घटाने से ग्रह सावन दिन होते हैं । तब अपने सावन से पूर्वत् इष्ट अश्विनी नक्षत्रोदय कालिक मध्यम ग्रह होते है अर्थात् इष्टग्रहोदय कालिक ग्रहानयन करना हो तो इष्ट ग्रह सावना हर्गग मे यदि अश्विनी नक्षत्रोदय कालिक ग्रहानयन करना हो तो इष्ट भदिन से पूर्ववत् मध्यमग्रह साधन करना ॥ ३६ ॥

उपपत्ति ।

यदि युग कुदिन में युग स्वोदय पाते है तो अहर्गण में क्या उस अनुपात से गतस्वोदय आता है । तब फिर अनुपात करने है यदि युग कुदिन में युग नक्षत्र भगणोत्पन्न ग्रह पाते हैं तो अहर्गण मे क्या इस से गत नक्षत्र परिवर्त्तोत्पन्न ग्रह आते है । पुनः अनुपात करते है यदि युगनक्षत्र भगणोत्पन्न ग्रह में युग स्वोदय को घटाने से युगग्रह भगण पाते हैं तब इष्ट नक्षत्र भगणोत्पन्न ग्रह में इष्टगृह स्वोदय घटाने से क्या इसमे गृह आते हैं । सिद्धान्त शेखर में 'अहर्गणे स्वोदय संगुणे हृते' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति कथित प्रकार है इति ॥ ३६ ॥

इदानीं तृतीय प्रश्नो (गुणार्कैर्गुणं मध्यार्कमिष्टं मध्यं यो वेत्ति)त्तरमाह ।

रवि भगणाप्तं लिप्तादि सविकलं ज्ञेय मण्डलेभ्यो यत् ।
मध्यार्कं सविकल कला संगुणितं ज्ञेय मध्यकलाः ॥ ३७ ॥

सु. भा.—ज्ञेयमण्लेभ्यो ज्ञेयग्रह युगभगरणेभ्यो रवियुग भगणाप्तं यल्लिप्तादि फलं तेनमध्यार्क सकिलकला संगुणितं मध्यार्कस्य सविकलेन शेषेण याः कला अर्थाद्रविकलात्मकमानेन गुण तदा ज्ञेयग्रहस्य मध्यस्य कलाः स्युरिति ।

अत्रोपपत्तिः ।

त्रैराशिकेन यदि रवियुगभगणैर्मध्यमा रविकला लभ्यन्ते तदा ज्ञेयग्रह युगभगणैः किं लब्धा ज्ञेयमध्यकलाः $= \frac{\text{मरक} \times \text{ज्ञेयुभ}}{\text{युरभ}} = \text{मरक} \times \frac{\text{ज्ञेयुभ}}{\text{युरभ}}$ । अत उपपद्यते ।।३७।।

वि. भा.—ज्ञेय ग्रह युगभगणेभ्यो रवि युगभगण भक्तं लब्धं यत्कलादि फलं तेन मध्यार्क सविकल (सशेष) कला संगुणितं (रविकलात्मकमानेन संगुणितं) तदा ज्ञेय ग्रहस्य कला भवन्तीति ।। ३७ ।।

अत्रोपपत्तिः ।

यदि रवि युगभगणैर्मध्यमा रविकला लभ्यन्ते तदा ज्ञेय ग्रह युगभगणैः किं जाताज्ञेयग्रहमध्यकलाः $= \frac{\text{मरक} \times \text{ज्ञेयग्रहयुभ}}{\text{युगरविभ}} = \text{मरक} \times \frac{\text{ज्ञेयग्रयुभ}}{\text{युगरविभगण}}$

एतावताऽऽचार्योक्तमुपपन्नम् ।

अब तृतीय प्रश्न (गुणक गुणित मध्यार्क से इष्ट मध्यमग्रहानयन) के उत्तर को कहते हैं ।

हि. भा.—ज्ञेय ग्रह युग भगण से रवि युग भगण में भाग देने से जो कलादि लब्ध हो उस से सशेष मध्यार्क कला (रविकलात्मक मान) को गुणा करने से ज्ञेयग्रह कला होती है ।। ३७ ।।

उपपत्ति ।

यदि रवि युग भगण में मध्यम रवि कला पाते हैं तो ज्ञेय ग्रह युग भगण में क्या इस अनुपात से ज्ञेय ग्रह मध्य कला $= \frac{\text{मरक. ज्ञेयग्र युगभ}}{\text{युगरविभ}} = \text{मरक} \frac{\text{ज्ञेयग्रयुभ}}{\text{युगरविभ}}$ इस से आचार्योक्त उपपन्न हुआ ।। ३६ ।।

इदानीं पातानानुलोमगमीनित्यादेरुत्तरमाह ।

इष्ट भगणेन भूदिन शेषैर्भगणैः कृतो मध्यः ।
अनुलोमगो विलोमो विलोमगो वाऽनुलोमगतिः ।। ३८ ।।

सु. भा.—इष्टग्रहयुगभगणोनेभ्यो युगकुदिनेभ्यो ये शेषास्तत्समैर्युगभगणै-रहर्गणानुपातेन यो मध्यः कृतः स्यात् स यद्यनुलोमगस्तदा विलोमो भवेद्विलोमगो वा ऽनुलोमगतिर्भवति ।

अत्रोपपत्तिः ।

युकुदि- इयुभ एतेऽहर्गणगुणा. कुदिनभक्ता लब्धभगणादिके भगणानपास्य राश्यादिको ग्रहः क्रियते तदेष्टग्रहश्चक्रशुद्धो भवत्यतो ऽनुलोमगो विलोमो भवतीति ॥ ३८ ॥

वि. भा.—इष्टग्रहयुगभगणहीनैर्युगकुदिनैर्ये शेषास्तत्तुल्यैर्युगभगणैरहर्गणानु-पातेन यो मध्यः कृतो भवेत् स यदि क्रमिकगतिकस्तदा विपरीतगतिको भवति, यदि विपरीतगतिकस्तदा क्रमिकगतिको भवतीति ॥ ३८ ॥

अत्रोपपत्तिः ।

युगकुदि—इग्रयुभ एतत्तुल्यैर्युगभगणैरहर्गणानुपातेना

$\frac{(\text{युगकुदि}-\text{इग्रयुभ}).\ \text{अहर्गग}}{\text{युकुदि}}$ नेन यो भगणादिको ग्रहः समागतस्तत्र भगणान् त्यक्त्वा यो राश्यादिकग्रहः स चक्र (द्वादश राशि) शुद्धोभवत्यतोऽनुलोमगो विलोमो भवतीति ॥ ३८ ॥

प्रथम प्रश्न के उत्तर के लिये कहते हैं ।

हि. भा.—युग कुदिन में इष्टग्रह युग भगण को घटाने से जो शेष रहे तत्तुल्य युग भगण से और अहर्गण से अनुपात द्वारा जो मध्यम ग्रह आते हैं वे यदि अनुलोमगतिक हैं तो विलोम गतिक होते हैं । यदि विलोम गतिक है तो अनुलोम गतिक होते हैं ॥ ३८ ॥

उपपत्ति ।

युगकुदि—इग्रयुभ. एतत्तुल्य युगभगण से और अहर्गण से अनुपात

$\frac{(\text{युकुदि}-\text{इग्रयुभ}).\ \text{अहर्ग}}{\text{युकुदि}}$ से जो भगणादिक ग्रह आते है उन में भगण को छोड़कर जो राश्यादिक ग्रह रहते हैं वह चक्र (द्वादश राशि) शुद्ध होते हैं इसलिये अनुलोमग ग्रह विलोमग होते हैं इति ॥ ३८ ॥

इदानीं प्रकारान्तरेणोत्तरमाह ।

द्युगणोनकुदिनशेषैर्भगणैरनुलोमगो विलोमगतिः ।
भवति विलोमो मध्योऽनुलोमगो वा कृतः प्राग्वत् ॥ ३९ ॥

सु. भा.—अहर्गणोनानां युगकुदिनानां यानि शेषाणि तैः शेषैर्गम्याहर्गणैर्ग्रह युगभगणैश्चानुपातेन प्राग्वत् कृतोऽनुलोमगो ग्रहो विलोभगतिर्भवति मध्यो विलोमश्चानुलोमगो वा भवति ।

अत्रोपपत्तिः ।

यदि गम्याहर्गणेनानेन युकुदि—अह । ग्रहः साध्यते तदा ग्रहः= $\frac{\text{ग्रयुभ (युकुदि—अह)}}{\text{युकुदि}}$ =ग्रयुभ— $\frac{\text{ग्रयुभ} \times \text{अह}}{\text{युकुदि}}$ । अत्रापि भगणानां त्यागाद्राश्यादिको ग्रहश्चक्रशुद्ध उत्पद्यतेऽतोऽनुलोमगो विलोमगो विलोमश्चानुलोमगो भवतीति स्फुटम् ॥३९॥

वि. भा.—अहर्गण हीनेभ्यो युगकुदिनेभ्यो ये शेषास्तैर्गम्याहर्गणैश्चानुपातेन पूर्ववत् कृतोऽनुलोमगो ग्रहो विलोमगो भवति, मध्योविलोमश्चानुलोमगो वा भवतीति ॥ ३९ ॥

अत्रोपपत्तिः ।

युगकुदिन— अहर्गण = गम्याहर्गण, एतेन साधितो भगणादिग्रहः= $\frac{\text{ग्रहयुभगण} \times \text{(युगकुदिन—अहर्गण)}}{\text{युगकुदिन}}$ =ग्रहयुभगण— $\frac{\text{ग्रहयुभगण. अहर्गण}}{\text{युकुदिन}}$ अत्र भगणानपास्य राश्यादिको ग्रहो गृह्यते तदा चक्रशुद्ध एव जायते तस्मादनुलोमगो विलोमगो विलोमगश्चानुलोमगो भवतीति । सिद्धान्तशेखरे "चक्रोनितक्षितिदिन प्रकरावशेषैश्चक्रैः कृतोऽयमनुलोमगतिर्विलोमः । प्राग्वद्विलोमगतिरप्यनुलोमगः स्यात् यद्वा द्युराशिरहितैः कुदिनैः स्वचक्रैः ॥" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव । अस्याभिप्रायः—यदाऽनुलोमो ग्रहः प्रतिलोमो ज्ञातुमिष्यते राश्यादिकः पातो वाऽनुलोमगस्तदा ज्ञेयग्रहस्य चक्रेण (भगणपरिवर्त्तेन) ऊनितानां (रहितानां) क्षितिदिनानां (युग कुदिनानां) यः प्रकरः (समूहः) तस्य शेषैः स्वचक्रै (ज्ञेयग्रह चक्रत्वेन निरूपितैः) प्राग्वन्निष्पन्नोऽयं ग्रहोऽनुलोमो विलोमः स्यात् द्युराशिरहितैः (इष्टाहर्गणाहीनैः) कुदिनैः (युगकुदिनैः) स्वचक्रैश्च (स्वभगणैश्च) पूर्ववत् कृतोमध्यो विलोमगोऽनुलोमगः स्यादिति ॥ ३९ ॥

अब प्रकारान्तर से उत्तर को कहते हैं ।

हि. भा.—अहर्गण रहित युग कुदिन का जो शेष (गम्य अहर्गण) है उससे और ग्रह के युगभगण से अनुपात द्वारा पूर्ववत् साधित ग्रह यदि स्वभावतः अनुलोमगतिक रहते है तो विलोम गति होते है । स्वभाव से विलोमगतिक ग्रह अनुलोमगतिक होते हैं ॥ ३९ ॥

उपपत्ति ।

. युगकुदिन—अहर्गण = गम्याहर्गण, इससे और ग्रहयुग भगण से साधित भगणादि

$$\text{ग्रह} = \frac{\text{ग्रहयुभगण (युग कुदिन — अहर्गण)}}{\text{युग कुदिन}} = \text{ग्रहयुगभगण} - \frac{\text{ग्रहयुभगण. अहर्गण}}{\text{युग कुदिन}}$$

यहाँ भगणों को छोड कर राश्यादिक ग्रह लेते है तो वह चक्र शुद्ध ही आता है इसलिये स्वभावतः यदि ग्रह अनुलोम गति होते है, तो विलोमगति होते हैं । और स्वभावतः यदि विलोमगति होते है तो अनुलोमगति होते हैं । सिद्धान्त शेखर मे 'चक्रोनितक्षितिदिनप्रकरादशेषैः' इत्यादि संस्कृतोपपत्ति मे लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥३९॥

इदानीं तृतीय प्रश्नस्यो (शन्याद्यैर्विपरीतैर्दिवस वारं वेत्तीत्यस्य) त्तरमाह ।

कल्पदिनसप्तकवधात् कल्पगताहर्गणोनकाच्छेषात् ।
सप्तहृताद्दिनवारः शेषः शन्यादिको भवति ॥ ४० ॥

सु. भा.—कल्पदिनसप्तकवधात् कल्पकुदिनसप्तघातात् कि विशिष्टात् कल्पगताहर्गणेनोन काद्यः शेपस्तस्मात् सप्तहृतात् शेपः शन्यादिको दिनवारो भवति । अर्थाद्रवेरनन्तरं शनिः शनेरनन्तर शुक्र इति विपरीत गणनया दिनवारो भवति ।

अत्रोपपत्तिः ।

सप्ततष्टोऽहर्गणो यदि शे, तथा सप्तकघ्नो ७ ककुदि—अह । अयं शे कल्प्यते तदा शे = ७—शे, । अतो—शे, ऽस्माद्या रव्यादितः क्रमगणना सैव ७—अशे, अस्मात् शन्यादेर्विपरीतगणना । यथा यदि शे, = १ तदा क्रमगणनया वर्त्तमानः सोमवारस्तथा शे = ६ । अस्मात् । रविः । शनिः । शुक्रः । गुरुः । बुधः । कुजः । इति विपरीत गणनया वर्त्तमानः सोम एव जातः ॥४०॥

वि. भा.—कल्पगताहर्गणेन रहितात् कल्पकुदिनसप्तघाताद्यः शेषस्तस्मात् सप्तभक्ताच्छेषः शन्यादिको दिनवारो भवत्यर्थाद्रविशनिशुक्रादि विपरीत गणनया दिनवारो भवतीति ॥ ३९ ॥

अत्रोपपत्तिः ।

सूत्रोक्त्या "७ ककुदिन—अहर्गणोऽयं सप्तभक्तः शेषं = शे कल्प्यते, तथाऽहर्गणः सप्तभक्तः शेषं = शे' कल्प्यते तदा शे = ७—शे' अतोऽस्मात् शन्यादेर्विपरीतगणनया या भवति सैवाशे'ऽस्माद्रव्यादितः क्रमगणनया भवति । यथा यदि शे' = १ तदा शे = ६ अस्माद्विपरीतगणनया रविः, शनिः, शुक्रः, गुरुः, बुधः, मङ्गलः, वर्त्त-

मानो वारः सामो जातः । शे अस्मात् क्रमगणनया वर्त्तमानो वारः सोम एवा-गच्छत्यत आचार्योक्तं युक्तियुक्तमिति ।।

अब तृतीय प्रश्न (शनि आदि ग्रहों की विलोम गणना से दिवसवार को जानना) के उत्तर को कहते हैं।

हि. भा.—कल्प कुदिन और सात के घात में कल्पगत अहर्गण को घटाने से जो शेष रहे उसको सात से भाग देने से शेष शनि आदि दिनवार होता है अर्थात् रवि, शनि, शुक्र, आदि विपरीत गणना से दिनवार होता है ।।

उपपत्ति ।

आचार्योक्त सूत्र के अनुसार ७ ककुदि—अहर्गण इसको सात से भाग देने से शेष =शे । तथा अहर्गण को सात से भाग देने से शेष = शे, तब शे = ७—शे इसलिए शे इससे रवि आदि क्रमगणना से जो होता है वही ७—शे इससे शनि आदि विपरीत गणना से होता है। जैसे यदि शे = १ तो क्रम गणना से वर्त्तमान सोमवार होता है तथा शे = ६ इससे रवि, शनि, शुक्र, गुरु, बुध, कुज इस विपरीत गणना से भी वर्त्तमान सोमवार ही हुआ इति । ४० ।।

इदानीं प्रथम द्वितीय तृतीय प्रश्नामुत्तराण्याह ।

व्यतिपातवैधृतान्यर्कचन्द्रभगणयुतिर्द्विसङ्गुणिता ।
गुरुवर्षाणि गृहयुता द्वादशगुणिता गुरोर्भगणाः ।। ४१ ।।

सु. भा.—अर्कचन्द्रभगणा युता द्विसंगुणिताश्च व्यतिपातवैधृतानि भवन्ति अर्थाद्रविचन्द्रभगणयोगे यावन्तो भगणास्ते द्विसङ्गुणितास्तावन्तो व्यतिपात वैधृताह्वयाः स्युः । गुरोर्भगणा द्वादशगुणिता वर्त्तमानगुरुगृहयुता गुरुवर्षाणि स्युः ।

अत्रोपपत्तिः ।

रविशशियोगे भार्द्धे व्यतिपातश्चक्रे च वैधृताह्वयः एवं रविशशियोगैकभ-गणे वारद्वयं तेन योगभगणा द्विसङ्गुणास्तावन्तो व्यतिपातवैधृताह्वया गताः स्युः । बृहस्पतेर्मध्यमराशिभोगात् सांहितिका गुरुवर्षं वदन्ति । अतो गुरुभगणा द्वादशगुणा वर्त्तमानराशिसहिता गुरुवर्षाणि भवन्तीति । संप्रति प्रसिद्धसूर्य सिद्धान्ते ऽप्ययमेव गुर्वब्दानयनप्रकारो वर्त्तते ।।४१।।

वि. भा.—रविचन्द्रभगणयुतिर्द्विसङ्गुणिता तदा व्यतिपातवैधृतानिस्युरर्थाद्रविचन्द्र भगणयोगे यावन्तो भगणास्ते द्विगुणितास्तावन्तो व्यतिपात वैधृत संज्ञकाः स्युः। गुरोर्भगणा द्वादशगुणिता वर्तमानगुरुगृहयुता गुरुवर्षाणि भवन्ति ॥ ४१ ॥

अत्रोपपत्तिः ।

यदि रविचन्द्रयोर्योगः षड्राशितुल्यस्तदा तौ भिन्नायनस्थावेकगोलस्थौ च भवतः। यथा यद्येकः=१ रा, तदा परः=५ रा, एवं द्वयोः प्रमाणे षड्राशितुल्ये योगे १।५॥२।४॥३।३॥४।२ अत्र द्वयोर्भुजयोस्तुल्यत्वात् तयोः स्थानीये क्रान्ती समे, अतोऽत्र व्यतिपातयोगः। विशेषेण (अत्यन्त) शुभफलं पातयति (नाशयति) इति व्यतिपात नाम योग विशेषः॥

यदि रविचन्द्रयोर्योगो द्वादश राशिसमस्तदा तौ भिन्नगोलस्थावेकायनगतौ च स्याताम्। यथा यद्येकः=१ रा तदा परः=११ रा, एवं तयोः प्रमाणे १।११॥२।१०॥३।९॥४।८॥५।७॥६।६॥७।५ अत्र द्वयोर्भिन्नगोलावयनयोरैक्यं च। अत्र भुजयोस्तुल्यत्वाद्रविक्रान्तिसमा चन्द्रस्थानक्रान्तिरतस्तत्र वैधृतयोगः। मङ्गलं विशेषेण ध्रियते अवरोध्यत इति विधृतः। विधृतः एव-वैधृतः॥

रविचन्द्र योगे षड्राशितुल्ये व्यतिपातः, द्वादशराशितुल्ये च वैधृतसंज्ञकः एवं रवि चन्द्रयोगैकभगणे वारद्वयं तस्माद्योगभगणा द्विगुणिता स्तावन्तो व्यतिपातवैधृतसंज्ञका गताः स्युरिति॥ यद्यपि मुहूर्तकल्पद्रुमादौ स्पष्टगुरुराशिसञ्चारवशतोऽपि गुरुवर्षाणि साधितानि तथापि प्राचीनैः सर्वैर्वराहमिहिरादिभिर्मध्यमगुरुराशिसंचारवशेन वर्षाण्यानीतानि। तथा च भास्करः "बृहस्पतेर्मध्यमराशिभोगात्संवत्सरं सांहितिका वदन्ति" "मध्यगत्या भभोगेन गुरोर्गौरववत्सराः" इति लघुवशिष्ठ सिद्धान्तोक्ते मध्यमगुरुराशिभोगकाल एक गुरुवर्षं सृष्ट्यादेर्गुरोः सम्पूर्णराशिभोगज्ञानार्थं गता गुरुभगणा द्वादशगुणा वर्त्तमानराशिसंख्यासहिता गुरु वर्षाणि भवन्ति।

सूर्य सिद्धान्तेऽप्येवमेव गुरु वर्षानयनमस्ति यथा—

"द्वादशघ्ना गुरोर्याता भगणा वर्त्तमानर्कैः।
राशिभिः सहिताः शुद्धाः षष्ट्या स्युर्विजयादयः॥"

संहिताकारैः शुभाशुभफलज्ञानार्थं षष्टिर्गुरुवर्षाणि कथितानि, कस्यचित् पद्यमं "कल्पादितो मध्यमजीवभुक्ता ये राशयः षष्टिहृतावशेषाः। सम्वत्सरास्ते

विजयाश्विनाद्या इतीज्यमानं किल संहितोक्तम् ॥" सृष्ट्यादौ विजय नामवर्षसद्भावाद्विजयादितो गणना कृता सूर्य सिद्धान्तेऽपि विजयादिवर्षाणामुल्लेखः संहितोक्त समान एवेति सुधियो विभावयन्तु ॥ ४१ ॥

अब प्रथम द्वितीय और तृतीय प्रश्नों के उत्तर को कहते हैं।

हि. भा.—रवि और चन्द्र के भगण योग को दो से गुणा करने से व्यतिपात और वैधृत होते हैं अर्थात् रवि और चन्द्र के भगण योग में जितने भगण है उनको द्विगुणित करने से जो होगा उतने व्यतिपात और वैधृत होंगे। गुरु के भगण को बारह से गुणा कर वर्त्तमान गुरु राशियों को जोड़ने से गुरु वर्ष होते है।।४१।।

उपपत्ति।

यदि रवि और चन्द्र का योग छः राशि के बराबर होता है तो वे (रवि-चन्द्र) भिन्न अयन स्थित और एक गोल स्थित होते है। जैसे यदि उनमें से एक=१ रा, तो दूसरा=५ रा, एवं दोनों के प्रमाण योग छः राशि के बराबर १।५॥ २।४॥ ३।३॥ ४।२ यहाँ दोनों (रवि-चन्द्र) के भुज बराबर होने से स्थानीय क्रान्ति तुल्य होती है इसलिये इसको व्यतिपात योग कहते है। शुभ फल को विशेष (अत्यन्त) रूप से नाश करता है इसलिये इसका नाम व्यतिपात योग है॥

यदि रवि और चन्द्र का योग बारह राशि के बराबर होता है तो वे दोनों भिन्न गोल स्थित और एक अयनस्थित होते हैं। जैसे यदि उन दोनो में से एक=१ रा है, तो दूसरे=११ रा, एवं उन दोनों के प्रमाण १।११॥२।१०॥३।९॥४।८॥५।७॥६।६॥७।५ यहाँ दोनों के भिन्न गोल है और अयन एक है। यहाँ दोनों के भुज बराबर होने से रविक्रान्ति के बराबर चन्द्रस्थानीय क्रान्ति होगी इसलिये इसको वैधृत नाम का योग कहते है। मङ्गल कार्य को विशेषरूप से अवरूद्ध करता है इसलिये इसका नाम वैधृत योग है॥

उपर्युक्त रवि और चन्द्र का योग छः राशि होने से व्यतिपात योग और बारह राशि होने से वैधृत योग होता है एवं रवि-चन्द्र का योग एक भगण मे दो बार होता है इसलिये योग भगण को दो से गुणा करने से जो होगा उतने ही गत व्यतिपात और वैधृत होंगे॥

यद्यपि मुहूर्तकल्पद्रुमादि ग्रन्थों में स्पष्ट गुरु राशि सञ्चार वश से भी गुरुवर्षानयन हैं तथापि प्राचीन वराहमिहिरादि सब आचार्यो ने मध्यम गुरु राशि सञ्चारवश ही से गुरुवर्षानयन किया है। सिद्धान्त शिरोमणि में 'बृहस्पतेर्मध्यमराशि भोगात्' इत्यादि संस्कृतोपपत्ति में लिखित भास्करोक्ति से तथा 'मध्यगतया भभोगेन गुरोर्गौरव वत्सराः' इस लघुवशिष्ट सिद्धान्तोक्ति से मध्यममान से गुरु का एकराशि भोगकाल गुरु का एक एक वर्ष होता है। सृष्ट्यादि से गुरु

के सम्पूर्ण राशि भोग ज्ञान के लिये गुरु के गतभगण को बारह से गुणाकर वर्त्तमान राशि संख्या जोड़ने से गुरुवर्ष होते हैं। सूर्य सिद्धान्त में भी इसी तरह गुरुवर्षानयन है जैसे "द्वादशघ्ना गुरोर्याता भगणा वर्त्तमानकैः। राशिभिः सहिताः शुद्धाः षष्ट्या स्युर्विजयादयः॥" संहिताकार ने शुभाशुभफलज्ञान के लिये गुरुवर्ष मान कहे हैं जैसे किसी का पद्य है "कल्यादितो मध्यमजीव भुक्ता ये राशयः षष्टिहृतावशेषाः" इत्यादि सङ्क्षेपोपपत्ति में लिखित है सृष्ट्यादि में विजय नाम का वर्ष था. इसलिये विजयादि से गणना की है। सूर्य सिद्धान्त में भी विजयादि वर्षों के उल्लेख साहितिकोक्त समान ही हे, लेकिन आचार्य ने विजयादिवर्षों की चर्चा नहीं की है ॥४१॥

इदानीं चतुर्थपञ्चमप्रश्नयोरुत्तरार्थमाह ।

आद्यग्रहपरिव..ों विशेषिताः स्वोच्चनीचपरिवर्ताः ।
भगणान्तरं द्वियोगाः कार्यास्त्रैराशिकेन गताः ॥४२॥

सु. भा.—आद्यग्रहपरिवर्त्ताः पाठपठिता ग्रहभगणास्ते स्वोच्चभगणैर्विशेषिता अन्तरितास्ते स्वोच्चनीचपरिवर्त्ताः स्वकेन्द्रभगणाः स्युः। 'खेचरोच्चभगणान्तरोन्मिताः सन्ति मन्दचलकेन्द्रपर्यया—' इति भास्करोक्तमेतदनुरूपमेव । एवं द्वयोर्ग्रहयोर्युगभगणानामन्तरं युगे द्वियोगा द्वयोर्ग्रहयोर्योगाः स्युः। ततस्त्रैराशिकेनेष्टकाले युगकुदिनैर्भगणान्तरतुल्या योगास्तदाहर्गणेन किमिति लब्धा गता योगाः कार्याः ।

अत्रोपपत्तिः ।

केन्द्रानयनस्यातिसुगमा । कल्पे भगणान्तरसमा एव ग्रहयोर्योगा भवन्ति । उभयो प्राग्गमनात् इति ॥४२॥

वि. भा.—आद्यग्रहपरिवर्त्ता (पाठपठित ग्रहभगणाः) (स्वोच्चभगणैः) विशेषिताः (अन्तरिताः) तदा स्वोच्चनीचपरिवर्त्ताः (स्वकेन्द्रभगणाः) स्युः । तथा द्वयोर्ग्रहयोर्युगभगणान्तरं युगे तयोर्ग्रहयोर्योगाः स्युः । ततस्त्रैराशिकेन गता योगा भवन्तीति॥ ४२ ॥

अत्रोपपत्तिः ।

ग्रहोच्चान्तरं केन्द्रम्, एतदेवान्तरं प्रतिवर्षं वर्धनेन युगे ग्रहभगणोच्च भगणयोरन्तरतुल्यं भवत्यतो ग्रहयुगभगणानामुच्चयुगभगणानामन्तर समा ग्रहकेन्द्र भगणाः सिद्धाः । सिद्धान्तशिरोमणौ "खेचरोच्चभगणान्तरोन्मिताः सन्ति मन्द चल केन्द्र पर्ययाः" भास्कराचार्येण कथितमिदमाचार्योक्तानुरूपमेव । तथा द्वयोरेकदिशं गच्छतोर्ग्रहयोः प्रतिदिनं गत्यन्तरतुल्यमेवान्तरं भवति, इदमेवान्तरं

वर्धित्वा युगे ग्रहयोर्युग भगणान्तरं भवति तत्तुल्या एव तयोर्युगे योगा भवन्ति। ततोऽनुपातेने 'युगकुदिनैर्ग्रहयोर्भगणान्तरतुल्या योगास्तदाऽहर्गणेन किमिति' ष्टकाले गतायोगा समागच्छन्तीति ॥ ४२ ॥

अब चतुर्थ और पञ्चम प्रश्न के उत्तर के लिये कहते हैं।

हि. भा.—पाठ पठित ग्रह भगण और स्वोच्च भगण (ग्रहोच्च भगण) का अन्तर ग्रह का केन्द्र भगण होता है। तथा दो ग्रहों के युगीय भगणान्तर तुल्य युग में इन दोनों ग्रहों का योग होता है उस से त्रैराशिक से इष्टकाल में गत योग लाना चाहिये इति ॥

उपपत्ति।

ग्रह और उच्च का अन्तर केन्द्र है। यही अन्तर बढते बढ़ते युग में ग्रहभगण और उच्च भगण का अन्तर तुल्य होता है अतः ग्रह और उच्च का युग भगणान्तर तुल्य ग्रह केन्द्र भगण सिद्ध हुआ। सिद्धान्त शिरोमणि में 'खेचरोच्च भगणान्तरोन्मिताः सन्ति मन्दचल-केन्द्र पर्ययाः' इस से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है। एवं एक दिशा में चलते हुए दो ग्रहों का प्रत्येक दिन गत्यन्तर तुल्य ही अन्तर होता है, यही अन्तर बढते बढते युग में दोनो ग्रहों के भगणान्तर के बराबर होता है, एतत्तुल्य ही युग में दोनों ग्रहो का योग होता है। इस से अनुपात करते हैं यदि युग कुदिन में दो ग्रहों का भगणान्तर तुल्य योग पाते है तो अहर्गण में क्या इस से इष्टकाल में गतयोग आते है ॥ ४२ ॥

इदानीं प्रथम द्वितीय प्रश्नयो (सावनमासाब्दाधिपौ यो वेत्तीत्यनयोः) रुत्तरमाह।

द्युगणात् त्रिंशद्भक्ताद्यल्लब्धं द्विगुणितं सरूपं तत्।
सप्तविभक्तं शेषः सावनमासाधिपोऽर्कादिः ॥ ४३ ॥

षष्टिशतत्रयभक्तात् कल्पगताहर्गणात् फलं त्रिगुणम्।
सैकं सप्तविभक्तं सावन वर्षाधिपोऽर्कादिः ॥४४ ॥

सु. भा.—त्रिंशद्भक्तादहर्गणाद्यल्लब्धं तद् द्विगुणितं सैकं च कार्यम्। ततः सप्तविभक्तं शेषोऽर्कादिः सावनमासाधिपा भवति। एवं कल्पगताहर्गणाद् षष्ट्यधिकशतत्रयभक्ताद्यत्फलं तत् त्रिगुणं सैकं च कार्यम्। ततः सप्तविभक्तं शेषोऽर्कादिः सावनवर्षाधिपो भवति।

अत्रोपपत्तिः।

दिनत्रिंशतैकः सावनमासो भवति अतोऽहर्गणस्त्रिंशता हृतो लब्धा गताः सावनमासास्ते द्विसङ्गुणा कृता यतस्त्रिंशद्दिनात्मके सावनमासे सप्ततष्टे द्वयमव-

शिष्यते । वर्त्तमानमासपत्यर्थं सैकाः कृतास्ततः सप्ततष्टे मासाधिपतिरर्कादिर्भवति यत कल्पादौ मासपतिरर्क आसीत् । एवं षष्ट्यधिकशतत्रयदिनैरेकः सावनोऽब्दः परिकल्पितः प्राचीनैस्ततस्तैर्दिनैर्हृतोऽहर्गणो लब्धा गताब्दास्त्रिसङ्गुणा यतः षष्ट्यधिकशतत्रयदिनात्मक एकस्मिन् सावनाब्दे सप्ततष्टे त्रयमवशिष्यते । वर्त्तमानाब्दपार्थं द्विसङ्गुणाः सैकाः कृताः । शेषोपपत्तिरतिसुगमा । प्रसिद्धसूर्यसिद्धान्तेऽप्ययमेव प्रकारः ॥४३-४४॥

वि. भा.—त्रिंशद्भक्तादहर्गणाद्यल्लब्धं तत् द्विगुणितं सैकं च कार्यम् ततः सप्तभक्तं शेषो रव्यादिकः सावनमासपतिर्भवति । एवं कल्पगताहर्गणात् षष्ट्यधिकशतत्रयभक्ताद्यल्लब्धं तत् त्रिगुणित सैकं च कार्यम् । ततः सप्तभक्तं शेषो रव्यादिकः सावनवर्षपतिर्भवतीति ॥ ४३-४४ ॥

अत्रोपपत्तिः ।

माससंख्यया दिनत्रिंशता वर्षसंख्यया दिनषष्ट्यधिकशतत्रयेण यद्येको मासो वर्ष च लभ्यते तदाऽहर्गणेन किं प्रथम स्थाने लब्धा गताः सावनमासा द्वितीय स्थाने च लब्धानि गतानि सावन वर्षाणि । एकस्मिन् सावनमासे त्रिंशद्दिनात्मके सप्तभक्ते द्वयमवशिष्यतेऽतो गतमाससंख्या द्विगुणितास्तदा गत मासपा भवन्ति, वर्त्तमानाधिपत्यर्थं रूपयोजनं कार्यम्, ततः सप्तभक्ते मास पतयो भवन्ति । एकस्मिन् सावनवर्षे षष्ट्यधिकशतत्रयदिनात्मके सप्तभक्ते त्रयमवशिष्यतेऽतो गतवर्षसंख्या त्रिगुणिता तदा गतवर्षपा भवन्ति, वर्त्तमानाधिपत्यर्थं रूपयोजनं कार्यम् । ततः सप्ततष्टे वर्षपा भवन्ति । सृष्ट्यादौ मासपतिर्वर्षपतिश्च रविरेवाऽऽसीदतोऽत्रापि रव्यादितो गणना समुचिता । सूर्यसिद्धान्ते "मासाब्ददिनसंख्याप्तं द्वित्रिघ्नं रूप संयुतम् सप्तोद्धृतावशेषौ तु विज्ञेयौ मासवर्षपौ' ऽनेन मासपतिवर्षपत्यो रानयनमाचार्योक्त सदृशमेवास्ति, सिद्धान्त शेखरे 'सावनाब्दपतिमत्र चतुर्थं मासनाथमपि विद्धि तृतीयम्' ऽनेन श्रीपतिना कथ्यते यदर्कवारे कल्पारम्भ आसीत् ततः सावन वर्ष प्रमाणे षष्ट्यधिकशतत्रयदिनात्मके सप्त भक्ते त्रयमवशिष्यते ततोऽर्काच्चतुर्थः सावन वर्षपतिर्भवति । त्रयाणां गतत्वाद्वर्त्तमानस्य चतुर्थत्वात् । तथा त्रिंशद्दिनात्मके मासप्रमाणे सप्तभक्ते द्वयमवशिष्यते ततश्च द्वौ गतौ वर्त्तमानस्तृतीयो मासपतिर्भवति ॥ ४३-४४ ॥

अब प्रथम और द्वितीय प्रश्नों (सावन मासपति और वर्ष पति ज्ञान) के उत्तर के लिये कहते हैं ।

हि. भा.—अहर्गण को तीस से भाग देकर जो लब्ध हो उसको द्विगुणित कर जोड़ कर जो हो उसमें सात से भाग देने से शेष रवि आदि सावन मासपति होते हैं । एवं कल्प-

गताहर्गण को तीन सो साठ से भाग देने से जो लब्ध हो उसको तीन से गुणा कर एक जोड़ देना चाहिये, उसमें सात से भाग देने से शेष रवि आदि सावन वर्षपति होने हैं ॥ ४३-४५ ॥

उपपत्ति ।

यदि तीस दिन के एक महीने में एक मास पाते हैं तो अहर्गण में क्या इस अनुपात से लब्ध गत सावनमास आता है, तीस दिन के एक सावन मास में सात से भाग देने से शेष दो रहता है इसलिये गत सावन मास संख्या को दो से गुणा करने से गत मासपति होते हैं, वर्त्तमान मास पति के लिये उसमें एक जोडना चाहिये तब सात से भाग देने से मासपति होते हैं। एवं तीन सौ साठ दिन के एक साबन वर्ष में एक वर्ष पाते हैं तो अहर्गण में क्या इस अनुपात से लब्ध गत सावन वर्ष आता है। तीन सौ साठ दिन के एक सावन वर्ष में सात से भाग देने से तीन शेष रहता है इसलिये गत वर्ष संख्या को तीन से गुणा करने से गत वर्ष-पति होते है, वर्त्तमान वर्षपति के लिये एक जोड़कर सात से भाग देने से वर्षपति होते है। सृष्टयादि काल में मासपति और वर्षपति रवि ही थे इसलिये यहा भी रव्यादि से गणना करना समुचित है। इससे आचार्योक्त उपपन्न होता है। सूर्यसिद्धान्त में 'मासाब्ददिन संख्याप्तं द्वित्रिघ्न' इत्यादि संस्कृतोपपत्ति मे लिखित श्लोक से मासपति और वर्षपति के आनयन आचार्योक्त के सदृश ही है ॥ ४३-४४ ॥

इदानीं तृतीय प्रश्न (होरेशं यो वेत्तीत्यस्य) स्योत्तरार्थमाह।

अर्कोनलग्नहोराः पञ्चगुणाः सविकला यदि सरूपाः ।
सप्तविभक्ताः शेषोदिनपाद्यः कालहोरेशः ॥ ४५ ॥

सु. *भा*—अर्कोनलग्नेन होराः साध्याः अर्कस्य भोग्यकालो लग्नभुक्तकालो मध्योदयाश्चैषां योगो घटयात्मक इष्टकाल स च सार्धद्विभक्तो लब्धा होरा भवन्ति यतो घटीद्वयं सार्धं होरेति जातकज्ञानां सिद्धान्तः। लब्धा होराः पञ्चगुणा यदि होराः सविकलाः सावयवास्तदा पंचगुणा ये कृतास्ते सरूपाः कार्याः। अन्यथा पंचगुणा एव ग्राह्याः। ततस्ते सप्तविभक्ताः शेषो दिनपाद्यः काल होरेशो भवति। अर्थाद् दिनवारादिक्रमगणनया कालहोरेशो भवतीति।

अत्रोपपत्तिः।

प्रथमा होरा दिनपते द्वितीया दिनपतेः षष्ठस्यैवं षष्ठः षष्ठः कालहोरेशो भवति। अतो द्वयोर्होरेशयोरन्तरं पंच। अतो होराः पंचगुणाः सर्वे वारा भवन्ति यदि होराः सावयवास्तदा वर्त्तमानहोरेशानयनार्थं ते पंचगुणाः सैकाः कार्याः। ततः सप्ततष्टे दिनाद्धोरेशो भवतीति।

अत्र चतुर्वेदाचार्येणार्कोनलग्नभागाः पञ्चदशहृता होरा भवन्तीति काललवान् सार्धद्विघटीभवान् पञ्चदशलवान् प्रकल्प्य क्षेत्रांशान्तरैरर्कलग्नान्तरभागैरनुपातः कृतः स च गणितयुक्तितो न युक्त इति बुद्धिमद्भिश्चिन्त्यम् ॥४५॥

वि. भा.—अर्कोनलग्नेन होरानाड्या अर्थात् 'अर्कस्य भोग्यस्तनु भुक्तयुक्तो मध्योदयाढ्यश्च समयो विलग्नात्' इति भास्करोक्तेरर्कस्य भोग्यकालः। लग्नस्य भुक्तकालो रविलग्नयोर्मध्ये राश्युदयाश्चैषां सर्वेषां योगो घट्यात्मक इष्टकालः। सार्धं घटीद्वयं होरा प्रमाणमिति फलितज्ञाः स्वीकुर्वन्ति। तत इष्टकालः सार्धद्वि $\frac{5}{2}$ भक्तो होरा भवन्ति लब्धाहोराः पञ्चगुणा यदि होराः सविकला (सशेषाः) स्तदा पञ्चगुणितहोराः सैका कार्याः, अन्यथा पञ्चगुणा एव ग्राह्याः। ततस्ते सप्तभक्ताः शेषो दिनवारादि क्रमगणनया कालहोरेशो भवतीति ॥४५॥

अत्रोपपत्तिः।

प्रथमा होरा दिनपतेर्भवन्ति, ततः षष्ठो द्वितीयहोरेश एवं ततः षष्ठस्तृतीयहोरेशो भवति, एवं षष्ठः षष्ठः कालहोरेशो भवत्यतो द्वयोः कालहोरेशयोरन्तरं पञ्च। तस्माद्धोराः पञ्चगुणाः सर्वे वारा भवन्ति, यदि होराः सशेषास्तदा वर्त्तमानकालहोरेशज्ञानार्थं पञ्चगुणाः सैकाश्च कार्याः, ततः सप्तभक्ताग्तदा दिनपात् क्रमात् कालहोरेशो भवतीति, मुहूर्तचिन्तामणौ "वारादेर्घटिका द्विघ्नाः स्वाक्षहृच्छेषवर्जिताः। सैकास्तष्टानगैः कालहोरेशा दिनपात् क्रमात्" रामाचार्योक्तमिदं कालहोरेशानयनमक्षरश आचार्योक्तानुरूपमेव। अत्र चतुर्वेदाचार्येणार्कोन लग्नभागा पञ्चदशहृता होरा भवन्तीति काललवान् सार्धद्विघटीभवान् पञ्चदशलवान् प्रकल्प्य क्षेत्रांशान्तरैरर्कलग्नान्तरभागैरनुपातः कृतः स च न युक्त इति विद्वद्भिर्विचारणीयम्। सिद्धान्तशेखरे "अर्कोनलग्नस्य गृहाग्निहोराद्विघ्नानि ताः पञ्चगुणाः सशेषाः। चेद्रूपयुक्ता दिनपादयस्ते होराधिनाथाः क्रमशो भवेयुः" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति बोध्यम् ॥४५॥

अब तृतीय प्रश्न (होरेशज्ञान) के उत्तर को कहते हैं।

लग्न में रवि को घटाकर जो हो उससे होरा साधन करना चाहिये। 'अर्कस्यभोग्यस्तनुभुक्तः' इत्यादि भास्करोक्ति से रवि के भोग्यकाल, लग्न के भुक्त काल, रवि और लग्न के अन्तर में राश्युदय, इन सबों का योग घट्यात्मक इष्ट काल होता है। अढ़ाई २$\frac{1}{2}$=$\frac{5}{2}$ घटी की होरा होती है यह जातक पण्डितों का सिद्धान्त है इष्ट घटी को अढ़ाई से भाग देने से लब्धि होरा होती है। यदि होरा सशेष हो तो पांच से गुणाकर सैक करना चाहिये। शेषाभाव में केवल पांच से गुणा करना चाहिये, उसमें सात से भाग देने से शेषाङ्क के बराबर दिन पति आदि काल होरेश होते हैं इति ॥४५॥

उपपत्ति ।

प्रथम होराधिपति दिनपति होते हैं। द्वितीय होराधिपति दिनपति से छठे ग्रह होते हैं। इसी तरह छठे-छठे ग्रह काल होरेश होते हैं। यहां दो काल होरेश का अन्तर पाँच है इसलिए होरा को पांच से गुणा करने से सब वार (दिन) होते है। यदि होरा सशेष हो तो वर्त्तमानकाल होरेशज्ञानार्थ होरा को पाँच से गुणा कर एक जोड देना चाहिये अन्यथा (शेषाभाव में) केवल पाँच से ही गुणा करना चाहिये, तब सात से भाग देने से शेषाङ्क के समान दिनपतिक्रम से काल होरेश होते हैं ।। इससे आचार्योक्त उपपन्न हुआ. । सिद्धान्त शेखर में 'अर्कोनलग्नस्यगृहाणि होरा' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से, श्रीपति ने आचार्योक्तकाल होरेशानयन के अनुरूप ही काल होरेशानयन किया । मुहूर्तचिन्तामणि में 'वारादेर्घटिका द्विघ्नाःस्वाक्षह्रच्छेषवर्जिताः' इत्यादि संस्कृतोपपत्ति में लिखितश्लोक से रामाचार्य ने भी आचार्योक्त के अनुरूप ही काल होरेशानयन किया है, इति ।।४५।।

इदानीं मासवर्षपत्यादौ विशेषमाह ।

त्रिचतुरनन्तरषष्ठाः सावनमासाब्ददिवस होरेशाः ।
दिनगत घटिका द्विगुणाः पञ्चहृता वा ऽन्यमतमेतत् ।।४६।।

सु. भा.—सावनमासपतिस्त्रिको भवति । अर्थाद्यदि मासपतिरर्कस्तदा तदन्यमासपतिः कुजः । एवं त्रिकस्त्रिको मासपतिर्भवति । एवं सावनाब्दपतिश्च-तुर्थश्चतुर्थो भवति । वारपतिरनन्तरो रवेरन्तरं सोमस्ततो भौम इति । होरेशश्च षष्ठः षष्ठ इति होरेशानयने मतान्तरमाह—दिनगतघटिका इति । दिनगत घटिका द्विगुणाः पंचहृता लब्धा होरेशा भवन्ति दिनपाद्वा । एतदन्यमतं न सर्वसम्मतमिति । यत एतन्मते यावत्यो होरास्तावन्त एव वारक्रमेण होरेशा न षष्ठक्रमेणेति ।

अत्रोपपत्तिः ।

माससङ्ख्या ३० सप्ततष्टा शेषम् २ । अतस्त्रिकस्त्रिको मासपतिः । एवं वर्षसङ्ख्या ३६० सप्ततष्टा शेषम् ३ । अतश्चतुर्थश्चतुर्थो वर्षपतिः । शेषं परि-भाषातः स्पष्टम् ।। ४६ ।।

वि. भा.—सावन मास पतिस्त्रिको भवत्यर्थाद्यदि मासपती रविस्तदाऽन्यमास-पतिर्भौमः, एवंत्रिकस्त्रिको मासपतिर्भवति । सावनवर्षपतिश्चतुर्थो भवति, वारपति-नन्तरोऽर्थाद्रवेरनन्तरं सोमस्ततो भौम इत्यादि । होरेशश्च षष्ठः षष्ठ इति । दिनगत घटिका द्विगुणाः पञ्चभक्ता लब्धा दिनपात् होरेशा भवन्ति; एतत्सर्वसम्मत मतम् नान्यमतम् । यत एतन्मते यावत्यो होरास्तावन्त एव वारक्रमेण होरेशा न षष्ठक्र-मेणेति मतान्तरमस्ति ।।४६।।

अत्रोपपत्तिः ।

रविदिने कल्पारम्भ आसीत् तस्मात्सावनवर्षमाने पञ्चषष्ट्यधिकशतत्रयदिनात्मके सप्तभक्ते त्रीण्यवशिष्यन्ते ततो रवेश्चतुर्थः सावनवर्षपतिर्भवति, त्रयाणां गतत्वाद्वर्त्तमानस्य चतुर्थत्वात् । तथा त्रिंशद्दिनात्मके सावनमासे सप्तभक्ते द्वयमवशिष्यते ततो द्वौ व्यतीतौ वर्त्तमानस्तृतीयो मासपतिर्भवत्यतस्त्रिकस्त्रिको मासपतिर्भवति । तथा रविदिने प्रथमः कालहोरेशो रविरेव; द्वितीयो रवेरारभ्य षष्ठः, तस्मात् षष्ठस्तृतीय इत्यादि । दिनान्तरेतु तत्तद्दिनपतिरेव प्रथम होरेशो द्वितीयस्तस्मात् षष्ठ इत्यादि चिन्त्यम् । सिद्धान्तशेखरे "सावनाब्दपतिमत्र चतुर्थमासनाथमपि विद्धि तृतीयम् । वासरेश्वरमनन्तरमर्कात् षष्ठमेव खलु हौरिकमीशम् ॥" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवास्ति । सूर्यसिद्धान्ते 'दिनाब्दमासहोराणामधिपज्ञानार्थं ग्रहकक्षास्थितिवशेनास्ति' यथा "मन्दादधः क्रमेण स्युश्चतुर्था दिवसाधिपाः । वर्षाधिपतयस्तद्वत् तृतीयाश्च प्रकीर्त्तिताः ॥ ऊर्ध्वक्रमेण शशिनो मासानामधिपाः स्मृताः । होरेशाः सूर्यतनयादधोऽधः क्रमशस्तथा ॥" कक्षाक्रमेण मन्दात् (शनैश्चरात्) अधः क्रमेण चतुर्था दिवसा भवन्ति, 'भूमेः पिण्डः शशाङ्कज्ञकविरविकुजेज्यार्किनक्षत्रकक्षावृत्तैरिति, भास्करोक्त्या कक्षाक्रमः च । बु । शु । र । भौ । गु । श अत्रोपर्युक्त सूर्यसिद्धान्तोक्तानुसारेण शनैश्चरादधः क्रमेण चतुर्थो रविः प्रथमदिवसपतिस्ततश्चतुर्थश्चन्द्रो द्वितीयदिवसपतिः ततश्चतुर्थो भौमस्तृतीयदिवसपतिरित्यादयः । तद्वच्छनैश्चरादधः क्रमेण तृतीया वर्षाधिपतयो भवन्ति । यथा यदि प्रथमवर्षपतिः शनिस्तदा ततस्तृतीयो भौमस्ततस्तृतीयः शुक्र इत्यादयो वर्षपतयः स्युः । चन्द्रादूर्ध्वक्रमेण मासानामधिपतयः पूर्वैः कथिताः । प्रथममासपतिर्यदि चन्द्रस्तदा द्वितीयो मासपतिर्बुधस्तृतीयः शुक्र इत्यादि, शनेरधोऽधः क्रमेण होरेशा भवन्ति यथा यदि प्रथमहोरेशः शनिस्तदा द्वितीयो गुरुस्तृतीयो भौम इत्यादयः । सूर्योदयात् सार्धघटीद्वयेनैकैका होरा भवति । यस्मिन् दिने यो वारः स एव प्रथम होरायाः पतिर्भवति ततः पूर्वोक्तप्रकारेणान्ये होरेशा ज्ञेयाः । अत्र प्राचीनकारिका च । वारप्रवृत्तिसमयाद्धोरा सार्धघटीद्वयम् । अपि तद्वारनाथस्य षष्ठः षष्ठस्ततोऽपर इति ॥४६॥

अब मासपति आदि में विशेष कहते हैं ।

हि. भा.—मासपति तीसरे तीसरे होते हैं अर्थात् यदि मास पति रवि है तो अन्य मासपति भौम होंगे, इसी तरह तीसरे तीसरे मास पति होते हैं । एवं सावन वर्ष पति चौथे-चौथे होते हैं, वार पति अनन्तर होते हैं अर्थात् रवि के बाद सोम-सोम के बाद भौम इसी तरह । होरेश छठे छठे होते हैं, होरेशानयन में मतान्तर को कहते हैं । दिन गत घटी को दो से गुणाकर पाँच से भाग देने से दिन पति क्रम से होरेश होते हैं । यह अन्यमत सर्व

सम्मत नहीं है। क्योंकि इस मत में जितनी होरा होती हैं उतने ही बार क्रम से होरेश होते हैं षष्ठ क्रम (छठे छठे) क्रम से नहीं होते हैं इति ॥४६॥

उपपत्ति।

तीस दिन का एक महीना होता है इसलिये मास संख्या (३० दिन) में सात से भाग देने से शष दो रहता है इसलिये तीसरे तीसरे मास पति होते हैं यह सिद्ध हुआ क्योंकि दो गत है, वर्त्तमान तृतीय है। एवं एक सावन वर्ष में दिन संख्या ३६० तीन सौ साठ है इसमें सात से भाग देने से शेष तीन रहता है अतः चौथे चौथे वर्ष पति होते हैं यह सिद्ध हुआ, क्योंकि तीन गत है, वर्त्तमान चतुर्थ है। तथा रवि दिन में प्रथम काल होरेश रवि ही है, द्वितीय काल होरेश रवि से छठे ग्रह, उससे छठे ग्रह तृतीय काल होरेश होते हैं इसी क्रम से आगे भी समझना चाहिये। दिनान्तर में तत्तद्दिन पति ही प्रथम होरेश होते हैं, द्वितीय होरेश उससे छठे ग्रह इत्यादि। सिद्धान्त शेखर में 'सावनाब्दपतिमत्र चतुर्थमासनाथमपि विद्धि तृतीयम्' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से, श्रीपति ने आचार्योक्त के अनुरूप ही कहा है। सूर्यसिद्धान्त में दिन, वर्ष, मास, होरा इनके अधिपति ज्ञान के लिये ग्रह कक्षा स्थिति वश से है जैसे 'मन्दादधः क्रमेण स्युश्चतुर्था दिवसाधिपाः' इत्यादि सस्कृतोपपत्ति में लिखित श्लोकों के अनुसार, कक्षाक्रम से शनैश्चर से अधः क्रम से चौथे चौथे ग्रह दिनपति होते है। सिद्धान्त शिरोमणि में 'भूमेः पिण्डः शशाङ्कज्ञकवि रवि कुजेज्यार्किनक्षत्रकक्षा वृत्तैः' इस भास्करोक्ति के अनुसार कक्षा क्रम इस प्रकार है. चं।बु।शु।र।भौ।गु।श उपर्युक्त सूर्य सिद्धान्तोक्त के अनुसार शनैश्चर से अधः क्रम से चौथे रवि प्रथम दिनपति, उससे चौथे चन्द्र द्वितीय दिनपति, उससे चौथे भौम (मङ्गल) तृतीय दिन पति इसी तरह आगे भी समझना चाहिये। शनैश्चर से अधः क्रम से तृतीय तृतीय ग्रह वर्षपति होते है जैसे यदि प्रथम वर्षपति शनैश्चर है तो उससे तृतीय भौम उससे तृतीय शुक्र इत्यादि वर्ष पति होते हैं। चन्द्र से ऊर्ध्व क्रम से मासों के अधिपति होते है, जैसे प्रथम मासपति चन्द्र, द्वितीय मास पति बुध, तृतीय शुक्र इत्यादि। शनैश्चर से अधोऽधः क्रम से होरेश होते है। प्रथम होरेश शनि, द्वितीय गुरु, तृतीय भौम इत्यादि। सूर्योदय से अढ़ाई अढ़ाई दण्ड की एक काल होरा होती है प्रथम काल होरेश वारेश ही होते है द्वितीयादि होरेश पूर्वोक्त प्रकार से समझना चाहिये। यहाँ प्रचीन कारिका भी है। 'वार प्रवृत्ति समयात् इत्यादि' संस्कृतोपपत्ति में लिखित श्लोक है इति ॥४६॥

इदानीं चतुर्थ प्रश्न (इष्टमध्यसंयोगा निष्टैर्गुणैर्युतोना निष्ठान् यो वेत्तीत्यस्य) स्योत्तरमाह।

गच्छधनमिष्टगुणितैर्धनैर्युतोनं पृथक् पृथक् सहितम्।
गुणकयुतोनपदहृतं सर्वधनमतोऽवशेषाणि ॥ ४७ ॥

सु. भा.—सर्वेषामिष्टानां ग्रहाणामेकजातीनां योगो गच्छधनमिति संज्ञा

सर्वधनमित्यर्थः। तस्मात् सर्वधनादिष्टगुणगुणः प्रथमो ग्रहो विशोध्यते वा तत्र योज्यते यो भवति स ज्ञायते। एवं तस्मादेव तेनैव गुणेन गुणो द्वितीयो ग्रहो विशोध्यते वा तत्र योज्यते यो भवति सोऽपि ज्ञायते। एवं तेनैव गुणेन गुणितान् सर्वानभीष्टान् ग्रहांस्तस्मात् सर्वधनादपास्य वा तत्र संयोज्य या याः संख्या भवन्ति तास्ताः पृथक् पृथग् ज्ञायन्ते। धनानि च पृथक् पृथग्ग्रहमानानि। यावन्तो ऽभीष्टा ग्रहास्तत् पदं वा गच्छमानम्। तेनायमर्थः। गच्छधनमिष्टगुणितैर्धनैर्ग्रहैर्युतोनं कृतं सद्व्यक्तमस्ति पृथक् पृथक् तत् सहितं कार्यम्। गुणकयुतोनपदहृतमर्थाद्येन गुणकेन गुणं ग्रहमानं सर्वधने युतोनं कृतम् तेन गुणकेन युतोनं पदं कार्यं तेन हृतं लब्धं सर्वधनं गच्छधनं भवति अतोऽस्मादवशेषाणि पृथक् पृथग्ग्रहमानानि ज्ञायन्ते।

अत्रोपपत्तिः।

कल्प्यन्ते ग्र$_1$, ग्र$_2$, ग्र$_3$, ग्र$_4$ ········इष्टगुणकारः इ। सर्वधनम्=स। युतोने कृते सङ्ख्या ह$_1$, ह$_2$, ········तदा

$$ह_1=स\pm इ.ग्र_1$$
$$ह_2=स\pm इ.ग्र_2$$
$$ह_3=स\pm इ.ग्र_3$$
$$\vdots \qquad \vdots$$

सर्वयोगे $ह_1+ह_2+ह_3+\cdots\cdots=प.स\pm इ(ग्र_1+ग्र_2+\cdots)$

$$=प.स\pm इ.स=स(प\pm इ)$$

$\therefore स=\frac{ह_1+ह_2+ह_3\cdots\cdots}{प\pm इ}$ अत उपपन्नम्।

अथ $ह_1=स\pm इ.ग्र_1 \;\therefore\; ग्र_1=\frac{स\sim ह_1}{इ}$।

एवं सर्वेषां ग्रहाणां मानानि स्युः॥४७॥

वि. भा.—सर्वेषामिष्टानां ग्रहाणामेकजातीनां योगो गच्छधनं (सर्वधनं)। तस्मात् सर्वधनादिष्टगुणगुणः प्रथमो ग्रहो विशोध्यते वा तत्र योज्यते यो भवति स ज्ञायते। एवं तस्मादेव तेनैव गुणेन गुणो द्वितीयो ग्रहो विशोध्यते यो भवति सोऽपि ज्ञायते। एवं तेनैव गुणेन गुणितान् सर्वानभीष्टान् ग्रहांस्तस्मात् सर्वधनादपास्य वा तत्र संयोज्य या याः संख्या भवन्ति तास्ताः पृथक् पृथक् ज्ञायन्ते। धनानि च पृथक् पृथग् ग्रहमानानि। यावन्तोऽभीष्टा ग्रहास्तत् पदं वा गच्छमानम्। तेनायमर्थः — गच्छधनमिष्टगुणितैर्धनैर्ग्रहैर्युतोनं कृतं स द्व्यक्तमस्ति पृथक् पृथक् तत् सहितं कार्यम्। गुणकयुतोनपदहृतमर्थाद्येन गुणकेन गुणं ग्रहमानं

सर्वधने युतोनं कृतं तेन गुणकेन युतोनं पदं कार्यं तेनहृतं लब्धं सर्व धनं (गच्छ-धनं) भवति। अतोऽस्मादवशेषाणि पृथक् पृथक् ग्रह मानानि ज्ञायन्ते ॥

अत्रोपपत्तिः।

कल्प्यन्ते ग्रहमानानि $ग्र_1$, $ग्र_2$, $ग्र_3$, $ग्र_4$ ....

इष्टगुणकारः = इ। सर्वधनम् = स। युतोने कृते संख्या $ह_1$, $ह_2$, ...

$$तदा\ ह_1 = स \pm इ.\ ग्र_1$$
$$ह_2 = स \pm इ.\ ग्र_2$$
$$ह_3 = स \pm इ.\ ग्र_3$$
$$\vdots \qquad \vdots$$

$$सर्वयोगे\ ह_1 + ह_2 + ह_3 + \cdots\cdots = प.\ स \pm इ\ (ग्र_1 + ग्र_2 + \cdots\cdots)$$
$$= प.\ स \pm इ.\ स = स(प \pm इ)$$

$$स \therefore \frac{ह_1 + ह_2 + ह_3 + \cdots\cdots}{प \pm इ}$$ अत उपपन्नम्।

अथ $ह_1 = स \pm इ.\ ग्र_1$

$$\therefore ग्र_1 = \frac{स \sim ह_1}{इ}$$ एवं सर्वेषां ग्रहाणां मानानि स्युः।

इदानीमध्यायोपसंहारमाह।

मध्योत्तर मेकोनार्या पञ्चाशत् त्रयोदशोऽध्यायः।
ज्ञात्वैवं तन्त्र विदामाचार्यो भवति मध्यगतौ ॥ ४८ ॥

सु. भा.—स्पष्टार्थम् ॥

मधुसूदनसूनुनोदितो यस्तिलकक: श्री पृथुनेह जिष्णुजोक्ते।
हृदि तं विनिधाय नूतनोऽयं रचितो मध्यगतौ सुधाकरेण ॥

इति श्री कृपालुदत्तसूनुसुधाकरद्विवेदि विरचिते ब्राह्मस्फुटसिद्धान्तनूतन-तिलके मध्यगत्युत्तराध्यायस्त्रयोदशः ॥१३॥

इति ब्राह्मस्फुट सिद्धान्ते मध्यगति प्रश्नोत्तराध्यायस्त्रयोदशः ॥ १३ ॥

अब चतुर्थ प्रश्न के उत्तर को कहते हैं।

हि. भा.—एक जातीय सब इष्टग्रहों का योग गच्छधन (सर्वधन) संज्ञक है। उस

सर्वधन में इष्टगुण गुणित प्रथम ग्रह को घटाते है या जोड़ते है तब जो होता है सो विदित है। एवं उसी सर्वधन में उसी गुणक से गुणित द्वितीय ग्रह को घटाने से जो होता है सो भी विदित है। एवं उसी गुणक से गुणित सब अभीष्ट ग्रहों को उसी सर्वधन में घटाकर या उसमें जोड़कर जो-जो संख्या होती है वे भी पृथक्-पृथक् विदित है। अत सब पृथक् पृथक् ग्रहमान है। जितने अभीष्ट ग्रह है वे पद या गच्छमान है। गच्छ धन में इष्ट गुणित धनो (ग्रहमानो) को युत ऊन करने से जो होता है व्यक्त है। पृथक् पृथक् उनको सहित (जोडना) करना चाहिये। गुणक युत-ऊन पद में भाग देना अर्थात् जिस गुणक से गुणित ग्रहमान को सर्वधन में युत-ऊन किया गया है उस गुणकसे युत-ऊन पद को करना चाहिये। उससे भाग देने में लब्ध सर्वधन (गच्छ धन) होता है। उससे अवशेष पृथक् पृथक् ग्रहमान जाने जाते है इति ॥ ४७ ॥

उपपत्ति ।

कल्पना करते हैं। ग्रहमान $ग_1, ग_2, ग_3, ग_4 \cdots\cdots \cdots\cdots$, इष्ट गुणकार $=इ$, सर्वधन$=स$, युत ऊन करने से संख्या $ह_1, ह_2 \cdots\cdots\cdots\cdots$,

$$तब\ ह_1=स\pm इ.ग_1$$
$$ह_2=स\pm इ.ग_2$$
$$ह_3=स\pm इ.ग_3$$
$$\vdots \qquad \vdots$$

सबों को योग करने से $ह_1+ह_2+ह_3+\cdots\cdots=प.स\pm इ.(ग_1+ग_2+\cdots\cdots)$
$$=प.स\pm इ.स=स(प\pm इ)$$

$$\therefore \frac{ह_1+ह_2+ह_3\cdots\cdots\cdots}{प\pm इ}=स$$ इससे आचार्योक्त उपपन्न हुआ।

अथ. $ह_1=स\pm इ.ग_1 \quad \therefore ग_1 = \frac{स\backsim ह_1}{इ}$ इस तरह सब ग्रहों के मान होते हैं।

अब अध्याय के उपसंहार को कहते हैं।

उच्छ्वास आर्याछन्द श्लोकों से सम्बद्ध मध्यमाधिकार प्रश्नों के उत्तरों को समझकर गणक मध्यगति में तन्त्र ज्ञाताओं में आचार्य होते हैं, यह तेरहवां अध्याय है इति ॥ ४८ ॥

इति श्री ब्राह्मस्फुट सिद्धान्त में मध्यगति प्रश्नोत्तराध्याय तेरहवां अध्याय समाप्त हुआ ॥

ब्राह्मस्फुटसिद्धान्त

अथ स्फुटगत्युत्तराध्यायः

ब्राह्मस्फुटसिद्धान्तः

७

अथ स्फुटगत्युत्तराध्यायः

तत्रादौ प्रश्नानाह ।

भुजभागैः कोटिज्यां कोटयंशैर्यः करोति बाहुज्याम् ।
कोटिं भुजेन बाहुं कोटचा वा स्फुटगतिज्ञः सः ॥ १ ॥

सु. भा.—यो भुजभागैः कोटिज्यां करोति । कोटयंशैश्च बाहुज्यां करोति । भुजेन भुजज्यया कोटिं कोटिज्यां करोति । कोटचा कोटिज्यया वा बाहुं भुजज्यां करोति स स्फुटगतिज्ञः स स्फुटगतिं जानातीत्यर्थः । एवमत्र प्रश्नचतुष्टयम् ॥१॥

वि. भा.—यो भुजभागैः (भुजांशैः) कोटिज्यां जानाति, कोटयंशैश्च बाहुज्यां (भुजज्यां) जानाति । भुजेन (भुजज्यया) कोटिं (कोटिज्यां) जानाति, कोटचा (कोटिज्यया) बाहुं (भुजज्यां) जानाति, स स्फुटगतिं जानातीति । अत्र प्रश्न चतुष्टयमस्ति ॥१॥

अब स्फुटगत्युत्तराध्याय प्रारम्भ किया जाता है ।

उसमें पहले प्रश्नों को कहते हैं ।

हि. भा.—जो व्यक्ति भुजांश से कोटिज्या को जानते हैं (१) । कोट्यंश से भुजज्या को जानते हैं (२) । भुजज्या से कोटिज्या को जानते हैं (३) । कोटिज्या से भुजज्या को जानते हैं (४) । वे स्फुट गति को जानते है । यहां चार प्रश्न है ।। १ ।।

इदानीमन्यान् प्रश्नानाह ।

परमफल केन्द्रविद्यः करोति कोटिज्यया स्फुटं कर्णम् ।
कर्णात् कोटिं कोटचा बाहुं वा स्फुटगतिज्ञः सः ॥२॥

सु. भा.—यः परमफलकेन्द्रविद् गणकः कोटिज्यया केन्द्रकोटिज्यया स्फुटं कर्णं शीघ्रकर्णं करोति भजफलं विनैव। कर्णात् कोटिं केन्द्र कोटिज्यां यः करोति। कोटचा केन्द्र कोटिज्यया वा बाहुं केन्द्र भुजज्यां करोति स स्फुटगतिज्ञः। एवमत्र प्रश्नचतुष्टयम् ॥२॥

वि भा.--यः परमफलकेन्द्रविन् (अन्त्यफलज्या-केन्द्रज्याविज्ञ) गणकः कोटि-ज्यया (शीघ्रकेन्द्रकोटिज्यया) स्फुट कर्णं (शीघ्रकर्णं) भुजफल विनैव जानाति। कर्णाच्छीघ्रकेन्द्रकोटिज्यां जानाति, वा कोट्या (शीघ्रकेन्द्र कोटिज्यया) बाहुं (केन्द्र भुजज्यां) जानाति स स्फुटगतिज्ञोऽस्तीति। अत्र प्रश्नचतुष्टयमस्ति ॥ २ ॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—जो अन्त्यफलज्या और केन्द्रज्या के ज्ञाता गणक भुजफल विना शीघ्र केन्द्र कोटिज्या से स्फुट कर्ण (शीघ्रकर्ण) को जानते हैं, कर्ण से शीघ्र केन्द्र कोटिज्या को जानते है। वा शीघ्र केन्द्र कोटिज्या से केन्द्र भुजज्या को जानते है वह स्फुट गतिज्ञ है ॥ २ ॥

इदानीमन्यान् प्रश्नानाह।

केन्द्रभुजकोटिजीवापरमफलज्ञः करोति यः कर्णम्।
स्वोच्चं सफलं स्पष्टं करोति यः स्फुटगतिज्ञः सः ॥ ३ ॥

सु. भा.—यः केन्द्रभुजज्या-केन्द्रकोटिजीवा परमफलज्ञः कर्णं शीघ्रं वा मन्दं करोति। स्वोच्चं सफलं स्पष्टं च यः करोति अर्थान्मन्दस्पष्टं स्फुटं ग्रहं च यः करोति स स्फुटगतिज्ञः। एवं मन्दशीघ्रभेदेनात्र प्रश्नचतुष्टयम् ॥ ३ ॥

वि. भा.—यः केन्द्रभुजज्या केन्द्रकोटिज्याऽन्त्यफलविज्ञः कर्णं (शीघ्रकर्णं मन्दकर्णं वा) जानाति, स्वोच्चं सफलं स्पष्टं च यो जानाति सः स्फुटगतिज्ञोऽस्तीति। अत्र मन्दशीघ्र भेदेन प्रश्न चतुष्टयमस्ति ॥ ३ ॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—जो केन्द्र भुजज्या-केन्द्रकोटिज्या और अन्त्य फलज्या का ज्ञाता शीघ्र कर्ण वा मन्दकर्ण को जानता है फल सहित अपने उच्च को जो जानता है। वह स्फुटगतिज्ञ है यहां मन्द और शीघ्र के भेद से चार प्रश्न हैं ॥ ३ ॥

इदानीमन्यान् प्रश्नानाह।

द्युगणात् स्फुटं ग्रहं यो भुजकोटिज्ये फले विना ज्याभिः।
ज्याभिर्विना फलधनुः करोति वा स्फुटगतिज्ञः सः ॥ ४ ॥

सु० भा०—अहर्गणादेव यः स्फुटं मन्दशीघ्रफलादिसंस्कृतं ग्रहं करोति। ज्याभिः पठितैर्ज्याखण्डैर्विना यो भुजकोटिज्ये फले भुजकोटिफले च करोति। एवं ज्याभिर्विना यः फलचापं ज्यायाश्चापं वा करोति। स एव स्फुटगतिज्ञः। एवमत्र प्रश्नचतुष्टयम् ॥४॥

वि. भा.—योऽहर्गणात् मन्द शीघ्रफलादि संस्कृतं ग्रहं जानाति, यो ज्याभि (पठितैर्ज्या खण्डैः) विना भुजकोटिज्येफले भुजकोटिफले च जानाति। तथा ज्याभिर्विना फलचापं ज्यायाश्चापं जानाति सः स्फुटगतिज्ञोऽस्तीति। अत्र प्रश्नचतुष्टयमस्ति ॥ ४ ॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—जो व्यक्ति अहर्गण से मन्द फल-शीघ्रफलादि संस्कृत स्फुट ग्रह को जानता है, पठित ज्याखण्ड विना भुजज्या और कोटिज्या तथा (भुजफल और कोटिफल) को जानता है। तथा ज्याविना फलचाप अर्थात् ज्या के चाप को जानता है वह स्फुटगतिज्ञ है। यहा चार प्रश्न है ॥ ४ ॥

इदानीमन्यान् प्रश्नानाह।

इष्टाश्विन्यौदयिकान् करोति मध्यान् ग्रहान् स्पष्टान्।
स्वोच्च स्फुटैर्ग्रहं यः करोति वा स्फुटगतिज्ञः सः ॥ ५ ॥

सु. भा.—इष्टग्रहौदयिकान् मध्यान् ग्रहान् यः स्पष्टान् करोति। अश्विन्यौदयिकान् मध्यान् वा यः स्पष्टान् करोति। वा यः स्वोच्चस्फुटैर्मन्दोच्चशीघ्रोच्च स्फुटग्रहैर्यो ग्रहं मध्यग्रह करोति स स्फुटगतिज्ञः। एवमत्र प्रश्नत्रयम् ॥५॥

वि. भा.—य इष्टग्रहौदयिकान् मध्यान् ग्रहान् स्पष्टान् करोति, अश्विन्यौदयिकान् मध्यान् यः स्पष्टान् करोति, वा स्वोच्चस्फुटैः (मन्दोच्च शीघ्रोच्च) स्फुट ग्रहैर्मध्यमं ग्रहं करोति स स्फुटगतिज्ञः। अत्र प्रश्नत्रयमस्ति ॥

हि. भा.—जो व्यक्ति इष्टग्रहोदय कालिक मध्यमग्रह को स्पष्ट करते हैं। अश्विन्यौदयिक मध्यम ग्रह को जो शीघ्रोच्च स्फुट करते हैं। वा मन्दोच्च शीघ्रोच्च स्फुट ग्रहों से मध्यम ग्रह को जानते है वह स्फुटगति के पण्डित है। यहां तीन प्रश्न है ॥ ५ ॥

इदानीमन्यान् प्रश्नानाह।

संक्रान्तेराद्यन्तौ ग्रहस्य यो राशिभतिथि करणान्तान्।
व्यतिपाताद्यन्तौ वा यो वेत्ति स्फुटगतिज्ञः सः ॥ ६ ॥

सु. भा.—यो ग्रहस्य संक्रान्तेराद्यन्तौ वेत्ति । ग्रहस्य राशिभस्य नक्षत्रस्याद्यन्तौ वेत्ति । तिथेराद्यन्तौ वेत्ति । करणस्याद्यन्तौ वेत्ति । वा व्यतिपातस्याद्यन्तौ वेत्ति अर्थात् सर्वेषां सन्धिमानं यो वेत्ति स स्फुटगतिज्ञः । एवमत्र प्रश्नपञ्चकम् ॥६॥

वि. भा.—यः संक्रान्तेराद्यन्तौ राश्यन्तात् नक्षत्रान्तात् तिथि करणान्तात् जानाति, वा व्यतिपाताद्यन्तौ जानाति सः स्फुटगतिज्ञोऽस्तीति ॥ ६ ॥

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—जो व्यक्ति ग्रह संक्रान्ति के आदि और अन्त को जानते हैं । राश्यन्त, नक्षत्रान्त, तिथ्यन्त, करणान्त को जानते है वा व्यतिपात-वैधृत को जानते है वह स्फुटगति के पण्डित है ॥६॥

इदानी प्रथम श्लोकान्तर्गत प्रश्नचतुष्टयानामुत्तराण्याह ।

व्यासदलमितरजीवा भुजकोटयंशोत्क्रमज्यया हीनम् ।
कोटि भुजज्या व्यासार्धकृतिविशेषात् पदं चान्या ॥७॥

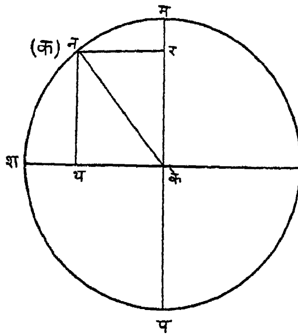
सु. भा.—व्यासदलं भुजोत्क्रमज्यया हीन शेषमितरजीवा कोटिजीवा स्यात् कोटयुत्क्रमज्यया हीनं व्यासदलं शेषमितरजीवा भुजज्या भवेत् । एवं कोटिज्या व्यासार्धवर्गान्तरात् भुजज्या स्याद्भुजज्या व्यासार्धवर्गान्तरात्च पदमन्या कोटिज्या स्यादिति ।

अथोपपत्तिर्ज्योत्पत्त्या स्फुटा ॥७॥

वि. भा.—व्यासदलं (वृत्त व्यासार्ध) भुजांशोत्क्रमज्यया हीनं तदेतरजीवा (कोटिज्या) स्यात् । कोटयंशोत्क्रमज्यया हीनं व्यासार्धमितरजीवा (भुजज्या) स्यात् । तथा कोटिज्या व्यासार्धयो र्वर्गान्तरान्मूलमन्या (भुजज्या) स्यात् । भुजज्या व्यासार्धयोर्वर्गान्तरान्मूलमन्या (कोटिज्या) स्यादिति ॥७॥

अत्रोपपत्तिः

के—वृत्तकेन्द्रम् । मप=वृत्तव्यासः । केम = व्यासार्धम्=त्रिज्या=त्रि । नम=भुजांशाः । मश=९०, ९०—नम = ९०—भुजांश = नश = कोट्यंश । नर=भुजज्या, रम=भुजांशोत्क्रमज्या-भुजज्या । नय=केर=कोटिज्या, शय=



कोट्यंशोत्क्रमज्या=कोउज्या, तदा केम—रम =त्रि—भुउज्या=केर = कोटिज्या। तथा केश=व्यासार्धम्=त्रिज्या=त्रि। केश—शय =त्रि—कोट्युत्क्रमज्या=केय = भुजज्या= त्रि—कोउज्या।

एतावता प्रथम प्रश्नद्वयोत्तरं जातम्। तथा केनर त्रिभुजे $\sqrt{\text{केन}^2 - \text{केर}^2}$=नर =भुजज्या=$\sqrt{\text{त्रि}^2 - \text{कोटिज्या}^2}$ वा केन^2 —नर^2=केर^2=त्रि^{2}—भुजज्या^{2}=कोटिज्या^{2} ∴ $\sqrt{\text{त्रि}^2 - \text{भुजज्या}^2}$=कोटिज्या।

एतेनान्यप्रश्नद्वयोत्तरमपि जातम्। एवं प्रश्नचतुष्टयोत्तराणि जातानीति. सिद्धान्तशेखरे "त्रिशिञ्जिन्या वर्गे भुजकृतिविहीने कृतपदे भवेत्कोटिः कोट्याः कृतिविरहिते मूलमपि दोः। त्रिमौर्वीकोट्यंशोत्क्रमगुणविहीना भुजगुणो भुजांश-व्यस्तज्यारहितपदजीवा तदितरा॥" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति. ॥७॥

प्रथम चार प्रश्नों के उत्तरों को कहते है।

हि. भा.—वृत्तव्यासार्ध में भुजांशोत्क्रमज्या को घटाने से कोटिज्या होती है। तथा व्यासार्ध में कोट्यशोत्क्रमज्या को घटाने से भुजज्या होती है। व्यासार्ध और कोटिज्या का वर्गान्तर मूल भुजज्या होती है। तथा व्यासार्ध और भुजज्या का वर्गान्तर मूल कोटिज्या होती है इति ॥७॥

उपपत्ति।

यहाँ संस्कृतोपपत्ति में लिखित(क) क्षेत्र को देखिये। के=वृत्तकेन्द्र। मप=वृत्तव्यास, केम=व्यासार्ध=त्रिज्या=त्रि, मशचाप=९०, नम=भुजांश, ९०—नम=नश=९०—भुजांश =कोट्यंश नर=भुजज्या=केय, नय=केर=कोटिज्या, रम=भुजांशोत्क्रमज्या=भुउज्या, शय=कोट्यंशोत्क्रमज्या=कोउज्या, तब केम—रम=केर=त्रि—भुउज्या=कोटिज्या। तथा केश=व्यासार्ध = त्रि, केश—शय=केय=त्रि—कोट्युत्क्रमज्या=त्रि—कोउज्या =भुजज्या, इससे प्रथम दो प्रश्नों (१) (२) का उत्तर हो गया। केनर त्रिभुज मे केन^2 —केर^2=नर^2=भुजज्या^{2} ∴ $\sqrt{\text{केन}^2 - \text{केर}^2}$=$\sqrt{\text{त्रि}^2 - \text{कोटिज्या}^2}$=नर=भुजज्या वा केन^2 — नर^2 = केर^2= त्रि^{2} — भुजज्या^{2} = कोटिज्या^{2}।

∴ $\sqrt{\text{त्रि}^2 - \text{भुजज्या}^2}$=कोटिज्या, इससे अवशिष्ट (३) (४) प्रश्नों के उत्तर सिद्ध हुए, इस तरह पूर्वोक्त चारों प्रश्नों के उत्तर सम्पन्न हो गये॥ सिद्धान्त शेखर में

'त्रिभिज्जिन्या वर्गे भुज [illegible]' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से, श्रीपति ने आचार्योक्त के अनुरूप ही कहा है ॥ ७ ॥

इदानीं द्वितीय श्लोकान्तर्गत प्रश्नानामुत्तराण्याह ।

कोटिज्यया द्विगुणयाऽन्त्यफलज्यया गुणितया युतोनायाः ।
मृगकर्क्यादौ त्रिज्यान्त्यफलज्या कृतियुतेः पदं कर्णः ॥८॥

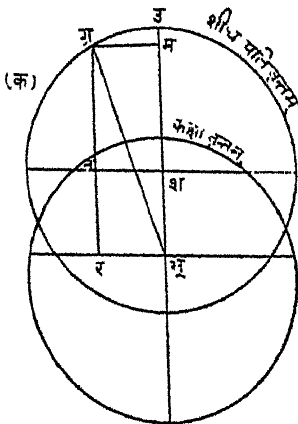
सु. भा.—त्रिज्यान्त्यफलज्याकृतियुतेर्मृगादौ केन्द्रे द्विगुणयाऽन्त्यफलज्या गुणितया कोटिज्यया युतायाः कर्क्यादौ केन्द्रे तु तयोनाया यत्पदं स कर्णो भवेत् ।

अत्रोपपत्त्यर्थं भास्कर कर्णानयनस्य प्रकारचतुष्टय 'स्वकोटिजीवान्त्यफलज्ययोर्यो योगो मृगादौ' इत्यादि द्रष्टव्यम् ॥८॥

वि. भा.—मकरादौ केन्द्रे त्रिज्यान्त्य फलज्याकृतियुतेर्द्विगुणयाऽन्त्यफलज्या गुणितया कोटिज्यया युतायाः कर्क्यादौ केन्द्रे तथा हीनायाः पदं (मूलं) कर्णो भवेदिति ॥८॥

अत्रोपपत्तिः

भू=भूकेन्द्रम् । उ=शीघ्रोच्चम् । ग्र=शीघ्रपतिवृत्तमन्दस्पष्टग्रहः । भूग्र=शीघ्रकर्णः=स्पष्टकर्णः । भूश=शीघ्रान्त्यफलज्या=अंफज्या । उग्र=शीघ्रकेन्द्रम् । ग्रम=शीघ्रकेन्द्रज्या=केज्या । ग्रन=शीघ्रकेन्द्रकोटिज्या=केकोज्या । नर=अंफज्या । ग्रम=भूर=केज्या । मकरादिकेन्द्रे ग्रन+नर=ग्रर=केकोज्या+अंफज्या=स्पष्टाकोटिः । कर्क्यादि केन्द्रे केकोज्या—अंफज्या=स्पष्टा कोटिः । अतो मकरादि कर्क्यादि केन्द्रवशात् केकोज्या±अंफज्या=स्पष्टाकोटिः । ग्रर^2+भूर^2=स्पष्टको^{2}+केज्या^{2}=(केकोज्या±अंफज्या)^2+केज्या^{2}=भूग्र^2=शीघ्रकर्ण^2=केकोज्या^{2}±२ केकोज्या. अंफज्या+अंफज्या^{2}+केज्या^{2}=केकोज्या^{2}+केज्या^{2}±२ केकोज्या. अंफज्या+अंफज्या^{2}



=त्रि^{2}+अंफज्या^{2}±२ केकोज्या. अंफज्या=शीकर्ण^2 मूलग्रहणेन

$\sqrt{\text{त्रि}^2+\text{अंफज्या}^2\pm २\ \text{केकोज्या अंफज्या}}$=शीकर्णः । एतावताऽऽचार्योक्तमुपपन्नम् ।

सिद्धान्तशेखरे "कोटिज्यया द्विगुणितान्त्यफलोत्थजीवा प्रक्षुण्णयेन्दुभमृगादिषु

हीनयुक्ता । कृत्योर्युतिः परफलोत्थगुणत्रिमौर्व्योस्तस्याः पदं भवति वा प्रतिवृत्त-कर्णः ॥" श्रीपत्युक्तमिदं सिद्धान्तशिरोमणौ 'मूलं श्रुतिर्वाऽन्त्यफल त्रिमौर्व्योर्वर्ग-क्यराशेश्च तथा युतोनात् कोटिज्यया वाऽन्त्यफलद्विनिघ्न्या' भास्करोक्तमिदं वाऽऽ-चार्योक्तानुरूपमेवेति ॥८॥

अब दूसरे श्लोक में दिये गये प्रश्नों के उत्तर के लिये कहते हैं ।

हि. भा.—मकरादि केन्द्र में त्रिज्या और अन्त्यफलज्या के वर्गयोग में द्विगुणित अन्त्यफलज्या गुणित कोटिज्या को जोड़ने से और कर्क्यादि केन्द्र में घटाने से जो हो उसका मूल कर्ण होता है ॥८॥

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । भू=भूकेन्द्र । उ=शीघ्रोच्च । ग्र=शीघ्र प्रति वृत्त में मन्दस्पष्ट ग्रह, भूग्र=शीघ्र कर्ण=स्पष्ट कर्ण, भूश=नर=शीघ्रा-न्त्यफलज्या=अंफज्या । उग्र=शीघ्र केन्द्र, ग्रम=शीघ्र केन्द्रज्या=केज्या=भूर । ग्रन= शीघ्र केन्द्र कोटिज्या=केकोज्या, मकरादि केन्द्र मे ग्रन+नर= ग्रर=केकोज्या+अंफज्या =स्पष्टाकोटि, कर्क्यादि केन्द्र में केकोज्या−अंफज्या=स्पष्टाकोटि, अतः मकरादि और कर्क्यादि केन्द्र वश से केकोज्या±अंफज्या=स्पष्टाकोटि, ग्रर^2+भूर^2=भूग्र^2=स्पष्टा-कोटि^{2}+केज्या^{2}=शीघ्र कर्ण^2=(केकोज्या±अंफज्या)^2+केज्या^{2}= केकोज्या^{2}±२ केकोज्या. अंफज्या+अंफज्या^{2}+केज्या^{2}=केकोज्या^{2}+केज्या^{2}±२ केकोज्या. अंफज्या+अंफज्या^{2} =त्रि^{2}+अंफज्या^{2}±२ केकोज्या. अंफज्या=शीकर्ण^2, मूल लेने से $\sqrt{\text{त्रि}^2+\text{अंफज्या}^2\pm\text{२ केकोज्या. अंफज्या}}$=शीकर्ण, इससे आचार्योक्त स्पष्ट कर्णानयन उपपन्न हुआ । सिद्धान्त शेखर में 'कोटिज्यया द्विगुणितान्त्यफलोत्थजीवा' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपति प्रकार तथा सिद्धान्त शिरोमणि में 'अन्त्य फल त्रिमौर्व्यो-र्वर्गैक्य राशेरन्त्य फल द्विनिघ्न्या कोटिज्यया युतोनात पदं' यह भास्करोक्त प्रकार आचार्योक्त के अनुरूप ही है इति ॥८॥

इदानीं कर्णात्कोटिमित्यादेरुत्तरमाह ।

त्रिज्यान्त्यफलकृतियुतेः कर्णकृतेश्चान्तरेऽवशेषं यत् ।
द्विगुणान्त्यफलहृतं तत् कोटिज्या बाहुजीवातः ॥९॥

सु. भा.—त्रिज्यान्त्यफलज्या वर्गयोगस्य कर्णवर्गस्य चान्तरे यदवशेषं तद्द्वि-गुणान्त्यफलज्यया हृतं लब्धं तत्कोटिजीवा केन्द्रकोटिज्या स्यादत उक्तप्रकारेण कोटिज्यावर्गोनात् त्रिज्यावर्गात् पदमित्यनेन बाहुजीवा केन्द्रज्या स्यादित्यर्थः ।

अत्रोपपत्तिः । कर्णानयनवैपरीत्येन सुगमेति ॥ ९ ॥

वि भा. —त्रिज्यान्त्यफलज्ययोर्वर्गयोगस्य कर्णवर्गस्य चान्तरे यच्छेषं तत् द्विगुणितान्त्यफलज्यया भक्तं कोटिज्या स्यात् अतो बाहुजीवा (केन्द्रज्या) स्यादिति ॥९॥

अत्रोपपत्तिः -

पूर्वोक्त कर्णानयनप्रकारेण त्रि²+अंफज्या²±२ केकोज्या. अंफज्या = शीकर्ण²=कर्ण², समशोधनेन २ केकोज्या. अंफज्या=कर्ण²∼(त्रि²+अंफज्या²)

$\therefore$ $\frac{\text{कर्ण}^2 \sim (\text{त्रि}^2 + \text{अंफज्या}^2)}{\text{२ अंफज्या}}$ = केकोज्या ततः, $\sqrt{\text{त्रि}^2 - \text{केकोज्या}^2}$ = केन्द्रज्या,

एतेनाऽऽचार्योक्तमुपपन्नम्। सिद्धान्तशेखरे "योगस्त्रिजीवाऽन्त्यफलोत्थकृत्योस्तस्यान्तरं यत्सह कर्णकृत्या। भक्तं द्विनिघ्नान्त्यफलज्यया तत् स्यात् कोटिजीवाऽथ ततो भुजज्या" श्रीपत्युक्त मिदमक्षरशः आचार्योक्तानुरूपमेवेति ॥९॥

अब कर्ण से केन्द्र कोटिज्या को जानना इत्यादि प्रश्नो के उत्तर को कहते है।

हि. भा. – त्रिज्या और अन्त्य फलज्या के वर्ग योग और कर्ण वर्ग के अन्तर करने से जो शेष रहे उसको द्विगुणित अन्त्यफलज्या से भाग देने मे कोटिज्या होती है, इससे केन्द्रज्याज्ञान होता है ॥९॥

उपपत्ति।

पूर्वोक्त कर्णानयन प्रकार से त्रि²+अंफज्या²±२ केकोज्या, अंफज्या=कर्ण² समशोधन करने से कर्ण²∼(त्रि²+अंफज्या²)=२ केकोज्या . अंफज्या

$\therefore$ $\frac{\text{कर्ण}^2 \sim (\text{त्रि}^2 + \text{अंफज्या}^2)}{\text{२ अंफज्या}}$ = केकोज्या, $\therefore$ $\sqrt{\text{त्रि}^2 - \text{केकोज्या}^2}$ = केज्या, इससे आचार्योक्त उपपन्न हुआ। सिद्धान्त शेखर में 'योगस्त्रिजीवान्त्यफलोत्थकृत्योः' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपति प्रकार आचार्योक्त के अनुरूप ही है इति ॥ ९ ॥

इदानीं प्रतिवृत्तभङ्गीमाह।

कक्षामण्डलतुल्य प्रतिमण्डलमध्यमवनि मध्यात् खे।
तत्स्वोच्चनीचवृत्त व्यासार्धेऽभिमुखमुच्चस्य ॥ १० ॥

प्रतिमण्डलस्य परिधौ मध्यमभुक्त्या स्फुटग्रहो भ्रमति।
मन्दोच्चादनुलोमं शीघ्रात् प्रतिलोममवनिस्थः ॥ ११ ॥

स्पष्टं पश्यति यस्मात् मध्यादूनाधिकं स्वकक्षायाम्।
तस्मात्तदन्तरफलमृणं धनं वा ग्रहे मध्ये ॥ १२ ॥

सु. भा.—खे आकाशे स्वोच्चस्याभिमुखमवनिमध्यात् तत् स्वोच्चनीचवृत्तव्यासार्धेऽन्त्यफलज्याग्रे कक्षामण्डलतुल्यस्य प्रतिमण्डलस्य मध्यं केन्द्रं भवतीति। अवनिस्थो भूगर्भस्थो द्रष्टा। स्वकक्षायां कक्षामण्डले भवलये। शेषं स्पष्टार्थम्। 'त्रिभज्यकासमितकर्कटकेन'—इत्यादि भास्करोक्त मेतदनुरूप मेवेति ॥१०-१२॥

वि. भा.—खे (आकाशे) स्वोच्चाभिमुखं–अवनि मध्यात् (भूकेन्द्रात्) तत्स्वोच्चनीच व्यासार्धे (अन्त्यफलज्याग्रे) कक्षामण्डलतुल्यस्य प्रतिवृत्तस्य मध्यं (केन्द्रं) भवति। प्रतिवृत्त परिधौ मन्दोच्चादनुलोमं शीघ्रोच्चात् प्रतिलोमं (विलोमं) मध्यगता स्फुटग्रहो भ्रमति, अवनिस्थः (भूगर्भस्थो द्रष्टा) स्वकक्षायां (कक्षावृत्ते भवलये) यस्मात्कारणात् मध्यमग्रहात् न्यूनाधिकं स्पष्टग्रहं पश्यति तस्मात् कारणात्तदन्तरफलं मध्ये ग्रहे ऋणं धनं क्रियते। अर्थात् कक्षावृत्ते स्फुटमध्यग्रहयोरन्तरं फलम् तच्च मध्यग्रहात् स्फुटग्रहेऽग्रस्थे धनं पृष्ठस्थे च ऋणम्। तत्र मन्दोच्चात् मध्यमग्रहपर्यन्तं मन्दकेन्द्रं मन्दस्पष्टग्रहात् शीघ्रोच्चपर्यन्तं च शीघ्रकेन्द्रमिति केन्द्रयोः स्वरूपवैपरीत्येन मन्दशीघ्रकर्मणोः फलयोर्धनर्णतावैपरीत्यम् ॥१०-१२॥

अब प्रतिवृत्तभङ्गी को कहते हैं।

हि. भा.—आकश में अपने उच्च के संमुख भूकेन्द्र से अन्त्यफलज्याग्र पर कक्षावृत्त के तुल्य प्रतिवृत्त का केन्द्र होता है। प्रतिवृत्त परिधि मे मन्दोच्च से अनुलोम (क्रमिक) और शीघ्रोच्च से विलोम मध्यगति से स्फुटग्रह भ्रमण करता है। भूगर्भस्थित द्रष्टा (दर्शक) जिस कारण से अपने कक्षावृत्त में (भवलय में) मध्यम ग्रह से न्यूनाधिक स्पष्ट ग्रह को देखते है इस कारण से उन दोनों का अन्तर फल मध्यमग्रह में ऋण और धन किया जाता है अर्थात् कक्षावृत्त में स्फुटग्रह और मध्यमग्रह का अन्तर फल है, मध्यमग्रह से स्फुट ग्रह आगे रहे तो वह फल धन होता है, और मध्यमग्रह से स्फुटग्रह पीछे रहे तो फल ऋण होता है। मन्दोच्च से मध्यमग्रह पर्यन्त मन्दकेन्द्र है और मन्द स्पष्टग्रह से शीघ्रोच्च पर्यन्त शीघ्रकेन्द्र है, इन दोनों केन्द्रों के स्वरूप वैपरीत्य के कारण मन्द कर्म और शीघ्र कर्म में फलद्वय की धनर्णता में वैपरीत्य होता है इति ॥१०–१२ ॥

इदानीं स्पष्टां कोटिमाह।

अन्त्यफलज्याग्रात् स्यात् पदयोराद्यन्तयोरुपरिकोटिः।
द्वितृतीययोरधस्तात् तदन्तरैक्यं ततः कोटिः ॥ १३ ॥

सु. भा.—कोटिः प्रतिमण्डलीयकेन्द्रकोटिज्या। ततस्तस्मात् तदन्तरैक्यं केन्द्रकोटिज्यान्त्यफलज्ययोराद्यन्तयोः पदयोरैक्यं कर्क्यादौ त्वन्तरं कोटिः स्पष्टा

कोटिः प्रतिमण्डलीयग्रहोपरात् तत्कक्षावृत्तकेन्द्रगतिर्यग्रेखावधिर्लम्बरूपा कोटिः स्यादित्यर्थः । 'मध्यस्थरेखे किलवृत्तयोर्ये' इत्यादि भास्करोक्तमेतदनुरूपमेव ।

अत्रोपपत्त्यर्थं भास्करगोलाध्यायस्य छेद्यकाधिकारो द्रष्टव्यः ॥१३॥

वि. भा.—आद्यन्तयोः पदयोः (मकरादि केन्द्रे) कोटिः (प्रतिवृत्तीय केन्द्रकोटिज्या) अन्त्यफलज्याग्रादुपरि भवति तस्मात्कारणात् केन्द्रकोटिज्यान्त्यफलज्ययोर्योगः, द्वितृतीयपदयो (कर्क्यादि केन्द्रे) अन्त्यफलज्याग्रात्केन्द्रकोटिज्याऽधस्ताद्भवति तस्मात्तयोरन्तरं कोटिः (स्पष्टाकोटिः) प्रतिवृत्तस्थग्रहात् कक्षामध्यगतिर्यग्रेखापर्यन्त लम्बरूपा स्यात् ॥ सिद्धान्तशेखरे 'नीचोच्चसञ्ज्ञवलयस्य च विस्तरार्धं कोटिज्ययाऽन्त्यफलजेन गुणेन कार्या । युक्तोनहीनरहिता च पदक्रमेणेति' श्रीपत्युक्तमिदं, सिद्धान्त शिरोमणौ 'मध्यस्थरेखे किलवृत्तयोर्ये तदन्तरालेऽन्त्यफलस्य जीवेत्यादि' भास्करोक्तं चाचार्योक्तानुरूपमेवेति ॥ १३ ॥

अब स्पष्टा कोटि को कहते हैं ।

हि. भा.—प्रथम पद और चतुर्थपद (मकरादि केन्द्र) में प्रतिवृत्तीय केन्द्र कोटिज्या अन्त्य फलज्याग्र से ऊपर होती है इसलिये केन्द्र कोटिज्या और अन्त्यफलज्या का योग करने से स्पष्टा कोटि होती है । और द्वितीय-तृतीय पदों (कर्क्यादि केन्द्र) में अन्त्यफलज्याग्र से केन्द्र कोटिज्या नीचे होती है इसलिये उन दोनों के अन्तर करने से स्पष्टा कोटि (प्रतिवृत्तस्थ ग्रह से कक्षावृत्तकेन्द्रगततिर्यग्रेखापर्यन्त लम्बरूप) होती है । सिद्धान्तशेखर में 'नीचोच्च संज्ञवलयस्य च विस्तरार्ध' इत्यादि संस्कृत वि. भा. में लिखित श्लोक से श्रीपति तथा सिद्धान्तशिरोमणि में 'मध्यस्थ रेखे किलवृत्तयोर्ये तदन्तरालेऽन्त्यफलस्यजीवा' इत्यादि से भास्कराचार्य भी आचार्योक्त के अनुरूप ही कहते हैं इति ॥ १३ ॥

इदानीं तृतीयश्लोकान्तर्गतप्रश्नानामुत्तराण्याह ।

कोट्यन्त्यफलज्यैक्यं मकरादावन्तरं कुलीरादौ ।
तद्बाहुज्याकृत्योः संयोगपदं भवति कर्णः ॥ १४ ॥

सु. भा.—स्पष्टार्थम् ।

अत्रोपपत्तिश्च भास्करच्छेद्यकाधिकारेण स्फुटा । अत्र चतुर्वेदाचार्येण स्वटीकायां यथा क्षेत्रसंस्था विस्तरतः प्रतिपादिता स्वगोलाध्यायस्य छेद्यकाधिकारे भास्करेण सैव सूत्रत्वेनोपनिबद्धा ॥१४॥

वि. भा.—मकरादौ केन्द्रे प्रतिमण्डलीयकेन्द्रकोटिज्याऽन्त्यफलज्ययोर्योगः स्पष्टा कोटिः, कुलीरादौ (कर्क्यादिकेन्द्रे) तयोरन्तर स्पष्टाकोटिः । तस्याः

(स्पष्टा कोटेः) केन्द्र भुजज्यायाश्च वर्गयोगमूलं कर्णो भवतीति ॥ शेषप्रश्नोत्तरं १७, १८ श्लोकयोरुपपत्तौ द्रष्टव्यमिति ॥ १४ ॥

अत्रोपपत्तिः ।

सिद्धान्त शिरोमणौ 'स्वकोटि जीवान्त्य फलज्ययोर्यो योगो मृगादावथ कर्कटादावित्यादि' भास्करोक्तेन स्फुटेति ॥ १४ ॥

तीसरे श्लोक में दिये गये प्रश्नों का उत्तर

हि. भा.—मकरादि केन्द्र में प्रतिवृत्तीय केन्द्र कोटिज्या और अन्त्यफलज्या का योग स्पष्टा कोटि होती है । कर्क्यादि केन्द्र मे उन दोनों का अन्तर स्पष्टा कोटि होती है । स्पष्टा कोटि और केन्द्र भुजज्या के वर्गयोग का मूल कर्ण होता है ॥ १४॥

उपपत्ति ।

सिद्धान्त शिरोमणि में 'स्वकोटि जीवान्त्य फलज्ययोर्यो योगो मृगादौ' इत्यादि भास्करोक्त प्रकार से स्पष्ट है इति ॥ शेष प्रश्न का उत्तर १७, १८ श्लोकों की उपपत्ति मे देखना चाहिये ॥ १४ ॥

इदानीं प्रतिमण्डल पदान्याह ।

प्रतिमण्डल पदमाद्यं गृहत्रयं सान्त्यफलधनुरतोऽन्यच्च ।
चक्रार्धमनेनोनं द्वितृतीयं चतुर्थमाद्यसमम् ॥ १५ ॥

सु० भा०—गृहत्रयं सान्त्यफलधनुरन्त्यफलज्या चापसहितमाद्य पदं स्यात् । अनेनाद्यपदेन चक्रार्धमूनमतोऽन्यद्द्वितृतीयं द्वितीयं पदं तदेव तृतीयं पदं च स्यात् । चतुर्थ पदं चाद्यसममाद्यपद सममेव वेद्यम् ।

अत्रोपपत्तिः । 'चापेन शीघ्रान्त्यफलज्यकायास्त्रिभं युतोनोनयुतम्''— इत्यादि भास्करविधिनास्फुटा ॥१५॥

वि. भा.—गृहत्रयं (राशित्रयं नवत्यंशं वा) सान्त्यफलधनु. (अन्त्यफलज्याचापसहितं) प्रथमपद स्यादर्थान्नवत्यंशेऽन्त्यफलज्या, चापयोजनेन प्रथमपदं स्यात् । अनेन प्रथमपदेन हीनं चक्रार्ध (राशिषट्कं) अन्यत् द्वितृतीयं द्वितीयं पदं तदेव तृतीयं पदं च स्यात् । चतुर्थं पदं च प्रथमपदसममेव ज्ञेयमिति । सिद्धान्त शिरोमणौ 'चापेन शीघ्रान्त्य फलज्यकायाः, त्रिभं युतोनोन युतं पदानीति' भास्करोक्तमाचार्योक्तानुरूपमेवेति ॥ १५ ॥

अब प्रतिमण्डलीय पदों को कहते हैं।

हि. भा.— तीन राशि को क्रम से अन्त्यफलज्या के चाप को जोड़ने से प्रथम पद होता है। इस प्रथम पद को छः राशि में से घटाने से द्वितीय पद होता है वही तृतीय पद भी होता है। चतुर्थ पद प्रथम पद के समान होता है सिद्धान्त शिरोमणि में 'चापेन शीघ्रान्त्य फलज्यकायाः। त्रिभं युतोनोनयुतं पदानि,' इस से भास्कराचार्य ने भी आचार्योक्त के अनुसार ही कहा है ॥ १५ ॥

पुनस्तान्येव पदान्याह।

त्रिभमन्त्यफलधनुर्युतमाद्यं नवमं तृतीयपदमूनम्।
द्वि चतुर्थे षड् द्वादश भानि प्रतिमण्डलपदानि ॥ १६ ॥

सु. भा.—त्रिभं राशित्रयमन्त्यफलधनुर्युतमाद्यं पदमुच्चादेवं नवममन्त्यफलधनुरोनमुच्चात् तृतीयपदमानं भवति। द्विचतुर्थे तु षड्द्वादशभानि अर्थादुच्चाद् द्वितीयपदमानं षड्राशयश्चतुर्थं पदमानं द्वादशराशयः। एवं प्रथमं यथास्थितं तद्राशिषट्काच्छोध्य द्वितीयम्। अन्त्यफलधनुरूनवभं चक्राद्विशोध्य शेषं चतुर्थम्। एवं प्रतिमण्डल पदानि भवन्ति।

अत्र चतुर्वेदाचार्यः। 'यदि नामेयमार्या ब्रह्मकृता न भवति प्रागार्यैव शोभते' ॥१६॥

वि. भा.—अन्त्यफलचापसहित राशित्रयं प्रतिमण्डलीयप्रथमपदं भवति। अन्त्यफलचापेन हीनं राशिनवात्मकं तृतीयं पद भवति। द्वितीयचतुर्थे पदे क्रमेण षड्राशि-द्वादशराशितुल्येऽर्थादुच्चात् द्वितीय पदमानं षड्राशयः, चतुर्थ पद मानं द्वादश राशयः। एवं प्रथमं यथास्थितं तद्राशिषट्काच्छोध्यं द्वितीयं पदम् अन्त्यफलचापेन हीनान्नवभाद्राशिषट्कं शोध्यं तदा तृतीयं पदं भवति। अन्त्यफल चाप रहित नवभं चक्रा द्विशोध्यं तदा चतुर्थ पदं भवति। एवं प्रति मण्डलपदानि भवन्तीति ॥ १६ ॥

अत्रोपपत्तिः।

प्रतिवृत्तीयोच्चात्प्रतिवृत्तीयदक्षिणोत्तर (प्रतिवृत्त केन्द्रगतिर्यक् रेखा) रेखां यावन्नवत्यंशमितं तत्रान्त्य फलज्याचाप सहितं तदोच्चात्मकक्षा मध्यगतिर्यग्रेखाप्रतिवृत्तयोर्योगबिन्दु यावत्प्रतिवृत्तीयचापं प्रथमं प्रतिवृत्तीयपदम्। कक्षामध्यगतिर्यग्रेखा प्रतिवृत्तयोर्योगबिन्दुतो नीचं यावत्प्रतिवृत्तीयचापं द्वितीयं पदम्। प्रतिवृत्तीयोच्चाद्वैपरीत्येन चतुर्थ पदं प्रथम पदतुल्यम्। तृतीयं पदं द्वितीयपदतुल्यमेवं

प्रतिमण्डलीयपदानि स्युरिति ॥ सिद्धान्त शेखरे "ग्रहपरफलचापेनान्वितं भत्रयं हि प्रथमपदमथोनं स्यान्नवर्क्षं तृतीयम् । रसरविभवनान्ते ते द्वितुर्ये क्रमेण प्रतिवलयसमुत्थे मान्दशैघ्र्ये भवेतामिति, श्रीपत्युक्त मिदमाचार्योक्तानुरूप मेवेति ॥१६॥

अब पुनः उन्हीं पदों को कहते हैं ।

हि. भा.—तीन राशि में अन्त्यफल चाप को जोडने से प्रतिमण्डलीय प्रथम पद होता है । नौ राशि में अन्त्यफल चाप को घटाने से तृतीय पद होता है, उच्च से छः राशि द्वितीय पद मान होता है, उच्च से बारह राशि चतुर्थ पद मान होता है । एवं यथास्थित प्रथम पद को छः राशि में से घटाने से द्वितीय पद होता है । नौ राशि में अन्त्यफल चाप को घटाने से शेष तृतीय पद होता है । अन्त्यफल चाप रहित नौ राशि को बारह राशि में से घटाने से शेष चतुर्थ पद होता है । इस तरह प्रतिमण्डलीय पद होते हैं इति ॥१६॥

उपपत्ति ।

प्रतिवृत्तीय उच्च से प्रतिवृत्तीय केन्द्र गत दक्षिणोत्तर रेखा पर्यन्त नवत्यंश है उसमें अन्त्यफल चाप को जोडने से उच्च से कक्षा मध्यगतिर्यक् रेखा और प्रतिवृत्त के योग बिन्दुपर्यन्त प्रतिवृत्तीयचाप प्रतिवृत्तीय प्रथम पद होता है । प्रथम पदान्त से नीच पर्यन्त प्रतिवृत्तीय चाप द्वितीय पद है । प्रतिवृत्तीय उच्च से वैपरीत्य (उल्टा) चतुर्थपद प्रथमपद के तुल्य होता है, तथा तृतीय पद द्वितीय पद के तुल्य होता है इस तरह प्रतिमण्डलीय पद होते हैं ॥ सिद्धान्तशेखर में 'ग्रहपरफलचापेनान्वितं भत्रयं हि' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से, श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥१६॥

इदानीं केन्द्रभुजकोटिजीवापरमफलज्ञो यः स्वोच्चं स्फुटं ग्रहं करोतीति प्रश्नोत्तरमाह ।

कर्णहृतं व्यासार्धं भुजज्यया गुणितमाप्तधनुराद्ये ।
प्रोह्य भदलाद् द्वितीये षड्राशियुतं तृतीयपदे ॥१७॥
चक्रात् प्रोह्य चतुर्थे स्फुटोच्चयोरन्तरं स्वमन्दोच्चे ।
क्षेप्यं शीघ्रे शोध्यं तत् स्पष्टः पूर्ववत् शेषम् ॥१८॥

सु. भा.—स्पष्टमार्याद्वियम् । 'त्रिज्याहता कर्णहृताभुजज्येत्यादि भास्करोक्तमेतदनुरूपमेव ।

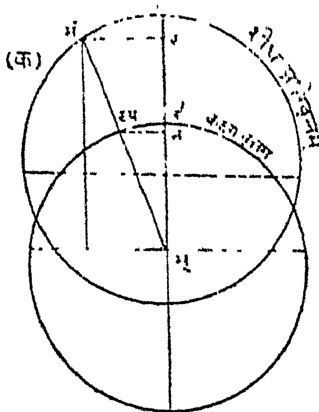
अत्रोपपत्तिः । इहाचार्येण प्रथमं स्पष्टकेन्द्रभुजज्या साधिता ततः प्रतिमण्डल पदवशेन स्पष्टकेन्द्रमानमानीतम् । तत् स्वमन्दोच्चे क्षेप्यं मन्दस्फुटो भवति

मन्दस्फुटान्मन्दोच्चोनिताद्यत् । स्पष्टमन्द केन्द्रम् । एवं यदि तत् स्पष्टशीघ्रकेन्द्रं तदा-शीघ्रं शीघ्रोच्चे तस्मिन् स्पष्टे सति स्यात् स्फुटेन शीघ्रोच्चस्य स्पष्टशीघ्रकेन्द्रत्वात् इति । एवमाचार्येण स्पष्टमन्दकर्णो मन्दकर्णं शीघ्रकर्णं इति कर्णद्वयं साधितम् । ततः शेषं मन्दफलशीघ्रफलादिकं प्राग्वत् गणितक्रियया सम्पद्यते । मध्यस्फुट केन्द्रयोरन्तरं फलमिति । तथा ज्ञानान्मन्द स्फुटात् प्राग्वच्छीघ्रकर्णादिना शीघ्र-फलं कार्यमिति सर्वं स्फुटम् ॥१७-१८॥

वि. भा.—व्यासार्धं (त्रिज्यामानं) भुजज्यया गुणितं कर्णहृतं यत्फलं तस्य चापं स्पष्टग्रहोच्चयोरन्तरं भवेत् शेषं स्पष्टमिति ॥१७-१८॥

अत्रोपपत्तिः ।

उ= शीघ्रोच्चम् । म=मन्दस्पष्टग्रहः । मंउ=शीघ्रकेन्द्रम् । मंर=शीघ्रकेन्द्रज्या=शीकेज्या स्प=स्पष्टग्रहः । स्पउ=स्पष्ट केन्द्रम् । भू=भू केन्द्रम् । भूम=शीघ्रकर्णः । स्पन=स्पष्ट केन्द्रज्या, भूस्प=त्रिज्या । तदा भूमर, भूस्पन त्रिभुजयोः साजात्यादनुपातः $\frac{\text{शीकेज्या.त्रि}}{\text{शीघ्रकर्ण}}$=स्पकेन्द्रज्या, अस्याश्चापम्=स्पष्टकेन्द्रम्=स्पष्ट ग्रहोच्चयो-रन्तरम् । मन्दकर्मणि शीघ्रकेन्द्रज्या स्थाने मन्दकेन्द्रज्या ग्राह्या शीघ्रकर्णस्थाने मन्द कर्णो ग्राह्यस्तदा पूर्ववदनुपातेन मन्दस्पष्ट केन्द्रज्या समागमिष्यति, चापकरणेन मन्दस्पष्ट केन्द्रांशा=मन्दस्पष्टग्रहोच्च योरन्तरम् । यदि प्रथमपदे केन्द्रं तदाऽऽनीतं मन्दस्पष्टग्रह-मन्दोच्चयोरन्तरं मन्दोच्चे योज्यं तदा मन्दस्फुटः स्यात् । यदि केन्द्रं द्वितीयपदे तदाऽऽनीतमन्तरं भार्धाद्विशोध्य शिष्टं मन्दोच्चे योज्यम् । तृतीयपदे केन्द्रे ऽऽनीतान्तरे राशिषट्कं योज्यम् । चतुर्थे पदे केन्द्रे ऽऽनीत-मन्तरं चक्राद्विशोध्य शिष्टं स्वमन्दोच्चे योजयेत्तदा मन्दस्फुटो भवतीति ।



एतस्मान्मन्दस्पष्टग्रहाच्छीघ्रकेन्द्रादिकं कृत्वा पूर्वोक्तानुपातेन $\frac{\text{शीकेज्या. त्रि}}{\text{शीकर्ण}}$= स्पष्ट केन्द्रज्या, समानीय चापं कार्यं तदा स्पष्टग्रहशीघ्रोच्चान्तरं भवेत् । प्रथमपदे शीघ्रकेन्द्रं चेत्तदा समानीतमन्तरं शीघ्रोच्चात् त्यजेत्तदा स्फुटग्रहः स्यात्, द्वितीय पदे केन्द्रे समानीतमन्तरं भार्धाद्विशोध्य शिष्टं शीघ्रोच्चाद्विशोधयेत् तृतीय पदे केन्द्रे तस्माच्छीघ्रोच्चाद्राशिषट्कं त्यजेत् । चतुर्थपदे पूर्वोक्तमन्तरं चक्राद्विशोध्य शिष्टं

शीघ्रोच्चात् त्यजेत्तदा स्फुटग्रहः स्यादिति ॥ सिद्धान्तशेखरे "बाहुज्या त्रिभजीवया विनिहता कर्णोद्धृता कार्ष्ठिता तादृक् पूर्वपदे भपदृक पतिता षड्भान्विता प्रोज्झिता। चक्रादुक्तपदक्रमेण भवति स्पष्टोच्चयोरन्तरं मन्दोच्चे विनियोजयेदपनयेच्छीघ्रोच्चतः स्यात् स्फुटः ॥" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति ॥१७-१८॥

अब केन्द्र भुज कोटिजीवा परमफलज्ञ जो स्वोच्च और स्फुट ग्रह को जानते है इस प्रश्न के उत्तर को कहते है ।

हि. भा.—त्रिज्या को भुजज्या से गुणा कर कर्ण से भाग देने से जो लब्ध हो उस का चाप स्पष्टग्रह और शीघ्रोच्च का अन्तर होता है, ॥ १७–१८ ॥

उपपत्ति ।

यहाँ संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । उ=शीघ्रोच्च । मं=मन्दस्पष्टग्रह । मंउ=शीघ्र केन्द्र । मर=शीघ्रकेन्द्रज्या=शीकेज्या, स्प=स्पष्टग्रह । स्पउ=स्पष्ट केन्द्र । भू=भूकेन्द्र, भूमं=शीघ्रकर्ण, स्पन=स्पष्टकेन्द्रज्या, भूस्प=त्रिज्या=त्रि, तब भूमर, भूस्पन दोनों त्रिभुजों के सजातीयत्व से अनुपात करते है $\frac{\text{शीकेज्या.त्रि}}{\text{शीघ्रकर्ण}}$=स्पकेज्या, इसका चाप =स्पष्टकेन्द्र=स्पष्टग्रह और शीघ्रोच्च का अन्तर । मन्द कर्म में शीघ्रकेन्द्रज्यास्थान में मन्दकेन्द्र ज्या और शीघ्रकर्णस्थान मे मन्दकर्ण ग्रहण करने से पूर्ववत् अनुपात से फल मन्दस्पष्ट केन्द्रज्या आती है, चाप करने से मन्दस्पष्टग्रह और मन्दोच्च का अन्तर होता है । यदि मन्द केन्द्र प्रथम पद मे है तो अन्तर (मन्दस्पष्टग्रह और मन्दोच्च के अन्तर) को मन्दोच्च में जोड़ने से मन्दस्पष्टग्रह होते है द्वितीय पद मे उस अन्तर कोछः राशि मे से घटाकर शेष को मन्दोच्च में जोड़ना चाहिए । तृतीय पद में उस अन्तर में छः राशि जोड़ना चाहिए । चतुर्थ पद में उस अन्तर को बारह राशि में से घटाकर शेष को मन्दोच्च मे जोडने से मन्द स्पष्टग्रह होते है । इस मन्द स्पष्टग्रह से शीघ्रकेन्द्रादि साधन कर पूर्वोक्तानुपात से $\frac{\text{शीकेज्या. त्रि}}{\text{शीकर्ण}}$ = स्पकेज्या, साधनकर चाप करने से स्पष्टग्रह और शीघ्रोच्च का अन्तर होता है प्रथम पद मे इस अन्तर को शीघ्रोच्च में घटाने से स्फुटग्रह होते है, द्वितीय में उस अन्तर को छः राशि मे से घटाकर शेष को शीघ्रोच्च में घटाना चाहिए । तृतीय पद में उस शीघ्रोच्च में से छः राशि घटा देना चाहिए । चतुर्थपद में उस अन्तर को बारह राशि मे घटाकर शेष को शीघ्रोच्च में घटाने मे स्फुटग्रह होते हैं सिद्धान्त शेखर में 'बाहुज्या त्रिभजीवया विनिहता कर्णोद्धृता' इत्यादि सस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है ॥ १७–१८ ॥

इदानीं भुजान्तरमाह ।

मध्यस्फुटान्तरकला बाहुफलं तीक्ष्णकिरणस्य ।
स्फुटभुक्त्याऽर्कादीनां भुजान्तरं क्षयधनं रविवत् ॥ १९ ॥

प्राग्वदर्कचन्द्रयोर्भुजफलं मन्दफलं भूसुतादीनां च मन्दफलं साध्यम् । छेदे कल्प-कुदिनाह्वये फलचाप कलागुणिते मण्डनकलाभिश्चक्रकलाभिर्हृते लब्धं मान्द वा शैघ्र्यफल भगणशेपजातीय तत् पूर्ववत् केन्द्रगोलवशान्मण्डलशेषे ऋणधन कार्य-मेवं स्फुटगणशेषं भवति । अस्मा द्राश्यात्मकः स्फुटो ग्रहः साध्यः ।

अत्रोपपत्तिः । भगणशेषादेवाचार्येण केन्द्रादिकं साधित । तत् एकस्मिन् भगणे चत्वारि पदानि तदा भगणशेषे किमिति पदानि $\frac{४ \times भशे}{ककुदि}$ । एवमेक-स्मिन् पदे ५४०० कलास्तदा गते वागम्ये पदे किं लब्धा गतगम्यकलास्तत्त्वाश्वि-हृता ज्यासङ्ख्या $\frac{गत. वा गम्य. \times ५४००}{ककुदि \times २२५} = \frac{गत. वा गम्य \times २४}{ककुदि}$ । ततो ज्यादीनामानयनं सुगमम् ।

अथ फलकलाश्चक्रकलाहृता जाता भगणात्मिका फलकलाः $= \frac{फक}{चक}$

$$= \frac{\frac{फक. ककुदि}{ककुदि}}{चक} = \frac{फक. ककुदि}{चक. ककुदि} = \frac{\frac{चक}{चक}}{ककुदि} = \frac{लब्ध}{ककुदि}$$ । एवं ग्रहभगणशेषे संस्कारयोग्यं समच्छेदं भगणात्मकं फलं जातमिति । शेषोपपत्तिः सुगमा ॥ २०-२२ ॥

वि. भा.—कल्पकुदिनैः कल्पग्रह भगणा लभ्यन्ते तदाऽहर्गणेन किमिति लब्धाः सशेषा गतभगणा अत्र गतभगणानां प्रयोजनाभावात् त्यक्तम् शेषं भगणशेषं मण्डलशेषं कथ्यते । तस्मात् सदृशं (सजातीयं) स्वोच्चं (उच्चभगणशेषं) विशोध्य शेषं केन्द्रभगणशेषं भवति । तस्माच्चतुर्गुणात् कल्पकुदिनैर्भक्ताद्यल्लब्ध तानि गतानि पदानि भवन्ति । शेषाज्जिनगुणात् कल्पकुदिनैर्भक्ताद्यानि लब्धानि तत्संख्यका जीवा गता शेषं ज्यान्तर गुणितं कल्पकुदिनैर्भक्तं लब्धं गतज्यायां योज्यं तदाभीष्टा केन्द्रज्या स्यात् पदक्रमेण गतैष्यगतैष्यैः केन्द्रज्यासाध्या । प्रथमे पदे गतात् द्वितीये एष्यात् तृतीये गतात्, चतुर्थे च एष्याज्ज्या साध्येति । छेदस्य (कल्पकुदिनस्य) यश्चतुर्थांशस्तत्तुल्यमेकं पदं भवति । बाहोः (भुजस्य) छेद-चतुर्थैः (चतुर्भिः पदैः) क्रमेण येय गतागतगतैःकोटिज्या साध्या । प्रथमे पदे एष्यात्, द्वितीये गतात्, तृतीयेऽगतात् (एष्यात्), चतुर्थे च गतात् कोटिज्या साध्येत्यर्थः । केन्द्रज्यया पूर्ववद्रविचन्द्रयो र्भुजफलं (मन्दफलं), कुजादीनां ग्रहाणां च मन्दफलं

साध्यम् । छेदे (कलाकुदिने) फलचापकलागुणिते चक्रकलाभिर्भक्ते लब्धं मान्दं वा शैघ्र्यं फलं भगणशेष जातीयं तत् पूर्ववत् केन्द्रगोलवशात् ग्रहभगणशेषे ऋणं धनं कार्यं तदा स्फुट भगण शेषं भवति । अस्माद्राश्यात्मकः स्फुटग्रहः साध्य इति ॥ २०-२२ ॥

अत्रोपपत्तिः ।

आचार्येण भगणशेषादेव केन्द्रादिकं साधितम् । तत एकस्मिन् भगणे चत्वारि पदानि तदा भगणशेषे किमिति पदानि $\frac{४ \times भशे}{ककुदि}$ । एवमेकस्मिन् पदे ५४०० कलास्तदा गते वा गम्ये पदे किं लब्धा गतगम्यकलास्तत्त्वाश्विभक्ता ज्यासंख्या $= \frac{गत. वा गम्य \times ५४००}{ककुदि \times २२५} = \frac{गत. वा गम्य \times २४}{ककुदि}$ ततोज्यादोना-मानयनं सुगमम् । अथ फलकलाश्चक्रकला फक्ता जाता भगणात्मिकाः फलकलाः $= \frac{फक}{चक} = \frac{फक. ककुदि}{चक. ककुदि} = \frac{फक. ककुदि}{\frac{चक}{ककुदि}} = \frac{लब्ध}{ककुदि}$, एवंभगणशेषे संस्कार योग्य समच्छेदं भगणात्मकं फलं जातमिति, शेषोपपत्तिः युगमेति ॥ एतावताऽऽचा ऽऽचार्योक्तमुपपन्नम् ॥२०-२२॥ सिद्धान्तशेखरे

"द्युचरभगणशेषात् स्वस्वतुङ्ग प्रसूतं सदृशभगणनिघ्नं प्रोज्झ्यशेषे युगघ्ने ।
क्षितिदिवसविभक्ते स्यात्पदाप्तिश्च शेषे पुनरपि जिननिघ्ने यातयेये तयोस्ते ॥
भवति हि भुजजीवा कोटिजीवाऽन्यथातो हरजलधिलवैर्वादोः फलं पूर्ववत्तत् ।
हरगुणमथ भक्तं चक्रलिप्ताभिराप्तं धनमृणमथ कुर्यादुक्तवच्चक्रशेषे ॥
मृदुचपलफलाभ्यां संस्कृतः स्पष्ट एवं भवति गगनगामी शीघ्रचक्रावशेषात् ।
विहगभगणशेषं प्रोज्झ्य शैघ्रं च कुर्यादिनफल चरखण्डाध्वान्तरं पूर्ववच्च ॥"

अस्यायमर्थः — अहर्गणमिष्टग्रहभगणैर्हत्वा कुदिनैर्भजेत् गतभगणा लभ्यन्ते तत्प्रयोजनमत्र नास्ति, यच्छेषं तद्ग्रह भगणशेषं तस्मात् प्रतिराशिहतात् स्वस्वतुङ्ग प्रसूतं—सदृश भगणशेषं - अह र्गणं स्वोच्चयुगभगणैर्हत्वा कुदिनैर्भजेत् लब्धा भगणास्त्याज्या अवशेषं भगणशेषं हित्वा शिष्टं स्वकेन्द्रस्य भगणशेषं भवति । तस्मिन् शेषे चतुर्भिर्गुणिते कुदिनभक्ते लब्धानि केन्द्रस्य भुक्तानि पदानि स्युः । पुनरपि शेषे चतुर्विंशतिगुणे कुदिनभक्ते लब्धा भुजजीवा भवति, शेषात् गतगम्यान्तरगुणात् कुदिनैर्भक्तात् यल्लब्धं तत् पूर्वस्थापिते योज्यं तदा स्फुटा भवति । सा च प्रथमकेन्द्रपदे शेषं कुदिनेभ्यो विशोध्य शेषं चतुर्विंशति गुणं कुदिनै-र्भजेत् लब्धा कोटिज्या भवति । शेषात् गतगम्यान्तरगुणितात् कुदिनैर्भक्तात्

ल्लब्धं तत्पूर्वलब्धे ज्यार्धे योज्य तदा स्फुटा कोटिज्या स्यात् इति प्रथमे केन्द्रपदे गतैर्भुजज्यायैयैः (एष्यै) कोटिज्या भवति। द्वितीये केन्द्रपदेऽतोऽन्यथा कोटिज्या गतैः तदूनशेषाद्यैर्भुजज्या तृतीये केन्द्रपदे यातैर्भुजज्या, येयैः (एष्यै) कोटिज्या चतुर्थे पदे यातैः कोटिज्या, येयैर्भुजज्या भवतीति। हरजलधिलवैर्यति। ग्रहभगण-शेषात् स्वोच्चभगणशेष त्यक्त्वा शेष भगणशेष भवति। तस्मात् कुदिनतुल्यस्य हरस्य ये चतुर्थाशास्तैर्भक्ते शेषे केन्द्रपदानामवशेषं तत्पदस्य भुक्त भवति। तत् कुदिनचतुर्थाश तुल्यात् स्वहराद्विशोध्य शेष पदस्य येय (अगत) भवति। ताभ्या गतागताभ्यां पूर्ववत् भुजकोटिज्ये यथाप्राप्ते कार्ये, ताभ्या भुजकोटिज्याभ्यां स्फुट-परिधिना च पूर्ववत् भुजफल मान्द शैघ्र वा कार्यम्। तद् भुजफल पुनर्हरगुणं कुदिनेन तच्चतुर्थाशेन वा गुणित कृत्वा चक्रकलाभिर्भक्त लब्ध चक्रशेषे पूर्ववत् पदवशेन धनमृणं वा कुर्यात्। एव मन्दशीघ्रफलाभ्यां सस्कृतो गगनगामी स्फुट एवाहर्गणा-दागच्छतीति। शीघ्रचक्रावशेषादिति। शीघ्रफलानयने क्रियमाणे स्पष्टग्रहभगणशेषं शीघ्रोच्चभगणशेषाद्विशोध्य शैघ्रं च स्फुट कुर्यात्। तथा सस्कारान्तरं मण्डलशेष एव कार्यमित्याह। अर्कदोर्विवरफल चरखण्डफल, अन्यान्तर (देशान्तर फल) एत-सर्व पूर्ववन्मण्डल शेष एव कार्यम्। इति श्रीपत्युक्तमाचार्योक्तानुरूपमेवेति ॥२०-२२

अब अहर्गण से स्फुटग्रह को जानना है (प्रथम प्रश्न) उसके उत्तर को कहते हैं।

हि. भा.—कल्प कुदिन में कल्पग्रहभगण पाते हैं तो अहर्गण में क्या इस अनुपात से सशेषगतभगण आता है, यहां गतभगणों के प्रयोजन नहीं है इसलिये उनको छोड़ देते हैं, शेष (भगणशेष)—मण्डल शेष कहलाता है, उस में सजातीय उच्च भगण शेष को घटाने से शेष केन्द्रभगण शेष होता है उसको चार से गुणा कर कल्प कुदिन से भाग देने से जो लब्ध होते हैं वे गत पद होते हैं, शेष को चौबीस से गुणा कर कल्पकुदिन से भाग देने से जो लब्ध होते हैं तत्संख्यक जीवागत होती है, शेष को ज्यान्तर से गुणा कर कल्पकु-दिन से भाग देने से जो लब्ध हो उसको गतज्या में जोड़ने से अभीष्ट केन्द्रज्या होती है, पदक्रम से गत-एष्य-गत एष्य से केन्द्रज्या साधन करना, अर्थात् प्रथम पद में गत से, द्वितीय पद में एष्य से, तृतीय पद में गत से, चतुर्थपद में एष्य से ज्या साधन करना, हर (कल्प-कुदिन) के चतुर्थाश के बराबर एक पद होता है, चारों पदों में एष्य-गत-एष्य-गत भुजक्रम से कोटिज्या साधन करना। अर्थात् प्रथम पद में एष्य से, द्वितीय पद में गत से, तृतीय पद में एष्य से, चतुर्थपद में गत से कोटिज्या साधन करना, केन्द्रज्या से पूर्ववत् रवि और चन्द्र के भुजफल साधन करना चाहिये। तथा कुजादि ग्रहों का मन्दफल साधन करना चाहिये। छेद (कल्पकुदिन) को फल चाप कला से गुणा कर चक्र कला से भागदेने से जो लब्ध हो वह मान्दफल वा शैघ्रफल भगणशेष जातीय होता है। उसको पूर्ववत् केन्द्रगोलवश से ग्रह भगण शेष में ऋण—धन करने से स्फुट भगण शेष होता है, इसमें राश्यात्मक स्फुटग्रह साधन करना चाहिये इति ॥२०-२२॥

उपपत्ति ।

आचार्य ने भगण शेष ही से केन्द्रादि साधन किया है तब अनुपात करते है यदि एक भगण मे चार पद पाते हैं तो भगणशेष मे क्या इससे पद आते है $\frac{४ \times भशे}{ककुदि}$, एवं यदि एकपद मे ५४०० कला पाते है तो गत वा गम्य पद में क्या इससे लब्ध गतकला, गम्य कला, आती है, दो सौ पचीस २२५ से भाग देने से ज्या संख्या $= \frac{गत वा गम्य \times ५४००}{ककुदि \times २२५}$ $= \frac{गत वा गम्य \times २४}{ककुदि}$ इससे ज्यादिओं का आनयन सुगम ही है। फलकला को चक्रकला से भाग देने से भगणात्मक फलकला $= \frac{फक}{चक} = \frac{फक. ककुदि}{चक. ककुदि} = \frac{\frac{फक ककुदि}{चक}}{ककुदि}$ $= \frac{लब्ध}{ककुदि}$, इस तरह भगणशेष मे संस्कार योग्य समच्छेद भगणात्मक फल हुआ। इससे आचार्योक्त उपपन्न हुआ। सिद्धान्तशेखर मे 'द्युचरभगणशेषात् स्वस्वतुङ्ग प्रसूत सद्गभगण निघ्न" इत्यादि संस्कृतोपपत्ति मे लिखित पद्यो से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥२०-२२॥

इदानीं ज्याभिर्विना भुजकोटिज्ये तत्फले च यः करोतीत्यस्यो (द्वितीय-तृतीय प्रश्नयोः) त्तरमाह ।

भुजकोटयंशोनगुणा भार्धाशास्तच्चतुर्थभागोनैः ।
पञ्चद्वीन्दु खचन्द्रैर्विभाजिता व्यासदल गुणिता ॥२३॥
तज्ज्ये परमफलज्या संगुणिता तत्फले विना ज्याभिः ।
इष्टोच्चनीचवृत्तव्यासार्धं परमफलजीवा ॥ २४ ॥

सु. *भा.*—भार्धांशाः खनागेन्दवो भुजांशैर्वा कोटयंशैर्येषां जीवाऽपेक्षिता तैरूना गुणाश्च कार्याः । ततस्त एव पञ्चद्वीन्दुखचन्द्रै १०१२५ स्तच्चतुर्थांशोनैर्भुजकोटयूनगुणखनागेन्दुचतुर्थांशोनैर्भक्ताः । लब्धिर्व्यासदलगुणा यस्मिन् व्यासार्धे जीवाऽपेक्षिता तेन गुणा तदा तज्ज्ये भुजकोटिज्ये भवतः । तथा सैव लब्धिः परमफलज्यागुणा तदा तत्फले भुजकोटिफले ज्याभिर्ज्याखण्डैर्विना भवत इति । परमफलज्या च केत्याहेष्टोच्चनीचवृत्तव्यासार्ध परमफलजीवा भवतीति ।

अत्रोपपत्तिः । यदि व्यासार्धे भुजज्या तदा द्विगुणव्यासार्धे का लब्धा द्विगुण व्यासार्धे भुजज्या $= \frac{ज्याभू. २ व्याद}{व्या.द.} = २ ज्याभु$ । अतः कस्मिन्नपि व्यासार्धे

द्विगुणभुजांशानां या पूर्णज्या सैव द्विगुणतद्द्व्यासार्धे भुजज्या भवतीति। परिधि व्यासार्धे द्विगुणभुजांशानां पूर्णज्यासाधनार्थं स्वल्पान्तरात्द्व्यासस्त्रिगुण परिधिः =३६०। वक्रांशैश्चक्रममचापोयमान लभ्यते तदा द्विगुणभुजांशैः किं लब्धं तच्चापमान=२ भु। ततश्चापोन निघ्न परिधि प्रथमाह्वयः स्यादित्यादि विधिना खार्कव्यासे द्विगुणभुजांशपूर्णज्या जाता खार्कमितत्रिज्यायां भुजज्या

$$= \frac{(३६० - २ \text{ भु}) \, २ \text{ भु} \times ४ \times १२०}{३६०^2 \times \frac{५}{४} - (३६० - २ \text{ भु}) \, २ \text{ भु}} = \frac{(१८० - \text{भु}) \text{ भु} \times १६ \times १२०}{\frac{३६० \times ३६० \times ५}{४} - (१८० - \text{भु}) \text{भु} \times ४}$$

$$= \frac{(१८० - \text{भु}) \text{ भु} . १२०}{\frac{९० \times ३६० \times ५}{१६} - \frac{(१८० - \text{भु}) \text{ भु}}{४}} = \frac{(१८० - \text{भु}) \text{ भु} \times १२०}{८५ \times ८५ \times ५ - \frac{(१८० - \text{भु}) \text{ भु}}{४}}$$

$$= \frac{(१८० - \text{भु}) \text{ भु} \times १२०}{१०१२५ - \frac{(१८० - \text{भु}) \text{ भु}}{४}}$$

यदि खार्कत्रिज्यायामियं भुजज्या तदेष्टत्रिज्यायां का जातेष्टत्रिज्यायां भुजज्या $= \frac{(१८० - \text{भु}) \text{ भु} . \text{त्रि}}{१०१२५ - \frac{(१८० - \text{भु}) \text{ भु}}{४}}$ त्रिज्ययेयं भुजज्या तदा परमफलज्यया किं जातं भुजफलम्।

$$= \frac{(१८० - \text{भु}) \text{ भु} . \text{ज्यापफ}}{१०१२५ - \frac{(१८० - \text{भु}) \text{ भु}}{४}}$$ । एवं भुजस्थाने कोटिं विन्यस्य कोटिज्या कोटिफले ज्ञेये। शेषोपपत्तिः स्फुटा। भास्करप्रकारोपपत्त्यर्थं कल्प्यते।

ज्याचा $= \frac{\text{या. व्या. चा } (\text{प} - \text{चा})}{\text{का. प}^2 - \text{चा } (\text{प} - \text{चा})}$ अत्र व्यासः = व्या, परिधिः = प, चापम्=चा, तत्पूर्णज्या=ज्या चा इति बोध्यम्।

अथ चापस्य परिधि दलमितत्वे तत्पूर्णज्या व्याससमा तेन

$$\text{व्या} = \frac{\text{या. व्या } \frac{\text{प}}{२}\left(\text{प} - \frac{\text{प}}{२}\right)}{\text{का. प}^2 - \frac{\text{प}}{२}\left(\text{प} - \frac{\text{प}}{२}\right)} = \frac{\text{या. व्या. } \frac{\text{प}^2}{४}}{\text{का. प}^2 - \frac{\text{प}^2}{४}}$$

$$= \frac{\text{या. व्या}}{\text{४ का} - १} \text{ वा } १ = \frac{\text{पा}}{\text{४ का} - १}$$

परिधिषष्ठांशसमचापस्य पूर्णज्या तु व्यासदलसमा त्रिज्यार्धं राशिज त्युक्तेः ।

$$\text{अतः } \frac{\text{व्या}}{२} = \frac{\text{या. व्या } \frac{\text{प}}{६}\left(\text{प} - \frac{\text{प}}{६}\right)}{\text{का. प}^{२} - \frac{\text{प}}{६}\left(\text{प} - \frac{\text{प}}{६}\right)} = \frac{\frac{५\,\text{प}^{२}}{३६} \text{ या. व्या}}{\text{का. प}^{२} - \frac{५\,\text{प}^{२}}{३६}}$$

$$= \frac{\text{५ या. व्या}}{\text{३६ का} - ५} \text{ वा } \frac{१}{२} - \frac{\text{५ या}}{\text{३६ का} - ५} \text{ पूर्वसिद्धम् } १ = \frac{\text{या}}{\text{४ का} - १} \text{ आभ्यां}$$

समीकरणेन $=४$, का$=\frac{५}{४}$ उत्थापनेन ज्या चा $= \frac{\text{४ व्या. चा (प—चा)}}{\frac{५}{४}\text{ प}^{२}\text{—चा (प—चा)}}$

यतोऽनेन विधिना परिधिदलपरिधिष्ठांशयोः पूर्णज्ये सूक्ष्मे आगमिष्यतः शून्यचापस्य ज्यापि शून्यसमैवागच्छतीत्युत्थापने स्फुटं तस्मादन्यचापानां ज्य अप्यनेन विधिना स्वल्पान्तरा आगच्छन्ति । एतेन—

चापोननिघ्नपरिधिः प्रथमाह्वयः स्यात्,
पञ्चाहतः परिधिवर्गचतुर्थभागः ।
आद्योनितेन खलु तेन भजेच्चतुर्घ्नं—
व्यासाहतं प्रथममाप्तमिह ज्यका स्यात् ॥
इत्युपपन्नम् ॥ २३-२४॥

वि. भा.—भार्धांशाः १८० भुजांशैर्वा कोटयंशैर्येषां जीवाऽपेक्षिता तैरून (हीना) गुणाश्च कार्याः । एतच्चतुर्थांशहीनैः पंचद्वीन्दुखचन्द्रै १०१२५ स्त ए भक्ता लब्धिर्व्यासदल (त्रिज्या) गुणिता तज्ज्ये (भुजकोटिज्ये) भवतः । सै लब्धिः परमफलज्या (अन्त्यफलज्या) संगुणिता तदा ज्याखण्डैर्विना भुजकोटि फले भवतः । इष्टोच्चनीचवृत्तव्यासार्धं परमफलजीवा (अन्त्यफलज्या) भवती ॥ २३-२४ ॥

अत्रोपपत्तिः ।

यदि त्रिज्यया भुजज्या लभ्यते तदा द्विगुणितत्रिज्यया किं लब्धा द्विगुणित त्रिज्यायां भुजज्या$=\frac{\text{ज्याभु. २ त्रि}}{\text{त्रि}}=$२ ज्याभु; अतः कस्मिन्नपि व्यासार्धे द्विगुण भुजांशानां या पूर्णज्या सैव द्विगुणतद्व्यासार्धे भुजज्या भवतीति । षष्टिव्यासा (त्रिज्यायां) द्विगुणभुजांशानां पूर्णज्या साधनार्थं स्वल्पान्तरात् ३ व्या$=$परिधि

=३६०, चक्रांशैश्चक्रसमचापीयमानं लभ्यते तदा द्विगुणभुजांशैः किं लब्धं तच्चाप-मानम्=२ भु। ततश्चापोननिघ्नपरिधिः प्रथमाह्वय इत्यादिनाऽऽचार्योक्तया १२० मितव्यासे द्विगुणभुजांशपूर्णज्या जाता। सार्क १२० मितत्रिज्यायां भुजज्या

$$=\frac{(३६०-२ भु) २ भु \times ४ \times १२०}{३६० \times \frac{५}{४}-(३६०-२ भु).२ भु}=\frac{(१८०-भु) भु \times १६ \times १२०}{३६० \times ३६० \times ५ - \frac{(१८०-भु) भु \times ४}{४}}$$

$$=\frac{(१८०-भु) भु \times १२०}{\frac{९० \times ३६० \times ५}{१६}-(१८०-भु) भु}=\frac{(१८०-भु) भु \times १२०}{८१ \times ४५ \times ५ - \frac{(१८०-भु) भु}{४}}$$

$$=\frac{(१८०-भु) भु \times १२०}{१०१२५-\frac{(१८०-भु) भु}{४}}$$ ततोऽनुपातो यदि सार्क १२० त्रिज्यायामियं भुजज्या

तदेष्टत्रिज्यायां का जातेष्टत्रिज्यायां भुजज्या $\frac{(१८०-भु) भु त्रि}{१०१२५-\frac{(१८०-भु) भु}{४}}$

तथा भुजज्या= $\frac{(१८०-भु) भु. त्रि}{१०१२५-\frac{(१८०-भु) भु}{४}}$ = लब्धि . त्रि पक्षौ अफज्यागुणितौ

तदा भुजज्या × अफज्या = लब्धि., त्रि. अंफज्या पक्षौ त्रिभक्तौ तदा $\frac{भुजज्या \times अंफज्या}{त्रि}$ = भुजफल=लब्धि × अंफज्या। एवमेव

कोटिज्या= $\frac{(१८०-को) को त्रि}{१०१२५-\frac{(१८०-को) को}{४}}$ =लब्धि.त्रि तत्र पक्षौ अन्त्यफलज्यया

गुणितौ त्रि भक्तौ तदा $\frac{कोटिज्या. अंफज्या}{त्रि}$ = कोटिफल = लब्धि. अफज्या, एतेना-चार्योक्तं सर्वमुपपन्नम् ॥ सिद्धान्त शेखरे "दोः कोटिभागरहिताभिहताः खनाग-चन्द्रास्तदीयचरणोनशरार्कदिग्भिः। ते व्यासखण्डगुणिता विहृताः फलं तु ज्याभिर्विनैव भवतो भुजकोटिजीवे ॥" श्रीपत्युक्त प्रकारस्यास्य मूलमाचार्योक्त सूत्र-मेवेति ॥ २३-२४ ॥

अब विनाज्या के भुजज्या, कोटिज्या और भुजफल तथा कोटिफल ज्ञान के लिये प्रश्नों के उत्तर को कहते हैं।

हि. भा.—जिस भुजांश वा कोटयंश की जीवा अपेक्षित है उसको (भुजांश वा कोटयंश) एक सौ अस्सी १८० में से घटा देना और गुण देना चाहिए तब जो हो उसको उसी के चतुर्थांश हीन १०१२५ इससे भाग देना चाहिए। भागफल (लब्धि) को त्रिज्या से

गुणा करने से भुजज्या और कोटिज्या होती है। तथा उसी लब्धि को अन्त्यफलज्या से गुणा करने से विना ज्याखण्ड के भुजफल और कोटिफल होता है इति ॥ २३–२४ ॥

उपपत्ति

यदि त्रिज्या में भुजज्या पाते है तो द्विगुणित त्रिज्या में क्या इस अनुपात से द्विगुणित त्रिज्या में भुजज्या आती है $\frac{\text{ज्याभु. २ त्रि}}{\text{त्रि}}$ = २ ज्याभु। अतः किसी व्यासार्ध में द्विगुणित भुजाश की जो पूर्णज्या होती है वही द्विगुणित उस व्यासार्ध में भुजज्या होती है। साठ ६० व्यासार्ध में द्विगुणित भुजांश की पूर्णज्या साधन के लिये स्वल्पान्तर से ३ व्या = परिधि = ३६०। चक्रांश में चक्रतुल्य चापीय मान पाते हैं तो द्विगुणित भुजांश में क्या लब्ध चापमान = २ भु। तब 'चापोन निघ्न परिधिः प्रथमाह्वयः स्यात्' इत्यादि भास्कर प्रकार से ११० व्यास में द्विगुणित भुजाश पूर्णज्या हुई। १२० त्रिज्या मे भुजज्या =

$$\frac{(\text{३६०}-\text{२ भु})\,\text{२ भु}\times\text{४}\times\text{१२०}}{\text{३६०}\times\frac{\text{५}}{\text{४}}-(\text{३६०}-\text{२ भु})\,\text{२ भु}}=\frac{(\text{१८०}-\text{भु})\,\text{भु}\times\text{१६}\times\text{१२०}}{\frac{\text{३६०}\times\text{३६०}\times\text{५}}{\text{४}}-(\text{१८०}-\text{भु})\,\text{भु}\times\text{४}}$$

$$=\frac{(\text{१८०}-\text{भु})\,\text{भु}\times\text{१२०}}{\frac{\text{९०}\times\text{३६०}\times\text{५}}{\text{१६}}-(\text{१८०}-\text{भु})\,\text{भु}}=\frac{(\text{१८०}-\text{भु})\,\text{भु}\times\text{१२०}}{\text{४५}\times\text{४५}\times\text{५}-(\text{१८०}-\text{भु})\,\text{भु}}$$

$$=\frac{(\text{१८०}-\text{भु})\,\text{भु}\times\text{१२०}}{\text{१०१२५}-\frac{(\text{१८०}-\text{भु})\,\text{भु}}{\text{४}}}$$ अब अनुपात करते हैं यदि १२० त्रिज्या में यह भुजज्या पाते है तो इष्ट त्रिज्या में क्या इससे इष्ट त्रिज्या में भुज्या = $\frac{(\text{१८०}-\text{भु})\,\text{भु. त्रि}}{\text{१०१२५}-\frac{(\text{१८०}-\text{भु})\,\text{भु}}{\text{४}}}$

= लब्धि × त्रि. दोनों पक्षों को अन्त्यफलज्या से गुणा कर त्रिज्या से भाग देने से $\frac{\text{भुजज्या}\times\text{अंफज्या}}{\text{त्रि}}$ = भुजफल = लब्धि × अंफज्या। इसी तरह कोटिज्या =

$\frac{(\text{१८०}-\text{को})\,\text{को. त्रि}}{\text{१०१२५}-\frac{(\text{१८०}-\text{को})\,\text{को}}{\text{४}}}$ = लब्धि × त्रि. दोनो पक्षों को अन्त्यफलज्या से गुणाकर त्रिज्या से भाग देने से $\frac{\text{कोज्या. अंफज्या}}{\text{त्रि}}$ = कोटिफल = लब्धि × अंफज्या, इससे आचार्योक्त उपपन्न हुआ। सिद्धान्त शेखर में 'दोः कोटि भागरहिताभिहताः खनागचन्द्राः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है। वस्तुतःश्रीपति प्रकार का मूल आचार्योक्त सूत्र ही है इति ॥ २३-२४ ॥

इदानीमिष्टज्यातश्चापानयनमाह ।

इष्टज्या संगुणिताः पञ्चकयमलैकशून्यचन्द्रमसैः ।
इष्टज्यापादयुतव्यासार्धविभाजिता लब्धम् ॥ २५ ॥
नवति कृतेः प्रोह्य पदं नवतेः संशोध्य शेषभागकला ।
एवं धनुरिष्टाया भवति ज्याया विना ज्याभिः ॥ २६ ॥

सु. भा.—इष्टज्याया यः पादश्चतुर्थांशस्तेन युत व्यासार्धं तद्भवति तेन विभाजिताः । शेषं स्पष्टम् ।

अत्रोपपत्तिः । पूर्वं प्रकारेण

$$ज्या = \frac{(१८०-चा)\,चा.त्रि.}{१०१२५-\frac{(१८०-चा)\,चा}{४}} = \frac{या\ त्रि}{१०१२५-\frac{या}{४}} \quad यदि$$

या$=(१८०-चा)$ चा । अतश्छेदगमेन ज्या $\times$ ४०५०० $-$ ज्या. या $=४$ त्रि. या, ततो या $= \frac{ज्या \times ४०५००}{ज्या + ४\ त्रि} = \frac{१०१२५\ ज्या}{त्रि + \frac{ज्या}{४}}$

$= ल = (१८०-चा)\,चा = १८०\ चा - चा^{२}$

समशोधनेन $चा^{२} - १८०\ चा + ल = ०$

$\therefore चा = ९० \pm \sqrt{९०^{२} - ल}$

आचार्येणाल्पं चापं गृहीतं तेन $चा = ९० - \sqrt{९०^{२} - ल}$

अत उपपन्नं सर्वम् ॥२५-२६॥

वि. भा.—१०१२५ एते अङ्का इष्टज्या गुणिता इष्टज्याया यश्चतुर्थांशस्तेन युतं व्यासार्धं यद् भवति तेन विभाजिता लब्धं नवतिवर्गाद्विशोध्य मूलं ग्राह्यं तन्नवतेः संशोध्य शेषभागकला इष्टाया ज्याया ज्याभिर्विना धनु (चापं) भवतीति ॥ २५-२६ ॥

अत्रोपपत्तिः ।

पूर्वश्लोकोपपत्त्या $ज्या = \frac{(१८०-चा)\,चा.\ त्रि}{१०१२५-\frac{(१८०-चा)\,चा}{४}} = \frac{य.\ त्रि}{१०१२५-\frac{य}{४}}$ अत्र

(१८०—चा) चा=य कल्प्यते। ततश्छेगमेन ज्या × ४०५००–ज्या . य = ४ त्रि य $\therefore \frac{\text{ज्या} \times ४०५००}{\text{ज्या} + ४ \text{ त्रि}} = \text{य} = \frac{१०१२५ \text{ ज्या}}{\text{त्रि} + \frac{\text{ज्या}}{४}} = \text{ल}$। य = (१८०—चा) चा = १८० × चा—चा^{२} = ल समशोधनेन चा^{२} – १८० चा + ल = ० ततः चा^{२} — १८० चा = ० — ल। पक्षौ (९०)^२ युतौ तदा चा^{२} – १८० चा + (९०)^२ = ९०^२ – ल, मूल ग्रहणेन चा — ९० = $\sqrt{(९०)^२ — \text{ल}}$ ∴ चा = ९० ± $\sqrt{(९०)^२ — \text{ल}}$ आचार्येणाल्पमेव चापं गृहीतम् तेन चा = ९० — $\sqrt{(९०)^२ – \text{ल}}$ एतेनाचार्योक्त मुपपन्नम् ॥ सिद्धान्त शेखरे "इष्टज्यया विनिहताः शरभास्कराशा ज्यापादयुक् त्रिगुणेन हृताः फलं तत्। त्यक्त्वा खनन्द कृनितः पदमभुनन्दभागाच्च्युत भवति धन्व विना ज्यकाभिः ॥

श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव।

एतत्सूत्रस्य मूलमाचार्योक्तसूत्रमेवेति ॥ २५-२६॥

अब इष्टज्या से चापानयन को कहते है।

हि. भा.—१०१२५ इन अङ्को को इष्टज्या से गुणा कर इष्टज्या की चतुर्थांशयुत त्रिज्या से भाग देने से जो लब्ध हो उसको नव्वे ९० के वर्ग से में घटाकर मूल लेना उसको नव्वे में से घटाने से शेष ज्याविना इष्टज्या का चाप होता है ॥ २५-२६ ॥

उपपत्ति।

पूर्वश्लोकोपपत्ति से ज्या = $\frac{(१८० — \text{चा}) \text{ चा. त्रि}}{१०१२५ — \frac{(१८० — \text{चा}) \text{ चा}}{४}} = \frac{\text{य.त्रि}}{१०१२५ — \frac{\text{य}}{४}}$ यहां (१८०—चा) चा = य कल्पना करते हैं। तब छेदगम से ज्या × ४०५००—ज्या × य = ४ त्रि. य $\therefore \frac{\text{ज्या} \times ४०५००}{\text{ज्या} + ४ \text{ त्रि}} = \text{य} = \frac{१०१२५ \text{ ज्या}}{\text{त्रि} + \frac{\text{ज्या}}{४}} = \text{ल} = (१८० — \text{चा}) \text{ चा} =$ १८० × चा—चा^{२} समशोधन से चा^{२} — १८० चा + ल = ० ∴ चा^{२} – १८० चा = – ल दोनों पक्षों में (९०)^२ जोडने से चा^{२} – १०८० चा + (९०)^२ = (९०)^२ – ल, मूल लेने से चा – ९० = $\sqrt{(९०)^२ — \text{ल}}$, ∴ चा = ९० ± $\sqrt{(९०)^२ — \text{ल}}$ यहां आचार्य ने अल्पमान ही को लिया है। तब चा = ९० — $\sqrt{(९०)^२ — \text{ल}}$, इस से आचार्योक्त उपपन्न हुआ ॥ सिद्धान्त शेखर में 'इष्टज्या विनिहताः शरभास्कराशा' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है। वस्तुतः श्रीपत्युक्त सूत्र का मूल आचार्योक्त सूत्र ही है इति ॥ २५-२६ ॥

इदानी मिष्टग्रहौदयिकान् मध्यान् स्पष्टान् च कर्तुमाह ।

इष्टौदयिकभुजान्तरमिनवत् स्फुटमध्यमान्तरकलाभिः ।
नाश्विन्यौदयिकेषु स्वचरप्राणैः स्वफलमिनवत् ॥ २७ ॥

सु. भा.—यथा मध्यरव्युदयकालिका ग्रहा भुजान्तरेण स्फुटार्कोदयकालिका निरक्षे क्रियन्ते पुनरर्कचरप्राणैः स्वदेशे स्फुटार्कोदयकालिका क्रियन्ते । एवमिष्ट-मध्यस्फुटग्रहान्तरकलाभिस्तदुत्थासव इनवदिष्टौदयिकभुजान्तरं साध्यम्, तथेनवत् स्वचरप्राणैरिष्टग्रहचरासुभिः स्वचालनफलं साध्यं तत्संस्कारेण स्वदेशे स्पष्टेष्ट ग्रहोदयकाले ग्रहा भवन्तीति गोलयुक्त्या स्फुटम् । यद्यश्विन्यौदयिका भोदयका-लिकाः स्पष्टग्रहा अपेक्षितास्तदा भस्य फलाभावाद्भुजान्तरं न भवतीति वेदितव्यम् ।

अत्र चतुर्वेदाचार्यस्य 'अथाश्विन्यौदयिकास्तच्चरदलकर्म न कर्त्तव्यमत्रा-श्विनी ग्रहणं मेषादिक विषुवदुपलक्षणार्थमन्यथा सर्वासामेव नक्षत्रयोगताराणां स्वचरदलघटिका भिन्नास्तद्भेदात् स्वदेशे तदुदया अपि भिन्नाः स्युस्तस्मादाचार्येण यत् कल्पादौ नाक्षत्रं सावनं प्रवृत्तं तस्य चरदलकर्मनिषेधः कृतोऽन्यथाश्विनी योगतारायां युगादावुदयाभाव एव स्यादेवमन्यासां योज्यमिति । एतया व्याख्या भुजान्तरं चरकर्मेति कर्मद्वयनिषेधकारिणी सा गम न सम्यता न सन्दस्य भुजा-न्तरेऽन्वयो गोलयुक्ति युतो बुद्धिमता ज्ञेय इति ॥ २७ ॥

वि. भा. मध्यमार्कोदयकालिका ग्रहा भुजान्तरसंस्कारेण निरक्षे स्फुटा-र्कोदयकालिकाः क्रियन्ते । पुना रविचरासुभिः स्वदेशे स्फुटार्कोदयकालिकाः क्रियन्ते । एवमिष्ट मध्यस्फुटग्रहान्तरकलाभिः (तन्मन्द फलकलासुभिः) तदुत्पन्नासवः (मन्दफल-कलासवः) रविवदिष्टौदयिकभुजान्तरं साध्यं तथा रविवदिष्टग्रहचरासुभिः स्वचालन-फलं साध्यं तत्संस्कारेण स्वदेशे स्पष्टेष्टग्रहोदयकाले ग्रहाभवन्तीति । यद्यश्विन्यौ-दयिका (भोदयकालिकाः) स्पष्टग्रहा अपेक्षितास्तदा भस्य (नक्षत्रस्य) फलाभावाद्-भुजान्तरं न भवतीति ॥ अत्र चतुर्वेदाचार्य 'अथाश्विन्यौदयिकास्तच्चरदलकर्म न कर्त्तव्यमत्राश्विनी ग्रहणं मेषादिकविषुवदुपलक्षणार्थमन्यथा सर्वासामेव नक्षत्र-योगताराणां स्वचरदलघटिका भिन्नास्तद्भेदात् स्वदेशे तदुदया अपि भिन्नाः स्युस्तस्मादाचार्येण यत् कल्पादौ नाक्षत्रं सावनं प्रवृत्तं तस्य चरदल कर्म निषेधः कृतोऽन्यथाश्विनी योगतारायां युगादावुदयाभाव एव स्यादेवमन्यासां योज्यमिति, एतया व्याख्यया भुजान्तरचरकर्मणोर्निषेधो भवति । 'न' इत्यस्य भुजान्तरे ऽन्वय इति ॥ २७ ॥

अब इष्टग्रहोदयकालिक मध्यम ग्रहको जो स्पष्ट करते हैं उस प्रश्न के उत्तर को कहते हैं ।

हि. भा.—मध्यमार्कोदयकालिकग्रह भुजान्तर संस्कार से निरक्ष में स्फुटार्कोदय

कालिक किये जाते हैं फिर चरासु से स्वदेश में स्फुटार्कोदय कालिक ग्रह होते हैं। एवं इष्ट मध्यम और स्पष्टग्रह की अन्तर कलो (उसकी मन्दफल कला) त्पन्नासु से रवि की तरह भुजान्तर साधन करना तथा रवि की तरह इष्टग्रह चरासु से स्वचालन फल साधन कर उस के संस्कार से स्वदेश में स्पष्ट इष्टग्रहोदय कालिक ग्रह होते है। यदि अश्विन्यौदयिक स्पष्टग्रह अपेक्षित हो तब नक्षत्र के फलाभाव के कारण भुजान्तर नही होता है इति ॥ २७ ॥

इदानीं स्वोच्चस्फुटैर्यो मध्यमं ग्रहं करोतीत्यस्योत्तरमाह

स्वोच्चाद्विशोध्य कृत्वा प्राग्वत् फलमृणधनं विपर्यस्तम् ।
कार्यमनष्टस्पष्टे पुनः पुनर्निश्चलो मध्यः ॥ २८ ॥

सु० भा०—स्फुटग्रहं स्वोच्चाद्विशोध्य केन्द्रं कृत्वा प्राग्वत् फलं मान्दं शैघ्र्यं च साध्यम् । तदनष्टस्पष्टे पृथक् स्थापितस्पष्टग्रहे विपर्यस्तमृणधनं कार्यं यदि धनं तदा ऋणमृणं च धनं कार्यमित्यर्थः । एवं पुनः पुनरसकृद्यदा निश्चलः स्थिरीभूतस्तदा स एव मध्यो ज्ञेय इति ।

अत्रोपपत्तिः । स्पष्टीकरणविपरीतक्रियया सुगमा 'स्फुटग्रहं मध्यखगं प्रकल्प्य कृत्वा फले मन्दचले यथोक्ते' इत्यादि भास्करोक्तमेतदनुरूपमेव । अत्र छेद्यकयुक्त्या स्फुटग्रहोनं शीघ्रोच्चं स्फुटकेन्द्रं ततस्त्रिज्यया स्फुटकेन्द्रज्या तदाऽन्त्यफलज्यया किं लब्धा सकृदेव स्फुटा शीघ्रफलज्या । तच्चापं शीघ्रफलं स्फुटं वास्तवमेव । अथाचार्योक्तस्पष्टीक्रिया क्रमतो यदा मन्दोच्चोन स्फुटग्रह केन्द्रतः पुनः पुनस्तदेव मन्दफलभागच्छेत् तदैव क्रियावसानः । अथोपान्तिमस्पष्टग्रहाद्यन्मन्दफलं तदेवोपान्तिमसमान्त्यस्पष्टग्रहाच्चातो मन्दोच्चोनस्फुटग्रहकेन्द्रतः सकृदेव वास्तवं मन्दफलं भवति भास्करादिना व्यर्थमेवासकृद्विधिर्विहित इति सुधीभिर्भृशंविचिन्त्यम् ॥२८॥

वि. भा.—स्फुटग्रहं स्वोच्चाद्विशोध्य केन्द्रं कृत्वा पूर्ववन्मान्दं शैघ्र्यं च फलं साध्यम् । तत् पृथक् स्थापितस्पष्टग्रहे विपरीतमृणधनं कार्यं यदि धनं तदा ऋणमृणं चेत् धनं कार्यम् । एवं पुनः पुनरसकृद्यदा निश्चलः (स्थिरी भूतः) तदा स एव मध्यग्रहो ज्ञेय इति ॥ २८ ॥

अत्रोपपत्तिः ।

शीघ्रोच्चं स्फुटग्रहेण हीनं तदा स्फुटकेन्द्रं भवति । तदा त्रिज्यया स्फुट केन्द्रज्या लभ्यते तदाऽन्त्यफलज्यया कि लब्धा स्फुटफलज्या, एतस्याश्चापं कार्यं तदा स्फुटं वास्तवं शीघ्रफलं भवति, एतद्वशेन सकृदेव स्पष्टग्रहान्मध्यमग्रहज्ञानं भवेत् । आचार्योक्तरीत्या मन्दोच्चेन हीन स्फुटग्रह केन्द्रतो यदा पुनः पुनस्तदेव

मन्दफलमागच्छेत्तदैव क्रियासमाप्तिः। अथोपान्तिमस्पष्टग्रहाद्यन्मन्दफलं तदेवो-पान्तिमतुल्यान्त्यस्पष्टग्रहाच्चातो मन्दोच्चोनस्फुटग्रहकेन्द्रतः सकृदेव मन्दफलं वास्तवं भवति। सिद्धान्तशिरोमणौ 'स्फुटं ग्रहं मध्यमतां प्रकल्प्य कृत्वा फलं मन्द-चले यथोक्तं' भास्करोक्तमिदमाचार्योक्तानुरूपमेव। असकृत्कर्मणोऽत्रावश्यकता नास्ति, भास्करादिभिर्योऽसकृद्विधिः प्रतिपादितः स निरर्थक एवेति॥ २८॥

अब स्वोच्च और स्फुट ग्रह से मध्यम ग्रह को जो जानते हैं उस प्रश्न के उत्तर को कहते हैं।

हि. भा.—अपने उच्च में से स्फुट ग्रह को घटाने से स्फुट केन्द्र होता है, उस से पूर्ववत् मन्दफल और शीघ्रफल साधन करना, उनको पृथक् स्थापित स्पष्ट ग्रह में विपरीत ऋण धन करना यदि धन फल है तो ऋण करना यदि ऋण है तो धन करना, एवं बार बार करना चाहिये जब तक स्थिरीभूत हो अर्थात् एक ही ग्रह आवे तब तक करना चाहिये तब वही मध्यमग्रह होते हैं इति॥ २८॥

उपपत्ति

शीघ्रोच्च में से स्फुटग्रह को घटाने से स्फुट केन्द्र होता है। तब अनुपात करते हैं यदि त्रिज्या में स्फुट केन्द्रज्या पाते हैं तो अन्त्यफलज्या में क्या इस से स्फुट फलज्या आती है, इसके चाप करने से वास्तव शीघ्रफल होता है, इस के वश से सकृत् प्रकार ही से स्फुटग्रह से मध्यम ग्रह ज्ञान हो जायगा। आचार्योक्त रीति से मन्दोच्चोन स्फुटग्रह केन्द्र से जब पुनः पुनः वही मन्द फल आवे तब ही क्रिया की समाप्ति होती है। उपान्तिम स्पष्टग्रह से जो मन्दफल होता है वही उपान्तिम तुल्य अन्त्य स्पष्ट ग्रह से भी होता है इसलिये मन्दोच्चोन स्फुटग्रह केन्द्र से सकृत् ही मन्द फल वास्तव होता है। सिद्धान्त शिरोमणि में 'स्फुटं ग्रहं मध्यमतां प्रकल्प्य' इत्यादि भास्करोक्त प्रकार आचार्योक्त के अनुरूप ही है। यहां असकृत् कर्म की जरूरत नहीं है भास्करादि आचार्यों ने जो असकृत् कर्म किये हैं सो निरर्थक है इति॥ २८॥

इदानीं ग्रहस्य संक्रान्तेराद्यन्तौ यो वेत्तीत्यस्योत्तरमाह।

मानार्धाद् षष्टिगुणाद् भुक्तिहृतान्नाडिकादिलब्धेन।
राश्यन्तात् प्रागादिः पश्चादन्तोऽर्क संक्रान्तेः॥ २९॥

सु. भा.—लब्धेन नाडिकादिना राश्यन्तात् प्रागर्कसङ्क्रान्तेरादिः पश्चा-दन्तः समाप्तिरिति। शेषं स्पष्टम्।

अत्रोपपत्तिः। 'षष्टिघ्नं बिम्बं ग्रहभुक्तिभक्तम्'—इत्यादि भास्करविधिना स्फुटा॥२९॥

वि. भा.—मानार्धात् षष्टिगुणितात् स्फुटरविगत्या भक्तान्नाड़िकादि लब्धफलेन रविसंक्रान्तेः, राश्यन्तात् पूर्वमादिः पश्चादन्तोऽर्थाद्रवेः संक्रमण राशे राश्यन्तरगमनं, सूर्यः स्वमण्डले पूर्वार्धेन पूर्वराश्यन्तं त्यजति उत्तरार्धेनोत्तरराशेः पूर्वभागं विशतीति ॥ २९ ॥

उपपत्ति।

यदि स्फुटरविगतिकलाभिः षष्टिघटिका लभ्यन्ते तदा सूर्यविम्बार्ध कलाभिः किं यद्घटयात्मकं फलं समागतं तेन राश्यन्तात प्राक् रविसंक्रान्तेरादिः, पश्चादन्तः (समाप्तिः) इति। सिद्धान्त शेखरे 'षष्टिघ्नं सूर्यबिम्ब स्फुटगतिविहृतं सोऽर्कसं क्रान्तिकालः, अनेन श्रीपतिना सिद्धान्तशिरोमणौ 'षष्टिघ्न बिम्बं ग्रहभुक्ति भक्तमित्यादिना' भास्करेण चाचार्योक्तानुरूपमेव कथितमिति ॥ २९ ॥

अब ग्रह सङ्क्रान्ति के आदि और अन्त को जो जानते है इस प्रश्न के उत्तर को कहते है।

हि. भा.—सूर्य बिम्बार्ध को साठ से गुणाकर स्फुट रविगति से भाग देने से जो नाडिकादि (दण्डादि) फल हो उससे रवि संक्रान्ति के राश्यन्त से पहले आदि और राश्यन्त के पश्चात् समाप्ति होती है; रवि एक राशि छोड़कर दूसरी राशि में जाते हैं उसी को रवि संक्रान्ति कहते हैं। रवि अपने मण्डल में पूर्वार्ध से पूर्वराश्यन्त को त्याग करते हैं और उत्तरार्ध से पर राशि के पूर्व भाग में प्रवेश करते है इति ॥२९॥

उपपत्ति ।

यदि स्फुट रवि गति कला में साठ घटी पाते हैं तो सूर्य बिम्बार्धकला में क्या इस अनुपात से जो घट्यात्मक फल आता है उससे राश्यन्त से पहले रवि संक्रान्ति के आदि और पश्चात् अन्त (समाप्ति) होता है॥ सिद्धान्तशेखर में 'षष्टिघ्नं सूर्यबिम्वं स्फुटगतिविहृतं सोऽर्कमक्रान्ति कालः' इससे श्रीपति तथा सिद्धान्तशिरोमणि मे 'षष्टिघ्नबिम्बं ग्रह भुक्तिभक्तम्' इत्यादि से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है ॥२९॥

इदानीं संक्रान्तिकालमाह।

संक्रान्ति पुण्यकालो यल्लब्धं नाड़िकादि तद्द्विगुणम्।
स्नानजपहोमदानादिकोऽत्र धर्मो विशिष्टफलः ॥३०॥

सु. भा.—स्पष्टार्थम् ॥ ३० ॥

वि. भा.—पूर्वं यन्नाड़िकादिफलं (स्फुटरवि गति कलाभिः षष्टिघटिकास्तदा

सूर्यबिम्बार्धकलाभिः) किमित्यनुपातेन, समागत नाड्यादिगुणित काल तदा संक्रान्ति पुण्यकालो भवत्यर्थाद्रविबिम्बस्य पूर्वपाली यदा राश्यादौ समागच्छति ततोऽनन्तरं यावता कालेन परपाली राश्यादावायाति तावान् कालः संक्रान्ति पुण्यकालः । मुहूर्तचिन्तामणौ 'संक्रान्तिकालादुभयत्र नाडिका पुण्या मता षोडश षोडशोष्णगोः' अनेन रामाचार्येण संक्रान्तिपुण्यकालः कथ्यते । सिद्धान्तशेखरे 'सोऽर्कसंक्रान्तिकालः पुण्यः स्मृत्यादिपूक्तः, अनेन श्रीपतिना, भास्कराचार्येणापि' संक्रान्तिनाड्योऽखिल धर्मकृत्यो रवेस्तु ताः पुण्यतमाः' अनेन रविसंक्रान्तिकालस्यातीव विशिष्टफलजनकत्वं कथितम् । अत्र(रविसंक्रान्ति काले) स्नानजपहोमदानादिको धर्मो विशिष्ट-फलदो भवति, अन्येषां ग्रहाणां सक्रान्तिकालपुण्यफलप्रदो नास्त्यतस्तत्सम्बन्धे केनाप्याचार्येण न किमपि कथितम् । रविसंक्रान्तिकालस्य पुण्यफलजनकत्वे सर्वेषामाचार्याणामैकमत्यमस्ति ॥३०॥

अब सक्रान्ति काल को कहते हैं ।

हि. भा.—पहले जो नाडिकादि (स्फुटरविगति कला में साठ घटी पाते हैं तो रवि बिम्बार्ध कला में क्या) इस अनुपात से आये हुए फल को द्विगुणित करने से संक्रान्ति पुण्य काल होता है अर्थात् रविबिम्ब की पूर्व पाली जब राश्यादि में प्रवेश करती है उसके बाद जितने काल में परपाली राश्यादि में आती है वह काल सक्रान्ति पुण्यकाल है । मुहूर्तचिन्ता-मणि में 'संक्रान्तिकाला दुभयत्र नाड़िकाः पुण्या मता षोडश षोडशोष्णगोः' इससे रामाचार्य ने संक्रान्ति पुण्यकाल कहा है । सिद्धान्त शेखर में 'सोऽर्कं संक्रान्तिकालः, पुण्यः स्मृत्यादियुक्तः' इससे श्रीपति तथा भास्कराचार्य ने भी 'सक्रान्तिनाड्योऽखिल धर्मकृत्ये, रवेस्तु ताः पुण्यतमाः' इससे संक्रान्तिकाल अतीव विशिष्ट फल प्रद होता है कहा है । रविसंक्रान्तिकाल में स्नान-जप होम-दानादिक करने से विशिष्ट फल होता है । अन्य ग्रहों के संक्रान्तिकाल पुण्य फल प्रद नहीं है इसलिये उनके सम्बन्ध में किसी भी आचार्य ने कुछ नहीं कहा है इति ॥ ३० ॥

इदानीं भतिथिकरणाद्यन्तौ यो वेत्तीत्यस्योत्तरमाह ।

एवं नक्षत्रान्तात् तिथिकरणान्ताच्छशिप्रमाणार्धात् ।
षष्टिगुणाद्रविशशिनोर्भुक्त्यन्तरलब्धघटिकाभिः ॥ ३१ ॥

सु. भा.—एवं शशिप्रमाणार्धात् शशिबिम्बार्धात् षष्टिगुणात् शशिभुक्ति-हृताल्लब्धनाड्यादिना नक्षत्रान्तात् प्राक् तन्नक्षत्रप्रवेशः पश्चाच्च निवृत्तिः । शेषं स्पष्टार्थम् ।

अत्रोपपत्तिः । 'शशितनु विकलाभ्यश्चन्द्रभुक्त्यै' इत्यादिभास्कर विधिना स्फुटा ॥३१॥

वि, भा.—चन्द्रविम्बार्धात् षष्टिगुणात् चन्द्रगत्या भक्ताद्यन्नाडयादि फलं समागच्छति तेन नक्षत्रान्तात्पूर्व तन्नक्षत्रप्रवेशः पश्चान्निवृत्तिः। एवं षष्टि गुणाच्चन्द्रबिम्बार्धाद्रविचन्द्रगत्यन्तर भक्ताद्यन्नाडयादि फल समागच्छति तत्करणतिथ्योःप्रान्तं स्यात्। सिद्धान्तशेखरे 'षष्टिघ्ने चन्द्रबिम्बेऽप्युडुकरणतिथिप्रान्तमन्तं युतेर्वा चान्द्रया भुक्तयेन्दुभान्वोर्गतियुतिवियुतिभ्यां क्रमान्नाड़िकादि' श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव केवल विष्कम्भादेर्योगसम्बन्धेऽधिकोऽस्ति श्रीपत्युक्तौ सिद्धान्तशिरोमणौ 'शशितनु विकलाभ्यश्चन्द्रभुक्त्येन्दु भान्वोरित्यादिना' भास्करेणाप्याचार्योक्तानुरूपमेव कथितमिति॥ ३१॥

अब भतिथि करणो के आदि अन्त को जो जानते हैं इस प्रश्न के उत्तर को कहते हैं।

हि भा.—चन्द्र बिम्बार्ध को साठ से गुणा कर चन्द्रगति से भाग देने से जो नाडयादिक फल होना है उससे नक्षत्रान्त से पहले नक्षत्र प्रवेश होता है और पश्चात् निवृत्ति होती है, एव चन्द्रबिम्बार्ध को साठ मे गुणा कर रवि और चन्द्र के गत्यन्तर से भाग देने से जो नाडयादिक फल होता है वह करण और तिथि का प्रान्त होता है। सिद्धान्तशेखर में 'षष्टिघ्ने चन्द्रबिम्बे ऽप्युडुकरण तिथि प्रान्तमन्त युतेर्वा चान्द्रया भुक्तयेन्दु भान्वोर्गति युति वियुतिभ्यां क्रमान्नाडिकादि' यह श्रीपत्युक्त आचार्योक्त के अनुरूप ही है, केवल विष्कम्भादियोग के विषय में आचार्योक्त से अधिक है, आचार्य ने विष्कम्भादि योग की चर्चा नही की है। सिद्धान्त शिरोमणि में 'शशितनु विकलाभ्यश्चन्द्रभुक्तयेन्दुभान्वोः' इत्यादि से भास्कराचार्य भी उन्हीं बातों को कहते है इति॥ ३१॥

इदानीं विशेषमाह।

संक्रान्तिस्थो यावत् करोति मिश्रं फलं ग्रहस्तावत्।
यस्मात् तस्माद्विष्टे राद्यन्तौ परिहरति लोकः॥ ३२॥

सु. भा.—यस्माद्यावद्ग्रहः सङ्क्रान्तिस्थस्तावदुभयो राश्योर्बिम्बैक देशगतत्वान्मिश्रफल करोति तस्माल्लोको जनो विष्टेर्भद्राया आद्यन्तौ शुभकर्मणि परिहरति यतस्तावत् तत्प्रवृत्तिरनिष्टाय भवति। आचार्यसमये विष्कम्भादिसप्तविंशतियोगानां प्रचारो नास्तीति प्रतिभाति। स्पष्टाधिकारे योगानयनाभावादिहापि तत्मन्धेरप्रतिपादनाच्च। आचार्यसमये व्यतिपातवैधृतयोरेव रविचन्द्रक्रान्ति साम्येन महानिष्टोत्पादकत्वाच्चचर्चाऽऽसीदत एवाग्रिमार्याभिस्तत्साधनं वक्ष्यतीति॥ ३२॥

वि. भा.—यस्मात्कारणात् ग्रहो यावत् संक्रान्तिस्थस्तावदुभयोराश्योर्विम्बैकदेशगतत्वान्मिश्रं फलं करोति। तस्मात् कारणात् लोको (जनः) विष्टेः (भद्रायाः)

आद्यन्तौ शुभकार्ये परिहरन्ति। यतस्तावत् तत्प्रवृत्तिरनिष्टफलदा भवति। स्पष्टाधिकारे योगानयनाभावादत्रापि तत्सम्बन्धे चर्चाभावाच्चानुमीयते तत्समये (आचार्यग्रन्थ रचनसमये) विष्कम्भादियोगानां प्रचारो नासीत्। केवलं महानिष्टफलजनकत्वाद्व्यतीपातवैधृतयोरेव तत्समये चर्चाऽभूदिति ॥ ३२ ॥

अब विशेष कहते हैं।

हि. भा.—जिस कारण से ग्रह जब तक सक्रान्ति में रहते हैं तब तक दोनों राशियों में बिम्ब के एक प्रदेश के प्रवेश के कारण मिश्र (मिला हुआ) फल होता है। इस हेतु से लोग भद्रा के आदि और अन्त को शुभकर्मों में त्याग करते हैं। स्पष्टाधिकार में विष्कम्भादि योगों के आनयन नहीं हैं, यहां भी उनके सम्बन्ध में कुछ चर्चा नहीं की गई है इससे अनुमान किया जाता है कि आचार्य के ग्रन्थ रचना समय में उन योगों का प्रचार नहीं था, केवल बहुत ही अनिष्ट फल देने वाले व्यतीपात और वैधृत की चर्चा उस समय में थी इति ॥ ३२ ॥

इदानीं व्यतिपाताद्यन्तौ यो वेत्तीत्यस्योत्तरं कथयितुं प्रथमं तल्लक्षणं कथ्यते।

चक्रार्धेऽर्कशशियुतौ भिन्नायनयोरपक्रमसमत्वे।
रविशशिनोः सममधुघृतयोगाद्विषदो व्यतीपातः ॥ ३३ ॥

सु. भा.—अर्कशशियुतौ चक्रार्धे राशिषट्केऽर्थात् राशिषट्कासन्ने भिन्नायनयो रविशशिनोरपक्रमसमत्वे सममधुघृतयोगाद्विषदो व्यतीपातो भवति। यथा सममधुघृतयोगेन विषदः पदार्थः विशेष उत्पद्यते तथा रविशशिनोः क्रान्ति साम्येन जगति विषदोऽनिष्ट फलदो व्यतीपातो विशेषेण अत्यन्तं शुभफलं पातयति विनाशयतीति योगविशेष उत्पद्यते ॥ ३३ ॥

वि. भा.—रविचन्द्रयोर्योगे चक्रार्धे (राशिषट्के) भिन्नायनस्थयोस्तयोरपक्रमसमत्वे (क्रान्तिसाम्ये) सममधुघृतयोगाद्विषदो व्यतीपातो भवति । यथा सममधुघृतयोगेन विषदः पदार्थः उत्पद्यते तथैव रविचन्द्रयोः क्रान्तिसाम्येन संसारे विषदोऽनिष्टफलदो व्यतीपातो भवति। विशेषेणात्यन्तं शुभफलं पातयति नाशयति इति व्यतीपातो नाम योगविशेष इति। यद्यप्यस्य लक्षणादिकं प्रश्नाध्याय एव पूर्वं मया प्रतिपादितं तथाप्यत्र कथ्यते। अत्रोपपत्तिः --रविचन्द्रयोर्योगः षड्राशितुल्यस्तौ भिन्नायनस्थावेकगोलस्थौ च भवतः यथा यद्येकः=१ रा, तदा परः=५ रा, एवं द्वयोः प्रमाणे षड्राशितुल्ये योगे १ । ५ ॥ २ । ४ ॥ ३ । ३ ॥ ४ । २ अत्र द्वयोर्भुजयोस्तुल्यत्वात् तयोः स्थानीये क्रान्तीसमे अतोऽत्र व्यतीपात इति, सिद्धान्त शेखरे "भवनदलसमासे क्रान्तिसाम्ये रवीन्द्वोर्नियतमयनभेदे गोलयोर्दिक् समत्वे । दिनमणिमणिनोलात् सोमसूर्याश्मयोगादपि दहन इवाशु स्याद् व्यतीपातनामा ॥"

अनेन श्रीपतिना सूर्यसिद्धान्ते "विपरीतायनगतौ चन्द्राकौं क्रान्ति लिप्तिकाः। समास्तदा व्यतीपातो भगणार्धे तयोर्युतौ ॥" अनेन, सूर्य सिद्धान्तकारेणापि तदेव कथ्यते। सूर्य सिद्धान्ते तन्मङ्गलनाशने हेतुमाह।

"तुल्यांशुजालसम्पर्कात् तयोस्तु प्रवहाहतः।
तद्दृक् क्रोधभवो वह्निर्लोकाभावाय जायते।"

तयोः क्रान्तिसाम्यकालिकयो रविचन्द्रयोस्तुल्यकिरणजालसंयोगात् तयोर्मिथो दृष्टिभ्यां क्रोधभवो वह्निः (अग्निः) प्रवहवायुनाऽऽहतो लोकानां विनाशाय जायत इति ॥ ३३ ॥

व्यतीपात के आदि और अन्त को जानने वाले के लिए अब पहले व्यतीपात का लक्षण कहते हैं।

हि. भा.—रवि और चन्द्र का योग छः राशि होने से दोनों भिन्न अयन में होते है और एक गोल में, वहाँ दोनों के प्रमाण = १ । ५ ॥ २ । ४ ॥ ३ । ३ ॥ ४ । २ यहां दोनो के भुज बराबर होने से स्थानीय क्रान्ति बराबर है इसलिये व्यतीपात सम्भव है। मङ्गल कार्य को विशेष रूप से नाश करता है इसलिये इसका नाम व्यतीपात है। जैसे समान मधु और घृत के सयोग से विषद पदार्थ उत्पन्न होता है वैसे ही रवि और चन्द्र के क्रान्ति साम्य से व्यतीपात संसार में विपद (अनिष्टफलद) होता है। यद्यपि इसके लक्षण आदि सब कुछ पहले ही (प्रश्नाध्याय में) हम लिख चुके है तथापि तहाँ प्रश्नोत्तरार्थ के लिये पुनः लिखते हैं। उपर्युक्त क्रान्ति साम्य दिखाना ही उपपत्ति भी है। सिद्धान्त शेखर में 'भवनदलसमासे क्रान्तिसाम्ये रवीन्द्वोः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने भी आचार्योक्त के अनुरूप ही कहा है। सूर्य सिद्धान्त में भी 'विपरीतायनगतौ चन्द्राकौं क्रान्तिलिप्तिका' इत्यादि से सूर्य सिद्धान्तकार तथा सिद्धान्त शिरोमणि में 'व्यतिपातोऽयनभेदे गोलैकत्वे ऽर्कचन्द्रयोः क्रान्त्योः' इत्यादि से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है। उसके मङ्गलनाश में कारण को सूर्य सिद्धान्त में इस तरह कहा गया है 'तुल्यांशुजालसम्पर्कात्तयोस्तु प्रवहाहतः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से इसका तात्पर्य यह है कि क्रान्ति साम्य कालिक रवि और चन्द्र के तुल्य किरण समूह के सयोग से दोनों की परस्पर दृष्टि से क्रोधोत्पन्नअग्नि प्रवह वायु से प्रेरित होकर लोगों के विनाश के लिये होती है इति ॥ ३३ ॥

इदानीं वैधृतलक्षणमाह।

चक्रे वैधृतमेकायनस्थयोः क्रान्तिजीवयोः साम्ये।
इन्धनरविमणियोगादग्निवद्गूनाधिककलाभ्यः ॥ ३४ ॥

सु. भा.—एवं रविशशियुतौ चक्रे राशिद्वादशकेऽर्थाद्राशिद्वादशकागमने एकायनस्थयो रविशशिनोः क्रान्तिजीवयोः साम्ये चेन्धनरविमणियोगादग्निवद्वैधृतं भवति। यथा रविमणियोगतो दूरस्थेऽपीन्धनेऽग्निरुत्पद्यते तथा रवितो दूरेऽपि शशिनि क्रान्त्योः साम्यादग्निवद्वैधृतमुत्पद्यत इति। ऊनाधिककलाभ्य इत्यस्याग्र सम्बन्ध इति ॥ ३४ ॥

वि. भा.—रविचन्द्रयोर्योगे राशिद्वादशके एकायनस्थयो रविचन्द्रयोः क्रान्ति-जीवयोस्तुल्ये चेन्धनरविमणियोगादग्निवद्वैधृतं भवति। रविमणि योगतो दूरस्थे-ऽपीन्धने यथाऽग्निरुत्पद्यते तथा रवितो दूरस्थेऽपि चन्द्रे क्रान्तिसाम्यादग्निवद्वैधृत-मुत्पद्यत इति। ऊनाधिक कलाभ्य इत्यस्याग्रे सम्बन्धः।

अत्रोपपत्ति।

यदा रविचन्द्रयोर्योगो द्वादश राशिसमस्तदा तौ भिन्नगोलस्थावेकायनगतौ स्याताम्। यथा यद्येकः=१ रा, तदा परः=११ रा, एवमनयो. २ । १० ॥ ३ । ९ ॥ ४ । ८ ॥ ५ । ७ ॥ ६ । ६ ॥ ७ । ५ अत्र भुजयोस्तुल्यत्वाद्रविक्रान्तिसमा चन्द्र-स्थानीयक्रान्तिर्भवितुमर्हत्यतोऽस्य नाम वैधृतयोगः। विशेषेण मङ्गलं ध्रियते अवरोध्यत इति विधृतः। विधृत एव वैधृतः। सूर्यसिद्धान्ते "एकायन गतौ स्यातां सूर्याचन्द्रमसौ यदा। तद्युतौ मण्डले क्रान्त्योस्तुल्यत्वे वैधृताह्वयः" सिद्धान्तशेखरे "अयन कृत समत्वे गोलयोर्भिन्नदिक्त्वेदिनकर शशियोगे चक्रतुल्ये च जाते। तदपम-समतायां मङ्गलोन्मूलनार्थं विषमिव मधुसर्पिसाम्यतो वैधृतः स्यात्॥ श्रीपत्युक्त-मिदं चाचार्योक्तसदृशमेवेति। अस्य लक्षणादिकं पूर्वमेव प्रश्नाध्याये मया लिखितं अत्रैतत्सम्बधे प्रश्नस्तदुत्तरमप्यस्त्यतोऽत्रापि लिखितमिति ॥ ३४ ॥

अब वैधृत के लक्षण को कहते हैं।

हि. भा.—रवि और चन्द्र के योग बारह राशि के बराबर होने के कारण दोनों के एक अयन में स्थित होने पर दोनों की क्रान्तिज्या के तुल्य होने से रविमणि योग से दूरस्थ लकड़ी रहने पर भी जैसे अग्नि की उत्पत्ति होती है वैसे ही रवि से चन्द्र के दूर रहने पर भी क्रान्ति साम्य से अग्निवत् वैधृतोत्पत्ति होती है इति ॥ ३३ ॥

उपपत्ति।

जब रवि और चन्द्र का योग बारह राशि के बराबर होता है तो दोनों भिन्न गोल में और एक अयन में होते हैं जैसे यदि एक=१ रा, है तो दूसरा ११ रा, इस तरह दोनों का प्रमाण=२ । १० ॥ ३ । ९ ॥ ४ । ८ ॥ ५ । ७ ॥ ६ । ६ ॥ ७ । ५ यहाँ दोनों के भुज बराबर होने के कारण रवि क्रान्ति के बराबर चन्द्र की स्थानीय क्रान्ति होती है इसलिये इसका

नाम वैधृत योग है। मङ्गल कार्य को विशेषरूप से रोकता है इसलिये इसका नाम वैधृत पड़ा। सूर्यसिद्धान्त और सिद्धान्त शेखर सिद्धान्त शिरोमणि आदि ग्रन्थों में भी इसी तरह कहा गया है। इसके लक्षणादि पहले प्रश्नाध्याय में लिख चुके है। यहां इसके सम्बन्ध में प्रश्न और उसका उत्तर आचार्य ने लिखा है इसलिये यहां हमने भी लिखा है इति ॥ ३४ ॥

इदानीं रविचन्द्रयोश्चक्रचक्रार्धतुल्ययोगकाले रविचन्द्रपातानामानयनमाह।

भुजैक्यलब्धदिवसैरवीन्दुपाता युतोनकाः स्वफलैः।
अर्कक्रान्तिज्या धनुरिन्दोर्विक्षेपयुक्तोनम् ॥३५॥

सु. भा.—यदा रविशशियोगो भार्धाच्चक्राच्च न्यूनो वाधिको भवति। तदा न्यूनाधिककलाभ्यो भुक्त्यैक्येन रविशशिगतियोगेन ये लब्धा दिवसास्तैः स्वफलैः स्वचालनफलैर्न्यूने रवीन्दुपाता युता अधिके चोनाश्चक्रार्धकालिका वा चक्रकालिका रवीन्दुपाता भवन्ति। ततस्तात्कालिकार्क क्रान्तिज्याधनुरर्क क्रान्तिर्भवति। इन्दोः क्रान्तिज्याधनुस्तद्विक्षेपयुक्तोनं दिगैक्ये युतं दिग्भेदे हीनमेवं तत्क्रान्तिर्भवति ॥ ३५ ॥

वि. भा.—रविचन्द्रयोर्योगो यदा षड्राशिभ्यो द्वादशराशिभ्यश्च न्यूनोऽधिको वा भवेत्तदा न्यूनाधिककलाभ्यो रविचन्द्रगतियोगेन चा (रविचन्द्रयोर्गति योगेनैकं दिनं लभ्यते तदा न्यूनाधिककलाभ्यः किमिति) नेनानुपातेन ये दिवसा समागच्छेयुस्तैः स्वचालनफलै र्न्यूने रवीन्दुपाता युता अधिके च हीनास्तदा चक्रार्ध (षड्राशि) कालिकाश्चक्र (द्वादशराशि) कालिका वा रविचन्द्रपाता भवन्ति। ततस्तात्कालिक रविक्रान्तिज्या साध्या तच्चापं रविक्रान्तिर्भवेत्। चन्द्रक्रान्तिचापं तच्छर युक्तोनं (दिक् साम्ये युतं दिग्भेदे हीनं) तदा तत्क्रान्तिर्भवेत्। सिद्धान्तशेखरे "तपनशशिसमासे चक्रचक्रार्धहीनाधिकतरकलिकास्तद्भुक्तियोगेन भक्ताः। फलमिह दिवसाद्यं स्यात् क्रियन्तेऽनुपातात् स्वफलयुतविहीनाः सूर्यशीतांशुपाताः" श्रीपत्युक्तमेवमेवास्तीति ॥ ३५ ॥

अब जिस समय रवि और चन्द्र का योग छः राशि और बारह राशि होता है उस काल में रवि-चन्द्र और पात के साधन करते हैं।

हि. भा.—रवि और चन्द्र का योग छः राशि और बारह राशि से न्यून वा अधिक हो तब न्यूनाधिक कलाओं से और दोनो के गतियोग से (रवि और चन्द्र के गति योग मे एक दिन पाते हैं तो न्यूनाधिक कला में क्या) इस अनुपात से जो लब्ध दिन हो उन अपने चालन फलों से न्यून में रवि-चन्द्र और पात में जोडना अधिक में हीन करना तब चक्रार्ध कालिक रवि चन्द्र और पात होते हैं। इस रवि से उनकी तात्कालिक क्रान्तिज्या साधन

करना उस का चाप रवि की तात्कालिक क्रान्ति होती है। एवं चन्द्र क्रान्ति चाप में उसके शर को युक्त और हीन (दिक् साम्य में युत और दिग्भेद में हीन) करने से उस की क्रान्ति होती है। सिद्धान्तशेखर में 'तपनशशिसमासे चक्रचक्रार्धहीनात्रिभवन क्रान्तिकाः' इत्यादि श्रीपति प्रकार आचार्योक्त प्रकार के सदृश ही हैं। श्रीपति ने केवल रवि और चन्द्र की क्रान्ति की चर्चा नहीं की है आचार्य ने रवि और चन्द्र की क्रान्ति के साधन भी किये हैं इति ॥३५॥

इदानीं पातस्य भावाभावमाह।

त्रिनवगृहेन्दुक्रान्तिर्मेषतुलादौ दिवाकरक्रान्तेः।
ऊना यावदभावस्तावद्भावोऽन्यथाऽर्केन्द्वोः ॥३६॥

सु. भा.—त्रिनवगृहेन्दुक्रान्तिर्द्विचतुर्थपदोद्भवा क्रान्तिः सा मेषतुलादौ दिवाकर क्रान्तेः प्रथमतृतीय पदोद्भवक्रान्तेर्यावदूना तावत् क्रान्तिसाम्याभावोऽन्यथाऽर्केन्द्वोः क्रान्तिसाम्यभावो वेदितव्य इति।

अत्रोपपत्तिः। अत्र 'स्वायनमन्दाविन्दोः क्रान्तिस्तत्काल भास्करक्रान्तेर्यावदूना तावत् क्रान्तिसाम्याभावो गोलयुक्त्या सिध्यत्यत आचार्योक्तं न समीचीनम्' इति भास्करः स्वपाताधिकारे व्यलिखत्। अथ यदि त्रिनवगृहेन्दु क्रान्तिरित्यनेन चन्द्रस्य परमा क्रान्तिर्गृह्यते तदाऽऽचार्योक्तं भास्करसमं शोभनमेव। अत्र चतुर्वेदाचार्यः स्ववासनायां 'मिथुनान्त गम्येन्दोरवश्यमेव तत्क्रान्तिः परमा भवति। क्रान्तिः परमा भवतीत्यनेन मिथुनान्तेनचन्द्रायनसन्धिर्गृह्यते स्फुटम्। यद्यपि तैश्चन्द्रगोलानयनसन्धी न साधितौ तथाऽपि तदुपपत्तिस्तद्वशे नैव विलिखितास्तीति सिद्धान्तविदां स्फुटमेव ॥ ३६ ॥

वि. भा.—त्रिनवगृहेन्दुक्रान्तिरर्थात् द्विचतुर्थपदोत्पन्ना चन्द्रक्रान्तिर्मेषतुलादौ दिवाकरक्रान्तेरर्थात् प्रथमतृतीयपदोत्पन्नरविक्रान्तितो यावदूना तावत् क्रान्तिसाम्याभावोऽन्यथा रविचन्द्रयोः क्रान्तिसाम्य भावो ज्ञेय इति ॥

अत्रोपपत्तिः।

त्रिनवगृहेन्दुक्रान्तिरित्यनेन यदि चन्द्रस्य परमा स्पष्टक्रान्तिर्गृह्यते तदा क्रान्तिसाम्यकथनं गोलयुक्तिसिद्धं स्यादन्यथा स्वसिद्धान्तशिरोमणौ पाताधिकारे वासनाभाष्ये भास्कराचार्येण "अत्र धीवृद्धिदपक्षेसूर्यापमादोजपदोद्भवादित्यादि लक्षणेन क्रान्तिसाम्याभावः। तथाऽऽचार्य पक्षेऽपि त्रिनवगृहेन्दुक्रान्तिरित्यादिना लक्षणेन तथा "त्रिनव भवनजाता क्रान्तिरिन्दोर्यदाऽल्पा दिनकृदपमतः स्यान्मेषजूकादिजातात्। नहि भवति तदा च क्रान्तिसाम्यं रवीन्द्वो नियतमपरथात्वे जायते सम्भवोऽस्य" इति सिद्धान्तशेखरोक्तलक्षणेन तथा "रवे

रोजपदक्रान्तेश्चन्द्रयुग्मपदोद्भवा । स्वल्पा चेन्न तयोः क्रान्त्योः साम्यं स्यादन्यथा भवेत्" इति माधवोक्तसिद्धान्तचूडामणिलक्षणेनापि क्रान्तिसाम्याभावः । 'स्वायनसन्धाविन्दोः क्रान्तिस्तत्कालभास्करक्रान्तेः । यावदूना तावत् क्रान्तेः साम्यं तयोर्नास्तीति गोलयुक्त्या सिध्यत्यत आचार्योक्तं न समीचीनम्' इति पाताधिकारे भास्करेण लिखितम् । यदि त्रिनवगृहेन्दुक्रान्तिरित्यनेन चन्द्रस्य परमा क्रान्तिर्गृह्यते तदा ऽऽचार्योक्तं भास्करोक्तसम समीचीनमेवेति । अत्र चतुर्वेदाचार्यः स्ववासनायां 'मिथुनान्तगस्येन्दोरवश्यमेव तत्क्रान्तिः परमा भवति ।' क्रान्तिः परमा भवतीत्यनेन मिथुनान्तेन चन्द्रायनसन्धिरिति स्फुटम् । यद्यपि तैश्चन्द्रगोलायनसन्धी न साधितौ तथापि तदुपपत्तिस्तद्वशेनैव विलिखितास्तीति ॥ ३६ ॥

अब पात के भावाभाव को कहते हैं ।

हि. भा.—द्वितीय और चतुर्थ पदीय चन्द्रक्रान्ति प्रथम पदीय और तृतीय पदीय रवि क्रान्ति से जब तक अल्प रहती है तब तक क्रान्ति साम्याभाव होता है अन्यथा रवि और चन्द्र का क्रान्ति साम्य होता है इति ॥३६॥

उपपत्ति ।

आचार्योक्त सूत्र 'त्रिनव गृहेन्दु क्रान्तिर्मेषतुलादौ दिवाकरक्रान्तेः' में यदि चन्द्र की परम क्रान्ति ग्रहण की जाय तब क्रान्तिसाम्य का कहना गोलयुक्ति सिद्ध है अन्यथा अपनी सिद्धान्त शिरोमणि के पाताधिकार में वासना भाष्य में भास्कराचार्य "अत्र धीवृद्धिदपक्षे 'सूर्यापमादोजयदोद्भवादित्यादि' लक्षणेन क्रान्ति साम्याभावः । तथाऽऽचार्यपक्षेऽपि 'त्रिनव-गृहेन्दु क्रान्तिरित्यादिना लक्षणेन, त्रिनवभवनजाता क्रान्तिरिन्दोर्यदाल्पा' इत्यादि सिद्धान्त शेखरोक्त लक्षणेन तथा "रवेरोजपद क्रान्तेश्चन्द्र युग्म पदोद्भवा । स्वल्पा चेन्नतयोः क्रान्त्योः साम्यं स्यादन्यथा भवेत्" इति माधवोक्त सिद्धान्त चूडामणि लक्षणेनापि क्रान्ति साम्याभावः स्वायन सन्धाविन्दोः क्रान्तिस्तत्काल भास्करक्रान्तेः यावदूना तावत्क्रान्तेः साम्यं तयोर्नास्तीति गोल युक्त्या सिध्यत्यत आचार्योक्तं न समीचीनम् । यह पाताधिकार में भास्कराचार्य ने लिखा है ॥ इति ॥

इदानीं विशेषमाह ।

व्यतिपातोऽपक्रमयोर्दिक् साम्यो वैधृतो दिगन्यत्वे ।
अधिको न्यूनः कल्प्यो दिग्भेदेऽपक्रमः शशिनः ॥ ३७ ॥

सु. भा.—पूर्वार्धं स्पष्टभास्करलक्षणमेतदनुरूपमेव 'व्यतिपातोऽयनभेदे गोलैक्यत्वे' इत्यादि । अथ यदि शशिनश्चन्द्रस्यापक्रमो दिग्भेदे ह्युत्पन्नोऽर्थाद्यदा

चन्द्रस्थानीया क्रान्तिरेव दिग्भेदे शरादेव शुध्यति तदा यदि चन्द्रस्यापमो रवेरप-मान्न्यून स्तदा तु न्यून एव परन्तु तदा यदि सोऽपमो रवेरपमादधिकस्तदापि न्यून एव कल्प्यस्तस्य क्षयत्वादिति ।

अत्रोपपत्तिः । व्यतिपातवैधृतपरिभाषयैव स्फुटा ॥ ३७ ॥

वि. भा.—रविचन्द्रयोः क्रान्ति दिक्साम्ये व्यतिपातयोगः । दिग्भेदे वैधृतो योग इति व्यतिपातोऽयनभेदे गोलैकत्वे इत्यादि भास्करोक्तमेतदनुरूपमेव । यदि शशिनः (चन्द्रस्य) अपक्रमः (क्रान्तिः) दिग्भेदे तदा उत्पन्नोऽर्थात्तदा चन्द्रस्थानीया क्रान्तिरेव दिग्भेदे शरादेव शुध्यति तदा यदि चन्द्रस्य क्रान्ती रवेःक्रान्तेर्न्यूना तदा तु न्यून एव परन्तु तदा यदि सा क्रान्तीरवेः क्रान्तेरधिका तदापि न्यून एव कल्प्य-स्तस्य क्षयत्वादिति । सिद्धान्तशेखरे "नयति शशिशरश्चेत् स्वां दिशं क्रान्तिचापं समधिकतनुरन्यक्रान्तिसीम्नस्तदानीम् । अधिकतरमपीत न्यूनमेव प्रकल्प्यं तुहिन किरणमूर्त्तेस्तत् स्फुटं क्रान्तिचापम् ॥" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव । शिष्यधीवृद्धिदतन्त्रे "कल्प्योऽधिकोऽप्यूनक एव चान्द्रः स्फुटोऽपमश्चन्द्रमसोऽन्य-दिक्स्थः" इति लल्लोक्तमप्याचार्योक्त सदृशमेवास्तीति ॥३७॥

अब चन्द्र के शर रहने में विशेष कहते हैं ।

हि. भा.—रवि और चन्द्र के क्रान्ति के दिक्साम्य में व्यतिपात योग होता है । दिग्भेद में वैधृत योग होता है, 'व्यति पातोऽयन भेदे गोलैकत्वे' इत्यादि भास्करोक्त इसके अनुरूप ही है । यदि चन्द्र की क्रान्ति दिग्भेद में उत्पन्न हो अर्थात् चन्द्र की स्थानीय क्रान्ति ही दिग्भेद में चन्द्रशर में घटे तब यदि चन्द्र की क्रान्ति रवि क्रान्ति से न्यून हो तब न्यून ठीक है, लेकिन तब यदि चन्द्र क्रान्ति रवि क्रान्ति से अधिक हो तब भी न्यून ही कल्पना करना उस के क्षयत्व के कारण ; सिद्धान्त शेखर में 'नयति शशिशरश्चेत् स्वां दिशं क्रान्ति-चापं' इत्यादि विज्ञान भाष्य में लिखित श्रीपति कथित विषय आचार्योक्त के अनुरूप ही है शिष्य धीवृद्धिद तन्त्र में 'कल्प्योऽधिकोऽप्यूनक एव चान्द्रः इत्यादि' लल्लोक्त आचार्योक्त के सदृश ही हैं इति ॥ ३७ ॥

इदानीं पातस्य गतागतत्वमाह ।

मेषतुलादाविन्दोरपक्रमेरव्यपक्रमादूने ।
एष्यत्यधिकोऽतीतो विपरीतः कर्कमकरादौ ॥३८॥

सु. भा.—रव्यपक्रमादिन्दोर्मेषतुलादावोजपदस्थेऽपक्रमे न्यूने पात एष्यति भविष्यति । अधिके चातीतो व्यतीत इति वेदितव्यम् । कर्कंकारादौ समपदस्थे विध्वपक्रमे च विपरीतो ज्ञेयः । ऊनेऽतीतोऽधिके भविष्यति ।

अत्रोपपत्तिः । अत्र चन्द्रस्य गोलायनसन्ध्यन्तं यदि पदं गृह्यते तदा गतागत-सम्भवो गोलयुक्त्या समीचीनो यतस्तदैवौजपदस्थे विध्वपक्रमे न्यूनेऽग्रे चालनेन रविक्रान्ति समश्चन्द्रापमो भविष्यति समपदस्थे च पृष्ठतश्चालनेन रविक्रान्तिसमो भवति । ओजपदेऽग्रे क्रान्तिरूपचीयते समपदे च पृष्ठत उपचीयत इति गोलयुक्त्या स्फुटम् । अत एव भास्करः—

'ओजपदेन्दुक्रान्तिर्महती सूर्यपमाल्लघुः समजा ।
यदि भवति तदा ज्ञेयो यातः पातस्तदन्यथा गम्यः—' इति ॥३८॥

वि. भा.—रविक्रान्तितश्चन्द्रस्य मेषतुलादिस्था (विषमपदीया) क्रान्तिर्यदि-न्यूना तदा पात एष्यति (भविष्यति) यद्यधिका तदा पातो व्यतीतो ज्ञेयः । कर्क मकरादौ (समपदे) चन्द्रकान्तौ च विपरीतोज्ञेयः । ऊनेऽतीतोऽधिके भविष्यति ॥३८॥

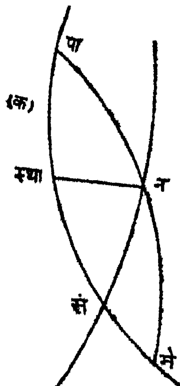
अत्रोपपत्तिः ।

नाड़ी विमण्डलयोः सम्पातोपरिगतं कदम्बप्रोतवृत्तं यत्र क्रान्तिवृत्ते लगति स एव बिन्दुश्चन्द्रगोलसन्धिः । अत्र नवत्यंशयोजनेन यो बिन्दुरर्थान्नाडीवृत्त विमण्ड-लयोः सम्यातान्नवत्यंश वृत्तक्रान्तिवृत्तयोः सम्पात विन्दुश्चन्द्रायन सन्धिः प्राचीनैः स्वीकृतः । वस्तुतो नाड़ीवृत्तविमण्डलयोः सम्पातान्नवत्यंशवृत्तस्य क्रान्तिवृत्तोप-र्यलम्बरूपत्वात्प्राचीनाचार्य स्वीकृतगोलायन सन्धिर्वास्तव गोलायनसन्धिस्तु । तत्पूर्वोक्त नवत्यंशवृत्तं यत्र विमण्डले लगति तदुपरिगतं कदम्बप्रोतवृत्तं यत्र क्रान्तिवृत्ते लगति स बिन्दुः । अत्र यदि चन्द्रस्य गोलायनसन्ध्यन्तं पदं गृह्यते तदा गोलयुक्त्या गतागतसम्भवः समीचीनो यतस्तदैव विषमपदस्थे चन्द्रापक्रमे न्यूनेऽग्रे चालनेन रविक्रान्तिसमा चन्द्रक्रान्तिर्भविष्यति । समपदे च पृष्टतश्चालनेन रविक्रान्तिसमा, विषमपदेऽग्रे क्रान्तिरुपचीयते समपदे च पृष्ठत उपचीयते इति, तत एव भास्करेण सिद्धान्त शिरोमणौ "ओजपदेन्दु क्रान्तिर्महती सूर्यपमाल्लघुः समजा । यदि भवति तदा ज्ञेयो यातः पातस्तदन्यथा गम्यः ॥" इति कथितः । यत्र दक्षिणक्रान्तेरभावस्तत्र प्रथमगोलसन्धिः । ततः परमोत्तरं स्पष्टक्रान्तिपर्यन्तं प्रथमं विषमपदम् । प्रथमविषमपदान्तमेव प्रथमायनसन्धिः कथ्यते । ततः स्पष्ट-क्रान्त्यभावपर्यन्तं प्रथमसमपदम् । प्रथमसमपदान्तं द्वितीयगोलसन्धिः । ततः परमदक्षिणस्पष्टक्रान्तिपर्यन्तं द्वितीयविषमपदम् । तत्पदान्तं च द्वितीयायनसन्धिः कथ्यते । ततो दक्षिणस्पष्टक्रान्त्यभावपर्यन्तं द्वितीयसमपदमिति । अत्राचार्येण यद्यपि रविचन्द्रगोलायनसन्ध्यानयनं न कृतम् तथापि गणितस्कन्धे जातबोधेन तदानयनं कर्त्तव्यमेव । यदि चन्द्रस्य स्थानीया क्रान्तिः शराद्विशुध्यति अर्थाद्यत्र स्थानक्रान्तिशरयोरन्तरेण स्फुटा क्रान्तिर्भवति तदा यदि शरादेव चन्द्रस्थान

क्रान्तिर्विशुद्धा भवति तदा मध्यस्फुटक्रान्त्योर्दिग्भेदात् स्थानीयपदाच्चन्द्रस्य पदान्यत्वं ज्ञेयम् । स्थानक्रान्तेरुपचये स्फुटक्रान्तेरपचयः । स्थानक्रान्तेरपचये च स्फुट-क्रान्तेरुपचयः । अत उपचयापचययोर्भेदात् स्थानीयपदाच्चन्द्रबिम्बपदान्यत्वं भवत्येव । स्थानपद समे तदा बिम्बपदं विषमे । स्थानपदं विषमे तदा बिम्बपदं सम इति । रविस्तावत् स्थिरगतिश्चन्द्रोऽतीव गत्वरगतिस्तेन क्रान्तेः प्रतिक्षणमन्यथात्वम् । अतश्चन्द्रमधिकृत्योच्यते विषमपदे वर्त्तमानस्य चन्द्रस्य क्रान्ति रुपचये वर्त्तते । यथा यथा ग्रहोऽग्रतो याति तथा तथा तस्य क्रान्तिर्विषमपदे उपचीयते । प्रथमपदस्य तृतीयपदस्य च गोलसन्धावादिः । तदग्रतस्त्रिभेऽन्तरे क्रान्तेः परमत्वम् । अतो विषमपदे वर्त्तमानो यथा यथाऽग्रतो याति तथा तथा क्रान्तिरुपचीयते । ततस्त्रिभात् परतो द्वितीयगोलसन्धिं यावत् समपदम् । तत्र वर्त्त-मानो यथा यथाग्रतोयाति तथा तथा क्रान्तिरपचीयते । एवं तृतीयचतुर्थपदयोरपि । अतो विषमपदे वर्त्तमानस्य चन्द्रस्य क्रान्तिर्यदा रविक्रान्तेर्महती तदाऽग्रे चालितस्य चन्द्रस्यातिशयेन महती भवति । यथा यथा पृष्ठतश्चाल्यते चन्द्रस्तथा तथा क्रान्ति-रूनैव भवति, अतोऽनया रविक्रान्त्या सह साम्य गतमेवानुमितम् । अथ समपदे वर्त्तमानस्य चन्द्रस्य क्रान्तीरविक्रांतेर्लघ्वी तदा पृष्ठतश्चालितस्य चन्द्रस्य क्रान्तिर्महती भवति । अतो महत्या रविक्रान्त्या सह साम्यं गतम् । अस्माल्लक्षणादन्यथात्वे क्रान्तिसाम्यमेष्यमित्यर्थाज्ज्ञायते । अतो गतगम्यलक्षणं युक्तयुक्तम् ॥ रविचन्द्र गोलायनसन्ध्यानयनं भास्करेण कृतम् । तत्र रविगोलायनसन्धी भास्करकृतौ नैव समीचीनौ ।

चन्द्रगोलसन्ध्यर्थं विचारः ।

नसं = नाड़ीवृत्तम् । पास्थासंमे = क्रान्तिवृत्तम् । पान = विमण्डलम् । मेसंस्थापा=चन्द्रपातः । <स्थासंन=परमक्रान्तिः=प । <स्थापान = चन्द्रपरम-शरः = श । <पानसं = १८० — चन्द्रपरमक्रान्ति, संस्थापा=अयनांशोनित पातः=पा, तदा त्रिज्यागुणाद्भ-रणि कोटिगुणा दित्यादिना



$$\frac{\text{त्रि}^2.\ \text{कोज्याचंपक्रां} - \text{त्रि}.\ \text{कोज्याप}.\ \text{कोज्याश}}{\text{ज्याप}.\ \text{ज्याश}} = -\text{कोज्यापा}$$

$\therefore$ कोज्याचंपक्रां =

$$= \frac{\text{त्रि}.\ \text{कोज्याप}.\ \text{कोज्याश} - \text{ज्याप}.\ \text{कोज्याप}.\ \text{ज्याश}}{\text{त्रि}^2}$$

$$= \frac{\text{कोज्याप}.\ \text{कोज्याश}}{\text{त्रि}} - \frac{\text{ज्याप}.\ \text{कोज्यापा}.\ \text{ज्याश}}{\text{त्रि}.\ \text{त्रि}.}$$ अत्र

मकरादिकेन्द्रे व्ययनांशपाते तत्कोटिज्या धनमन्यथा ऋणं ज्ञेयम् । आनीतायाः 'कोज्याचंपक्रां' एतस्याश्चापं नवतें-

विशोध्यं तदा चन्द्रस्य परमा क्रान्तिर्भवेत् । संपानत्रिभुजे न बिन्दुतः क्रान्तिवृत्तोपरि नस्था लम्बकरणेन स्था = चन्द्रगोलसन्धिः । ततः कोणानुपातेन ज्यानसं $= \frac{\text{ज्यापा. ज्याश}}{\text{ज्यार्चंपक्रां}}$, नसंसमे भुजांश माने विषुवांशाः=संस्था, अत्र मे मेषादेः क्रमगणनया सं पर्यन्तं रविगोलसन्धिः स व्ययनांशोनितपाते मेषादिषट्कस्थे संस्थाचापेन हीनोऽन्यथा युक्तस्तदा चन्द्रगोल सन्धिः स्यात् । एतेन "परेषु जीवा व्ययनांश पात कोटिज्यकाघ्नी" इत्यादि संशोधकोक्तमुपपद्यते । अत्र 'चन्द्रस्य गोलसन्धी राशित्रितयेन संयुक्तौ । क्रमशस्तदयनसन्धी ज्ञेयौ स्वल्पान्तरौ सुगोलविदा ॥' संशोधकोक्तो विशेषः कमलाकररीतिवज्ज्ञेयः । तयोर्मतेन चन्दायनसन्ध्यानयनं स्थूलमिति ॥ सूर्य सिद्धान्ते "अथौजपदगस्येन्दोः क्रान्तिर्विक्षेपसंस्कृता । यदि स्यादधिका भानोः क्रान्तेः पातो गतस्तदा. ॥ ऊना चेत् स्यात्तदा भावो वामं युग्मपदस्यच । पदान्यत्वं विधोः क्रान्तिर्विक्षेपाच्चेद्विशुध्यति" एवमत्र लिखितमस्ति, शिष्यधीवृद्धिदतन्त्रे "अयुग्मजश्चान्द्रमसोऽपमश्चेदपक्रमाद् भानुमतोऽधिकः स्यात् । समोद्भवो वापि लघुस्तदैतो निपातकालो भविताऽन्यथाऽतः" इति लल्लोक्तं च सिद्धान्तशिरोमणौ "ओजपदेन्दु क्रान्तिर्महती सूर्यापमादित्यादि" भास्करोक्तं च सर्वमेकरूपमेवेति ॥३८॥

अब पात के गतागतत्व को कहते हैं।

हि. भा.—यदि चन्द्र की मेष तुलादिस्थ (विषम पदीय) क्रान्ति रवि क्रान्ति से न्यून हो तब पात एष्य होता है, यदि अधिक हो तो पात व्यतीत (गत) होता है। कर्क मकरादि (समपद) में चन्द्र क्रान्ति रहने से विपरीत जानना चाहिये अर्थात् ऊन में गत और अधिक में एष्य होता है इति ॥३८॥

उपपत्ति।

यदि यहां गोलायन सन्ध्यन्त पद ग्रहण करते हैं तब गोलयुक्ति से गतागत सम्भव ठीक होता है क्योंकि तब ही विषम पदस्थ चन्द्र क्रान्ति के न्यून रहने पर आगे चालन से रवि क्रान्ति के बराबर चन्द्रक्रान्ति होगी, समपद में पीछे से चालन करने से रविक्रान्ति के बराबर चन्द्र क्रान्ति होती है। विषम पद में आगे क्रान्ति बढती है। सम पद में पीछे से क्रान्ति बढ़ती है। जहां दक्षिण क्रान्ति का अभाव होता है वहां प्रथम गोल सन्धि है। उसके बाद परम उत्तर स्पष्ट क्रान्ति पर्यन्त प्रथम विषम पद है। प्रथम विषम पदान्त ही को प्रथमायन सन्धि कहते हैं। वहां से स्पष्टक्रान्त्यभाव पर्यन्तं प्रथम सम पद है। प्रथम समपदान्त द्वितीय गोल सन्धि है। वहां से परम दक्षिण स्पष्ट क्रान्ति पर्यन्त द्वितीय विषम पद है। उसका पदान्त द्वितीयायन सन्धि कही जाती है। वहां से दक्षिण स्पष्टक्रान्त्यभाव पर्यन्त द्वितीय समपद है। यहां आचार्य ने यद्यपि रवि और चन्द्र का गोलायन सन्ध्यानयन नहीं

किया है तथापि गणित स्कन्ध में उसका ज्ञान रहने से आगणन करना ही चाहिये। यदि चन्द्र की स्थानीय क्रान्ति शर में से घट जाय अर्थात् जहां स्थान क्रान्ति और शर के अन्तर से स्फुट क्रान्ति होती है। तब यदि शर ही में चन्द्र की स्थान क्रान्ति विशुद्ध हो तब स्थानस्थ और स्पष्ट क्रान्ति के दिग्भेदसे स्थानीय चन्द्र पद से पदान्तर समझना चाहिए। स्थान क्रान्ति के उपचय में स्फुट क्रान्ति का अपचय, स्थान क्रान्ति के अपचय में स्फुट क्रान्ति का उपचय इसलिये उपचय अपचय के भेद से स्थानीय पद से चन्द्र बिम्ब पदान्तर होता ही है। स्थान पद सम में रहने से बिम्ब पद विषम में होगा। यहां चन्द्र को लेकर विचार करते हैं। विषम पद में चन्द्र क्रान्ति उपचित होती है। जैसे जैसे ग्रह आगे जाते हैं वैसे वैसे उसकी क्रान्ति विषम पद में बढ़ती है। प्रथम पद और तृतीय पद की गोल सन्धि ही आदि है। उससे आगे तीन राशि पर क्रान्ति का परमत्व होता है। इसलिये विषम पद में जैसे जैसे ग्रह आगे जाते है वैसे वैसे क्रान्ति बढ़ती है। तीन राशि के बाद द्वितीय गोल सन्धि पर्यन्त सम पद है। इसमें जैसे जैसे ग्रह आगे जाते हैं वैसे वैसे क्रान्ति घटती है। ऐसे ही तृतीय और चतुर्थपद में भी। इसलिये विषम पद में स्थित चन्द्र की क्रान्ति यदि रवि क्रान्ति से बड़ी होती है तब आगे चन्द्र को चालन करने से चन्द्र की क्रान्ति अतिशय बड़ी होती है। जैसे जैसे पीछे चन्द्र को चालित करते हैं चन्द्र की क्रान्ति ऊन ही होती है। इसलिये इस रवि क्रान्ति के साथ साम्य गत ही कहा जायगा। सम पद में चन्द्र क्रान्ति यदि रवि क्रान्ति से छोटी हो तब पीछे चालित चन्द्र की क्रान्ति बड़ी होती है। इसलिये बड़ी रवि क्रान्ति के साथ साम्य गत ही होता है। इन लक्षणों से भिन्न में क्रान्ति साम्य गम्य होता है। इसलिये गत-गम्य लक्षण ठीक है। रवि और चन्द्र का गोलायन सन्ध्यानयन भास्कराचार्य ने किया है, रवि गोलायन सन्धि ज्ञान भास्करोक्त ठीक नहीं है। चन्द्रगोल सन्धि के लिये विचार करते हैं। यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये। नसं नाडीवृत्त। पास्थासमे =क्रान्तिवृत्त। पान=विमण्डल। मेसंस्थापा=चन्द्रपात। ∠ स्थामन=परमक्रान्ति =प। ∠ स्थापान=चन्द्रपरमशर=श। ∠ पानसं=१८०−चन्द्रपरमक्रान्ति। संस्थापा=अयनांशोनितपात=पा। तब 'त्रिज्या गुणाद्धरणि' कोटिगुणात् इत्यादि से

$$\frac{\text{त्रि}^2.\ \text{कोज्याचंपक्रां}-\text{त्रि}.\ \text{कोज्याप}.\ \text{कोज्याश}}{\text{ज्याप}.\ \text{ज्याश}}=-\text{कोज्यापा}$$

$$\therefore\ \text{कोज्याचंपक्रां}=\frac{\text{त्रि}.\ \text{कोज्याप}.\ \text{कोज्याश}-\text{ज्याप}.\ \text{कोज्यापा}.\ \text{ज्याश}}{\text{त्रि}^2}$$

$$=\frac{\text{कोज्याप}.\ \text{कोज्याश}}{\text{त्रि}}-\frac{\text{ज्याप}.\ \text{कोज्यापा}.\ \text{ज्याश}}{\text{त्रि}.\ \text{त्रि}}$$

यहां मकरादिकेन्द्र में अयनांश पात रहने से उसकी कोटिज्या धन अन्यथा ऋण समझना चाहिये। आनीत कोज्या चंपक्रां इसके चाप को नव्वे में घटाने से चन्द्र की परम क्रान्ति होती है। संपान त्रिभुज में न बिन्दु से क्रान्ति-वृत्त के ऊपर नस्था लम्ब करने से स्था=चन्द्रगोल सन्धि। तब कोणानुपात से ज्यानसं $=\frac{\text{ज्यापा}.\ \text{ज्याश}}{\text{ज्याचंपक्रां}}$, नसं के बराबर भुजांश में विषुवांश=संस्था, यहां से मेषादिसे क्रमगणना

से सं पर्यन्त रवि गोल सन्धि है। मेषादि छः राशि में व्ययनांशोनित पात के रहने से रवि गोल सन्धि में सस्था चाप को घटाने से अन्यथा जोड़ने से चन्द्रगोल सन्धि होती है। इस से 'परेषु जीवा व्ययनांशपातकोटिज्यकाघ्नी' इत्यादि संशोधकोक्त उपपन्न होता है। सूर्य-सिद्धान्त में "अथौजपदगस्येन्दोः क्रान्तिर्विक्षेपसंस्कृता। यदि स्यादधिका भानोः क्रान्तेः पातो गतस्तदा ।। ऊना चेत्स्यात् तदा भावी वाम युग्मपदस्य च। पदान्यत्व विधोःक्रान्तिर्विक्षेपाच्चेद्विशुध्यति ।।" इति सूर्य सिद्धान्तकारोक्त, शिष्यधीवृद्धिदतन्त्रे "अयुग्मजश्चान्द्रमसोऽपमश्चेदपक्रमाद् भानुमतोऽधिकः स्यात्। समोद्भवो वापि लघुस्तदेतो निपातकालो भविताऽन्यथाऽतः" यह लल्लोक्त, सिद्धान्त शिरोमणि में 'ओज पदेन्दुक्रान्तिर्महती' इत्यादि भास्करोक्त ये सब एक रूप ही है। भास्कराचार्य आदि प्राचीनाचार्य चन्द्रगोल सन्धि साधन कर उसमें तीन राशि (नवत्यंश) जोड़कर चन्द्रायन सन्धि कहते हैं। नाडीवृत्त और विमण्डल के सम्पातोपरिगत कदम्बप्रोतवृत्त क्रान्तिवृत्त का सपात बिन्दु चन्द्र गोल सन्धि है। नाड़ीवृत्त और विमण्डल के संपात को केन्द्र मानकर नवत्यंश से जो वृत्त होता है वह क्रान्तिवृत्त में जहां लगता है वह बिन्दु प्राचीनायन सन्धि है क्योंकि चन्द्रगोल सन्धि मे नवत्यंश जोड़ने से वही बिन्दु होता है, चन्द्रगोल सन्धि से वह बिन्दु नवत्यंशान्तर पर है। परन्तु वह नवत्यंशोत्पन्न वृत्त क्रान्ति वृत्त के ऊपर लम्ब नही है इसीलिये वह वास्तव चन्द्रायनसन्धि बिन्दु नहीं हो सकता है। नवत्यंशोत्पन्नवृत्त नाड़ीवृत्त में जहां लगता है तदुपरि गत कदम्ब प्रोतवृत्त क्रान्तिवृत्त का सम्पात बिन्दु वास्तव चन्द्रायन सन्धि बिन्दु है, अतः प्राचीनोक्त चन्द्रायन सन्धि सर्वथा युक्ति शून्य है इति ।। ३८ ।।

अथ यस्मिन् काले रविचन्द्रयोगश्चक्रार्धं वा चक्रं तस्मात् कालाद्गत-
गम्यस्य क्रान्तिसाम्यकालस्य परिज्ञानमाह।

क्रान्त्योर्युतिरन्यदिशोरेकदिशोरन्तरं व्यतीपाते।
एकदिशोर्युतिरन्तरमन्यदिशोर्वैधृते प्रथमः ।। ३९ ।।
एवं द्वितीय राशिर्युतहीनैरिष्ट नाड़िका स्वफलैः।
एष्यादतीतं वा यदि राशिद्वयमपि तदन्तरकम् ।। ४० ।।
छेदोऽन्यथा तदैक्यं घातस्येष्टघटिका प्रथमराश्योः।
फलघटिकाभिर्मध्यं द्वयोरपि प्रथमराशिवशात् ।। ४१ ।।

सु. भा.—द्वयोर्व्यतिपातवैधृतयोः । शेषं स्पष्टम्। 'तत्क्रान्त्यारेकदिशोरन्तरमैक्यं विभिन्नदिशोः-' इत्यादि भास्करोक्त मेतदनुरूपमेव।

अत्रोपपत्तिः। पाताधिकारे भास्करोक्तैव ज्ञेया ।। ३९-४१ ।।

वि. भा.—रविचन्द्रयोरन्यदिशोर्भिन्नदिक्कयोः क्रान्त्योर्युतिः, एकदिशोरन्तरं व्यतीपातयोगे प्रथमः (प्रथमराशिः) क्रान्त्योरेकदिशोर्युतिः, अन्यदिशो (भिन्न-

किया है तथापि गणित स्कन्ध में इसका ज्ञान रहने से प्रत्यन्त आवश्यकता नहीं है। यदि चन्द्र की स्थानीय क्रान्ति शर में से घट जाय अर्थात् जहां स्थान क्रान्ति और शर के अन्तर से स्फुट क्रान्ति होती है। तब यदि शर ही से चन्द्र की स्थान क्रान्ति विशुद्ध हो तो अयन और स्पष्ट क्रान्ति के दिग्भेदसे स्थानीय चन्द्र पद से पदान्तर समझना चाहिए। स्थान क्रान्ति के उपचय से स्फुट क्रान्ति का अपचय, स्थान क्रान्ति के अपचय से स्फुट क्रान्ति का उपचय इसलिये उपचय अपचय के भेद से स्थानीय पद से चन्द्र बिम्ब पदान्तर होता ही है। स्थान पद सम में रहने से बिम्ब पद विषम में होगा। यहां चन्द्र को लेकर विचार करते हैं। विषम पद में चन्द्र क्रान्ति उपचित होती है। जैसे जैसे ग्रह आगे जाते हैं वैसे वैसे उसकी क्रान्ति विषम पद में बढ़ती है। प्रथम पद और तृतीय पद की तीन राशि ही आदि है। इससे आगे तीन राशि पर क्रान्ति का परमत्व होता है। इसलिये विषम पद में जैसे जैसे ग्रह आगे जाते है वैसे वैसे क्रान्ति बढ़ती है। तीन राशि के बाद द्वितीय तीन राशि पर्यन्त सम पद है। इसमें जैसे जैसे ग्रह आगे जाते हैं वैसे वैसे क्रान्ति घटती है। ऐसे ही तृतीय और चतुर्थपद में भी। इसलिये विषम पद में स्थित चन्द्र की क्रान्ति यदि रवि क्रान्ति से बड़ी होती है तब आगे चन्द्र को चालन करने से चन्द्र की क्रान्ति अधिकाधिक होती है। जैसे जैसे पीछे चन्द्र को चालित करते हैं चन्द्र की क्रान्ति कम ही होती है। इसलिये इस रवि क्रान्ति के साथ साम्य गत ही कहा जायगा। सम पद में चन्द्र क्रान्ति यदि रवि क्रान्ति से छोटी हो तब पीछे चालित चन्द्र की क्रान्ति बड़ी होती है। इसलिये बड़ी रवि क्रान्ति के साथ साम्य गत ही होता है। इन लक्षणों से भिन्न में क्रान्ति साम्य गम्य होता है। इसलिये गत-गम्य लक्षण ठीक है। रवि और चन्द्र का गोलायन सन्ध्यानयन भास्कराचार्य ने किया है, रवि गोलायन सन्धि ज्ञान भास्करोक्त ठीक नहीं है। चन्द्रगोल सन्धि के लिये विचार करते हैं। यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये। नमं नाडीवृत्त। पाम्यामंमे =क्रान्तिवृत्त। पान=विमण्डल। मेमंस्थापा=चन्द्रपात। $\angle$ स्थामन=परमक्रान्ति =प। $<$ स्थापान=चन्द्रपरमशर=श। $<$ पानमं=१८०- चन्द्रपरमक्रान्ति। संस्थापा=अयनांशोनितपात=पा। तब 'त्रिज्या गुणाद्धरणि' कोटिगुणात् इत्यादि से

$$\frac{\text{त्रि}^2 . \text{कोज्याचंपक्रां} - \text{त्रि} . \text{कोज्याप} . \text{कोज्याश}}{\text{ज्याप} . \text{ज्याश}} = -\text{कोज्यापा}$$

$$\therefore \text{कोज्याचंपक्रां} = \frac{\text{त्रि} . \text{कोज्याप} . \text{कोज्याश} - \text{ज्याप} . \text{कोज्यापा} . \text{ज्याश}}{\text{त्रि}^2}$$

$$= \frac{\text{कोज्याप} . \text{कोज्याश}}{\text{त्रि}} - \frac{\text{ज्याप} . \text{कोज्यापा} . \text{ज्याश}}{\text{त्रि} . \text{त्रि}}$$

यहां मकरादिकेन्द्र में अयनांश पात रहने से उसकी कोटिज्या धन अन्यथा ऋण समझना चाहिये। आनीत कोज्या चंपक्रां इसके चाप को नब्बे में घटाने से चन्द्र की परम क्रान्ति होती है। संपान त्रिभुज में न बिन्दु से क्रान्तिवृत्त के ऊपर नस्था लम्ब करने से स्था=चन्द्रगोल सन्धि। तब कोणानुपात से ज्यानसं $= \frac{\text{ज्यापा} . \text{ज्याश}}{\text{ज्याचंपक्रां}}$, नसं के बराबर भुजांश में विषुवांश=संस्था, यहां से मेषादिसे क्रमगणना

से सं पर्यन्त रवि गोल सन्धि है। मेषादि छः राशि में व्ययनाशोनित पात के रहने से रवि गोल सन्धि में संस्था चाप को घटाने से अन्यथा जोड़ने से चन्द्रगोल सन्धि होती है। इस से 'परेषु जीवा व्ययनांशपातकोटिज्यकाघ्नी' इत्यादि संशोधकोक्त उपपन्न होता है। सूर्य-सिद्धान्त में "अथौजपदगस्येन्दोः क्रान्तिर्विक्षेपसस्कृता। यदि स्यादधिका भानोः क्रान्तेः पातो गतस्तदा॥ ऊना चेत्स्यात् तदा भावी वाम युग्मपदस्य च। पदान्यत्व विधोःक्रान्तिर्विक्षेपाच्चेद्विशुध्यति॥" इति सूर्य सिद्धान्तकारोक्त, शिष्यधीवृद्धिदतन्त्रे "अयुग्मजश्चान्द्रमसोऽपमश्चेदपक्रमाद् भानुमतोऽधिकः स्यात्। समोद्भवो वापि लघुस्तदेतो निपानकालो भविताऽन्यथाऽतः" यह लल्लोक्त, सिद्धान्त शिरोमणि मे 'ओज पदेन्दुक्रान्तिर्महती' इत्यादि भास्करोक्त ये सब एक रूप ही है। भास्कराचार्य आदि प्राचीनाचार्य चन्द्रगोल सन्धि साधन कर उसमें तीन राशि (नवत्यश) जोड़कर चन्द्रायन सन्धि कहते हैं। नाडीवृत्त और विमराडल के सम्पातोपरिगत कदम्बप्रोतवृत्त क्रान्तिवृत्त का सपात बिन्दु चन्द्र गोल सन्धि है। नाड़ीवृत्त और विमण्डल के संपात को केन्द्र मानकर नवत्यश से जो वृत्त होता है वह क्रान्तिवृत्त में जहां लगता है वह बिन्दु प्राचीनायन सन्धि है क्योंकि चन्द्रगोल सन्धि मे नवत्यंश जोड़ने से वही बिन्दु होता है, चन्द्रगोल सन्धि से वह बिन्दु नवत्यशान्तर पर है। परन्तु वह नवत्यशोत्पन्न वृत्त क्रान्ति वृत्त के ऊपर लम्ब नहीं है इसीलिये वह वास्तव चन्द्रायनसन्धि बिन्दु नहीं हो सकता है। नवत्यंशोत्पन्नवृत्त नाड़ीवृत्त में जहां लगता है तदुपरि गत कदम्व प्रोतवृत्त क्रान्तिवृत्त का सम्पात बिन्दु वास्तव चन्द्रायन सन्धि बिन्दु है, अतः प्राचीनोक्त चन्द्रायन सन्धि सर्वथा युक्ति शून्य है इति॥ ३८॥

अथ यस्मिन् काले रविचन्द्रयोगश्चक्रार्धं वा चक्रं तस्मात् कालाद्गत-गम्यस्य क्रान्तिसाम्यकालस्य परिज्ञानमाह।

क्रान्त्योर्युतिरन्यदिशोरेकदिशोरन्तरं व्यतीपाते।
एकदिशोर्युतिरन्तरमन्यदिशोर्वैधृते प्रथमः॥ ३९॥
एवं द्वितीय राशिर्युतहीनैरिष्ट नाड़िका स्वफलैः।
एष्यादतीतं वा यदि राशिद्वयमपि तदन्तरकम्॥ ४०॥
छेदोऽन्यथा तदैक्यं घातस्येष्टघटिका प्रथमराश्योः।
फलघटिकाभिर्मध्यं द्वयोरपि प्रथमराशिवशात्॥ ४१॥

सु. भा.—द्वयोर्व्यतिपातवैधृतयोः' शेषं स्पष्टम्। 'तत्क्रान्त्यारेकदिशोरन्तरमैक्यं विभिन्नदिशोः–' इत्यादि भास्करोक्त मेतदनुरूपमेव।

अत्रोपपत्तिः। पाताधिकारे भास्करोक्तैव ज्ञेया॥ ३९-४१॥

वि. भा.—रविचन्द्रयोरन्यदिशोर्भिन्नदिक्कयोः क्रान्त्योर्युतिः, एकदिशोरन्तरं व्यतीपातयोगे प्रथमः (प्रथमराशिः) क्रान्त्योरेकदिशोर्युतिः, अन्यदिशो (भिन्न-

दिक्कयो:) रन्तरं वैधृते पाते प्रथमराशिर्भवति। एवमिष्टनाड़िकाप्तफलैर्युत-हीनैर्द्वितीयराशि: साध्य: । एतदुक्तं भवति काश्चिदिष्टनाड़िका: परिकल्प्य ताभिश्चन्द्ररविराहुगती: संगुण्य षष्ट्या विभजेत् लब्धं कलादिकं रविचन्द्र-राहुषु गतगम्ययो: पातकालयो: धनर्णं कृत्वा ततस्तत्कालेऽपि रवि चन्द्रयो: क्रान्ती आनीय पूर्ववत् 'क्रान्त्यो र्युतिरन्यदिशोरित्यादिना' द्वितीयोऽपि राशि: साध्य इति। यदि राशिद्वयं (प्रथम द्वितीय राशिद्वयं) एष्यं (भावि) अतीतं (गतं) वा स्यात् तदा तत्तयोरन्तरकम्, अन्यथा यदा च तयो: प्रथमद्वितीययोरेको गतोऽन्यश्चैष्य-स्तदा तदैक्यं (तयोर्योग:) छेद: (हर:) स्यात्। कस्य हर इति कथयति। इष्ट-घटिका प्रथमराश्यो: (इष्टघटिकाया: प्रथमाख्यराशेश्च) घातस्य। पूर्वं प्रकल्पि-तेष्टनाड़िकागुणितस्य प्रथमराशेरित्यर्थ:। फलघटिकाभि: (पूर्वप्रकल्पितेष्ट घटि-काभि) र्गुणित: प्रथमराशि: छेदेन भक्तैर्लब्धाभि: फलघटीभि: पातमध्यं भवति। प्रथमराशिवशात् (पूर्वराशिवशत:) विगतोऽथ भविष्यत् पातमध्य ज्ञेयम्॥ सिद्धान्त शेखरे "क्रान्त्योर्योगो विसदृशदिशोरन्तरं चैकदिक्त्वे पूर्वो राशिर्भवति नियतं म व्यतीपातयोगे। आशैकत्वे युतिरपमयोर्वैधृते भिन्नदिक्त्वे भेदो य: स्यात् सच कथितवत् यातयेयोऽवधार्य:॥ अभिमतघटिकाप्त्या चानुपाताद्युतोनैरिनहिमकर-पातै: प्राग्वदन्योऽपि साध्य:। द्वितयमिदमतीतं भावि वा स्यात् तदा तद्विवरमपरथा चेत् संयुतिश्छेदक: स्यात्॥ प्रथममथ घटीनामाहते: पातमध्यं भवति फलघटीभि: पूर्वराशेर्वशेन, विगतमथ भविष्यत् तद्वदेवेष्टनाड़ी फलरहित युतैस्तैश्चासकृत्कर्म-णैव॥"इति सर्वं श्रीपत्युक्तमाचार्योक्तानुरूपमेवास्ति, सिद्धान्त शिरोमणौ "तत्क्रा-न्त्योरेकदिशोरन्तरमैक्यं विभिन्न दिशो:। कार्यं व्यतिपाताख्ये तदन्यथा वैधृते प्रथम एवम्॥ गतगम्येष्टघटीभी रवीन्दुपातान् प्रचाल्य साध्योऽन्य:। आद्यान्यकालयोरपि यदि गम्यं लक्षणं गतं यदि वा॥ आद्यान्ययोस्तदाऽन्तर मतोऽन्यथैक्यं च तेन हृता:। आद्यगुणा नाड्योऽसकृदिष्टा: स्पष्टा: स्युरेवमेतासु॥ चक्रार्धचक्र कालाद् गत गम्यं पातमध्यमाद्यवशात्॥" इति भास्करोक्तं सर्वमेव श्रीपत्यनुरूपमिति, प्रकारोऽयं शिष्य धीवृद्धिद तन्त्रेऽप्येवमेवास्ति, पाताधिकारे भास्कराचार्येण लल्लब्रह्मगुप्त-श्रीपत्यादीनां व्यतीपातवैधृतयोर्भावाभावे गतगम्यत्वे च महान् व्यभिचारो भवतीति बहुधा प्रतिपादितं तत्सर्वं तत्रैव द्रष्टव्यमिति॥ ३९-४१॥

अब जिस काल में रवि और चन्द्र का योग छः राशि होता है उस काल से गत और गम्य क्रान्ति साम्य काल ज्ञान के लिये कहते हैं।

हि० भा०—रविक्रान्ति और चन्द्र क्रान्ति भिन्न दिशा की रहें तो दोनों का योग, एक दिशा में दोनों के योग का अन्तर व्यतीपात योग में प्रथम राशि संज्ञक होता है। एक दिशा में दोनों क्रान्ति का योग, भिन्न दिशा में अन्तर वैधृत पात में प्रथम राशि है। इस तरह इष्ट घटी से प्राप्त फल से युत और हीन से द्वितीय राशि साधन करना अर्थात् कोई इष्ट

घटी कल्पना कर उस से चन्द्र-रवि-पात की गतियों को गुणा कर साठ से भाग देकर जो कलादि लब्ध हो गत-गम्य पात काल में उस कलादि फल-को रवि-चन्द्र और पात में धन ऋण कर कर के तब उस काल में भी रवि और चन्द्र की क्रान्ति लाकर पूर्ववत् द्वितीय राशि साधन करना। यदि राशि (प्रथम राशि और द्वितीय राशि) एष्य (भावि) वा गत हो तब दोनों के अन्तर अन्यथा अर्थात् उन दोनों राशियों में एक गत हो और अन्य एष्य हो तो दोनों का योग छेद (हर) होता है। किस का हर होता है सो कहते हैं। इष्ट घटिका और प्रथम राशि के घात का हर होता है अर्थात् पूर्वकल्पित इष्टघटी गुणित प्रथमराशि का हर होता है। पूर्वकल्पित इष्टघटीगुणित प्रथमराशि को छेद (हर) से भाग देने से लब्ध फल घटीं कर के पात मध्य होता है। प्रथम राशिवश से गत और भविष्य पात मध्य समझना चाहिये॥ सिद्धान्त शेखर में 'क्रान्त्योर्योगो विसदृश दिशोरन्तरं' इत्यादि श्रीपत्युक्त सब कुछ आचार्योक्त के अनुरूप ही है। सिद्धान्त शिरोमणि में 'तत्क्रान्त्योरेकदिशोरन्तर मैक्यं' इत्यादि भास्करोक्त सब कुछ श्रीपत्युक्त के अनुरूप ही है। पाताधिकार में लल्ल-ब्रह्मगुप्त-श्रीपति आदि आचार्यों के व्यतीपात और वैधृत के भावाभाव में गत गम्यत्व में भी बहुत व्यभिचार होता है ये बातें बहुधा कही हैं, ये सब वहीं देखना चाहिये इति॥ ३९-४१॥

इदानीं पाताद्यन्तकालमाह।

तात्कालिकैर्ग्रहैरसकृदिष्टघटिकाफलोनयुक्तैस्तैः।
प्राग्वत्प्रथमश्छेदः प्रमाणयोगार्धलिप्तानाम्॥ ४२॥
इष्ट घटिका गुणानामसकृत् फलनाड़िकाभिराद्यन्तौ।
व्यतिपातवैधृतानयनमन्यतन्त्रेषु न ब्राह्मात्॥ ४३॥

सु. भा.—प्रथमः साध्यः प्राग्वच्छेदश्चेष्टघटिकागुणानां प्रमाणयोगार्धलिप्तानां मानैक्यार्धकलानाम्। शेषं स्पष्टार्थम्॥

अत्रोपपत्तिः। यदा स्पष्टक्रान्त्यंतरं मानैक्यार्धसमं तदा पातादिः पातान्तश्च बिम्बैकदेशजक्रान्त्योः साम्यात्। अतोऽनुपातो यदि छेदसमक्रान्त्यन्तरेणेष्टघटिकास्तदा मानैक्यार्धेन किं लब्धा असकृद्विधिना नाड्यः स्फुटा भवन्तीति॥ ४२-४३॥

वि. भा.—पूर्वकथितरीतिवदेवेष्टघटिकाफलोनयुक्तैस्तैः रविचन्द्रराहुभिरसकृत्कर्मणा पातमध्यं भवतीति। पूर्ववत्प्रथमः साध्यश्छेदश्चेष्ट घटिका गुणानां प्रमाणयोगार्धलिप्तानां (मानैक्यार्धकलानाम्) प्रथमेन विभाजितानां फलनाड़िकाभिराद्यन्तौ भवतोऽर्थात् पातमध्यकालात्पूर्वमादिः। पातमध्यकालादग्रतः पातान्तः ब्राह्मात् (ब्राह्मस्फुटसिद्धान्तात्) अन्यतन्त्रेषु व्यतिपातवैधृतानयनं नास्तीति। सिद्धान्तशेखरे "स्थितिरभिमतनाड़ीताड़िते मानयोगे प्रथमविभजिते स्यात्

तन्निवृत्तिः प्रवृत्तिः। स्थितिदलयुतहीने मध्यकालेऽथ तस्मिन् फलमुदित मनन्तं दान होमादिषु ज्ञैः ॥" श्रीपत्युक्तप्रकारोऽस्ति। सिद्धान्तशिरोमणौ "मानैक्यार्धं गुणितं स्पष्टघटीभिर्विभक्तमाद्येन। लब्धघटीभिर्मध्यादादिः प्रागग्रतश्च पातान्तः" भास्करोक्तमेवास्ति। सूर्यसिद्धान्ते "रवीन्दुमानयोगार्ध षष्टया संगुण्य भाजयेत्। तयोर्भुक्त्यन्तरेणाप्तं स्थित्यर्ध नाडिकादि तत् ॥ पात कालः स्फुटोमध्यः सोऽपि स्थित्यर्धवर्जितः। तस्य सम्भवकालः स्यात् तत्संयुक्तोऽन्त्यसंज्ञितः ॥" इत्थमानयनं कृतम्। अस्योपपत्तिः। रविचन्द्र केन्द्राभिप्रायेण क्रान्तिसाम्यकालः पातमध्यकालः यावद्बिम्बैक देशयोः क्रान्तिसाम्यं तावत्तस्य स्थितिरिति मनसि धृत्वा प्राचीनैस्तदारम्भनिवृत्तिकालौ च केन्द्राभिप्रायक्रान्त्योरन्तरं मानैक्यार्धसमं प्रकल्प्य साधितौ। मध्यात् प्रागपरयोस्तत्कालज्ञानार्थमनुपातो यदि षष्टिघटिकात्मकरविचन्द्रक्रान्त्यन्तरेण षष्टिघटिकास्तदा मानैक्यार्धेन किमिति लब्धं मध्यात् प्रागपरयोः स्थित्यर्धनाड्यः। मध्यकाले तदन्तरेण प्रारम्भकाले योजनेन च निवृत्तिकालः स्फुटः। तथा च भास्करः। "तावत्समत्वमेव क्रान्त्योर्विवरं भवेत्तावत्। मानैक्यार्धादूनं साम्याद्बिम्बैक देशज क्रान्त्योः।"

आचार्योक्तस्योपपत्तिः।

यदा स्पष्टक्रान्त्यन्तरं मानैक्यार्धसमं तदा पातादिः पातान्तश्च बिम्बैकदेशज क्रान्त्योः साम्यात् ततोऽनुपातो यदि छेदसमक्रान्त्यन्तरेणेष्ट घटिकास्तदा मानैक्यार्धेन किं लब्धा असकृद्विधिना स्फुटा नाड्य इति ॥४२-४६॥

अब पाताद्यन्त काल को कहते हैं।

हि. भा.—पूर्व कथित रीति के अनुसार इष्ट घटी फल से ऊन-युक्त रवि-चन्द्र और राहु से असकृत् प्रकार से पातमध्यकाल होता है। पूर्ववत् प्रथम साधन करना, तथा छेद साधन करना, इष्ट घटी से गुणित मानैक्यार्ध कला को प्रथम से भाग देने से जो फल घटी हो उस से आदि और अन्त होता है अर्थात् पात मध्यकाल से पूर्व आदि और पात मध्यकाल से आगे अन्त होता है। ब्राह्म सिद्धान्त (ब्राह्म स्फुट सिद्धान्त) से अन्य तन्त्रों में व्यतिपात और वैधृत का आनयन नहीं है। सिद्धान्त शेखर में "स्थितिरभिमत नाड़ी ताड़िते मानयोगे प्रथमविभजिते' इत्यादि विज्ञान भाष्य में लिखित श्लोक श्रीपत्युक्त प्रकार है। सिद्धान्त शिरोमणि में 'मानैक्यार्धं गुणितं स्पष्ट घटीभिर्विभक्तमाद्येन' इत्यादि वि. भा. में लिखित श्लोक भास्करोक्त है। भास्कराचार्य इस प्रसंग में 'तावत्समत्वमेव क्रान्त्योर्विवरं भवेत्तावत्' इत्यादि भी कहते हैं।

उपपत्ति।

जब स्पष्ट क्रान्त्यन्तर मानैक्यार्ध के समान होता है तब पातादि बिम्ब के एक प्रदे-

शीय क्रान्ति के साम्य (तुल्यता) से पातान्त होता है। तब अनुपात करते हैं यदि छेद तुल्य क्रान्त्यन्तर में इष्ट घटी पाते हैं तो मानैक्यार्धं में क्या लब्ध असकृत् विधि से स्फुट घटी होती है इति॥ ४२-४३॥

इदानीं कियत्कालपर्यन्तं पातफलमित्याह।

रवि बिम्बमेकमार्गाच्छशि बिम्बापक्रमे भवति यावत्।
तावत्फलं तदुक्तं तदभावे तत्फलाभावः॥ ४४॥

सु. भा.—एकमार्गादेकाहोरात्राद्यावच्छश्यपक्रमे रविबिंबं भवति। अर्थाद्यावत् क्रान्त्योर्विवरं मानैक्यार्धादल्पं भवति तावत्बिंबैकदेशजक्रान्त्योः साम्यात् तत् फलमुक्तं महर्षिभिरतस्तदभावे तत्फलाभावो वेदितव्य इति। अतो यावत् क्रान्तिसाम्यं तावदेव तस्य फलं वाच्यं तेन यस्मिन् दिने पातस्तत् समयं दिनं न दुष्टमिति फलितम्॥ ४४॥

वि. भा. — रविबिम्बं चन्द्रबिम्बस्य स्पष्टक्रान्तौ यावत्कालपर्यन्तमेकमार्गाद्भवत्यर्थाद्रविबिम्बं चन्द्रस्पष्टक्रान्त्या सह यावत्कालपर्यन्तं एकमार्गे (एकस्मिन्नहोरात्रवृत्ते) ऽर्थाद्यावत्क्रान्त्यन्तरं मानैक्यार्धादल्पं भवति तथा सति बिम्बैकदेशज क्रान्त्योः साम्यं भवतीत्यर्थः तावत्कालपर्यन्तं तत्फलं (पातसंजातफलं) कथितं फलादेशकृद्भिर्मुनिभिः। तदभावेऽर्थाद्रविबिम्बस्य चन्द्रस्पष्ट क्रान्त्या सहैकमार्गावस्थानाभावे तत्फलस्याप्यभावो भवति॥ सिद्धान्तशेखरे "भानोर्बिम्बं तुहिनकिरणापक्रमेणैकमार्गे यावत्तावन्मुनिभिरुदितः सम्भवस्तत्फलस्य। तस्याभावे भवति नियतं तत्फलस्याप्यभावो यत्रोद्वाहादिषु पुनरिह द्युत्रयं नैवदुष्टम्॥" श्री पत्युक्तमिदमाचार्योक्तानुरूपमेव, केषुचित्फलग्रन्थेषु व्यतीपातवैधृतयोः सतोस्तद्दिनं तत्पूर्वदिनं परदिनं चेति दिनत्रयं माङ्गलिककार्ये निषिद्धमिति कैश्चिदुक्तं तत्परिहारार्थं श्रीपतिना कथ्यते द्युत्रयं नैवदुष्टमर्थात् पातस्थितिकाले यात्रोद्वाहादिषु मङ्गल कार्येषु द्युत्रयं (दिनत्रयं) दुष्टं नैवेति। सूर्य सिद्धान्ते "आद्यन्तकालयोर्मध्यः कालो ज्ञेयोऽतिदारुणः। प्रज्वलज्ज्वलनाकारः सर्वकर्मसु गर्हितः॥ एकायनगतं यावदर्केन्द्वोर्मण्डलान्तरम्। सम्भवस्तावदेवास्य सर्वकर्म विनाशकृत्॥ स्नानदानजपश्राद्धव्रतहोमादिकर्मभिः। प्राप्यते सुमहच्छ्रेयस्तत्कालज्ञानतस्तथा॥" एवं कथितं सूर्यसिद्धान्तकारेण, एतद्व्याख्या-पातस्याद्यन्त कालयोर्मध्यः कालो यः सोऽतिदारुणः प्रज्वलद्दहनाकारः सर्वं कर्मसु निन्दितो ज्ञेयः। यावद्रविचन्द्रयोर्मण्डलान्तरमेकायनगतमेकस्थानगतमर्थात्समानक्रान्त्युत्पादकं मण्डलस्पर्शरूपं केन्द्राभिप्रायेण क्रान्त्यन्तरं मानैक्यार्धसमं तावदेवास्य सम्भवो बिम्बैकदेशज क्रान्त्यो साम्यात्। अयं कालः सर्वकर्म विनाशकारको ज्ञेयः। अत्र पातकाले स्नान-

दानजपश्राद्धव्रतहोमादिकर्मभिर्महत्कल्याणं प्राप्यते । तस्य पातस्य काल ज्ञानतस्तथैवमहत्कल्याणं प्राप्यते गणकैरिति ॥ ४४ ॥

अब कितने काल तक पात होता है सो कहते हैं ।

हि. भा.—जब तक रविबिम्ब स्पष्टक्रान्ति के साथ एक मार्ग (एक अहोरात्रवृत्त में) होता है अर्थात् जब तक क्रान्त्यन्तर मानैक्यार्ध से अल्प होता है उस स्थिति मे बिम्ब के एक प्रदेश जनित क्रान्ति का साम्य (तुल्यता) होता है । तावत्काल पर्यन्त उसका फल (पात जनित फल) फलादेश कारक मुनियों से कथित है । उसके अभाव में अर्थात् चन्द्रबिम्ब स्पष्ट-क्रान्ति के स थ रविबिम्ब के एकमार्गावस्थानाभाव में उसके फल का भी अभाव होता है। सिद्धान्त शेखर में "भानोर्बिम्बं तुहिनकिरणापक्रमेणैकमार्गे" इत्यादि विज्ञान भाष्य में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है । किसी-किसी फल ग्रन्थ में व्यतीपात और वैधृत योग में तीन दिनों (व्यतीपात वैधृत सम्भव दिन, उससे पूर्व दिन और परदिन) को शुभ कार्यों में निषिद्ध कहा गया है उसके परिहार के लिये श्रीपति कहते हैं कि पातस्थिति काल में यात्रा-विवाह आदि मङ्गल कार्यो में तीन दिन दुष्ट नहीं है अर्थात् क्रान्ति साम्य ही तक उसका फल होता है । सूर्य सिद्धान्त में 'आद्यन्तकालयोर्मध्य: कालो ज्ञेयोऽति दारुण:' इत्यादि विज्ञान भाष्य में लिखित श्लोकों से इस तरह कहा गया है कि पात का आदि और अन्त का मध्य काल अति भयङ्कर और प्रज्वलित अग्नि के आकार का होता है सब शुभ कर्मों में निन्दित होता है । जब तक रवि और चन्द्र का मण्डलान्तर एक स्थानगत होता है अर्थात् समान क्रान्तिजनक मण्डल स्पर्शरूप (केन्द्राभिप्रायिक क्रान्त्यन्तर मानैक्यार्ध के बराबर) होता है तब ही तक इसका सम्भव होता है क्योंकि बिम्बैक देशज क्रान्ति बराबर है । यह काल सब कर्मो का विनाश कारक होता है । इस पात काल में स्नान-दान-जप-श्राद्ध-व्रत-होम आदि कर्मो से बहुत कल्याण प्राप्त होता है । उस पातकाल ज्ञान से गणकों को भी उसी तरह बहुत कल्याण प्राप्ति होती है क्योंकि लोगों के उस काल के आदेश गणक ही करते हैं इति ॥ ४४ ॥

इदानीं कक्षायां विशेषमाह ।

ग्रह कक्षयैव तुल्या कक्ष्या तन्मंदपातानाम् ।
यस्मात् तस्मान्न पृथक् कक्षा कल्प्या चलोच्चाद्या ॥ ४५ ॥

सु. भा.—स्पष्टार्थम् । 'ग्रहस्य कक्षैव हि तुङ्गपातयो:' इत्यादि भास्करोक्त मेतदनुरूपमेव ॥ ४५ ॥

वि. भा.—यस्मात्कारणात् ग्रह कक्षया तुल्यैव ग्रहमन्दोच्चानां पातानां च कक्ष्याऽस्ति, तस्मात्कारणात् शीघ्रोच्चाद्या कक्षा पृथक् न कल्प्येति ॥ 'ग्रहस्य कक्षैव हि तुङ्गपातयोरित्यादि' भास्करोक्तमेतदनुरूपमेवास्तीति ॥ ४४ ॥

अब कक्षा में विशेष कहते हैं।

हि. भा.—जिस हेतु से ग्रह कक्षा के बराबर ही उनके मन्दोच्च और पातों की कक्षा है इसलिये शीघ्रोच्चादि कक्षा पृथक् कल्पना नहीं की गई है इति ॥ ४५ ॥

इदानीं वक्ष्यमाणाध्यर्धार्धैक भोग नक्षत्रणामानयने कारणमाह।

पौलिशरोमकवासिष्ठसौरपैतामहेषु यत् प्रोक्तम्।
तन्नक्षत्रानयनं नार्यभटोक्तं तदुक्तिरतः ॥ ४६ ॥

सु. भा.—पौलिशरोमकवासिष्ठसौरपैतामहेषु पंचसिद्धान्तेषु यन्नक्षत्रानयनं सूक्ष्मं प्रोक्तं तदार्यभटोक्तं नास्ति। अतस्तदुक्तिरुचिताऽस्ति। तन्नक्षत्रानयनमारम्भार्हमित्यर्थः।

अत्र चतुर्वेदाचार्यः। 'पंचसिद्धान्तानुसारेण मयैतद्वक्ष्यमाणं तन्नक्षत्रानयनमुपनिबद्ध्यते स्वमनीषिकयेत्यर्थः।' ॥ ४६ ॥

वि. भा.—पौलिश-रोमक-वासिष्ठ-सौर-पैतामहेषु सिद्धान्तेषु यन्नक्षत्रानयनं कथितं तदार्य भटोक्तं नास्ति अतस्तेषामुक्तिः समीचीनास्ति तस्मात्सूक्ष्मनक्षत्रानयनमारम्भकरणायोग्यमिति ॥ वासिष्ठः (वसिष्ठ सिद्धान्तः) सौरः (सूर्यसिद्धान्तः) पैतामहः (ब्राह्म सिद्धान्तः)

अब अध्यर्धार्धैक भोग नक्षत्रों के आनयन में कारण कहते हैं।

हि. भा.—पौलिशसिद्धान्त-रोमकसिद्धान्त-वसिष्ठसिद्धान्त-सूर्यसिद्धान्त-ब्राह्मसिद्धान्त-इन सिद्धान्तों में जो नक्षत्रानयन कहे गये हैं वे आर्यभट कथित नक्षत्रानयन नहीं है, इसलिये उन सबों की उक्ति (कथन) उचित है अतः सूक्ष्मनक्षत्रानयन करना चाहिये इति ॥ ४६ ॥

इदानीमध्यर्धादीनां नक्षत्राणां संख्यामाह।

अध्यर्धानि भवन्ति षड्नक्षत्राण्युडूवड्र्धानि।
पञ्चदश समक्षेत्राण्यभिजिद् भोगो भवत्येकः ॥ ४७ ॥

सु. भा.—षट् नक्षत्राण्यध्यर्धभोगानि सार्धैकभोगानि। षडुडूनि नक्षत्राण्यर्धान्यर्धभोगानि। पंचदश नक्षत्राणि समक्षेत्राण्येकभोगानि। एवं सप्तविंशति नक्षत्रेभ्योऽपरश्चैकोऽभिजिद्भोगो भवति वर्त्तत इति ॥ ४७ ॥

वि. भा.—षड्नक्षत्राण्यध्यर्धान्यर्धाच्चन्द्रगत्यर्धयुक्तचन्द्रगतितुल्यभोगात्मकानि

भवन्ति, षड्नक्षत्राणि अर्धान्यर्थाच्चन्द्रगत्यर्धतुल्यभोगानि, पञ्चदश नक्षत्राणि समक्षेत्राण्यर्थाच्चन्द्रगतितुल्यभोगानि भवन्ति। एकोऽभिजिद् भोगो भवतीति ।।४७।।

अब अध्यर्धादि नक्षत्रों की संख्या को कहते हैं।

हि. भा.—छः नक्षत्र अध्यर्धभोग है अर्थात् चन्द्रगति कला में चन्द्रगति कला का आधा जो होता है तत्तुल्यभोग वाले होते है। छः नक्षत्र चन्द्रगति कला के आधे के बराबर भोग वाले होते है। और पन्द्रह नक्षत्र चन्द्रगति कला के तुल्य भोग वाले होते है। एक अभिजित् नक्षत्र का भोग होता है ।। ४४ ।।

इदानीमध्यर्धानि भोगानि नक्षत्राण्याह ।

केशादित्य विशाखा प्रोष्ठपदार्यम्णवैश्वदेवानि ।
षड् षड् ज्येष्ठा भरणी स्वात्यार्द्रावारुणाश्लेषाः ।। ४८ ।।
पञ्चदशात्रानुक्तान्येको ऽभिजिदुक्त ऋक्षभोगोऽन्यः ।
यस्मात्तन्नक्षत्रं दुरधिगमं मन्दबुद्धीनाम् ।। ४९ ।।

सु. भा.—यस्माद् भिन्नभोगानि नक्षत्राणि सन्ति तस्मात् तन्नक्षत्रं तन्नक्षत्रमानं मन्दबुद्धीनां गणकानामार्यभटादितन्त्रेष्वनुक्तत्वाद् दुरधिगमं दुर्गममिति । शेषं स्पष्टम् । 'स्थूलं कृतं भानयनं यदेतज्ज्योतिर्विदां संव्यवहारहेतोः' इत्यादि भास्करोक्त मेतदनुरूपमेव ।। ४८-४९ ।।

वि. भा.—रोहिणी-पुनर्वसू, विशाखा-उत्तरात्रयमितिषट्-अर्धाधिक (चन्द्रगतिकला$+\frac{\text{चन्द्रगतिक}}{२}$=(७९०।३५)+(३९५।१७) = ११८५।५२ भोगनक्षत्राणि स्युः । ज्येष्ठा भरणी-स्वाती-आर्द्रा शतभिक्-अश्लेषा इति षट् अर्ध-$\left(\frac{\text{चन्द्रगतिक}}{२}=\text{३९५।१७}\right)$ भोगनक्षत्राणि, एभ्यो भिन्नान्यनुक्तानि पंचदश नक्षत्राणि चन्द्रगतिकला (७९०।३५) प्रमाणभोगानि कथितानि । एभ्योऽन्यो ऽभिजिन्नक्षत्रभोगः कथितः । यस्मात् कारणात् भिन्नयोगानि नक्षत्राणि सन्ति । तस्मात् तन्नक्षत्रमानं मन्दबुद्धीनां ज्योतिर्विदां दुर्गममार्यभटादितन्त्रेष्वनुक्तत्वादिति ।। सिद्धान्त शेखरे "यदुक्तमृक्षानयनं महर्षिभिर्विवाह यात्रादि फल प्रसिद्धये । निराकुलत्वाय तदब्दवेदिनां परिस्फुटं सम्यगथाभिधीयते ।। द्विदैवतादित्यविरिंचभानि त्रीण्युत्तराणीति भषट्कमेतत् । अध्यर्धभोगं वरुणाहि रुद्रयमानिलेन्द्राह्वयमर्धभोगम् ।। शेषाणि पंचदश यानि शशाङ्कभुक्ति भोगानि तानि कथितानि हि

दिव्यदृग्भिः । सर्वर्क्षभोग रहिता भगणस्य लिप्ता भोगो भवेदभिजितश्च कलामयो ऽसौ ॥" इति सूक्ष्मनक्षत्रानयनं श्रीपतिना तत्पश्चात् भास्कराचार्येण च सिद्धान्तशिरोमणौ "स्थूलं कृतं भानयनं यदेतज्ज्योतिर्विदां संव्यवहारहेतोः । सूक्ष्मं प्रवक्ष्ये ऽथमुनि प्रणीतं विवाह यात्रादि फल प्रसिद्ध्यै ॥" इत्यादिनाऽऽचार्योक्तानुरूपमेव कथितमिति ॥ ४८-४९ ॥

अब अध्यर्धभोगादि नक्षत्रों को कहते है ।

हि. भा.—रोहिणी-पुनर्वसू-विशाखा-तीनों उत्तरा (उत्तरफल्गुनी-उत्तराषाढ-उत्तरभाद्रपद) ये छः नक्षत्र अध्यर्ध (चन्द्रगत्यर्धयुत चन्द्रगतिकला=(७९०।३५+(३९५।१७)= भोगनक्षत्र हैं । ज्येष्ठा-भरणी-स्वाती-आर्द्रा-शतभिक्-अश्लेषा ये छः नक्षत्र अर्ध (चन्द्रगति ११९५।५२ कलार्ध=३९५।१७) भोगनक्षत्र हैं । शेष पन्द्रह नक्षत्र चन्द्रगति कलासम ७९०।३५ भोग नक्षत्र हैं । इन सबों से अन्य एक अभिजित् नक्षत्र भोग कथित है । जिस कारण से भिन्न-भिन्न भोग नक्षत्र हैं इसलिये उन नक्षत्रों के मान मन्द बुद्धि वाले गणको के लिये दुर्गम है क्योंकि आर्यभटादि तन्त्रों में ये विषय नही कहे गये है ॥ सिद्धान्त शेखर में 'यदुक्त मृक्षानयनं महर्षिभिर्विवाह यात्रादि फल प्रसिद्धये' इत्यादि से श्रीपति ने पश्चात् भास्कराचार्य ने सिद्धान्त शिरोमणि में 'स्थूलं कृतं भानयन यदेतज्ज्योतिर्विदां संव्यवहार हेतो.' इत्यादि से सूक्ष्मनक्षत्रानयन आचार्योक्त के अनुरूप ही कहा है इति ॥ ४८-४९ ॥

इदानीमभिजिन्नक्षत्रभोगानयनं ग्रहभुक्तनक्षत्रानयनञ्चाह ।

अध्यर्धार्धसमक्षेत्राणां मध्यगति लिप्तिकाः शशिनः ।
अध्यर्धार्धैकगुणा भभोगलिप्तास्तदैक्योनाः ॥ ५० ॥
मण्डललिप्ताः शेषोऽभिजितो भोगः शशाङ्कभगणा वा ।
त्रिघनगुणाः संशोध्याः कल्पदिनेभ्यो यदवशेषम् ॥ ५१ ॥
तद्भगणैर्दिनभोगो ऽभिजितो भोगो भभोगलिप्तोनाः ।
भानिग्रहभुक्तकला गतगम्या गतिहृता दिवसाः ॥ ५२ ॥

सु. भा.—शशिनश्चन्द्रस्य मध्यगति कला अध्यर्धार्धैकगुणास्तदा क्रमेणाध्यर्धार्ध समक्षेत्राणां भभोगलिप्ता भवन्ति । सार्धैकगतिकला अध्यर्धभोगकलाः । अर्धगतिकला अर्धभोगकलाः । गतिकलाश्चैकभोगकलाः । सर्वभोगकलायोगोनामण्डल लिप्ताश्चक्रकलाः शेषोऽभिजितो भोगः स्यात् । अथ प्रकारान्तरेणाभिजिद्भोगमाह शशाङ्कभगणा वेति । कल्पचन्द्रभगणाः सप्तविंशत्या गुणाः कल्पदिनेभ्यः कल्पकुदिनेभ्यः संशोध्याः । शेषमभिजितः कल्पभगणाः कल्प्याः । तद्भगणैर्यो दिनभोगः कलात्मिका दिनगतिः स्यात् सोऽभिजितो भोगो भवेत् । ग्रहभुक्त-

कलाभ्यो यावतां भानां भोगकलाः शुद्धास्तावन्ति गतभानि। शेषाः कलाश्च वर्त्तमाननक्षत्रस्य गतकलास्तास्तद्भोगकलाभ्यः शुद्धा गम्यकला भवन्ति। ततो ग्रहगत्यैको दिवसस्तदा गतगम्यकलाभिः किमित्यनुपातेन गतगम्या दिवसा भवन्ति।

अत्रोपपत्तिः। षडध्यर्धभोगकला नामैक्यम् $= \frac{३ \text{ चग}}{२} \times ६ = ९$ चग

षडर्धभोगकलानामैक्यम् $= \frac{\text{चग}}{२} \times ६ = ३$ चग

पंचदशैकभोगकलाना मैक्यम् = १५ चग = १५ चग

सर्वयोगकलाः = २७ चग

चक्रकलाभ्यः शुद्धा सर्वयोगकला जाता अभिजिद्भोगकलास्तद्दिनगतिः = चक − २७ चग। इय कल्पकुदिनगुणाश्चक्रकलाभक्ता जाता. कल्पेऽभिजितो भगणाः = ककु − २७ कचभ। शेषोपपत्ति र्भास्करसूक्ष्मनक्षत्रायन विधिनास्फुटा ॥ ५०-५२ ॥

वि. भा.—शशिनः (चन्द्रस्य) मध्यगतिकला अध्यर्धार्धैक ($\frac{३}{२}$, $\frac{१}{२}$, १) गुणास्तदाऽध्यर्धार्धसमनक्षत्राणां भभोगकलाः स्युः। तदैक्योनाः (तेषां कथितानां सर्वेषां नक्षत्राणां ये भोगास्तै रहिता मण्डललिप्ताः (भगणकलाः २१६००) कार्याः शेषोऽभिजितो भोगो भवेत्। वा शशाङ्कभगणाः (कल्प चन्द्रभगणाः) त्रिघनगुणाः (सप्त विंशत्या गुणाः) कल्पदिनेभ्यः (कल्पकुदिनेभ्यः) संशोध्याः शेषमभिजितः कल्पभगणाः स्युः। तद्भगणैर्यो दिनभोगः (यदि कल्पकुदिनैरभिजितः कल्पभगणा लभ्यन्ते तदैकेन दिनेन किमित्यनुपातेन समागता कलात्मिका दिनगतिः) सोऽभिजितो भोगो भवेत्। ग्रहभुक्तकला भभोगलिप्तोनाः (ग्रहकलासमूहान्नक्षत्रभोगकला विशोध्याः) तदा भानि भवन्ति। ग्रहभुक्तकलाभ्यो यावतां नक्षत्राणां भोगकलाः शुद्धा भवन्ति तावन्ति गत नक्षत्राणि, शेषाः कला वर्त्तमाननक्षत्रस्य गतकलास्तास्तद्भोगकलाभ्यः शुद्धास्तदा गम्यकला भवन्ति। तदा ग्रहगतिकलाभिरेकं दिनं लभ्यते तदा गतगम्यकलाभिः किमित्यनुपातेन गत गम्यदिनानि भवन्ति ॥ ५०-५२ ॥

अत्रोपपत्तिः।

षडध्यर्धभोगकलानामैक्यम् $= \frac{३ \text{ चंग}}{२} \times ६ = ३$ चंग $\times ३ = ९$ चंग

षडर्धभोगकलानामैक्यम् $= \frac{\text{चंग}}{२} \times ६ = ३$ चंग

पञ्चदशैक भोगकलानामैक्यम् = चंग × १५

सर्वेषां योगः = ९ चंग + ३ चंग + १५ चंग = २७ चंग = सर्वनक्षत्रभोगः चक्रकलाभ्यः शुद्धाः सर्वनक्षत्रभोगसंख्यास्तदाऽभिजिद् भोगकलास्तद्दिनगतिः = चक्र—२७ चंग ततः कल्पेऽभितो भगणाः = $\frac{(\text{चक}-२७ \text{ चंग}) \text{ ककुदि}}{\text{चक्रकला}}$ =

ककुदि—२७ कल्पचंभगण एतेनाचार्योक्तमुपपन्नम् । सिद्धान्त शेखरे "चक्राणि वा शशभृतस्त्रिघनाहतानि शोध्यानि भूदिनचयादवशेषचक्रैः । स्यादेकवासरभवा कलिकागतिर्या सा वैश्ववैष्णवभमध्यगधिष्ण्य भुक्तिः ॥ इष्टग्रहस्य कलिकानिकराद्विशोध्या नक्षत्रभोगकलिका ग्रहभुक्तभानि । शेषात्तु भोग्यकलिका पतितात्तु गम्यं ताभ्यां भवन्ति गतगम्यदिनानि भुक्त्या ॥" इति श्रीपतेः पद्यद्वयं "सर्वर्क्षभोगोनितचक्रलिप्ता वैश्वाग्रतः स्यादभिजिद्भभोग" इत्यादि भास्करोक्तं च सर्वमाचार्योक्तस्य सर्वथैव समानार्थकमिति ॥ ५०-५२ ॥

अब अभिजित् नक्षत्र के भोगानयन और ग्रहभुक्त नक्षत्रानयन को कहते हैं ।

हि. भा.—चन्द्रमध्यगति कला को $\frac{३}{२}$, $\frac{१}{२}$, १ इन से गुणा करने से अध्यर्ध, अर्ध, सम नक्षत्रों की भभोग कला होती है । सब नक्षत्रों की जो भोग कला है उनको भगण कला में से घटाने से जो शेष रहता है वह अभिजित् भोग है । वा कल्प चन्द्र भगण सत्ताइस से गुणा कर कल्पकुदिन में से घटाने से शेष अभिजित् का कल्प भगण होता है, इन भगणों से जो दिन भोग (कल्प कुदिन में यदि अभिजित् का कल्प भगण पाते हैं तो एक दिन में क्या इस अनुपात से लब्ध कलात्मक दिनगति) होता है वह अभिजित् भोग होता है । ग्रहकलासमूह में से नक्षत्र भोग कला को घटाने से नक्षत्र होते हैं, अर्थात् ग्रहभुक्त कला में जितने नक्षत्रों की भोग कला शुद्ध हो उतने गतनक्षत्र होते हैं, शेषकला वर्त्तमान नक्षत्र की गत कला है उसको नक्षत्र भोग कला में से घटाने से गम्य कला होती है । तब ग्रहगति कला में एक दिन पाते हैं तो गत-गम्य कला में से क्या इस अनुपात से गतदिन और गम्यदिन होते हैं ॥ ५०—५२ ॥

उपपत्ति ।

छः अध्यर्ध भोगकला नक्षत्रों का ऐक्य = $\frac{३ \text{ चंग}}{२}$ × ६ = ३ चग × ३ = ९ चग

छः अर्धभोग कला नक्षत्रों का ऐक्य = $\frac{\text{चंग}}{२}$ × ६ = चग × ३

पन्द्रह एक भोग (समान भोग) कलानक्षत्रों का ऐक्य = चंग × १५

सबों का योग = सर्वनक्षत्र भोग कला = ९ चंग + ३ चंग + १५ चग = २७ चंग

इसको चक्र कला में से घटाने से शेष अभिजित् भोगकला = चक — २७ चंग, तब अनुपात से कल्प में अभिजित् का भगण = $\frac{(\text{चक} - २७ \text{ चंग}) \text{ ककुदि}}{\text{चक}}$ = ककुदि — २७ × कल्पचंभगण इससे आचार्योक्त उपपन्न हुआ। सिद्धान्त शेखर में 'चक्राणि वा शगभूनस्त्रिघना हृतानि' इत्यादि 'इष्टग्रहस्य कलिकानिकराद्विशोध्या' इत्यादि विज्ञान भाष्य में लिखित श्रीपत्युक्त पद्य द्वय तथा 'सर्वर्क्षभोगोनितचक्रलिप्तावैस्वाग्रतः' इत्यादि भास्करोक्त भी सर्वथा आचार्योक्त के समानार्थक है इति ॥ ५०-५२ ॥

इदानीं यैरभिजिद्भोगो न कथितस्तान् दूषयति ।

भफलं प्रोक्तमभिजितो मङ्गलयात्रासु संहिताकारैः ।
यैस्तद्भोगो नोक्तस्ते गणकाः संहिता बाह्याः ॥ ५३ ॥

सु० भा०—स्पष्टार्थम् ॥ ५३ ॥

वि. भा.—मङ्गलकार्ये यात्रासु च संहिताकारैरभिजिन्नक्षत्रफलं कथितमस्ति । यैर्गणकैस्तद् भोगो न कथितस्ते (गणकाः) संहिताबाह्याः (संहिताऽनभिज्ञाः) सन्तीति ॥ ५३ ॥

हि. भा.—मङ्गल कार्य में यात्राओं में संहिताकार ने अभिजित् नक्षत्र के फल कहे हैं । जिन गणकों ने अभिजित् नक्षत्र के भोग को नहीं कहा है वे संहिता शास्त्र से बाहर हैं अर्थात् संहिता शास्त्र को नहीं जानते हैं इति ॥ ५३ ॥

इदानीमार्यभटं दूषयति ।

अध्यर्धादिक्षेत्राणि संहितास्वभिहितानि गर्गाद्यैः ।
यस्मादुडूनि तस्मान्नार्यभटोक्तं तदानयनम् ॥ ५४ ॥

सु. भा.—यस्माद् गर्गाद्यैः स्वसंहितास्वध्यर्धार्धसमक्षेत्राण्युडून्यभिहितानि तस्मादिदं सूक्ष्मनक्षत्रानयनमेव समीचीनमत आर्यभटोक्तं तदानयनं स्थूलनक्षत्रानयनं न समीचीनमित्यध्याहार्यम् ॥ ५४ ॥

वि, भा.—यस्मात् कारणात् गर्गाद्यैराचार्यैः स्वसंहितासु-अध्यर्धार्धसमक्षेत्राण्युडूनि कथितानि तस्मात् इदं सूक्ष्मनक्षत्रानयनमेव युक्तियुक्तम् अत आर्यभटोक्तं स्थलनक्षत्रानयनं न समीचीनमिति ॥ ५४ ॥

अब आर्य भटोक्त मे दोष दिखाते है।

हि. भा.—जैसा कि गर्गादि आचार्यों ने अध्यर्ध-अर्ध-सम नक्षत्रों को कहा है यह सूक्ष्म नक्षत्रानयन ही समीचीन है, आर्य भटोक्त स्थूल नक्षत्रानयन ठीक नहीं है इति ॥५४॥

इदानीमध्यायोपसंहारमाह।

आर्याणां पञ्चाशच्चतुर्भिरधिका चतुर्दशोऽध्यायः।
स्फुटगत्युत्तरमन्यान् दिशाऽनयाऽभ्युपगमेत् प्रश्नान् ॥ ५५ ॥

सु. भा.—अनया दिशाऽनेन पूर्वप्रतिपादितमार्गेणान्यान् प्रश्नान् गणकोऽभ्युपगमेज्जानीयादिति। शेषं स्पष्टार्थम् ॥ ५५ ॥

मधुसूदन सूनुनोदितो यस्तिलकं श्रीपृथुनेह जिष्णुजोक्ते।
हृदि तं विनिधाय नूतनोऽयं रचितः स्पष्टगतौ सुधाकरेण ॥

इति श्रीकृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्तनूतन तिलके स्फुटगत्युत्तरो नाम चतुर्दशोऽध्यायः।

वि. भा.—अनया दिशा(पूर्वोदितमार्गेण) ऽन्यान् प्रश्नान् जानीयादिति ॥ ५४ ॥

इति श्री ब्राह्मस्फुटसिद्धान्ते स्फुटगत्युत्तराध्यायश्चतुर्दशः समाप्तः।

अब अध्याय के उपसंहार को कहते हैं।

हि. भा.—चौवन आर्याओं से स्फुटगत्युत्तर नामक चौदहवां अध्याय है, इन पूर्व कथित मार्ग से भिन्न अन्य प्रश्नों को भी गणक समझें इति ॥ ५५ ॥

इति ब्राह्मस्फुटसिद्धान्त में स्फुटगत्युत्तर नामक चौदहवां अध्याय समाप्त हुआ।

ब्राह्मस्फुटसिद्धान्तः

त्रिप्रश्नोत्तराध्यायः

•

ब्राह्मस्फुटसिद्धान्तः

७

त्रिप्रश्नोत्तराध्यायः

अथ त्रिप्रश्नोत्तराध्यायः प्रारभ्यते। तत्र प्रथमं दिक् सम्बन्धि प्रश्नमाह।

योऽह्नः पूर्वापरयोस्तुल्यच्छायाङ्गुलाग्रयोर्बिन्दू।
वीक्ष्य क्रान्त्यक्षांशैर्विना दिशो वेत्ति गणकः सः॥ १॥

सु. भा.—यो दिवसस्य पूर्वापरकपालयोस्तुल्यच्छायाङ्गुलाग्रयोः। जलसमीकृतक्षितिगते वृत्ते पश्चिमकपाले केन्द्रस्थशङ्कोश्छायाग्रं यत्र विशति पूर्वकपाले च यतो निः सरति तौ बिन्दू वीक्ष्य क्रान्त्यक्षांशैर्विना दिशः पूर्वापरादीन् वेत्ति स एव गणक इत्यहं मन्य इति॥ १॥

वि. भा.—यो दिनस्य पूर्वापरयोः (पूर्वपश्चिमकपालयोः) तुल्यच्छायाङ्गुलाग्रयोः (जलेन समीकृते भूमिपृष्ठे मध्यान्हच्छायाऽधिकैः शङ्क्वङ्गुलैरेकं क्षितिजसंज्ञकं वृत्तं विलेख्यं तस्य केन्द्रे स्थापितस्य शङ्कोश्छायाग्रं पूर्वकपालेपश्चिमकपाले च यत्र स्पृशेत्) इति बिन्दू (बिन्दुद्वयं) दृष्ट्वा क्रान्त्यक्षांशैर्विना (क्रान्त्यक्षांशज्ञानमन्तरा) दिशः (पूर्वपश्चिमादीन्) जानाति सः गणको (ज्योतिः शास्त्रज्ञः) ऽस्तीति॥ १॥

अब त्रिप्रश्नोत्तराध्याय प्रारम्भ किया जाता है।

उसमें पहले दिशा सम्बन्धी प्रश्न को कहते हैं।

हि. भा.—जो व्यक्ति दिन के पूर्वकपाल में और पश्चिम कपाल में तुल्य छायाङ्गुलाग्र अर्थात् जल से समान की हुई भूमि में मध्यान्हच्छाया से अधिक शङ्क्वङ्गुल से एक क्षितिज संज्ञकवृत्त लिखकर उसके केन्द्र में स्थापित शङ्कु के छायाग्र (पूर्वकपाल में और पश्चिम कपाल में जहाँ स्पर्श करता है) बिन्दुद्वय को देखकर क्रान्ति और अक्षांश के बिना पूर्व-पश्चिमादि दिशाओं को जानते है वे ज्योतिःशास्त्रज्ञ हैं इति॥ १॥

इदानीमन्यान् प्रश्नानाह ।

त्रिच्छायाग्रज्ञो यः क्रान्त्यक्षार्कैर्विना दिशो भ्रमणम् ।
छायाग्रस्य दिनार्धच्छायां वा वेत्ति गणकः सः ॥ २ ॥

सु. भा.—यस्त्रिच्छायाग्रज्ञः क्रान्त्यक्षार्कैर्विना दिशो वेत्ति । छायाग्रस्य भ्रमणं भाभ्रमरेखां वेत्ति । वा दिनार्धच्छायां मध्याह्नच्छायां वेत्ति स एव गणकः । एवमत्र प्रश्नत्रयम् ॥ २ ॥

वि. भा.—यस्त्रिकालिकच्छायाग्रपण्डितः क्रान्तिज्ञानं विना, अक्षांशज्ञानं विना रविज्ञानं विना दिशः (पूर्वपश्चिमादीन्) जानाति, छायाग्रस्य भ्रमणमर्थात् छायाभ्रमणं जानाति, वा मध्यान्हकालिकच्छायां जानाति सो गणकोऽस्तीति, अत्र प्रश्नत्रयमस्ति ॥ २ ॥

अब अन्य प्रश्नो को कहते है ।

हि. भा.—जो तीन कालिक छायाग्र के ज्ञाता क्रान्तिज्ञान बिना, अक्षांशज्ञान बिना और रविज्ञान विना पूर्व पश्चिम आदि दिशाओं को जानते हैं, छायाभ्रमण को जानते हैं । वा मध्यान्ह कालिक छाया को जानते है वे ज्योतिःशास्त्र के पण्डित है इति । यहां तीन प्रश्न हैं ॥ २ ॥

इदानीमन्यान् प्रश्नानाह ।

यश्छायाग्रं दृष्ट्वा क्रान्त्यक्षज्ञो दिशो विजानाति ।
शङ्कुच्छायाभ्रमणे दिग्ज्ञो वा वेत्ति गणकः सः ॥ ३ ॥

सु. भा.—यः क्रान्त्यक्षज्ञश्छायाग्रमेकमेव दृष्ट्वा दिशो विजानाति । वा यो दिग्ज्ञः शङ्कुभ्रमणं वा छायाभ्रमणं वेत्ति स एव गणकः । एवमत्र प्रश्नत्रयम् ॥ ३ ॥

वि. भा.—यः क्रान्त्यक्षज्ञः केवलं छायाग्रं ज्ञात्वा दिशः (पूर्वपश्चिमादीन्) जानाति, वा यो दिग्ज्ञः (दिक्ज्ञाता) शङ्कुभ्रमणं छायाभ्रमणं वा जानाति सो गणकोऽस्तीति । अत्र प्रश्नत्रयमस्ति ॥ ३ ॥

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—जो क्रान्ति और अक्षांश के ज्ञाता केवल छायाग्र को जान कर दिशाओं

को जानते हैं वा जो दिशाओं के ज्ञाता शङ्कुभ्रमण वा छायाभ्रमण को जानते हैं वे ज्योतिः शास्त्र के पण्डित है। यहाँ तीन प्रश्न है ॥ ३ ॥

इदानीमन्यान् प्रश्नानाह।

दृष्ट्वा विषुवच्छायां लम्बाक्षज्ये करोति यो बहुधा।
मध्यच्छायार्कज्ञोऽक्षांशान् यो वेत्ति गणकः सः ॥ ४ ॥

सु. भा.—यो विषुवच्छायां पलभां दृष्ट्वा बहुधा बहुभिः प्रकारैर्लम्बाक्षज्ये करोति। लम्बज्यामक्षज्यां च करोति। एवं यो मध्यच्छायार्कज्ञोऽक्षांशान् वेत्ति स एव गणकः। एवमत्र प्रश्नत्रयम् ॥ ४ ॥

वि. भा.—यो विषुवच्छायां (पलभां) ज्ञात्वा बहुप्रकारै-र्लम्बज्यामक्षज्यां च जानाति, यो मध्यच्छाया-रविज्ञाता च अक्षांशान् जानाति सो गणकोऽस्तीति। अत्र प्रश्नत्रयमस्ति ॥ ४ ॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—जो पलभा के ज्ञाता बहुत प्रकारों से लम्बज्या और अक्षज्या को जानते हैं। तथा जो मध्यच्छाया और रवि के ज्ञाता अक्षांश को जानते हैं वे ज्योतिः शास्त्र के पण्डित है। यहाँ तीन प्रश्न है ॥ ४ ॥

इदानीमन्यान् प्रश्नानाह।

यश्चरखण्डकलङ्कोदयान् विजानाति लग्नमुदयैः स्वैः।
लग्नाद् घटिकाश्छायां गतशेषनताच्च गणकः सः ॥ ५ ॥

सु. भा.—यश्चरखण्डानि जानाति। लङ्कोदयान् जानाति। स्वैरुदयैः स्वदेशोदयैर्लग्नं विजानाति। लग्नाद् घटिका इष्टघटिका जानाति। गताद्दिनगताच्छायां जानाति। शेषाद्दिनशेषाच्छायां जानाति। वा नतान्नतकालाच्छायां विजानाति स एव गणकः। एवमत्र सप्त प्रश्नाः ॥ ५ ॥

वि. भा.—यश्चरखण्डकान् जानाति, लङ्कादेशीयराश्युदयमानानि जानाति, स्वैरुदयैः (स्वदेशीयराश्युदयमानैः) लग्नं जानाति, लग्नज्ञानात् इष्टघटिकां जानाति, दिनगतात् छायां जानाति, दिनशेषाच्च छायां जानाति, नतकालाच्च छायां जानाति सो गणकोऽस्तीति। अत्र सप्त प्रश्नाः सन्तीति ॥ ५ ॥

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—जो व्यक्ति चरखण्डों को जानते हैं । लंकादेशीय राशियों के उदयमान को जानते हैं, स्वदेशीय राश्युदय मानों से लग्न को जानते है, लग्नज्ञान से इष्टकाल को जानते हैं। दिन गत से छाया को जानते है, दिन शेष से छाया को जानते है । तथा नतकाल से छाया को जानते हैं वे ज्योतिः शास्त्र के पण्डित है । यहां सात प्रश्न है ॥ ५ ॥

इदानीमन्यान् प्रश्नानाह ।

गत शेषनता घटिकाश्छायातोऽभीष्टदिनदलच्छायाम् ।
बहुधा क्रान्त्यर्काक्षान् दृष्ट्वा यो वेत्ति गणकः सः ॥ ६ ॥

सु. भा.—यः क्रान्त्यक्षार्कान् दृष्ट्वा बहुधा गतघटिकाः शेषघटिका नतघटिकाश्च वेत्ति । वा छायात इष्टकालच्छायातो बहुधाऽभीष्ट दिनदले छायां वेत्ति स एव गणकः । एवमत्र चत्वारः प्रश्नाः ॥ ६ ॥

वि. भा.—यः क्रान्त्यर्काक्षान् दृष्ट्वा (क्रान्ति रविमक्षांशं च ज्ञात्वा) बहुधा गतघटिकाः शेषघटिका नतघटिकाश्च जानाति, वा इष्टछायात इष्ट दिनार्धकाले छायां बहुधा जानाति सो गणकोऽस्तीति । अत्र प्रश्न चतुष्टयमस्ति ॥ ६ ॥

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—जो व्यक्ति क्रान्ति-रवि और अक्षांश को जानकर अनेक प्रकार से दिन गत घटी, दिनशेषघटी और नतघटी को जानते हैं, वा इष्टच्छाया से इष्ट दिनार्धकाल में अनेक प्रकार से छाया को जानते हैं वे गणक (ज्योतिर्वित्) हैं । यहां चार प्रश्न है ॥ ६ ॥

इदानीमन्यान् प्रश्नानाह ।

क्रान्तिज्ञः सममण्डलशंकुकर्णं च योऽवलम्बज्ञः ।
जानाति कोणशंकुच्छाया घटिकाः स तन्त्रज्ञः ॥ ७ ॥

सु. भा.—यः क्रान्तिज्ञः सममण्डलशङ्कुं जानाति । योऽवलम्बज्ञः सममण्डलकर्णं च जानाति । कोणशङ्कुं कोणशङ्कुच्छायां कोणवृत्तप्रवेशे घटिकाश्च जानाति स एव तन्त्रज्ञः सिद्धान्तज्ञ इति । एवमत्र पंच प्रश्नाः ॥ ७ ॥

वि. भा.—यः क्रान्ति वेत्ता समशंकुं जानाति यो लम्बांशवेत्ता सममण्डलकर्ण (समवृत्तकर्ण) जानाति, कोणशंकुं, कोणशंकुच्छायां, कोणवृत्तस्थे रवौ घटिकाश्च जानाति स ज्यौतिषसिद्धान्त पण्डितोऽस्तीति ॥ अत्र पञ्च प्रश्नाः सन्तीति ॥ ७ ॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—जो क्रान्ति के ज्ञाता समशंकु को जानते है। जो लम्बांश वेत्ता समवृत्त को जानते हैं, कोणशंकु को जानते हैं, कोणशंकुच्छाया को जानते है। कोणवृत्त प्रवेश मे घटी को जानते हैं वे ज्यौतिष सिद्धान्त के पण्डित है,। यहां पांच प्रश्न है ॥ ७ ॥

इदानीमन्यान् प्रश्नानाह।

शंकुतलप्राच्यपरान्तरद्वयं वीक्ष्य यो विजानाति।
विषुवच्छायामेकं दृष्ट्वाऽऽदित्यं च गणकः सः ॥ ८ ॥

सु. भा.—शङ्कुतलप्राच्यपरान्तरं भुजः। यो भुजद्वयं वीक्ष्य विषुवच्छायां पलभां विजानाति। एकमेव भुजं दृष्ट्वा विषुवच्छायामादित्यमर्कं च विजानाति स गणकः। एवमत्र प्रश्नत्रयम् ॥ ८ ॥

वि. भा.—शंकुतलपूर्वापररेखयोरन्तरं भुजोऽस्ति, यो भुजद्वयं ज्ञात्वा पलभां जानाति एकं भुजं ज्ञात्वा पलभां रविं च जानाति स गणकोऽस्तीति। अत्र प्रश्नत्रयमस्ति ॥ ८ ॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—शंकुतल और पूर्वापर रेखा का अन्तर भुज है। जो व्यक्ति दो भुजों को जान कर पलभा को जानते हैं। एवं एक भुज को जान कर पलभा को जानते हैं तथा रवि को जानते है वे ज्योतिः शास्त्र के पण्डित है इति। यहां तीन प्रश्न है ॥ ८ ॥

इदानीमन्यान् प्रश्नानाह।

पातालशंकुमुदयेऽस्ते वा दृग्ज्यां रवेर्विजानाति।
दृक्पातालगशंकोः पृथक् तले वा स तन्त्रज्ञः ॥ ९ ॥

सु. भा.—यो रवेः पातालशङ्कुमधः शङ्कुं विजानाति। उदयेऽस्ते वा यो रवेर्दृग्ज्यामग्रां विजानाति। दृक्शङ्कुर्दिवोर्ध्वशङ्कुः। पातालगशङ्कुर्निशि रवेरधः शङ्कुः। तयोः पृथक् पृथक् तले शङ्कुतले च वा यो विजानाति स एव तन्त्रज्ञ इति। एवमत्र प्रश्नचतुष्टयम् ॥ ९ ॥

वि. भा.—यो रवेः पातालशंकुं (अधः शंकुं) जानाति। उदयेऽस्ते वा रवेर्दिग्ज्यां जानाति, दृक् शंकुः (दिनोर्ध्वशंकुः) पातालगशंकुः (रात्रौ रवेरधः शंकुः)

तयोः शंक्वोः पृथक् तले (शंकुतले) वा यो जानाति स तन्त्रज्ञो (ज्यौतिपसिद्धान्तज्ञो) ऽस्तीति। अत्र प्रश्न चतुष्टयमस्ति ॥ ९ ॥

अब अन्य प्रश्नों को कहते है।

हि. भा.—जो व्यक्ति रवि के अधःशंकु को जानते है। उदय काल मे वा अस्त काल मे रवि की दिग्ज्या को जानते हैं। दिन में उर्ध्वशंकु तल, रात्रि में अधः शकुनल को पृथक् जो जानते है वे ज्यौतिष सिद्धान्त वेत्ता है इति। यहा चार प्रश्न है॥ ९ ॥

इदानीमन्यान् प्रश्नानाह।

दिनगतशेषप्राणैरिष्टार्को दिनदलान्नतैरथवा।
भवति सममण्डले यैर्यस्तान् कथयति स तन्त्रज्ञः ॥ १० ॥

सु. भा.—यैर्दिनगतप्राणैर्दिनशेपप्राणैरथवा दिनदलान्नतैः प्राणैरिष्टार्कः सममण्डले भवति प्रविशति तान् प्राणान् यः कथयति स एव तन्त्रज्ञः। एवमत्र प्रश्नत्रयम् ॥ १० ॥

वि. भा.—यैर्दिनगतप्राणैः, दिनशेषप्राणैः। अथवा दिनदलान्नतैः प्राणैः, इष्टार्कः सममण्डले प्रविशति तान् प्राणान् यः कथयति स तन्त्रज्ञोऽस्ति। अत्र प्रश्न त्रयमस्ति ॥ १० ॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा—जो व्यक्ति दिनगत प्राण से, दिनशेष प्राण से, अथवा दिनार्ध से, नतप्राण से इष्टकालिक रवि सम मण्डल में प्रवेश करते हैं उन प्राणों को कहते हैं वे ज्योतिः शास्त्र-वेत्ता हैं इति। यहां तीन प्रश्न हैं॥ १० ॥

इदानीमन्यान् प्रश्नानाह।

सममण्डलगः प्राणैर्दिनगतशेषैर्नतैर्दिनार्धाद्वा।
यैर्भवति ज्ञात्वा तान् योऽर्कं कथयति स तन्त्रज्ञः ॥ ११ ॥

सु. भा.—यैर्दिनगतप्राणैः शेषप्राणैर्दिनार्धाद्वा नतैः प्राणैरर्कः सममण्डलगो भवति तान् ज्ञात्वा यो ऽर्कं कथयति स एव तन्त्रज्ञ इति। एवमत्र प्रश्नत्रयम् ॥११॥

वि. भा.—यैर्दिनगत प्राणैः। दिनशेषप्राणैः। वा दिनार्धान्नतैः प्राणैः रविः सममण्डलगो भवति तान् प्राणान् ज्ञात्वा यो रविं कथयति स तन्त्रज्ञोऽस्तीति ॥ अत्र प्रश्नत्रयमस्ति ॥ ११ ॥

अब अन्य प्रश्नों को कहते है ।

हि. भा.—जो व्यक्ति दिनगत काल, दिन शेषकाल वा दिनार्ध से नत काल से रवि सममण्डलगत होते हैं उन कालों को जानकर रवि को कहते है वे तन्त्रज्ञ है । यहाँ तीन प्रश्न है ॥ ११ ॥

इदानीमन्यान् प्रश्नानाह ।

यः सममण्डल शंकुं कर्णं वा वीक्ष्य सूर्यमानयति ।
रविसममण्डलशंकुज्ञोऽक्षं कथयति स तन्त्रज्ञः ॥ १२ ॥

सु. भा.—यः सममण्डलशङ्कुं वीक्ष्य सूर्यमानयति । सममण्डलकर्णं वीक्ष्य सूर्यमानयति । अथवा यो रविं सममण्डलशङ्कुं च ज्ञात्वा ऽक्षं कथयति स एव तन्त्रज्ञः । एवमत्र प्रश्नत्रयम् ॥ १२ ॥

वि. भा.—यः समशंकुं ज्ञात्वा रविं कथयति, वा समकर्णं ज्ञात्वा रविं कथयति, अथवा रविं समशंकुं च ज्ञात्वाऽक्षांशं कथयति स तन्त्रज्ञोऽस्तीति । अत्र प्रश्नत्रयमस्ति ॥ १२ ॥

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—जो व्यक्ति समशंकु को जानकर रवि को कहते हैं वा समकर्ण को जान कर रवि को कहते है । अथवा रवि और समशंकु को जान कर अक्षांश को कहते है वे तन्त्रज्ञ है इति । यहां तीन प्रश्न है ॥ १२ ॥

इदानीमन्यान् प्रश्नानाह ।

रविलग्नान्तरघटिका विनोदयैर्लग्नमिष्टघटिकाभिः ।
वेत्ति चरार्धादक्षं योऽर्कज्ञो वा स तन्त्रज्ञः ॥ १३ ॥

सु. भा.—स्वदेशोदयैर्विना यो रविलग्नान्तरघटिका वेत्ति वा स्वदेशोदयैर्विनेष्टघटिकाभिर्लग्नं वेत्ति । वा योऽर्कज्ञश्चरार्धादक्षं वेत्ति स एव तन्त्रज्ञः । एवमत्र प्रश्नत्रयम् ॥ १३ ॥

वि. भा.—य उदयै (स्वदेशीयराश्युदयैः) विना रविलग्नान्तरघटीप्रमाणं जानाति । वा स्वदेशीयराश्युदयैर्विना इष्ट घटीभिर्लग्नं जानाति । वा रविं ज्ञात्वा चरखण्डतोऽक्षांशं जानाति स तन्त्रज्ञोऽस्तीति । अत्र प्रश्नत्रयमस्ति ॥ १३ ॥

अब अन्य प्रश्नों को कहते है।

हि. भा.—जो व्यक्ति स्वदेशीय राश्युदय के बिना रवि और लग्न की अन्तर घटी को जानते है, वा स्वदेशीय राश्युदय के बिना इष्टकाल से लग्न को जानते है। वा रवि को जानकर चर खण्ड से अक्षांश को जानते है वे तन्त्रज्ञ है। यहा तीन प्रश्न है ॥ १३ ॥

इदानीमन्यान् प्रश्नानाह।

अक्षचरार्धज्ञोऽर्कं छायातो यश्चरार्धमिष्टायाः।
इष्टचरार्धादथवा छायां कथयति स तन्त्रज्ञः ॥ १४ ॥

सु. भा.—योऽक्षचरार्धज्ञोऽर्कं कथयति। यश्छायातः पलभात इष्टायाः पलभायाश्चरार्धं कथयति। अथवा इष्टचरार्धात् छायां विषुवच्छायां कथयति स एव तन्त्रज्ञः। एवमत्र प्रश्नत्रयम् ॥ १४ ॥

वि. भा.—योऽक्षांशं चरार्धं च ज्ञात्वा रविं कथयति। वा छायातः (पलभातः) इष्टायाः पलभायाश्चरखण्डं कथयति अथवा इष्टचरार्धात् छायां (पलभां) कथयति स तन्त्रज्ञोऽस्तीति। अत्र प्रश्नत्रयमस्ति ॥ १४ ॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—जो व्यक्ति अक्षांश और चरार्ध को जानकर रवि को कहते है। वा पलभा से इष्ट पलभा के चरार्ध को कहते है। अथवा इष्ट चरार्ध मे पलभा को कहते है वे तन्त्रज्ञ है। यहां तीन प्रश्न है ॥ १४ ॥

इदानीमन्यान् प्रश्नानाह।

मध्यच्छायातोऽक्षविदानयति रविं दिवाकरज्ञोऽक्षम्।
योऽग्रार्कज्ञो लम्बाक्षांशान् कथयति स तन्त्रज्ञः ॥ १५ ॥

सु. भा.—यो ऽक्षविदक्षांशज्ञो मध्यच्छायातो रविमानयति। दिवाकरज्ञश्च मध्यच्छायातो ऽक्षमानयति। वा योऽग्रार्कज्ञो लम्बाक्षांशान् कथयति स एव तन्त्रज्ञः। एवमत्र प्रश्नत्रयम् ॥ १५ ॥

वि. भा.—योऽक्षं जानाति, अक्षांशं च वेत्ति, मध्यच्छायातश्च सूर्यं मानयति। रविं ज्ञात्वा मध्यच्छायातः योऽक्षमानयति। अथवा योऽग्रार्कं ज्ञात्वा लम्बाक्षांशांश्च कथयति, स एव तन्त्रं ज्योतिः शास्त्रं जानातीति। एवमत्र प्रश्नत्रयमस्ति ॥ १५ ॥

हि. भा.—जो व्यक्ति अक्ष को जानकर मध्यच्छाया से सूर्य का आनयन कर लेता है। रवि को जानकर मध्यच्छाया से जो अक्षानयन करता है तथा अग्रार्क को जानकर अक्षांश और लम्बांश को बतला देता है। वही ज्योतिषशास्त्र का ज्ञाता है। इस प्रकार यहां तीन प्रश्न हैं ॥ १५ ॥

इदानीमन्यान् प्रश्नानाह ।

उदयेऽस्तमये वाऽग्रां वेत्ति दिनार्धे नतोन्नतज्ये यः ।
ताभिर्विषुवच्छायाऽक्षज्या लम्बान् स तन्त्रज्ञः ॥ १६ ॥

सु. भा.—य उदये वा ऽस्तमये ऽर्कं दृष्ट्वा ऽग्रां वेत्ति । वा दिनार्धे नतोन्नतज्ये नतज्यामुन्नतज्यां च वेत्ति। ताभिरग्रानतोन्नतज्याभिर्विषुवच्छायाक्षज्या लम्बान् यो वेत्ति स एव तन्त्रज्ञः । एवं प्रश्नत्रयमेवात्र ॥ १६ ॥

वि. भा.—य उदये वाऽस्तमये रविं ज्ञात्वाऽग्रां जानाति, वा दिनार्धकाले नतज्यामुन्नतज्यां च जानाति । ताभिरग्रानतोन्नतज्याभिः पलभाऽक्षज्या लम्बान् जानाति स तन्त्रज्ञोऽस्तीति । अत्र प्रश्नत्रयमस्ति ॥ १६ ॥

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—जो व्यक्ति उदय काल में वा अस्तकाल में रविको जानकर अग्रा को जानते है। वा दिनार्धकाल में नतज्या और उन्नतज्या को जानते हैं, तथा उन नतज्या और उन्नतज्या से पलभा, अक्षज्या और लम्बज्या को जानते है वे तन्त्रज्ञ है। यहां तीन प्रश्न हैं ॥ १६ ॥

इदानीमन्यान् प्रश्नानाह ।

यश्चरदलं विना स्वे दिनरात्र्यर्धे करोति वा ताभ्याम् ।
अक्षावलम्बकौ वा ऽनस्तमयार्कान् स तन्त्रज्ञः ॥ १७ ॥

सु. भा.—यश्चरदलं विना स्वे दिनरात्र्यर्धे करोति । वा ताभ्यां दिनरात्र्यर्धाभ्यां यो ऽक्षावलम्बकौ करोति । वा ऽनस्तमयार्कान् सदोदितार्कान् यः करोति स एव तन्त्रज्ञः । एवमत्र प्रश्नत्रयम् ॥ १७ ॥

वि. भा.—यश्चरार्धं विना स्वकीये दिनार्धे जानाति । वा ताभ्यां (दिनरात्र्यर्धाभ्यां) अक्षांशलम्बांशौ जानाति वाऽनस्तमयरविं सदोदितरविं करोति स तन्त्रज्ञोऽस्तीति । अत्र प्रश्नत्रयमस्ति ॥ १७ ॥

अब अन्य प्रश्नों को कहते है ।

हि. भा.—जो व्यक्ति बिना चरार्ध (चरखण्ड) के अपने दिनार्ध और राज्यर्ध को जानते है। वा उन दिनार्ध और रात्र्यर्ध से अक्षांश और लम्बांश को जानते है वा अनस्तमय (उदित) रवि को सदोदित रवि करते है वे तन्त्रज्ञ है। यहां तीन प्रश्न हैं ॥ १७ ॥

अथ केषां प्रश्नानामत्रोत्तराणि सन्तीत्याह ।

आर्यानवकोक्तानां प्रश्नानामुत्तरं चतुः षष्ट्या ।
आर्याणां प्रश्नोक्त्या शेषप्रश्नोत्तरोक्तिरतः ॥ १८ ॥

सु. भा.—आर्यानवकोक्तानां प्रश्नानां 'योऽह्नः पूर्वा परयोः' इत्यादीनां 'पृथक्तले वा स तन्त्रज्ञः' इत्यन्तानामुत्तराणि प्रश्नोक्त्या त्रिप्रश्नाधिकारोक्त्याऽऽर्याणां चतुः षष्ट्या प्रदिपादितानि। अत्रोऽत्र शेष प्रश्नोक्तिरुचितेति। त्रिप्रश्नाध्याये षट्षष्टि रार्याः सन्ति अतोऽत्र 'षट्षष्ट्या' इति पाठः साधुः ॥ १८ ॥

वि. भा.–आर्यानवककथितानां प्रश्नानां 'योऽह्नः पूर्वापरयोस्तुल्यच्छाया-ग्रयोर्बिन्दू' इत्यारभ्य 'पातालशङ्कुमुदयेऽस्ते वा दृग्ज्यां रवे विजानाती' त्यन्तानामुत्तराणि त्रिप्रश्नाधिकारोक्त नियमेनाऽऽर्याणां चतुःषष्ट्या कथितान्यतोऽत्र शेषाणां प्रश्नानां कथनमुचितमेव। अत्राध्याये षट्षष्टिरार्याः सन्त्यतः 'चतुः षष्ट्या' स्थाने 'षट्षष्ट्या' पाठः समुचित इति ॥ १८ ॥

अब यहाँ 'किन प्रश्नों के उत्तर हैं' कहते है ।

हि. भा.—'योऽह्नः पूर्वापरयोस्तुल्यच्छायाग्रयोर्बिन्दू' इति त्रिप्रश्नोत्तराध्याय के आरम्भ से 'पाताल शङ्कु मुदये ऽस्तेवा दृग्ज्यां इत्यादि' तक नौ आर्यायों के उत्तर त्रिप्रश्नाधिकारोक्ति द्वारा चौंसठ (६४) आर्यायों में कथित है। इसलिये अवशिष्ट प्रश्नों का कथन भी उचित ही है। इस अध्याय में छियासठ (६६) आर्याएं है इसलिये 'आर्यानवकोक्तानां प्रश्नानामुत्तरं चतुः षष्ट्या' यहां चतुःषष्ट्या (चौसठ ६४) के स्थान पर 'षट् षष्ट्या' (छियासठ ६६) ऐसा पाठ समुचित है ॥ १८ ॥

अथैषां प्रश्नानामुत्तराणि प्रतिपाद्यंते ।
दिनगतशेषप्राणैरित्यादि प्रश्नत्रयोत्तरमाह ।

विषुवच्छाया गुणितस्वाहोत्रार्धभाजिता त्रिज्या ।
क्रान्तिद्वादशगुणिता फलचापकलासुभिः सहितैः ॥ १९ ॥

स्वचरप्राणैर्दिनगतशेषैः सममण्डले रविर्भवति ।
फलचापन्यूनाभिस्तिथिघटिकाभिर्नताभिर्वा ॥ २० ॥

सु. भा.—त्रिज्या क्रान्तिद्वादशगुणिता क्रान्तिज्यया द्वादशभिश्च गुणिता । विषुवच्छायागुणितस्वाहोरात्रार्धभाजिता पलभा गुणितद्युज्यया हृता । फलचापकलासुभिः सहितैः स्वचरप्राणैस्तत्समैर्दिनगतशेषैर्वा फलचापन्यूनाभिस्तिथिघटिकाभिस्तत्समाभिर्नताभिर्नतघटिकाभी रविः सममण्डले भवति प्रविशतीत्यर्थः ।

अत्रोपपत्तिः । विषुवच्छायया द्वादशकोटिस्तदा क्रान्तिज्यया किं जाता कुज्योना तद्धृतिः $\frac{१२ \times ज्याक्रा}{वि}$ द्युज्ययेयं तदा त्रिज्यया किं जातं सूत्रम् $=\frac{१२ \times ज्याक्रा \times त्रि}{वि \times द्यु}$ । अस्य चापं चरयुतं सममण्डलप्रवेशे यातो वा शेष उन्नत कालः स्यात् । सूत्रचापोनाः पंचदशघटिकाश्च तदैव नतघटिकाः स्युरित्युपपद्यते सर्वमिति ॥ १९-२० ॥

वि.भा.—त्रिज्या द्वादशगुणितक्रान्तिज्यया गुणिता पलभा गुणितस्वाहोरात्रार्धं (द्युज्या) भक्ता यल्लब्धं तच्चापं कार्यं स्वचरासुभिः सहितैस्तैर्लब्धकलासुभिर्दिनगतशेषैः सममराडलं रविः प्रविशत्यर्थाच्चरासुभिः सहितं यल्लब्धचापं तावन्मिते उन्नतकाले रविः सममराडलं प्रविशति । वा फलचापरहितपञ्चदशघटिका नत घटिकाः स्युरेतैर्नतैः सममराडलं रविः प्रविशतीति ॥ १९-२० ॥

अत्रोपपत्तिः ।

पलभाभुजः । द्वादश कोटिः । पलकर्णः कर्णः । इत्येकमक्षक्षेत्रम् । क्रान्तिज्या भुजः । कुज्योनतद्धृतिः कोटिः । समशङ्कुः कर्णः । इति द्वितीयमक्षक्षेत्रम् । अनयोः साजात्यादनुपातः क्रियते यदि पलभया द्वादशकोटिस्तदा क्रान्तिज्यया केति समागता कुज्योनतद्धृतिस्तत्स्वरूपम् $=\frac{१२ \times क्रांज्या}{पभा}$ ततोऽनुपातो यदि द्युज्ययेयं कुज्योनतद्धृतिस्तदा त्रिज्यया किं समागतं सूत्रसंज्ञकं तत्स्वरूपम् $=\frac{१२ \times कांज्या \times त्रि}{पभा \times द्यु.}$ = रविगतध्रुवप्रोत वृत्तनाड़ीवृत्तयोः सम्पातात्पूर्वापरसूत्रोपरि लम्बरूपम् । अस्य चापं चरासुभिः सहितं तदा सममराडल प्रवेशकाले गतमेष्यं वा दिनगतमुन्नतकालसंज्ञकम् । सूत्रचापरहिता पञ्चदश घटिकास्तत्रत्या नतघटिकाः स्युरिति ॥ आचार्योक्तं सर्वमुपपन्नम् । सिद्धान्तशेखरे "रविभिरपममौर्व्या चाहता भत्रयज्या अमहतपलभाप्ता चापमेतच्चराढ्यम् । प्रविशति समवृत्तं भानुरप्युन्नतो

ऽसौ तिथिः निपतति शेषः सोऽपि कालो नताख्यः" श्रीपत्युक्तमिदमक्षरशः आचार्योक्तानुरूपमेवेति ॥ १९-२० ॥

अब इन प्रश्नों के उत्तर को कहते हैं।

दिनगतशेष प्राणैरित्यादि तीनों प्रश्नों के उत्तर को कहते हैं ।

हि. भा.—त्रिज्या को बारहगुणित क्रान्तिज्या से गुणाकर पलभा गुणितद्युज्या से भाग देने से जो लब्ध हो उसके चाप में चरासु को जोडने से जो हो उतने दिनगत शेष में रवि सममण्डल में प्रवेश करते हैं । वा पन्द्रह घटी मे लब्धचाप कला को घटाने से जो शेष नत घटी रहती है उतने में रवि सम मण्डल में प्रवेश करते है ॥ १९-२० ॥

उपपत्ति ।

पलभा भुज । द्वादश कोटि, पलकर्ण—कर्ण इन तीनों मे एक अक्ष क्षेत्र है, क्रान्तिज्या भुज, कुज्योन तद्धृति कोटि, समशङ्कु कर्ण, इन तीनो मे द्वितीय अक्ष क्षेत्र है । दोनों अक्ष क्षेत्र सजातीय हैं इसलिये अनुपात करते है । यदि पलभाभुज में द्वादश कोटि पाते है तो क्रान्तिज्या भुज में क्या इससे कुज्योन तद्धृति आती है उसका स्वरूप $= \frac{१२ \times \text{क्रांज्या}}{\text{पभा}}$,

रविगत ध्रुव प्रोतवृत्त नाडीवृत्त के सम्पात बिन्दु से पूर्वापर सूत्र पर लम्ब रेखा सूत्र कहलाती है, भूकेन्द्र रविगत रेखा त्रिज्या, सूत्र के मूल से, भूकेन्द्र तक रेखा सूत्र कोटिज्या, इन तीनों भुजाओं (त्रिज्या = कर्ण, सूत्र = भुज, सूत्रकोटिज्या = कोटि) से एक त्रिभुज बना, तथा सममण्डलाहोत्रवृत्त के सम्पात विन्दु से निरक्षोदयास्त सूत्र के ऊपर लम्बकुज्योनतद्धृति है, अहोरात्र वृत्त के गर्भ केन्द्र से सममण्डलाहोरात्रवृत्तसम्पातगता रेखा द्युज्या है, अहोरात्रवृत्त गर्भ केन्द्र से कुज्योन तद्धृति मूलगत रेखा, इन तीनों भुजाओं (द्युज्या = कर्ण, कुज्योनतद्धृति = भुज, अहो रात्र वृत्त गर्भकेन्द्र से कुज्योन तद्धृति मूलगत रेखा = कोटि) मे उत्पन्न द्वितीय त्रिभुज बना, दोनों त्रिभुज सजातीय हैं । इसलिए अनुपात करते है यदि द्युज्या में कुज्योनतद्धृति पाते हैं तो त्रिज्या में क्या इस अनुपात से सूत्र आता है उसका स्वरूप $= \frac{\text{कुज्योन तद्धृति} \times \text{त्रि}}{\text{द्यु}}$

कुज्योनतद्धृति को उत्थापन देने से $\frac{१२ \times \text{क्रांज्या} \times \text{त्रि}}{\text{पभा} \times \text{द्यु}}$ = सूत्र, इसके चाप में चरासु को जोड़ने से सममण्डल प्रवेशकाल में गत वा एष्य दिनगत उन्नत कालसंज्ञक होता है । पन्द्रह घटी में सूत्रचाप को घटाने से वहां की नत घटी होती है । इससे आचार्योक्त उपपन्न होता है । सिद्धान्त शेखर में 'रविभिरपममौर्व्या चाहता भत्रयज्या' इत्यादि संस्कृतोपपत्ति लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥ १९-२० ॥

इदानीं सममण्डलगः प्राणैर्दिनशेषैरिति प्रश्नद्वयस्योत्तरमाह।

उदयसममण्डलान्तरघटिकाज्यां लम्बकाहतां गुणयेत्।
अक्षज्यया हृताऽन्त्यक्रान्त्या व्यासार्धसङ्गुणया ॥ २१ ॥
लब्धधनुरिनोऽजादौ कर्क्यादौ यदि विशोध्य चक्रार्धात्।
तज्ज्या तदुदय सममण्डलान्तरासुज्यया भक्ता ॥ २२ ॥
प्रश्नसममण्डलासुक्रमज्यया सङ्गुणाऽसकृत्सूर्यः।
प्रश्नघटिकाभिरेवं गतशेषाभिर्भवत्यह्नः ॥ २३ ॥

सु. भा.--उदयसममण्डलान्तरघटिका उन्नतकालस्तज्ज्यां लम्बकहतां लम्बज्याहतामक्षज्यया गुणयेत्। गुणनेन या संख्या भवेत् सा ऽन्त्यक्रान्त्या जिनज्यया किं विशिष्टया व्यासार्धसङ्गुणाया हृता। लब्धस्य धनुरजादावाद्ये पदे इनः सूर्यो भवति। यदि कर्क्यादौ द्वितीये पदे प्रश्नस्तदा तद्धनुश्चक्रार्धाद्विशोध्य शेष रविः स्थूलः स्यात्। तुलादिराशिषट्के सममण्डलप्रवेशो न सम्भवत्यतस्तत्र प्रश्न एव खिलः। अथ तज्ज्या स्थूलरविभुजज्योन्नतकालज्यया भक्ता प्रश्नसममण्डलासुक्रमज्यया सङ्गुणा। स्थूलरवितश्चरज्यादिकं कृत्वा येष्टहृतिः सा प्रश्नसममण्डलासु क्रमज्या कथ्यते। एवं लब्धचापतः पदवशतः सूक्ष्मः सूर्यो भवति। पुन 'स्तज्ज्या तदुदय सममण्डलान्तरा सुज्यया भक्ते' त्यादिना सूर्यः साध्य एवमसकृत् अह्नो दिवसस्य गतशेषाभिः प्रश्नघटिकाभिः स्थिरीभूतः सूर्यो भवति।

अत्रोपपत्तिः। आचार्येण प्रथममुन्नतकालज्या स्थूलेष्टहृतिः कल्पिता। ततोऽक्षक्षेत्रानुपातेन सममण्डलप्रवेशे समशङ्कुः$=\frac{\text{ज्यालं}\times\text{इहृ}}{\text{त्रि}}$। क्रान्तिज्या$=$ $\frac{\text{ज्याअ}\times\text{ज्यालं}\times\text{इहृ}}{\text{त्रि}\times\text{त्रि}}$। रविभुजज्या$=\frac{\text{ज्याअ}\times\text{ज्यालं}\times\text{इहृ}}{\text{ज्याजि}\times\text{त्रि}}$ इष्टहृतिस्थाने यद्युन्नतकालज्या$=$ज्याउ गृह्यते तदा स्थूलभुजज्या$=\frac{\text{ज्याअ}\times\text{ज्यालं}\times\text{ज्याउ}}{\text{ज्याजि}\times\text{त्रि}}$

सूक्ष्मभुजज्या $=\frac{\text{ज्याअ}\times\text{ज्यालं}\times\text{इहृ}}{\text{ज्याजि}\times\text{त्रि}}$ $\therefore$ $\frac{\text{स्थूलभुजज्या}}{\text{सूक्ष्मभुजज्या}}=\frac{\text{ज्याउ}}{\text{इहृ}}$। $\therefore$ सूक्ष्मभुजज्या$=\frac{\text{इहृ}\times\text{स्थूलभुजज्या}}{\text{ज्याउ}}$। अतः पुनः पुनरिष्टहृतिवशेनासकृत् सूक्ष्मभुजज्या भवतीत्युपपन्नम्। अथ यदि सूत्रम्$=$ज्याअ। तदाऽक्षक्षेत्रयुक्त्या चरज्या$=$ज्याच $=\frac{\text{वि}\times\text{ज्याक्रा}\times\text{त्रि}}{१२\times\text{द्यु}}$। ज्याअ$=\frac{१२\times\text{ज्याक्रा}\times\text{त्रि}}{\text{वि}\times\text{द्यु}}$ $\therefore$ $\frac{\text{ज्याच}}{\text{ज्याअ}}=\frac{\text{वि}^{२}}{१२^{२}}$। ततः $\frac{\text{ज्याअ}+\text{ज्याच}}{\text{ज्याअ}-\text{ज्याच}}=\frac{\text{स्प}\frac{१}{२}(\text{अ}+\text{च})}{\text{स्प}\frac{१}{२}(\text{अ}-\text{च})}=\frac{\text{पक}^{२}}{१२^{२}-\text{वि}^{२}}$ अतः स्प $\frac{१}{२}$ (अ$-$च)

$= \frac{\text{स्प } \frac{1}{2} \text{ उका } (१२^{२} - \text{वि}^{२})}{\text{पक}^{२}}$ । अनेन स्पर्शरेखाखण्डतः सूत्रांशचरांशान्तरार्धं सकृदेव व्यक्तं भवति । तद्योगार्धमुन्नतकालदलं व्यक्तमेव । ततश्चरज्यादिकं सर्वं व्यक्तं भवति सकृद्विधिनैवातो 'या स्याद्रवेरुन्नतकालजीवा' इत्यादिभास्करोक्त प्रकार आचार्योक्त प्रकारसम एव ॥ २१-२३ ॥

वि. भा.—सूर्योदयाद्यावता कालेन रविः सममराडलं प्रविशति सकाल उन्नत कालस्तस्य ज्यां (उन्नतकालज्यां) लम्बज्या गुणिताक्षज्यया गुणयेत् । व्यासार्धेन (त्रिज्यया) गुणितयाऽन्त्यक्रान्त्या (जिनज्यया) भक्ता लब्धस्य चापं कार्य तन्मेषादिकेन्द्रे प्रश्ने सति इनो (सूर्यः) भवति स्थूलः । यदि कर्क्यादौ राशित्रये (द्वितीयपदे) प्रश्नस्तदा तच्चापं षड्भाद्विशोध्यं तदा रविः स्यात् । तुलादिराशिषट्के रवेः सममराडलप्रवेशाभावात्तत्र प्रश्न एव निरर्थकः तज्ज्या (रविभुजज्या) तदुदयसममराडलान्तरासुज्यया (तद्रवेश्चरासुभिर्हीनस्योन्नतकालस्य ज्यया) इष्टहृत्येत्यर्थः सङ्गुणा, तदुदयसममराडलान्तरासुज्या (उन्नतकालज्यया) भक्ता लब्धस्य चापं यत् सः पदवशेन सूक्ष्मः सूर्यो भवति । पुनः 'तज्ज्या तदुदयसममराडलान्तरासुज्ययेत्यादिना' सूर्यः साध्यः एवमसकृत्कर्मणा दिनस्य गतशेषाभिर्घटिकाभिर्निश्चितः सूर्यो भवतीति ॥ २१ ॥

अत्राचार्येणोन्नतकालज्या स्थूलेष्टहृतिः कल्पिता, ततोऽग्रासमशङ्कुतद्धृतिभिर्भुजत्रयैरुत्पन्नमेकमक्षक्षेत्रम् । अक्षज्या लम्बज्या त्रिज्येति भुजत्रयैश्चोत्पन्नं द्वितीयमक्षक्षेत्रम् । एतयोः क्षेत्रयोः सजातीयत्वादनुपातेन समशङ्कुः $= \frac{\text{लंज्या} \times \text{इहृ}}{\text{त्रि}}$

ततः क्रान्तिज्या $= \frac{\text{अज्या} \times \text{समशङ्कु}}{\text{त्रि}}$ अत्र समशङ्कोरुत्थापनेन $\frac{\text{अज्या. लंज्या. इहृ}}{\text{त्रि. त्रि.}}$

अथ $\frac{\text{त्रि} \times \text{क्रांज्या}}{\text{त्रिज्या}}$ = रविभुजज्या, अत्र क्रान्तिज्याया उत्थापनेन

$\frac{\text{त्रि. अज्या. लंज्या. इहृ}}{\text{त्रि. त्रि. जिज्या}} = \frac{\text{अज्या. लंज्या. इहृ}}{\text{त्रि. जिज्या}}$ = रविभुजज्या । परन्त्वत्र पूर्वमेवोन्नतकालज्या स्थूलेष्टहृतिः कल्पिताऽत इष्टहृतिस्थाने उन्नत कालज्या ग्रहणेन स्थूलरविभुजज्या $= \frac{\text{अज्या. लंज्या. उज्या}}{\text{त्रि. जिज्या}}$, सूक्ष्मरविभुजज्या $= \frac{\text{अज्या. लंज्या. इहृ}}{\text{त्रि. जिज्या}}$

अतः $\frac{\text{स्थूल रविभुज्या}}{\text{सूक्ष्म रविभुज्या}} = \frac{\text{उज्या}}{\text{इहृ}}$ ततः सूक्ष्म रवि भुजज्या $= \frac{\text{इहृ} \times \text{स्थूल रवि भुज्या}}{\text{उज्या}}$

अतः पुनः पुनरिष्टहृतिवशेनासकृत्कर्मणा सूक्ष्मरविभुजज्या भवतीति । एतावताऽऽचार्योक्तनुपपन्नम् । सिद्धान्तशेखरे "कालेन येन समवृत्तमुपैति भानुः । स्वादुद-

गमाद् भवति तस्य हि या क्रमज्या। सा ताड़िता पलगुणेन च लम्बकेन चान्त्यापमाभिहतभत्रितयज्ययाऽऽप्ता ॥ तच्चापं स्याद्दिनमणिरजात् कर्कटात् षड्भशुद्धं तज्ज्या पूर्वोन्नतजनितया जीवया ताड़नीया। भाज्या मौर्व्या दिनकरचरप्राणहीनोन्नतस्य प्राग्वच्चापं नियतमसकृत्कर्मणा भानुरेव" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति ॥ २१-२३ ॥

अब 'सममण्डलगः प्राणैर्दिनशेषैः' इन दोनों प्रश्नों के उत्तर को कहते हैं।

हि. भा.—उदय और सममराडल के अन्तर घटी उन्नत काल है, उन्नतकालज्या को अक्षज्या और लम्बज्या से गुणाकर जिनज्या गुणित त्रिज्या से भाग देने जो लब्ध हो उसका चाप मेषादि तीन राशि (प्रथम पद) में प्रश्न रहने से रवि होते है। यदि कर्कादि तीन राशि (द्वितीय पद) में प्रश्न रहे तो उस चाप को छः राशि में से घटाने से स्थूल रवि होते है। तुल्यादि छः राशिओं में सममराडल प्रविष्ट नही होता है इसलिये वहां प्रश्न ही निरर्थक है। स्थूल रवि भुजज्या को उन्नत कालज्या से भाग देना और प्रश्न सममण्डलासुक्रमज्या से गुणा करना इस तरह लब्ध के चाप से पदवश से सूक्ष्म रवि होते है। स्थूल रवि से चरज्या आदि सब से जो इष्ट हृति होती है वही प्रश्न सममण्डलासुक्रमज्या कहलाती है। पुनः 'तज्ज्या तदुदय सममराडलान्तरासुज्यया' इत्यादि से रवि का साधन करना, इस तरह दिन की गतशेष घटिकाओं से असकृत्कर्म द्वारा निश्चित सूर्य होते है इति ॥ २१-२३ ॥

उपपत्ति।

यहां आचार्य ने पहले उन्नत कालज्या को इष्टहृति कल्पित किया है। तब अग्रा, समशङ्कुतद्धृति इन तीनो भुजाओं से उत्पन्न एक अक्ष क्षेत्र है, तथा अक्षज्या, लम्बज्या-त्रिज्या इन तीनों भुजाओं से उत्पन्न द्वितीय अक्ष क्षेत्र है, ये दोनों अक्ष क्षेत्र सजातीय है इसलिये अनुपात करते हैं $\frac{\text{लंज्या. इहृ}}{\text{त्रि}}$ = समशङ्कु। तथा $\text{क्रांज्या} = \frac{\text{अज्या. समशङ्कु}}{\text{त्रि}}$

यहां समशङ्कु को उत्थापन देने से $\text{क्रांज्या} = \frac{\text{अज्या. लंज्या. इहृ}}{\text{त्रि. त्रि}}$, तथा $\frac{\text{त्रि. क्रांज्या}}{\text{जिज्या}}$ = रविभुजज्या, इसमें क्रान्तिज्या को उत्थापन करने से $\frac{\text{त्रि. अज्या. लंज्या. इहृ}}{\text{त्रि. त्रि. जिज्या}} = \frac{\text{अज्या. लंज्या. इहृ}}{\text{त्रि. जिज्या}}$ = रविभुजज्या यदि यहां इष्टहृति के स्थान में उन्नत कालज्या ग्रहण की जाय तब $\text{स्थूल रविभुजज्या} = \frac{\text{अज्या. लंज्या. उज्या}}{\text{त्रि. जिज्या}}$, $\text{सूक्ष्मरविभुजज्या} = \frac{\text{अज्या. लंज्या. इहृ}}{\text{त्रि. जिज्या}}$

अतः $\frac{\text{स्थूलरविभुज्या}}{\text{सूक्ष्मरविभुज्या}} = \frac{\text{उज्या}}{\text{इहृ}}$ तब $\text{सूक्ष्म रविभुजज्या} = \frac{\text{इहृ} \times \text{स्थूलरविभुज्या}}{\text{उज्या}}$ इससे बार

बार इष्टहृति वश से असकृत् कर्म द्वारा सूक्ष्मरविभुजज्या होती है; इसमे आचार्योक्त उपपन्न हुआ। सिद्धान्तशेखर मे 'कालेन येन समवृत्तमुपैति भानुः' इत्यादि संस्कृतोपपत्ति मे लिखित श्लोकों से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥ २१-२३ ॥

इदानीं नत प्राणान् वीक्ष्ययो ऽर्क वेत्तीत्यस्योत्तरमाह।

त्रिज्यादिनार्धसममराडलान्तरासुज्ययोः कृतिविशेषः।
स्वविषयविषुवच्छायावर्गेण गुणो द्विधा प्रथमः ॥ २४ ॥
व्यासार्धवर्गभक्तो लब्धं द्वादशजवर्गसंयुक्तम्।
छेदो द्वितीयराशेर्लब्धपदं क्रान्तिरर्कोऽतः ॥ २५ ॥

सु. भा.—दिनार्धसममण्डलान्तरासुज्या नतासुज्या नतज्या वा नतकालज्योच्यते। त्रिज्यानतज्ययोः कृतिविशेषः स्वदेशीयविषुवच्छायावर्गेण गुण्यो द्विधा स्थाप्यः। प्रथमो राशिर्व्यासार्धवर्गभक्तो यल्लब्धं तद् द्वादशजवर्गसंयुक्तं द्वितीयस्थाने स्थापितस्य द्वितीयराशेश्छेदो हरः स्यात् तस्माच्छेदाद्यल्लब्धं तस्य पदं क्रान्तिः क्रान्तिज्या स्यादतो विलोमविधिनाऽर्कः स्यादिति।

अत्रोपपत्तिः। सममण्डलप्रवेशेऽर्के द्युज्याचापांशाः कर्णः। सममण्डलनतांशा भुजो लम्बांशाः कोटिः। भुजसम्मुखकोणो नतकालः। ततस्त्रिसत्तावयवसिद्धान्तेन

$$\text{त्रि} \times \text{कोज्यान} = \frac{\text{त्रि} \times \text{ज्याक्रा}}{\text{द्यु}} \times \frac{\text{त्रि} \times \text{ज्यालं}}{\text{ज्याअ}} = \frac{\text{स्पक्रां} \times \text{त्रि} \times १२}{\text{वि}}$$

$$\therefore \quad \text{स्पक्रां} = \frac{\text{वि} \times \text{कोज्यान}}{१२}$$

$$\text{त्रि}^{2} + \text{स्प}^{2}\,\text{क्रा} = \text{छे}^{2}\,\text{क्रा} = \frac{१२^{2} \times \text{त्रि}^{2} + \text{वि}^{2} \times \text{कोज्या}^{2}\text{न}}{१२^{2}}$$

$$\text{ततः} \quad \text{ज्या}^{2}\,\text{क्रा} = \frac{\text{त्रि}^{2} \times \text{स्प}^{2}\text{क्रा}}{\text{छे}^{2}\text{क्रा}} = \frac{\text{वि}^{2} \times \text{कोज्या}^{2}\text{न} \times \text{त्रि}^{2}}{१२^{2} \times \text{त्रि}^{2} + \text{वि}^{2} \times \text{कोज्या}^{2}\text{न}}$$

$$= \frac{\text{वि}^{2} + \text{कोज्या}^{2}\text{न}}{१२^{2} + \frac{\text{वि}^{2} \times \text{कोज्या}^{2}\text{न}}{\text{त्रि}^{2}}}$$

अत उपपन्नमाचार्योक्तम्। 'तदा नतज्यात्रिभजीवयोर्यद्वर्गान्तरं तत् पलभाकृतिघ्नम्'—इत्यादि भास्करोक्तमेतदनुरूपमेवेति ॥ २४-२५ ॥

वि. भा.—दिनार्धसममराडलान्तरासुज्या नतकालज्या नतज्या वा कथ्यते। त्रिज्यानतज्ययोर्वर्गान्तरं स्वदेशीयपलभया सङ्गुण्य स्थानद्वये धार्यम्। प्रथमस्थाने स्थापितराशिस्त्रिज्यावर्गेण भक्तो यल्लब्धं तस्मिन् द्वादशवर्गयुतं कार्यं तदा

द्वितीयस्थाने स्थापितस्य राशेश्छेदः (हरः) स्यात्। तस्माद्धराद्यल्लब्धं तस्य लं क्रान्तिज्यास्यात्ततो विपरीतेन विधिना रविः साध्य इति।

अत्रोपपत्तिः।

नतांशलम्बांशद्युज्याचापांशोद्भवे त्रिभुजे रवेः सममण्डले स्थितत्वात्पूर्वा-रवृत्तस्य दृग्वृत्तरूपत्वाच खस्वस्तिकलग्नकोणः समकोणः। ध्रुवलग्नकोणो तकालः। उक्त त्रिभुजं जात्यात्मकम् यत्र द्युज्या चापांशाः कर्णः। तदा मध्यजा ोर्ज्या त्रिज्या गुणा प्रान्त्यस्पर्शरेखाहतिर्भवेदित्यादिना ध्रुवलग्नकोणं मध्यावयवं वीकृत्य स्थाने श्रवणकोणयोस्तकोटिमेव गृह्णीयादिति नियमेन च जातं स्वरूपम् $=$ त्रि $\times$ सूत्र $=$ स्पक्रां $\times$ स्पलं $= \frac{\text{क्रांज्या} \times \text{त्रि}}{\text{द्यु}} \times \frac{\text{लंज्या} \times \text{त्रि}}{\text{अज्या}}$। सूत्र$=$नत-कोटिज्या $= \frac{\text{क्रांज्या. लंज्या. त्रि}^2}{\text{द्यु}}$ $\therefore$ सूत्र$= \frac{\text{क्रांज्या. लंज्या. त्रि}^2}{\text{त्रि. द्यु. अज्या}} =$ $\frac{\text{क्रांज्या. लंज्या. त्रि}}{\text{द्यु. अज्या}}$ परन्तु $\frac{\text{लंज्या}}{\text{अज्या}} = \frac{१२}{\text{पभा}}$ $\therefore \frac{\text{क्रांज्या. लंज्या. त्रि}}{\text{द्यु. अज्या}} = \frac{\text{क्रांज्या. १२. त्रि}}{\text{द्यु. पभा}}$ $=$ सूत्र छेदगमेन क्रांज्या. १२. त्रि $=$ सू द्यु. पभा वर्गीकरणेन क्रांज्या^{2}.त्रि.१२$^2 =$ सू^{2}. द्यु^{2}. पभा^{2} परं त्रि$^2 -$ क्रांज्या$^2 =$ द्यु^{2} अत उत्थापनात् क्रांज्या^{2}. त्रि^{2} १२$^2 =$ सू^{2}. पभा^{2} (त्रि$^2 -$ क्रांज्या^{2}) $=$ सू^{2}. पभा^{2}. त्रि$^2 -$ सू^{2}. पभा^{2}. क्रांज्या^{2} पक्षयोः समयोजनेन क्रांज्या^{2}. त्रि^{2}. १२$^2 +$ सू^{2}. पभा^{2}. क्रांज्या$^2 =$ सू^{2}. पभा^{2}. त्रि$^2 =$ क्रांज्या^{2} (त्रि^{2}. १२$^2 +$ सू^{2}. पभा^{2}) ततः $\frac{\text{सू}^2\text{. पभा}^2\text{. त्रि}^2}{\text{त्रि}^2\text{. १२}^2 + \text{सू}^2\text{. पभा}^2} =$ क्रांज्या^{2}, हरभाज्यौ त्रि^{2} भक्तौ तदा $\frac{\text{सू}^2\text{. पभा}^2}{\text{१२}^2 + \frac{\text{सू}^2\text{. पभा}^2}{\text{त्रि}^2}} =$ क्रांज्या^{2}, मूलग्रहणेन $\frac{\text{सू. पभा}}{\sqrt{\text{सू १२}^2 + \frac{\text{पभा}^2\text{. सू}^2}{\text{त्रि.}^2}}} =$ क्रांज्या ततः $\frac{\text{त्रि} \times \text{क्रांज्या}}{\text{जिज्या}} =$ रविभुजज्या, अस्याश्चापं रविभुजांशाः स्युः। एतेनाचार्योक्तमुपप-न्नम्। सिद्धान्तशेखरे "समनरनतकालज्या त्रिमौर्वीकरण्योर्विवरमभिहतं तद्वैषु-वत्याश्च कृत्या। पृथगथपदजीवावर्गसंभक्तमाद्यं फलमिनकृतियुक्तं भाजकः सोऽन्यराशिः॥ फलस्य यत्पदं भवेदपक्रमस्य शिञ्जिनी। स्फुटं ततश्च पूर्ववत् प्रसाध येद्दिवाकरम्" श्रीपत्युक्तमिदं सिद्धान्तशिरोमणौ 'तदानतज्या त्रिभजीवयोर्यद्वर्गान्त-रमित्यादि' भास्करोक्तं चाचार्योक्तानुरूपमेवेति॥ २४-२५॥

अब 'नत प्राणान् वीक्ष्य योऽर्कं वेत्ति' इस प्रश्न के उत्तर को कहते हैं।

हि. भा.—त्रिज्या और नतज्या के वर्गान्तर को स्वदेशीय पलभा से गुणाकर दो स्थानों में स्थापन करना चाहिये प्रथम स्थान में स्थापित राशि को त्रिज्या वर्ग से भाग देकर

जो लब्ध हो उसमें बारह के वर्ग को जोड देना चाहिए वह द्वितीय स्थान में स्थापित द्वितीय राशि का हर होता है, उस हर से जो लब्धि होती है उसका मूल क्रान्तिज्या होती है, इससे विलोम विधि से रवि होते है इति ।। २४-२५ ।।

उपपत्ति ।

नतांश लम्बांश द्युज्याचापांश इन तीनों भुजों से उत्पन्न चापीय त्रिभुज मे रवि के सममण्डल में रहने के कारण दृग्वृत्त पूर्वा पर वृत्तानुकार ही है इसलिये उक्त चापीय त्रिभुज जात्यात्मक है जिसमें खस्वस्तिक लग्न कोण सम कोण है । अत: द्युज्याचापांश कर्ण है । ध्रुवलग्न कोण नतकाल है. तब उक्त चापीय जात्य त्रिभुज में 'मध्यजा दोर्ज्या त्रिज्या गुणा प्रान्त्यस्पर्श रेखाहतिर्भवेत्, स्थाने श्रवण कोणयोस्तत्कोटि मेव गृह्णीयात्' इस नियम से ध्रुवलग्न कोण को मध्यावयव मानने से—

सूत्र. त्रि = स्पक्रां. स्पलं $= \frac{\text{क्रांज्या. त्रि}}{\text{द्यु}} \times \frac{\text{लंज्या. त्रि}}{\text{अज्या}} = \frac{\text{क्रांज्या. लज्या. त्रि}^2}{\text{द्यु. अज्या}}$ । सूत्र = नतकोटिज्या $\therefore$ सूत्र $= \frac{\text{क्रांज्या. लज्या. त्रि}^2}{\text{त्रि. द्यु. अज्या}} = \frac{\text{क्रांज्या. लंज्या. त्रि}}{\text{द्यु. अज्या}}$, परन्तु $\frac{\text{लंज्या}}{\text{अज्या}} = \frac{१२}{\text{पभा}}$

इसलिए $\frac{\text{क्रांज्या. लंज्या. त्रि}}{\text{द्यु. अज्या}} = \frac{\text{क्रांज्या. १२. त्रि}}{\text{द्यु. पभा}}$ = सू छेदगम से क्रांज्या. त्रि. १२ = सू. द्यु. पभा वर्ग करने से क्रांज्या². त्रि². १२² = सू². पभा². द्यु², परन्तु त्रि² − क्रांज्या² = द्यु² अतः उत्थापन से क्रांज्या². त्रि². १२² = सू². पभा². (त्रि² — क्रांज्या²) = सू². पभा². त्रि² — सू². पभा² क्रांज्या² दोनों पक्षों में सू² पभा² क्रांज्या² जोड़ने से क्रांज्या². त्रि². १२² + सू² पभा² क्रांज्या² = सू². पभा². त्रि² = क्रांज्या² (त्रि². १२² + सू². पभा²) = सू². पभा². त्रि²

$\therefore \frac{\text{सू}^2\text{. पभा}^2\text{. त्रि}^2}{\text{त्रि. १२}^2 + \text{सू}^2 \text{ पभा}^2}$ = क्रांज्या² हर और भाज्य को त्रि² भाग देने से $\frac{\text{सू}^2\text{. पभा}^2}{\text{१२}^2 + \frac{\text{सू}^2\text{. पभा}^2}{\text{त्रि}^2}}$

= क्रांज्या, मूल लेने से $\frac{\text{सू. पभा}}{\sqrt{\text{१२}^2 + \frac{\text{सू}^2\text{. पभा}^2}{\text{त्रि}^2}}}$ = क्रांज्या, तब $\frac{\text{त्रि. क्रांज्या}}{\text{जिज्या}}$ = रविभुज्या,

चाप करने से रविभुजांश होता है । इससे आचार्योक्त उपपन्न हुआ ।। सिद्धान्त शेखर में 'समनरनतकालज्या त्रिमौर्वी करण्योः' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपत्युक्त प्रकार तथा सिद्धान्त शिरोमणि में 'तदा नतज्या त्रिभजीवयोर्यद्वर्गान्तरं' इत्यादि भास्करोक्त प्रकार आचार्योक्त के अनुरूप ही है इति ।। २४-२५ ।।

इदानीं समशङ्कुं वीक्ष्य यः सूर्यमानयतीत्यस्योत्तरमाह ।

सममण्डलशङ्कुगुणाऽक्षज्या जिनभागजीवया भक्ता
फलधनुरर्कोऽजादौ कर्कादौ प्रोह्य चक्रार्धात् ॥ २६ ॥

सु. भा.—अक्षज्या सममण्डलशङ्कुगुणा जिनजीवया भक्ता फलधनुरजादौ राशित्रये प्रथमपदेऽर्को भवति कर्क्यादौ द्वितीयपदे तद्धनुश्चक्रार्धात् प्रोह्यार्को ज्ञेय इति ।

अत्रोपपत्तिः । त्रिज्याकर्णे ऽक्षज्या भुजस्तदा सममण्डलशङ्कुकर्णे का जाता क्रान्तिज्या $= \frac{\text{सशं} \times \text{ज्या अ}}{\text{त्रि}}$ । ततो जिनज्यया त्रिज्या ऽर्कभुजज्या तदेष्ट-क्रान्तिज्यया किं जाताऽर्कभुजज्या $= \frac{\text{सशं} \times \text{ज्याअ}}{\text{ज्याजि}}$ । शेषवासना सुगमेति ॥२६॥

वि. भा.—अक्षज्या समशङ्कुगुणा जिनज्यया भक्ता लब्धफलस्य चापं मेषादिराशित्रये (प्रथमपदे) रविर्भवति कर्क्यादौ राशित्रये (द्वितीय पदे) तच्चापं षड्राशिभ्यो विशोध्य रविर्ज्ञातव्य इति ॥

अत्रोपपत्तिः ।

अक्षज्या, लम्बज्या, त्रिज्येति भुजकोटिकर्णात्मकस्य त्रिभुजस्य क्रान्तिज्या, कुज्योनतद्धृति, समशङ्कुभुजत्रयैरुत्पन्नत्रिभुजस्य च सजात्यादनुपातो यदि त्रिज्याकर्णेनाक्षज्याभुजस्तदा समशङ्कुकर्णेन क इति जाता क्रान्तिज्या $= \frac{\text{अज्या. सशङ्कु}}{\text{त्रि}}$, तथा जिनज्यया यदि त्रिज्या लभ्यते तदा क्रान्तिज्यया किं समागच्छति रवि भुजज्या $= \frac{\text{त्रि. क्रांज्या}}{\text{जिज्या}}$ अत्र क्रान्तिज्याया उत्थापनात् $\frac{\text{त्रि. क्रांज्या}}{\text{जिज्या}}$ $= \frac{\text{त्रि. अज्या. सशं}}{\text{जिज्या. त्रि}} = \frac{\text{अज्या. सशं}}{\text{जिज्या}} =$ रविभुज्या, अस्याश्चापं रविर्भवति मेषादि राशित्रये (प्रथमपदे), कर्क्यादि राशित्रये (द्वितीय पदे) तच्चापं षड्राशिभ्यो विशोध्यं शेषं रविः स्यात् । तुलादि षड्राशिषु समशङ्कोरभावात्तुलादेश्चर्चाऽऽचार्येण न कृता, एतावताऽऽचार्योक्तमुपपन्नम् । सिद्धान्त शेखरे "समवृत्त नरोऽक्षगुणेन हतो जिनभागभवेन गुणेन हृतः । फलचापमिनो भवति प्रथमे भदलात्पतितस्तु तदग्रपदे" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति ॥ २६ ॥

अब 'सममण्डल शङ्कुं वीक्ष्य यः सूर्यमानयति' इस प्रश्न के उत्तर को कहते हैं ।

हि. भा.—अक्षज्या को समशङ्कु से गुणा कर जिनज्या से भाग देने से जो फल

हो उसका चाप मेषादि तीन राशियों (प्रथम पद) में रवि होते है कर्क्यादि राशित्रय (द्वितीय पद) में उस चाप को छः राशियो मे से घटाने से रवि होते है इति ॥ २६ ॥

उपपत्ति ।

अक्षज्या, लम्बज्या, त्रिज्या यह भुज कोटि कर्णात्मक एक अक्ष क्षेत्र है, तथा क्रान्तिज्या, कुज्योन तद्धृति, समशङ्कु, यह भुज कोटि कर्णात्मक द्वितीय अक्ष क्षेत्र है, दोनो त्रिभुजों का सजातीयत्व से अनुपात करते है यदि त्रिज्या कर्ण मे अक्षज्याभुज पाते है तो समशङ्कु कर्ण में क्या इस अनुपात से क्रान्तिज्या आती है उसका स्वरूप $=\frac{\text{अज्या मश}}{\text{त्रि.}}$, क्रान्तिक्षेत्रद्वय के ज्याक्षेत्रों के सजातीयत्व से अनुपात करते है यदि जिनज्या भुज में त्रिज्या कर्ण पाते है तो क्रान्तिज्या भुज में क्या इससे रवि भुजज्या आती है $\frac{\text{त्रि. क्राज्या}}{\text{जिज्या}}=$ रविभुज्या, यहां क्रान्तिज्या को उत्थापन देने से $\frac{\text{त्रि. अज्या. सशं}}{\text{जिज्या. त्रि}}=$ रविभुज्या $=\frac{\text{अज्या. मश}}{\text{जिज्या}}$ इससे आचार्योक्त उपपन्न हुआ । सिद्धान्तशेखर में 'समवृत्तनरोऽक्षगुणेन हतः' इत्यादि सस्क्रतोपपत्ति में लिखित श्लोक से श्री पति ने आचार्योक्त के अनुरूप ही कहा है इति ॥ २६ ॥

इदानीं यः सममराडलकर्णं वीक्ष्य सूर्यमानयतीत्यस्योत्तरमाह ।

द्वादशगुणिताऽक्षज्या विषुवच्छायागुणाऽवलम्बज्या ।
सममराडलकर्णहृते क्रान्तिज्ये भास्करः प्राग्वत् ॥ २७ ॥

सु. भा.—अक्षज्या द्वादशगुणिता वाऽवलम्बज्या लम्बज्या विषुवच्छाया गुणा । उभे सममण्डलकर्णहृते तदा क्रान्तिज्ये भवतः । ततः प्राग्वद्भुजज्यया भास्करो भवतीति ॥

अत्रोपपत्तिः । 'त्रिज्यार्कघातः श्रुतिहृन्नरः स्यात्'—इति भास्करविधिना सममण्डलशङ्कुः $=\frac{१२\times\text{त्रि}}{\text{सक}}$ । ततस्त्रिज्यया ऽक्षज्या तदा समशङ्कुकर्णेन का जाता क्रान्तिज्या $=\frac{१२\times\text{त्रि}\times\text{ज्याअ}}{\text{त्रि}\times\text{सक}}=\frac{१२\times\text{ज्याअ}}{\text{सक}}=\frac{१२\times\text{ज्याअ}\times\text{ज्यालं}}{\text{ज्याल}\times\text{सक}}$
$=\frac{\text{वि}\times\text{ज्यालं}}{\text{सक}}$ अत उपपन्नम् ॥ २७ ॥

वि. भा.—अक्षज्या द्वादशगुणिता तथा लम्बज्या पलभया गुणिता, उभे सममराडलकर्णभक्ते तदा क्रान्तिज्ये भवतस्ततः पूर्ववद्रविः स्यादिति ॥ २७ ॥

अत्रोपपत्तिः ।

सममराडलच्छायाभुजः । द्वादशाङ्गुलशङ्कुः कोटिः सममराडलच्छायाकर्णः कर्णः, इत्येकं छायाक्षेत्रम् । दृग्ज्या भुजः । सममराडलशङ्कुः कोटिः । त्रिज्याकर्णः, इति द्वितीयं छायाक्षेत्रमनयोः साजात्यादनुपातः क्रियते यदि सममराडल कर्णेन द्वादशाङ्गुलशङ्कुः कोटिर्लभ्यते तदा त्रिज्यया किं समागच्छति समशङ्कुस्तत्स्वरूपम् $= \frac{\text{त्रि. १२}}{\text{सक}}$, ततो यदि त्रिज्या कर्णेनाऽक्षज्याभुजो लभ्यते तदा समशङ्कु कर्णेन किं जाता क्रान्तिज्या$=\frac{\text{अज्या. सशं}}{\text{त्रि.}}$ अत्र समशङ्कोरुत्थापनेन $\frac{\text{अज्या. त्रि. १२}}{\text{सक. त्रि}}=\frac{\text{अज्या. १२}}{\text{सक}}$ $=$क्रांज्या । अथ $\frac{\text{अज्या. १२}}{\text{सक}}=$ क्रांज्या, अत्र हरभाज्यौ लम्बज्यया गुणितौ तदा $\frac{\text{अज्या. १२ लंज्या}}{\text{सक. लंज्या}}=$क्रांज्या, परं $\frac{\text{अज्या. १२}}{\text{लज्या}}=$पलभा, अतः $\frac{\text{लंज्या. पभा}}{\text{सक}}$ $=$ क्रान्तिज्या, एतावताऽऽचार्योक्तमुपपन्नम् । सिद्धान्तशेखरे "सूर्याक्षभाघ्ने पललम्बजीवे कर्णेन भक्ते समशङ्कुजेन । क्रमाद् भवेतामपमज्यके ते विकर्त्तनः प्राक्तनकर्मणाऽतः" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति ॥ सूर्यसिद्धान्तेऽपि "लम्बाक्षजीवे विषुवच्छाया द्वादशसङ्गुणे । क्रान्तिज्याप्ते तु तौ कर्णौ सममराडलगे रवौ' इति सममराडल कर्णानयनवैपरीत्येन क्रान्तिज्ये समागच्छतः" प्रकारोऽयमाचार्योक्त सदृश एव । ततः क्रान्तिज्यावशेन पूर्ववद्रविर्भवतीति ॥ २७ ॥

अब 'यः सममराडल कर्णं रविमानयति' इस प्रश्न के उत्तर को कहते हैं ।

हि. भा,—अक्षज्या को बारह से गुणा करना तथा लम्बज्या को पलभा से गुणा करना, दोनों को सममराडल कर्ण से भाग देने से क्रान्तिज्या होती है, इससे पूर्ववत् रवि होते हैं इति ॥

उपपत्ति ।

क्रान्तिज्या भुज, कुज्योन तद्धृति कोटि, समशङ्कु कर्ण, यह अक्ष क्षेत्र है तब अनुपात करते है । यदि अक्षज्या भुज में त्रिज्या कर्ण पाते हैं तो क्रान्तिज्याभुज में क्या इससे समशङ्कु प्रमाण आता है । $\frac{\text{त्रि. क्रांज्या}}{\text{अज्या}}$ $=$सशङ्कु । तब समशङ्कु कोटि में त्रिज्या कर्ण तो द्वादश कोटि मे क्या इससे सममराडल कर्ण आता है इसका स्वरूप $\frac{\text{त्रि. १२}}{\text{सश}}$ $=$ समकर्ण,

यहां समशङ्कु को उत्थापन देने से $\frac{\text{त्रि. १२}}{\frac{\text{त्रि. क्रांज्या}}{\text{अज्या}}} = \frac{\text{त्रि. १२. अज्या}}{\text{त्रि. क्रांज्या}} = \frac{\text{१२ अज्या}}{\text{क्रांज्या}}$ = समकर्ण

= सक ∴ $\frac{\text{१२. अज्या}}{\text{सक}}$ = क्रांज्या, यहां हर और भाज्य को लम्बज्या से गुणा करने से

$\frac{\text{१२. अज्या. लंज्या}}{\text{सक. लज्या}} = \frac{\text{पभा. लज्या}}{\text{सक}}$ = क्रांज्या इससे आचार्योक्त उपपन्न हुआ। सिद्धान्तशेखर में 'सूर्याक्षभाघ्ने पललम्बजीवे' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है। तथा सूर्य सिद्धान्त में 'लम्बाक्षजीवे विषुवच्छाया द्वादशसङ्गुणे' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से समकर्णानयनन के विलोम से क्रान्तिज्या के मान आते हैं, यह प्रकार भी आचार्योक्त प्रकार के अनुरूप ही है। क्रान्तिज्या से पूर्ववत् रविज्ञान होता है इति॥ २७॥

इदानीं 'यो रविसममण्डलशङ्कुज्ञोऽक्षं कथयति', प्रश्नस्यास्योत्तरमाह।

परमापक्रमजीवा तात्कालिकसूर्यबाहुसङ्गुणिता।
सममण्डलशङ्कुहृताऽक्षज्या तच्चापमक्षांशाः॥ २८॥

सु. भा.—परमापक्रमजीवा जिनज्या तात्कालिक सूर्यबाहुसंगुणिता तात्कालिकसूर्यभुजज्यया गुणा समशङ्कुभक्ता ऽक्षज्या भवति तच्चापमक्षांशाः स्युरिति।

अत्रोपपत्तिः। त्रिज्यया जिनज्या तदाऽर्कबाहुज्यया किं जाता क्रान्तिज्या $= \frac{\text{ज्याजि} \times \text{ज्याभु}}{\text{त्रि}}$। समशङ्कुकर्णेन क्रान्तिज्या भुजस्तदा त्रिज्याकर्णेन किं जाताऽक्षज्या $= \frac{\text{ज्याजि} \times \text{ज्याभु}}{\text{सशं}}$। शेषवासना सुगमा॥ २८॥

वि. भा.—परमक्रान्तिज्या तात्कालिकरविभुजज्यया गुणिता समशङ्कुभक्ता तदाऽक्षज्या भवति, तच्चापमक्षांशाः स्युरिति॥ २८॥

अत्रोपपत्तिः।

यदि त्रिज्यया परमक्रान्तिज्या लभ्यते तदा रविभुजज्यया किमिति क्रान्तिक्षेत्रानुपातेन समागच्छति क्रान्तिज्या तत्स्वरूपम् $= \frac{\text{जिज्या. रभुज्या}}{\text{त्रि.}}$। ततः समशङ्कुकर्णेन क्रान्तिज्या भुजो लभ्यते। तदा त्रिज्याकर्णेन किं समागच्छत्यक्षज्या $= \frac{\text{क्रांज्या. त्रि}}{\text{सशं}}$ अत्र क्रान्तिज्याया उत्थापनात् $\frac{\text{जिज्या. रभुज्या. त्रि}}{\text{त्रि. सशं}}$

$= \frac{\text{जिज्या. रभुज्या}}{\text{सशं}}$ = अक्षज्या, अस्याश्चापम् = अक्षांशाः । एतावताऽऽचार्योक्तमुपपन्नम् ॥ सिद्धान्त शेखरे "जिनांशजीवा रविबाहुघातो नरेण भक्तः समवृत्तजेन । भवेत्पलज्या निजदेशजावा कोदराडमस्यास्तु पलांशकाः स्युः" श्रीपत्युक्तमिदमक्षरश आचार्योक्तानुरूपमेवेति ॥ २८ ॥

अब 'यो रवि सममण्डलशङ्कुज्ञोऽक्षं कथयति' इस प्रश्न के उत्तर को कहते हैं ।

हि. भा.—परम क्रान्तिज्या को तात्कालिक रविभुजज्या से गुणा कर समशङ्कु से भाग देने से अक्षज्या होती है, इसका चाप अक्षांश होता है इति ॥ २८ ॥

उपपत्ति ।

यदि त्रिज्या में परम क्रान्तिज्या पाते हैं तो रवि भुजज्या में क्या इस क्रान्तिक्षेत्रानुपात से क्रांन्तिज्या आती है उसका स्वरूप $\frac{\text{जिज्या. रभुज्या}}{\text{त्रि}}$ = क्रांज्या । पुनः अनुपात करते है यदि समशङ्कु कर्ण में क्रान्तिज्या भुज पाते है तो त्रिज्या कर्ण में क्या इससे अक्षज्या आती है $\frac{\text{क्राज्या. त्रि}}{\text{सशं}}$ = अज्या, यहां क्रान्तिज्या को उत्थापन देने से $\frac{\text{जिज्या. रभुज्या. त्रि}}{\text{त्रि. सश}}$ $= \frac{\text{जिज्या. रभुज्या}}{\text{सशं}}$ = अज्या, इसका चाप = अक्षांश, इससे आचार्योक्त उपपन्न हुआ । सिद्धान्त शेखर में 'जिनांश जीवा रविबाहुघातः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥ २८ ॥

इदानीमुदयैर्विना यो रविलग्नान्तरघटिकां वेत्तीत्यस्योत्तरमाह ।

लङ्कोदयचरदलवद्रविलग्नाभ्यां पृथक् पृथक् प्राणान् ।
कृत्वा तदन्तरैक्यं मृगकर्क्यादौ पृथग् लिप्ताः ॥ २९ ॥
मेषादिषु कर्क्यादिषु शोध्या भार्धात् तुलादिषु सभार्धाः ।
मकरादिषु संशोध्याश्चक्राद्रविभुक्तलिप्तोनाः ॥ ३० ॥
लग्नकला यद्यूनाः सचक्रलिप्ता विना स्वराश्युदयैः ।
एवं स्फुटाभवन्त्यर्कलग्नयोरन्तरे प्राणाः ॥ ३१ ॥

सु. भा.—भुजज्या परमाल्पद्युज्यया गुण्या स्वद्युज्यया भाज्या फलचापकलाः सम्पातात्लङ्कोदयासवः स्युरिति । भुजज्या जिनज्यागुणा त्रिज्याभक्ता क्रान्तिज्या भवति । सा पलभागुणा द्वादशहृता कुज्या । कुज्या त्रिज्यागुणा द्युज्याहृता चरज्या । तच्चापकलाश्चरासवः स्युरिति । एवं रविभुजज्यया लग्नभुजज्यया च लङ्कोदयचरदलवत् पृथक् पृथक् प्राणान् लङ्कोदयासून् चरासूंश्च कृत्वा

मृगादौ तदन्तरं कर्क्यादौ तु तदैक्यं कृत्वोभयो रविलग्नयोर्लिप्ता स्वदेश्युदयासवो मेषादिषु प्रथमे पदे भवन्ति । कर्क्यादिषु द्वितीये पदे ते ऽसवो भार्धाच्छोध्यास्तुला-दिषु तृतीये पदे स भार्धा मकरादिषु चतुर्थे पदे चक्रात् संशोध्यास्तदा स्वदेश्युदयासवो भवन्ति । ततो लग्नकला लग्नोदयासवो रविभुक्तलिप्तोना रव्युदयासुभिर्हीना यदि न शुध्यन्ति तदा सचक्रलिप्ता लग्नोदयासवो रव्युदयासुभिर्हीना. सेग स्वराश्युदयै-र्विनैवमर्कलग्नयोरन्तरे स्फुटाः प्राणा असवो भवन्ति ।

अत्रोपपत्तिः । स्वदेशोदयसाधनविधिना स्फुटा । इह रविरेकः क्रान्तिवृत्तीय प्रदेशो लग्न चापरस्तयोः स्वदेशोदयासून मेषादितो गोलचापीयक्षेत्रयुक्त्या प्रसाध्य तदन्तरमिष्टासव आनीताः । मृगकर्क्यादौ तदन्तरैक्यमित्यादेर्वासिना गोलयुक्त्या स्फुटेति ॥ २९-३१ ॥

वि. भा.—रविलग्नाभ्यां (रविभुजज्यया लग्नभुजज्यया च लङ्कोदय-चरदलवत् पृथक् पृथक् प्राणान् (लङ्कोदयासून्) चरासूंश्च कृत्वा मकरादौ केन्द्रे तदन्तरं कर्क्यादौ तयोर्युतिं कृत्वा रविलग्नयोर्लिप्ता मेषादिषु राशित्रयेषु (प्रथमेपदे) स्वदेश्युदयासवो भवन्ति । कर्क्यादिराशित्रये (द्वितीयपदे) तेऽसवः षड्राशिभ्यः शोध्यास्तुलादिराशित्रये (तृतीयपदे) तेऽसवो राशिषट्कयुता मकरादि-राशित्रये (चतुर्थपदे) तेऽसवो द्वादशराशिभ्यः शुद्धास्तदा स्वदेश्युदयासवः स्युः । ततो लग्नकला (लग्नोदयासवः) रव्युदयासुभिर्हीना यदि न शुध्यन्ति तदा लग्नो-दयासवश्चक्रकलाभिः सहितास्तत्र रव्युदयासवः शोध्यास्तदा स्वदेशराश्युदयैर्विना रविलग्नान्तरे स्फुटा असवो भवन्ति ॥

अत्रोपपत्तिः ।

राश्यादिबिन्दुर्यदा निरक्षक्षितिजे समागच्छति तस्मात्कालाद्यावता कालेन राश्यन्तबिन्दुस्तत्क्षितिजे समागच्छेदर्थाद्राश्याद्युपरिध्रुवप्रोतवृत्तराश्यन्तोपरिगत-ध्रुवप्रोतवृत्तयोरन्तर्गतं नाड़ीवृत्तीयचापं तद्राशे निरक्षोदयासवः । यथा मेषाद्युपरिगतध्रुवप्रोतवृत्तमेषान्तोपरिगत ध्रुवप्रोतवृत्तयोरन्तर्गतं नाड़ीवृत्तीयचापं मेषस्य निरक्षोदयमानम् । एवं वृषादिवृषान्तोपरिगतध्रुवप्रोतवृत्तयोरन्तर्गतं वृषस्य निरक्षोदयमानम् । एवं मिथुनस्यापि, एतावता मेषस्य भुजांशा एको भुजः । तत्क्रान्तिर्द्वितीयो भुजः । मेषनिरक्षोदयमान (विषुवांशाः) तृतीयो भुज इति भुज-त्रयैरेकं चापजात्यम् । तथा ध्रुवान्मेषान्तबिन्दुं यावन्मेषान्तद्युज्याचापमेकोभुजः । ध्रुवादयनप्रोतवृत्तक्रान्तिवृत्तयोः सम्पातं यावत्परमाल्पद्युज्याचापं द्वितीयो भुजः । क्रान्तिवृत्ते मेषान्तभुजकोट्यंशास्तृतीयो भुज इति भुजत्रयैरुत्पन्नं द्वितीय-चापजात्यम् । अनयोस्त्रिभुजयोर्ज्याक्षेत्रसाजात्यादनुपातः क्रियते यदि मेषान्त-द्युज्यया परमाल्पद्युज्या लभ्यते तदा मेषान्तभुजज्यया किं समागच्छति मेष-

निरक्षोदयमानज्या तत्स्वरूपम् $= \frac{\text{पद्यु. मेभुज्या}}{\text{मेद्यु}}$ अस्याश्चापं मेषनिरक्षोदयमानम्। एवं गोलसन्धितो वृषान्तं यावद्वृषान्तभुजांशा एको भुजः। वृषान्तक्रान्तिर्द्वितीयो भुजः। नाड़ीवृत्ते मेषान्तवृषान्तनिरक्षोदयमानयोर्योगरूपवृषान्तविषुवांशास्तृतीयो भुज इति भुजत्रयैरुत्पन्नमेकं चापजात्यम्। तथा वृषान्तद्युज्याचापमेको भुजः। परमाल्पद्युज्याचापं द्वितीयो भुजः। वृषान्तभुजकोटयंशास्तृतीयो भुज इति भुजत्रयैरुत्पन्नं द्वितीयचापजात्यम्। अनयोश्चापजात्ययोर्ज्याक्षेत्रसाजात्यादनुपातो यदि वृषान्तद्युज्यया परमाल्पद्युज्या लभ्यते तदा वृषान्तभुजज्यया कि समागच्छति मेषान्तवृषान्तयोर्निरक्षोदयमानयोगज्या तत्स्वरूपम् $= \frac{\text{पद्यु. वृभुज्या}}{\text{वृद्यु}}$ $=$ज्या (मे निरक्षोदय $+$ वृनिरक्षोदय) अस्याश्चापम् $=$ मेनिरक्षोदय $+$ वृनिरक्षोदय अत्र मेनिरक्षोदयमानस्य शोधनेन शुद्धं वृनिरक्षोदयमानं भवेदेवमग्रेऽपि[1]। अनया रीत्या लङ्कोदयासवो भवन्ति। तथा क्रान्तिक्षेत्रयोर्ज्याक्षेत्रसाजात्यादनुपातेन यदि त्रिज्यया जिनज्या लभ्यते तदा रविभुजज्यया किं समागच्छति क्रान्तिज्या तत्स्वरूपम् $= \frac{\text{जिज्या. रभुज्या}}{\text{त्रि}}$ ततः 'अग्रा, क्रान्तिज्या-कुज्ये'-ति कर्णकोटिभुजैरुत्पन्नमेकमक्षक्षेत्रम्। पलकर्णद्वादशपलभाभिः कर्णकोटिभुजैरुत्पन्नं द्वितीयमक्षक्षेत्रम्। अनयोः साजात्यादनुपातः $\frac{\text{पभा. क्रांज्या}}{१२}$ $=$कुज्या ततः ध्रुवात्क्षितिजाहोरात्रवृत्तसम्पातोपरिगतध्रुवपोतवृत्तनाड़ीवृत्तयोः सम्पातं यावद् ध्रुवप्रोतवृत्ते नवत्यंशा एको भुजः। ध्रुवात्पूर्वस्वस्तिकं यावदुन्मण्डले नवत्यंशा द्वितीयो भुजः। पूर्वस्वस्तिकाद् ध्रुवप्रोतवृत्तनाड़ीवृत्तयोः सम्पातं यावच्चरासवस्तृतीयो भुजः। इति भुजत्रयैरुत्पन्नमेकं त्रिभुजम्। ध्रुवात् क्षितिजाहोरात्रवृत्तयोः सम्पातं यावद् ध्रुवप्रोतवृत्ते द्युज्याचापमेको भुजः। ध्रुवादुन्मण्डलाहोरात्रवृत्तयोः सम्पातं यावद् द्युज्याचापं द्वितीयो भुजः। अहोरात्रवृत्ते कुज्याचापं तृतीयो भुज इति भुजत्रयैरुत्पन्नं द्वितीयत्रिभुजम्। अनयोर्ज्याक्षेत्रसाजात्यादनुपातः क्रियते यदि द्युज्यया कुज्या लभ्यते तदा त्रिज्यया किं समागच्छति चरज्या तत्स्वरूपम् $= \frac{\text{कुज्या. त्रि}}{\text{द्यु.}}$ पूर्वानीतकुज्या स्वरूपेणोत्थापनात्

$\frac{\text{पभा. क्रांज्या. त्रि}}{\text{द्यु १२}}$ $=$चरज्या एतस्याश्चापकलाश्चरासवः स्युः। सिद्धान्त शिरोमणौ

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१. सिद्धान्तशिरोमणौ "मेषादि जीवास्त्रिगृहद्युमौर्व्या क्षुण्णा हृताः स्वस्वदिनज्ययाप्ता" इत्यादि भास्करप्रकारः सिद्धान्तशेखरे "अन्त्यद्युज्या विनिघ्नाः क्रियवृषमिथुनज्या हृताः स्वद्युमौर्व्या प्राणानां चापलिप्ता विरचितविवराः स्युर्निरक्षोदयास्ते" इति श्रीपति प्रकारश्चैवमेवेति।

"अक्षप्रभासङ्गुणितापमज्यातद्द्वादशांशो भवति क्षितिज्या। सा त्रिज्यकाघ्नी विहृता द्युमौर्व्या चरज्यकाऽस्याश्च धनुश्चरं स्यादिति" भास्करोक्तप्रकार-इत्थमेवास्ति। एवं रविभुजज्यया लग्नभुजज्यया चोपरि प्रदर्शितलङ्कोदय-चरदलसाधनवत् पृथक् पृथक् लङ्कोदयासून् चरासूंश्चानीय मकरादौ तदन्तरं कर्क्यादौ तदैक्यं (तद्योग.) रविलग्नयोर्लिप्ताः स्वदेश्युदयासवो मेषादिराशित्रये (प्रथमपदे) भवन्ति। कर्क्यादिषु राशित्रयेषु (द्वितीयपदे) तेऽसव षड्राशिभ्यः शोध्याः। तुल्यादिराशित्रये (तृतीयपदे) तेऽसवः षड्राशियुता मकरादिराशि-त्रये (चतुर्थपदे) तेऽसवो द्वादशराशिभ्यः शोध्यास्तदा स्वदेशीयराश्युदयाः स्युः। ततो यदि लग्नकलाभ्यो रविकलाः शोधयितुं न शक्यन्ते तदा ताः सचक्रलिप्ताः कृत्वा रविभुक्तकलाः शोध्याः शेषा रविलग्नयोरन्तरे स्फुटा असवः स्युरिति॥ सिद्धान्तशेखरे "कृत्वा लङ्कोदयवदुदयासूंश्चरासूंश्च भानोस्तद्विश्लेषो मकरभवनादौ युतिः कर्कटादौ। लग्नाच्चैव प्रथमैकपदे प्रस्फुटास्ते परेषु भार्धाच्छुद्धा भदल-सहिताश्चक्रशुद्धाः पदेषु॥ स्पष्टा भवन्ति कलिकाश्च पृथक् पृथक् ता भास्वत्कला-विरहिताश्च विलग्नलिप्ताः। ऊनाः सचक्रकलिका रविलग्नमध्यप्राणा भवन्ति हि विनैव निजोदयैर्वेति" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति सुधियो विभावयन्तु॥ २९-३१॥

अब 'उदयैर्विना यो रविलग्नान्तरघटिकां वेत्ति' इस प्रश्न के उत्तर को कहते हैं।

हि. भा.—रविभुजज्या और लग्नभुजज्या से पृथक् पृथक् निरक्षोदयज्या और चर-ज्या साधनकर चाप करने से निरक्षोदयासु और चरासु ले आकर मकरादि में दोनों के अन्तर कर्क्यादि में दोनों का योग करने से रविलिप्ता और लग्न की लिप्ता मेषादि राशित्रय (प्रथमपद) में स्वदेशीय राश्युदयासु होती है। कर्क्यादि राशित्रय (द्वितीय पद) में उस असु को छः राशियों में से घटाना चाहिए, तुलादि राशित्रय (तृतीय पद) में उस असु में छः राशि जोड़ना चाहिये। मकरादि राशित्रय (चतुर्थ पद) में उस असु को बारह राशि में से घटाने से स्वदेशीय राश्युदयासु होती है। तब लग्नोदयासु में से रव्युदयासु को घटाना, यदि नहीं घटे तो लग्नोदयासु में चक्र कला सहित कर उसमें रव्युदयासु को घटाने से रवि और लग्न की स्फुट अन्तरासु होती है इति॥ २९-३१॥

उपपत्ति।

राश्यादि बिन्दु जब निरक्षक्षितिज में आता है उसके बाद जितने काल में राश्यन्त बिन्दु निरक्ष क्षितिज में आता है वही काल उस राशि का निरक्षोदयासु है अर्थात् राश्याद्युपरिगत ध्रुव प्रोतवृत्त नाड़ीवृत्त के सम्पात बिन्दु से राश्यन्तोपरिगत ध्रुवप्रोतवृत्त नाड़ीवृत्त के सम्पात पर्यन्त उस राशिका निरक्षोदयासु है। जैसे मेषादि (गोल सन्धि) के ऊपर ध्रुव प्रोतवृत्त नाड़ी-वृत्त के सम्पात से मेषान्तोपरिगत ध्रुव प्रोतवृत्त नाड़ीवृत्त के सम्पात पर्यन्त मेषका निरक्षोद-

यमान है। एवं वृषाद्युपरिगत ध्रुवप्रोतवृत्त नाडीवृत्त के सम्पात से वृषान्तोपरिगत ध्रुवप्रोतवृत्त नाड़ीवृत्त के सम्पात पर्यन्त वृष का निरक्षोदयमान है। इसी तरह मिथुन का भी समझना चाहिये। अब राशियों के निरक्षोदयमान साधन करते है। मेष का भुजांश एक भुज मेषान्तक्रान्ति द्वितीय भुज। मेषादि से मेषान्तोपरिगत ध्रुव प्रोतवृत्त नाड़ीवृत्त के सम्पात बिन्दु पर्यन्त मेष का विषुवांश (मेष निरक्षोदयमान) तृतीय भुज। इन तीनों भुजाओं से उत्पन्न एक चापजात्य त्रिभुज है। तथा ध्रुव से मेषान्त बिन्दु पर्यन्त मेषान्तद्युज्या चाप एकभुज। परमाल्पद्युज्याचाप द्वितीय भुज। क्रान्तिवृत्त में मेषान्तभुज कोटयंश तृतीय भुज। इन तीनों भुजाओं से उत्पन्न द्वितीय चापजात्य त्रिभुज है, दोनों त्रिभुजो के ज्याक्षेत्र सजातीय हैं इसलिए अनुपात करते है यदि मेषान्त द्युज्या में परमाल्प द्युज्या पाते हैं तो मेष भुजज्या में क्या इस अनुपात से मेष की निरक्षोदयमानज्या आती हैं उसका स्वरूप $=\frac{\text{पद्यु. मेभुजज्या}}{\text{मेद्यु}}=$ मे निरक्षोदयज्या। इसका चाप करने से मेषका निरक्षोदयमान होता है। एवं वृषान्तद्युज्या चाप एक भुज। परमाल्प द्युज्या चाप द्वितीय भुज। वृषभुजांश कोटि तृतीय भुज, इन तीनों भुजाओं से उत्पन्न एक चाप जात्य है। तथा गोल सन्धि से वृषान्त तक वृषभुजांश एक भुज। वृषान्त क्रांति द्वितीय भुज। गोल सन्धि से वृषान्तोपरिगत ध्रुवप्रोतवृत्तनाड़ीवृत्त का सम्पात पर्यन्त तृतीय भुज, इन तीनों भुजाओं से उत्पन्न द्वितीय चापजात्य त्रिभुज है। दोनो चापीय जात्य त्रिभुजों के सजातीयत्व से अनुपात करते हैं यदि वृषान्त-द्युज्या में परमाल्प द्युज्या पाते हैं तो वृष भुजज्या में इस अनुपात से मेषनिरक्षोदय और वृषनिरक्षोदयमान की योगज्या आती है $\frac{\text{पद्यु. वृभुज्या}}{\text{वृद्यु}}=$ ज्या (मेनिरक्षोदय+वृनिरक्षोदय) इस के चाप में मेषोदयमान को घटाने से शुद्ध वृषका निरक्षोदय मान होता है। इसीतरह मिथुन का भी साधन करना। तथा त्रिज्या में जिनज्या पाते हैं तो रवि भुजज्या में क्या इस अनुपात से क्रान्तिज्या आती है उसका स्वरूप $=\frac{\text{जिज्या. रभुज्या}}{\text{त्रि}}=$ क्रांज्या। तब पलभा भुज, द्वादशाङ्गुल शङ्कु-कोटि, पलकर्ण कर्ण इन तीनो भुजाओं से एक अक्षक्षेत्र है। कुज्या भुज, क्रांतिज्या कोटि, अग्रा कर्ण इन तीनों भुजाओं से उत्पन्न द्वितीय अक्षक्षेत्र है, दोनों त्रिभुज सजातीय हैं इस लिये अनुपात करते है $\frac{\text{पभा. क्रांज्या}}{१२}=$ कुज्या, अब ध्रुव से क्षितिजाहोरात्रवृत्त सम्पातोपरिगत ध्रुवप्रोतवृत्तनाड़ीवृत्त के सम्पात पर्यन्त ध्रुवप्रोतवृत्त मे नवत्यंश चाप एक भुज। ध्रुव से पूर्व स्वस्तिक पर्यन्त उन्मण्डल में द्वितीयभुज। पूर्व स्वस्तिक से ध्रुवप्रोतवृत्त नाड़ीवृत्त के सम्पात बिन्दु पर्यन्त नाड़ीवृत्त में चरासु तृतीयभुज। यह एक चापीय त्रिभुज है तथा ध्रुव से क्षितिजाहोरात्रवृत्त के सम्पात तक द्युज्या चाप एकभुज। ध्रुव से उन्मण्डलाहोरात्रवृत्त के सम्पात तक उन्मण्डल में द्वितीयभुज। क्षितिज और उन्मण्डल के अन्तर्गत अहोरात्र वृत्त में कुज्यांश तृतीय भुज। इन तीनों भुजाओं से द्वितीय त्रिभुज है। दोनों का ज्याक्षेत्र सजातीय है इसलिये अनुपात करते हैं यदि द्युज्या में कुज्या पाते हैं तो त्रिज्या में क्या इस

अनुपात से चरज्या आती है $\frac{\text{कुज्या. त्रि}}{\text{द्यु}}$ =चरज्या, इसमें पूर्वानीत कुज्या से उत्थापन देने से $\frac{\text{पभा. क्रांज्या. त्रि}}{\text{१२. द्यु}}$ =चरज्या, इसका चाप चरासु प्रमाण है। सिद्धान्त शिरोमणि में 'अक्षप्रभा सङ्गुणिता पमज्या तद् द्वादशांशो भवति क्षितिज्या' इत्यादि से भास्कराचार्य ने भी चरासु के आनयन इसी तरह किये है। इस तरह रविभुजज्या और लग्न भुजज्या उपर्युक्त नियम से लङ्कोदय चर दलवत् पृथक् पृथक् लङ्कोदयासु और चरासु लाकर मकरादि में दोनों का अन्तर कर्क्यादि में दोनों के योग रविलग्न की कला स्वदेशीय राश्युदयासु मेषादि तीन राशि में (प्रथम पद) होती है। कर्क्यादि तीन राशि (द्वितीय पद) में उस असु को छः राशियों में से घटाना चाहिए। तुलादि तीन राशि (तृतीय पद) में उस असु में छः राशि जोड़ना चाहिये। मकरादि तीन राशि (चतुर्थ पद) में उस असु को बारह राशियों मे से घटाना चाहिये तब स्वदेशीय राश्युदयासुमान होता है। उसके बाद यदि लग्नकला में रवि-कला नही घटे तब लग्न कला में चक्रकला जोड़ कर रविकला को घटाने से शेष रवि और लग्न का अन्तर.सु प्रमाण स्फुट ही होता है। सिद्धान्तशेखर मे 'कृत्वा लङ्कोदयवदुदयासूं-श्चरासूंश्च भानोः' इत्यादि श्लोकों से श्रीपति ने आचार्योक्त प्रकार के अनुरूप ही कहा है इति ॥ २९-३१ ॥

इदानीं स्वदेशोदयैर्विनेष्टघटिकाभिर्लग्नं यो जानातीत्यस्योत्तरमाह।

अष्टयमाः शून्यगुणा दिगिषुकलोना रदाः सतिथिलिप्ताः।
स्वचरार्धांशैरूना विपरीताः संयुता व्यस्तैः॥ ३२॥
व्यस्ताश्चाजादीनां कालांशैर्लग्नमिष्टघटिकांशैः।
लग्नाद् घटिकाः कालांशकैर्विनैवं स्वराश्युदयैः॥ ३३॥

सु. भा.—अष्टयमा दिक्कलोना मेषस्य ध्रुवांशाः २७°। ५०'। शून्यगुणा इषुकलोना वृषस्य २९°। ५५'। रदाः सतिथिलिप्ता मिथुनस्य ३२°। १५' ध्रुवांशाः। एते स्वचरार्धांशैरूनास्तथा त एव विपरीता व्यस्तैर्मेषादिचरांशैः संयुतास्तत एत एव व्यस्ताः स्थाप्याः। एवमजादीनां द्वादशराशीनां स्वदेशे कालांशाः स्युः। ततः कालांशैरिष्टघटिकांशैश्च लग्नानयनविधिना लग्नं लग्नाच्च कालांशकैरिष्ट-घटिका भवन्ति। एवं स्वराश्युदयैर्विनैव लग्नमिष्टघटिकाश्च भवन्तीति।

अत्रोपपत्तिः। ये लङ्कोदयासवस्ते षष्टिहृता अंशात्मकमुदयमानं लङ्कायां प्रसाध्य ध्रुवांशाः पठितास्तेभ्यश्चरांशैः स्वदेशोदया अंशात्मकाः साधितास्ततः सजातीयेष्टघटिकांशैर्लग्नाद्यानयनं सुगममिति। मेषादीनां लङ्कोदयासवः मे० १६७०। वृ० १७९३। मि० १९३७। एते षष्टिभक्ता ध्रुवांशाः २७। ५०॥ २९°।

५३ ॥ ३२ । १७ प्राचीनानां मते जीवाखण्डानां स्थूलत्वाद् द्वितीयतृतीयोदयौ १७९५ । १९३५ । अतो ध्रुवांशा आचार्योक्ता एवायान्ति ॥ ३२-३३ ॥

वि. भा.—लङ्कोदयाः षष्टया भक्ताः कालांशा (ध्रुवांशाः) भवन्ति, ते च मेषस्य दशकलोना अष्टाविंशतिर्भागाः = २७°।५०', पञ्चकलोनास्त्रिशद्भागा वृषस्य = २९°।५५', पञ्चदश कलाधिका द्वात्रिंशद्भागा मिथुनस्य = ३२°।१५', चरार्धासूनपि षष्टयोद्धृत्य चरार्धांशाः साध्याः। एतैश्चरार्धांशैः क्रमन्यस्ता मेषादि ध्रुवांशाः (कालांशाः) हीनाः, उत्क्रमन्यस्ताश्च व्युत्क्रमाद्योज्याः। एव तुलादि-क्रमन्यस्तेषु क्रमचरार्धैर्हीनाः मकरादिषूत्क्रमन्यस्तेषु उत्क्रमाद्युक्ताः कार्याः। एवं संस्कृतास्ते स्वदेशोदयाः सम्पद्यन्ते। ततो यासां घटिकानां सम्बन्धिलग्नमभीष्टं ताः प्राणीकृत्य षष्टयोद्धृता अभीष्टकालांशाः स्युस्तैः संस्कृतलङ्कोदयकालांशैश्च पूर्वकथितलग्नसाधनविधिना लग्नं साध्यं लग्नादपि पूर्वकथितलग्नात्कालानयन-विधिनेष्टघटिका भवन्तीति ॥ ३२।३३ ॥

अत्रोपपत्तिः।

नाडीवृत्तस्य दशकलोना अष्टाविंशत्यंशा यावदुदयं गच्छन्ति तावत्क्रान्ति-वृत्तस्य त्रिशदंशा उदयं गच्छन्ति। तथा च नाडीवृत्तीयपञ्चकलोनत्रिशदंशैः क्रान्तिवृत्तीयत्रिशदंशात्मकस्य वृषस्योदयः। एवं नाड़ीवृत्तीयपञ्चदशकलाधि-कैर्द्वात्रिशदंशैः क्रान्तिवृत्ते मिथुनस्य त्रिशदंशा उदयमुपयान्ति, कर्क्यादावुत्क्रमेण योज्यम्। एवं निरक्षदेशेषु साक्षदेशेषु पुनरक्षांशवशादूनैर्नाड़ीवृत्तीयांशैर्मकरादीनां षण्णां राशीनामुदयः, अधिकैः कर्क्यादीनां षण्णां राशीनामुदय इति॥ सिद्धान्त-शेखरे "रक्षोभर्त्तुः पुरि य उदयास्ते खषड्भिर्विभक्ताः कालांशास्ते चरदललवैः पूर्व-वद्धीनयुक्ताः। तैः कालांशैः कथितविधिनाऽभीष्टकालांशकेभ्यो लग्नं लग्नादपि च घटिकाः स्वोदयैः स्युर्विना वा" श्रीपत्युक्तमिदं स्वदेशोदयैर्विनेष्टघटिकातो लग्नसाधनमाचार्योक्तानुरूपमेवेति ॥ ३२-३३ ॥

अब 'स्वदेशोदयैर्विनेष्टघटिकाभिर्लग्नं यो वेत्ति' इस प्रश्न के उत्तर को कहते हैं।

हि. भा.—लङ्कोदय मान को साठ से भाग देने से ध्रुवांश (कालांश) होते हैं मेष के लङ्कोदय मान = १६७०, वृष के लङ्कोदय मा = १७९३, मिथुन के = १९३७ इनको साठ से भाग देने से मेष के ध्रुवांश = २७°।५०' ॥ वृष के ध्रुवांश = २९°।५५', मिथुन के ध्रुवांश = ३२°।१५'। चरार्धासु को भी साठ से भाग देने से चरार्धांश होते है। इन चरार्धांशों को क्रमस्थापित मेषादि ध्रुवांश में से हीन करना चाहिये। विपरीत स्थापितों में व्युत्क्रम से जोड़ना चाहिये। इस तरह तुलादि क्रम स्थापितों में क्रम चरार्ध को हीन करना, मकरादि उत्क्रम स्थापितों में युक्त करने से स्वदेशोदय होते हैं। जिस घटीसम्बन्धी लग्नसाधन

करना हो उस इष्ट घटिकासु को साठ से भाग देने से अभीष्ट कालांश होते है। इन से तथा पूर्वोक्त संस्कृत लङ्कोदय कालांश से कथित विधि से लग्न साधन करना चाहिये। तथा लग्न से भी पूर्व कथित विधि (लग्न से इष्टकालानयन विधि) से इष्टकाल साधन करना चाहिये इति ॥ ३२-३३ ॥

उपपत्ति ।

क्रान्तिवृत्त में तीस अंशात्मक मेष का जितने काल में उदय होता है उतने काल में नाडी वृत्त का २७°।५०′ उदित होता है। एवं क्रान्तिवृत्त में तीस अंशात्मक वृष के जितने काल में उदय होता है उतने में नाडी वृत्त का २९°।५५′ उदित होता है। इसी तरह क्रान्ति वृत्त में तीस अंशात्मक मिथुन के उदय काल में नाड़ीवृत्त का ३२°।१५′ उदित होता है; कर्क्यादि राशियों में व्युत्क्रम से जोड़ना चाहिये, इस तरह निरक्ष देशों में होता है। साक्ष (अक्षांश वाले) देशों में अक्षांश वश से ऊन नाडी वृत्तीयांशों मे मकरादि छः राशियों का उदय होता है। अधिक नाडी वृत्तीयांशों से कर्क्यादि छः राशिओं का उदय होता है॥ सिद्धान्तशेखर में 'रक्षोभर्त्तु: पुरि य उदयास्ते खषड्भिर्विभक्ता' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥ ३२-३३ ॥

इदानीं यो ऽर्कज्ञश्चरार्धादक्षं वेत्तीत्यस्योत्तरमाह ।

इष्टार्कचरार्धज्या क्षयवृद्धिज्या द्युरात्रदलगुणिता ।
व्यासार्धेन विभक्ता क्षितिजा द्वादश गुणा भक्ता ॥ ३४ ॥
क्रान्त्या विषुवच्छाया क्षितिजेष्टक्रान्तिवर्गयोगपदम् ।
अग्रा क्षितिजापक्रमजीवे त्रिज्यागुणे भक्ते ॥ ३५ ॥
अर्काग्रयाऽक्षलम्बक जीवे दिनकृच्चरासु विज्ञाने ।

सु० भा०—इष्टार्कस्य चरार्धज्या सैव क्षयवृद्धिज्या च कथ्यते। सा चरज्या द्युज्यया गुणा व्यासार्धेन विभक्ता क्षितिजा कुज्या भवति। सा द्वादशगुणा क्रान्त्या क्रान्तिज्यया भक्ता विषुवच्छाया पलभा भवति। क्षितिजायाः कुज्याया इष्टक्रान्तेरिष्टक्रान्तिज्यायाश्च वर्गयोगपदमग्रा भवति। कुज्याक्रान्तिजीवे त्रिज्यागुणे अर्काग्रया पूर्वानीतया भक्ते फले क्रमेण दिनकृच्चरासुविज्ञानेऽक्षज्यालम्बज्ये भवतः।

अत्रोपपत्तिः। अक्षक्षेत्रानुपातेन स्फुटा ॥ ३४-३५ ॥

वि. भा.—इष्टरवेश्चरार्धज्या क्षयवृद्धिज्योच्यते। सा चरज्या द्युज्यया गुणिता त्रिज्या भक्ता तदा क्षितिजा (कुज्या) भवति। सा कुज्या द्वादशगुणा क्रान्तिज्यया भक्ता तदा विषुवच्छाया (पलभा) भवेत्। कुज्या क्रान्तिज्ययोर्वर्गयोग-

मूलमग्रा भवति, कुज्या क्रान्तिज्ये त्रिज्यया गुणिते रवेरग्रज्यया भक्ते तदा रवि-चरासु विज्ञानेऽक्षज्या लम्बज्ये भवतः ॥ ३४-३५½ ॥

अत्रोपपत्तिः ।

त्रिज्या कर्णः । चरज्या भुजः । चरकोटिज्या कोटिः, इति कर्णभुजकोटि-भिरेकं त्रिभुजम् । तथा द्युज्याकर्णः कुज्याभुजः । तत्वर्गान्तरमूलं कोटिः । इति कर्णभुजकोटिभिर्द्वितीयं त्रिभुजम् । एतयोस्त्रिभुजयोः साजात्यादनुपातः क्रियते यदि त्रिज्यया चरज्या लभ्यते तदा द्युज्यया किं समागच्छति कुज्या तत्स्वरूपम् $= \frac{\text{च. ज्या. द्यु}}{\text{त्रि}}$, ततः पलभा भुजः । द्वादश कोटिः । पलकर्णः कर्णः इति भुजत्रयैरुत्पन्नमेकमक्षक्षेत्रम् । कुज्या भुजः । क्रान्तिज्या कोटिः । अग्रा कर्ण इति भुज-त्रयैरुत्पन्नं द्वितीयमक्षक्षेत्रम् । अनयोस्त्रिभुजयोः साजात्यादनुपातः $\frac{\text{कुज्या. १२}}{\text{क्रांज्या}}$ $=$पलभा, $\sqrt{\text{कुज्या}^2+\text{क्रांज्या}^2}=$अग्रा, ततः $\frac{\text{कुज्या. त्रि}}{\text{अग्रा}}=$अक्षज्या $\frac{\text{क्रांज्या. त्रि}}{\text{अग्रा}}$ $=$लम्बज्या एतावताऽऽचार्योक्तमुपपन्नम् ॥ ३४-३५½ ॥

अब रवि और चरार्ध से जो अक्षांश को जानते है इस प्रश्न के उत्तर को कहते हैं ।

हि. भा.—चरज्या को द्युज्या से गुणा कर त्रिज्या से भाग देने से कुज्या होती है । कुज्या को बारह से गुणा कर क्रान्तिज्या से भाग देने से पलभा होती है, कुज्या और क्रान्तिज्या का वर्ग योग मूल अग्रा होती है । कुज्या और क्रान्तिज्या को त्रिज्या से गुणा कर रवि की अग्रा से भाग देने से क्रमशः अक्षज्या और लम्बज्या होती है इति ॥ ३०-३५½ ॥

उपपत्ति ।

त्रिज्या कर्ण, चरज्या भुज, चर कोटिज्या कोटि, इन कर्ण भुज और कोटि से उत्पन्न एक त्रिभुज । तथा द्युज्या कर्ण, कुज्या भुज, दोनों का वर्गान्तर मूल कोटि, इन कर्ण भुज कोटि से उत्पन्न द्वितीय त्रिभुज । इन दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं । यदि त्रिज्या में चरज्या पाते हैं तो द्युज्या में क्या इस अनुपात से कुज्या आती है, तब पलभा भुज, द्वादशांगुल शंकु कोटि, पलकर्ण कर्ण इन तीनों भुजाओं से उत्पन्न एक त्रिभुज, कुज्या भुज, क्रान्तिज्या कोटि, अग्रा कर्ण इन तीनों भुजाओं से उत्पन्न द्वितीय त्रिभुज, इन दोनों त्रिभुजों के सजातीयत्व से अनुपातकरते हैं $\frac{\text{कुज्या. १२}}{\text{क्रांज्या}}=$पलभा । $\sqrt{\text{कुज्या}^2+\text{क्रांज्या}^2}$ $=$ अग्रा, तब $\frac{\text{कुज्या. त्रि}}{\text{अग्रा}}=$ अक्षज्या, $\frac{\text{क्रांज्या. त्रि}}{\text{अग्रा}}=$ लम्बज्या, इस से आचार्योक्त उपपन्न हुआ इति ॥ ३४-३५½ ॥

इदानीं योऽक्षचरार्धज्ञोऽर्कं कथयतीत्यस्योत्तरमाह ।

अर्काज्ञाने ज्ञाने विषुवच्छाया चरासूनाम् ॥ ३६ ॥
इष्टचरार्धस्य ज्या क्षयवृद्धिज्या तदर्कवधकृत्या ।
त्रिज्या विषुवच्छाया वधवर्गो युतहृतश्छेदः ॥ ३७ ॥
व्यासार्धं कृतेर्मूलं क्रान्तिज्या व्यासदलगुणा भक्ता ।
जिनभागजीवया लब्धचापमर्कः पदैः प्राग्वत् ॥ ३८ ॥

सु. भा.—पलभाचरासूनां ज्ञानेऽर्काज्ञाने वक्ष्यमाणः प्रकारो ज्ञेयः इष्ट-चरार्धस्य ज्या क्षयवृद्धिज्या भवतीति पूर्वमेव प्रतिपादितम् । तस्याश्चरज्याया अर्कानां द्वादशानां च या वधकृतिस्तया त्रिज्यापलभयोर्वधवर्गो युतो हृतश्च व्यासार्धकृतेस्त्रिज्यावर्गस्य छेदो हरो भवति । तेन त्रिज्याकृतिर्हृता या लब्धिस्तस्या मूलं क्रान्तिज्या स्यात् । सा व्यासदलगुणा जिनभागजीवया भक्ता फलचापं पदैः प्राग्वदर्को भवति ।

अत्रोपपत्तिः । क्षितिजेऽग्रा चापांशाः कर्णः । ग्रहध्रुवप्रोते क्रान्तिः कोटिः । नाड़ीवलये चरांशा भुजः । कोटिसम्मुखकोणो लम्बांशाः । ततस्त्रिसत्तावयव-सिद्धान्तेन $त्रि \times ज्याच = \frac{त्रि \times ज्याक्रा}{द्यु} \times \frac{त्रि \times ज्याअ्र}{ज्याल} = स्पक्रा \times त्रि \times वि \div १२$

अतः $स्पक्रा = \frac{१२ \times ज्याच}{वि}$ ।

$त्रि^{२} + स्प^{२}क्रा = छे^{२}क्रा = \frac{त्रि^{२} \times वि^{२} + १२^{२} \times ज्या^{२}च}{वि^{२}}$, ततः

$ज्या^{२}क्रा = \frac{त्रि^{२} \times स्प^{२}क्रा}{छे^{२}क्रा} = \frac{१२^{२} ज्या^{२} च \times त्रि^{२}}{त्रि^{२} \times वि^{२} + १२^{२} \times ज्या^{२}च} \cdots\cdots (१)$

$= \frac{त्रि^{२}}{\frac{त्रि^{२} \times वि^{२} + १२^{२} \times ज्या^{२}च}{१२^{२} \times ज्या^{२}च}}$ । अत उपपद्यते मूलोक्तम् ।

अथ (१) अस्मिन् भाज्यहारौ त्रिज्यावर्गेणापवर्त्य

$ज्या^{२}क्रा = \frac{१२^{२} \times ज्या^{२}च}{वि^{२} + \frac{१२^{२} \times ज्या^{२}च}{त्रि^{२}}}$ । $\therefore$ $ज्याक्रा = \frac{१२ \times ज्याच}{\sqrt{वि^{२} + \frac{१२^{२} \times ज्या^{२}च}{त्रि^{२}}}}$ ।

अनेन 'चरज्याकार्काभिहतिस्त्रिमौर्व्या भक्ता'— इत्यादि भास्करोक्तमा-चार्योक्तानुरूपमुपपद्यते ॥ ३५½-३८ ॥

वि. भा.—इष्टचरार्धज्या क्षयवृद्धिज्या कथ्यते। तस्या द्वादशानां च यो घातवर्गस्तेन त्रिज्यापलभयोर्वधवर्गो युतो भक्तश्च स च त्रिज्यावर्गस्य छेदो (हरः) भवति, तेन हरेण त्रिज्यावर्गभक्ते या लब्धिस्तन्मूलं क्रान्तिज्या स्यात्। सा त्रिज्या गुणा जिनज्यया भक्ता फलस्य चापं पदैः पूर्ववद्रविर्भवेदिति ॥ ३५$\frac{1}{2}$-३८ ॥

अत्रोपपत्तिः।

अत्र कल्प्यते क्रान्तिज्या प्रमाणम्=य, तदाऽक्षक्षेत्रानुपातेन $\frac{\text{य. पभा}}{१२}$ =कुज्या। अस्या वर्गः=$\frac{\text{य}^२\text{. पभा}^२}{१२^२}$, तथा त्रि^{२}—य^२=द्यु^{२} ततः $\frac{\text{चरज्या. द्यु}}{\text{त्रि}}$ =कुज्या, वर्गेण $\frac{\text{चज्या}^२ (\text{त्रि}^२-\text{य}^२)}{\text{त्रि}^२}$ = कुज्या^{२}, कुज्यावर्गयोः समीकरणम्।

$\frac{\text{य}^२\text{. पभा}^२}{१२^२}=\frac{\text{चज्या}^२ (\text{त्रि}^२-\text{य}^२)}{\text{त्रि}^२}$ प्रथमपक्षे हरभाज्यौ त्रि^{२} गुणितौ, द्वितीयपक्षे हरभाज्यौ १२^२ गुणितौ तदा $\frac{\text{य}^२\text{. पभा}^२\text{. त्रि}^२}{१२^२\text{. त्रि}^२}=\frac{१२^२\text{. चज्या}^२ (\text{त्रि}^२-\text{य}^२)}{\text{त्रि}^२\text{. }१२^२}$

छेदगमेन य^२.पभा^{२}. त्रि^{२}=१२^२ चज्या^{२} (त्रि^{२}—य^२)=१२^२. चज्या^{२}. त्रि^{२}—१२^२. चज्या^{२}. य^२, समयोजनेन य^२. पभा^{२}. त्रि^{२}+१२^२. चज्या^{२}. य^२=य^२ (पभा^{२}. त्रि^{२}+१२^२. चज्या^{२})=१२^२. चज्या^{२}. त्रि^{२} पक्षौ पभा^{२}. त्रि^{२}+१२^२. चज्या^{२} भक्तौ तदा $\frac{१२^२\text{. चज्या}^२\text{. त्रि}^२}{\text{पभा}^२\text{. त्रि}^२+१२^२\text{. चज्या}^२}$ = य^२ हरभाज्यौ चज्या^{२}. १२^२ भक्तौ तदा $\frac{\text{त्रि}^२}{\frac{\text{पभा}^२\text{. त्रि}^२+१२^२\text{. चज्या}^२}{\text{चज्या}^२\text{. }१२^२}}$ =य^२, मूल ग्रहणेन

$\sqrt{\frac{\text{त्रि}^२}{\frac{\text{पभा}^२\text{. त्रि}^२+१२^२\text{. चज्या}^२}{\text{चज्या}^२\text{. }१२^२}}}$ =य=क्रांज्या। ततः $\frac{\text{त्रि}\times\text{क्रांज्या}}{\text{जिज्या}}$ = रविभुजज्या, अस्याश्चापं रविभुजांशाः स्युरिति। एतावताऽऽचार्योक्तमुपपन्नम्। सिद्धान्तशेखरे "सूर्यघ्नी चरशिञ्जिनी कृतकृतिस्तद्युक्तभक्ता सती त्रिज्याऽक्षप्रभयोर्वधस्य करणी छेदस्त्रिभज्याकृतेः। लब्धेर्मूलमिनापमस्य हि गुणस्तस्मादपि प्रोक्तवत् तिग्मांशुर्विषुवत्प्रभाचरदलज्ञानादसौ जायते" श्रीपत्युक्तोऽयं प्रकार आचार्योक्तप्रकारस्य सर्वथा सदृशः। सिद्धान्त शिरोमणौ 'चरज्यकार्काभिहतिरित्यादि' भास्कर प्रकारश्चाप्याचार्योक्त प्रकारानुरूप एवेति ॥ ३५$\frac{1}{2}$–३८ ॥

अब 'योऽक्षचरार्धज्ञोऽर्कं कथयति' इस प्रश्न के उत्तर को कहते हैं।

हि. भा.—इष्ट चरज्या और बारह के घात के वर्ग को त्रिज्या और पलभा के घात

वर्ग में जोड़ कर तथा भाग देकर जो हो उससे त्रिज्यावर्ग में भाग देने से जो लब्धि हो उसका मूल क्रांतिज्या होती है। उस क्रान्तिज्या को त्रिज्या से गुणा कर जिनज्या से भाग देने से जो लब्धि हो उसका चाप रवि होते हैं इति ॥ ३५$\frac{१}{२}$-३८ ॥

उपपत्ति ।

कल्पना करते हैं क्रान्तिज्या मान=य, तब अक्ष क्षेत्रानुपात से $\frac{य. पभा}{१२}$ = कुज्या

$\therefore$ कुज्या$^२ = \frac{य^२. पभा^२}{१२^२}$, तथा त्रि^{२}—य^२=द्यु^{२} $\therefore \frac{चज्या^२. द्यु^२}{त्रि^२}$ = कुज्या^{२} = $\frac{चज्या^२ (त्रि^२—य^२)}{त्रि^२}$ दोनों कुज्या वर्गों के समीकरण करने से $\frac{य^२. पभा^२}{१२^२} = \frac{चज्या^२ (त्रि^२—य^२)}{त्रि^२}$ प्रथम पक्ष में हर और भाज्य को त्रि^{२} से तथा द्वितीय पक्ष में हर और भाज्य को १२^२ से गुणा करने से $\frac{य^२. पभा^२. त्रि^२}{१२^२. त्रि^२} = \frac{१२^२. चज्या^२ (त्रि^२—य^२)}{त्रि^२ \; १२^२}$

छेदगम से य^२. पभा^{२}. त्रि^{२}=१२^२. चज्या^{२} (त्रि^{२}—य^२)=१२^२. चज्या^{२}. त्रि^{२}— १२^२. चाज्या^{२}. य^२ दोनों पक्षों में १२^२. चज्या^{२}. य^२ जोड़ने से य^२. पभा^{२}. त्रि^{२}+१२^२ चज्या^{२}. य^२=य^२(पभा^{२}. त्रि^{२}+१२^२. चज्या^{२})=१२^२, चज्या^{२}. त्रि^{२} दोनों पक्षों को पभा^{२}. त्रि^{२}+१२^२. चज्या^{२} इससे भाग देने से—

$$\frac{१२^२. चज्या^२. त्रि^२}{पभा^२. त्रि^२+१२^२. चज्या^२} = य^२ \cdots\cdots\cdots\cdots (१)$$

हर और भाज्य को चज्या^{२}. १२^२ से भाग देने से—

$$\frac{त्रि^२}{\frac{पभा^२. त्रि^२+१२^२. चज्या^२}{चज्या^२. १२^२}} = य^२ \text{ मूल लेने से } \sqrt{\frac{त्रि^२}{\frac{पभा^२. त्रि^२+१२^२. चज्या^२}{चज्या^२. १२^२}}}$$

=य=क्रांज्या, $\therefore \frac{त्रि. क्रांज्या}{जिज्या}$ =रविभुज्या, इसका चाप करने से रविभुजांश होता है, इससे आचार्योक्त उपपन्न हुआ। सिद्धान्त शेखर में 'सूर्यघ्नी चरशिञ्जिनीकृतकृतिस्तद्युक्-भक्ता सती' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त प्रकार के अनुरूप ही कहा है (१) $\frac{१२^२. चज्या^२. त्रि^२}{पभा^२. त्रि^२+१२^२. चज्या^२}$ इसमें हर और भाज्य को त्रि^{२} से अपवर्तन देने से $\frac{१२^२. चज्या^२}{पभा^२+\frac{१२^२. चज्या^२}{त्रि^२}}$ =य^२, मूललेने से $\frac{१२. चज्या}{\sqrt{पभा^२+\frac{१२^२. चज्या^२}{त्रि^२}}}$ =य=क्रांज्या, इससे सिद्धान्त शिरोमणि में 'चरज्यकार्काभिहतिः' इत्यादि भास्करोक्त उपपन्न होता है इति ॥ ३५$\frac{१}{२}$—३८ ॥

इदानीं पलभाज्ञाने यश्चरार्धं कथयतीत्यस्योत्तरमाह ।

विषुवच्छाया भक्ता स्वचरार्धज्येष्टयाऽन्यया गुणिता ।
लब्धस्य चापमिष्टच्छायायाश्चरदलप्राणाः ॥ ३९ ॥

सु. भा.—स्वदेशीयचरज्यान्ययेष्टदेशीयपलभया गुणिता विषुवच्छाया भक्ता स्वदेशीयपलभया भक्ता लब्धस्य चापमिष्टच्छाया इष्टपलभायाश्चरदलप्राणाश्चरासवो भवन्तीति ।

अत्रोपपत्तिः । यदि द्वयोर्देशयोः पलभे $वि_1$, $वि_2$ कल्प्येते तथैकक्रान्तौ द्वयोर्देशयोश्चरे $च_1$, $च_2$ । तदा गोलयुक्त्या—

$ज्याच_1 = \frac{वि_1 \times ज्याक्रा}{१२} \times \frac{त्रि}{द्यु}$ । $ज्या\ च_2 = \frac{वि_2 \times ज्याक्रा}{१२} \times \frac{त्रि}{द्यु}$

अतः $\frac{ज्याच_1}{ज्याच_2} = \frac{वि_1}{वि_2}$ । ततः $ज्याच_2 = \frac{वि_2 \times ज्याच_1}{वि_1}$ ।

अत उपपद्यते यथोक्तम् ॥ ३९ ॥

वि. भा.—स्वदेशीयचरज्याऽन्ययेष्टविषुवच्छायया (अन्यदेशसम्बन्धिन्या पलभया) गुणिता, विषुवच्छायया (स्वदेशीयपलभया) भक्ता लब्धस्य चापमिष्टपलभायाश्चरासवो भवन्तीति ॥ ३९ ॥

अत्रोपपत्तिः ।

स्वदेशान्यदेशयोः पलभे कल्प्येते $पभा$, $पभा'$ तथैक क्रान्तौ तयोर्देशयोश्चरे $च$, $च'$ तदाऽक्षप्रभा संगुणितापमज्या तद् द्वादशांशो भवति क्षितिज्येत्यादि भास्करोक्त्या $\frac{पभा.\ क्रांज्या.\ त्रि}{१२.\ द्यु} = चज्या$, तथा $\frac{पभा'.\ क्रांज्या.\ त्रि}{१२.\ द्यु} = चज्या'$,
अनयोः सम्बन्धः $= \frac{चज्या}{चज्या'} = \frac{पभा}{पभा'}$ छेदगमेन $चज्या\ .\ पभा' = पभा\ .\ चज्या'$

$\therefore \frac{चज्या.\ पभा'}{पभा} = चज्या'$, अतः स्वदेशपलभया स्वदेशचरार्धज्या लभ्यते तदाऽन्यदेशीयपलभया केति अन्यदेशीय चरार्धज्या समागच्छतीति सिद्धमेतावताऽऽचार्योक्तसूत्रमुपपन्नम् । सिद्धान्तशेखरे 'अन्यदेशपलभा समाहृता स्वीयपत्तनचरार्धशिञ्जिनी । भाजिता पलभया स्वया ततश्चापमन्यविषये चरासवः" इति श्रीपतेः प्रकार आचार्योक्त प्रकारानुरूप एवेति ॥ ३९ ॥

अब 'पलभा ज्ञाने यश्चरार्धं कथयति' इस प्रश्न के उत्तर को कहते है।

हि. भा.—स्वदेशीय चरज्या को अन्य देशीय पलभा से गुणा कर स्वदेशीय पलभा से भाग देने से जो लब्ध हो उसका चाप अन्य देशीय चरार्धासु प्रमाण होता है इति ॥ ३९ ॥

उपपत्ति।

कल्पना करते है दोनों देशों की पलभा=पभा। पभा', पभा=स्वदेश पलभा, पभा'=अन्य देशपभा, तथा एक क्रान्ति में स्वदेशीय चरज्या=चज्या। अन्य देशीय चज्या=चज्या' तब 'अक्षप्रभा संगुणितापमज्या' इत्यादि।

भास्करोक्त प्रकार से $\frac{\text{पभा. क्रांज्या. त्रि}}{\text{१२. द्यु}}$ = चज्या, तथा $\frac{\text{पभा'. क्रांज्या. त्रि}}{\text{१२. द्यु}}$ =चज्या' इन दोनों के सम्बन्ध= $\frac{\text{चज्या}}{\text{चज्या'}} = \frac{\text{पभा}}{\text{पभा'}}$ छेदगम से चज्या. पभा'=पभा. चज्या' ∴ $\frac{\text{चज्या. पभा'}}{\text{पभा}}$ =चज्या' इस से 'स्वदेशीय पलभा में यदि स्वदेशीय चरार्धज्या पाते हैं तो अन्य देशीय पलभा में क्या अन्य देशीय चरार्धज्या आती है, सिद्ध हुआ, इस से आचार्योक्त उपपन्न हुआ। सिद्धान्त शेखर में 'अन्य देश पलभा समाहता स्वीय पलन चरार्ध शिञ्जिनी' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त प्रकार के अनुरूप ही कहा है इति ॥ ३९॥

इदानीं य इष्टचरार्धात् छायां कथयतीत्यस्योत्तरमाह।

स्व चरार्धज्या भक्ता विषुवच्छायेष्टचरदलासूनाम्।
गुणिता ज्ययेष्टचरवलविषुवच्छाया फलं भवति ॥ ४० ॥

सु. भा.—विषुवच्छाया स्वचरार्धज्या भक्ता इष्टचर दलासूनां ज्यया गुणिता फलमिष्टचरदलसम्बन्धिनी विषुवच्छाया भवति।

अत्रोपपत्तिः। पूर्वप्रकारवैपरीत्येन स्फुटा ॥ ४० ॥

वि. *भा.*—विषुवच्छाया (स्वदेशीय पलभा) इष्टचरदलासूनां ज्यया (इष्ट देश सम्बन्धिन्या चरज्यया) गुणिता, स्वचरार्धज्यया (स्वदेशीय चरज्यया) भक्ता फलमिष्टदेशीयचरार्धसम्बन्धिनी पलभा भवतीति ॥ ४० ॥

अत्रोपपत्तिः ।

पूर्वश्लोकोपपत्तौ $\frac{\text{चज्या. पभा}'}{\text{पभा}}$ = चज्या′, सिद्धमस्ति, छेदगमेन चज्या. पभा′ = पभा. चज्या′ पक्षौ चज्या भक्तौ तदा पभा′ = $\frac{\text{पभा. चज्या}'}{\text{चज्या}}$, अत्र पभा, चज्या स्वदेशीय पलभाचरज्ये स्तः । पभा′, चज्या′ इष्टदेशीय (अन्यदेशीय) पलभा चरज्ये स्तः । एतेनाचार्योक्तमुपपन्नम् । सिद्धान्त शेखरे "स्वदेशजाऽक्षद्युतिरिष्ट देशचरार्धजीवा गुणिता विभक्ता । स्वपत्तनोद्भूतचरार्धमौर्व्या प्रजायतेऽसौ पलभाऽन्यदेशे ।।" श्रीपत्युक्तोऽयं प्रकार आचार्योक्तानुरूप एवेति ।। ४० ।।

अब 'य इष्ट चरार्धात् छायां कथयति' इस प्रश्न के उत्तर को कहते हैं ।

हि. भा.—स्वदेशीय पलभा को इष्टदेशीय (अन्यदेशीय) चरज्या से गुणा कर स्वदेशीय चरज्या से भाग देने से फल इष्टदेशीय पलभा होती है ।। ४० ।।

उपपत्ति ।

पूर्वश्लोक की उपपत्ति से $\frac{\text{चज्या. पभा}'}{\text{पभा}}$ = चज्या′, सिद्ध है छेदगम से चज्या. पभा′ = पभा. चज्या′ दोनों पक्षों को (चज्या) भाग देने से $\frac{\text{पभा. चज्या}'}{\text{चज्या}}$ = पभा′, यहां पभा, चज्या स्वदेशीय पलभा और चरज्या है पभा′, चज्या′ इष्टदेशीय (अन्यदेशीय) पलभा और चरज्या है; इस से आचार्योक्त प्रकार उपपन्न हुआ । सिद्धान्त शेखर में 'स्वदेशजाऽक्षद्युतिरिष्टदेशचरार्धजीवा गुणिता' इत्यादि श्रीपत्युक्तप्रकार आचार्योक्त प्रकार के अनुरूप ही है इति ।।४०।।

इदानीं योऽक्षविन्मध्यच्छायातो रविमानयति दिवाकरज्ञोऽक्षमानयतीति प्रश्नद्वयोत्तरमाह ।

मध्यच्छायाग्रमुदक् शंकुतलाद्दक्षिणा नता भागाः ।
दक्षिणतो यदि सौम्या स्वाक्षांशाः सर्वदा याम्या ।। ४१ ।।

द्युदलनताक्षांशानामेकदिशामन्तरं युतिर्भेदे ।
क्रान्त्यंशाः प्राग्वदतः क्रान्त्यंशैरेवमक्षांशाः ।। ४२ ।।

सु. भा.—मध्यच्छायाग्रं शङ्कुतलाच्छङ्कुमूलादुदक् तदा दिनार्धीया नता

भागा दक्षिणा वेद्याः। यदि छायाग्रं दक्षिणगतस्तदा नतभागाः सौम्या उत्तरा ज्ञेयाः। स्वाक्षांशाश्च सर्वदा याम्या एव ज्ञेयाः। अथ मध्यच्छायातो मध्यच्छायाकर्णं प्रसाध्य तत्कर्णेन मध्यच्छायाभुजस्तदा त्रिज्यया किमित्यनुपातेन रविदृग्ज्यामानीय तच्चापांशा नतभागा ज्ञेयाः। द्युदले नतभागानामक्षांशानां चैकदिशामन्तरं भेदे दिग्भेदे, युतिः क्रान्त्यंशा भवन्ति। अतः प्राग्वदर्कः साध्यः। एवं क्रान्त्यंशैर्मध्यनतांशैश्च संस्कारेणाक्षांशा भवन्ति।

अत्रोपपत्तिः। 'दिनार्धद्युतेस्त्रिज्यकाघ्न्या हृताया स्वकर्णेन'--इत्यादि भास्करविधिना स्फुटा ॥ ४१-४२ ॥

वि. भा.—यदि शंकुमूलात् मध्यच्छायाग्रमुत्तरदिशि तदा दिनार्धनतांशा दक्षिणा ज्ञातव्याः। यदि छायाग्रं दक्षिणदिशि तदा नतांशा उत्तरा ज्ञेयाः। स्वाक्षांशाः सर्वदा दक्षिणाः 'लम्बाक्षौ दक्षिणौ सदा' इति सूर्य सिद्धान्तेऽपि 'सदाक्षलम्बाविह याम्यसौम्यौ' सिद्धान्तशिरोमणौ भास्करोक्तमपि. दिनार्धकाले एकदिशायां नतांशानामक्षांशानामन्तर कार्यं भिन्नदिशायां तयोर्योगः कार्यस्तदा क्रान्त्यंशा भवन्ति। ततः पूर्ववद्रविः साध्यः। एवं क्रान्त्यंशमध्यनतांशयोः संस्कारेणाक्षांशा भवन्तीति॥

अत्रोपपत्तिः।

अथ $\sqrt{१२^२ + मछा^२}$ = मध्यच्छायाकर्ण, तदाऽनुपातो यदि मध्यच्छाया कर्णेन मध्यच्छाया लभ्यते तदा त्रिज्यया किमिति समागच्छति दृग्ज्या = $\frac{मछा. त्रि}{मछाक}$ अस्याश्चापम् = मध्यनतांशाः। यदि खस्वस्तिक निरक्षखस्वस्तिकयोर्मध्ये रविरस्ति तदा खस्वस्तिकाद्रविं यावन्नतांशाः। खस्वस्तिकनिरक्षखस्वस्तिकयोरन्तरेऽक्षांशा अतोऽत्र द्वयोरन्तरेण अक्षांश—मध्यनतांश = क्रान्त्यंश = रवितोनिरक्षखस्वस्तिकं यावत्। यदि च खस्वस्तिकादुत्तरे याम्योत्तरवृत्ते रविस्तदा खस्वस्तिकान्निरक्षखस्वस्तिकं यावत् अक्षांशाः। खस्वस्तिकाद्रविं यावन्मध्यनतांशा अत्र द्वयोर्योगेन रवितो निरक्षखस्वस्तिकं यावत्क्रान्त्यंशा भवन्ति। ततः $\frac{त्रि. क्रांज्या}{जिज्या}$ = रविभुजज्या। अस्याश्चापम् रविभुजांशाः। एवं क्रान्त्यंशमध्यनतांशयोः संस्कारेणाक्षांशा भवन्तीति ॥४१-४२॥

अब जो अक्षांश ज्ञाता मध्यच्छाया से रवि को जानते हैं, तथा सूर्य से अक्षांश जानते हैं। इन दोनों प्रश्नों के उत्तर को कहते हैं।

हि. भा.—यदि शङ्कु मूल से मध्यच्छायाग्र उत्तर दिशा में हो तो दिनार्ध नतांश

को दक्षिण समझना चाहिये। यदि छायाग्र दक्षिण दिशा में हो तो मध्यनतांश को उत्तर समझना चाहिये। अक्षांश को सर्वदा दक्षिण ही समझना चाहिये। मध्यान्ह काल में नताश और अक्षांश की एक दिशा रहने से दोनों के अन्तर करने से क्रान्त्यश होता है, नतांश और अक्षांश के भिन्न दिशा रहने से दोनों का योग करने से क्रान्त्यंश होता है। इससे पूर्ववत् रवि का साधन करना चाहिये। एवं क्रान्त्यंश और मध्यनतांश के संस्कार से अक्षांश होता है॥

उपपत्ति।

$\sqrt{१२^२ + \text{मछाया}^२}$ = मछायाक। तब अनुपात करते है यदि मध्यच्छाया कर्ण में मध्यच्छाया भुज पाते हैं तो त्रिज्या कर्ण में क्या इस अनुपात से आती है दृग्ज्या = $\frac{\text{मछा. त्रि}}{\text{मछाक}}$ इसके चाप करने से मध्यनतांश होता है। यदि खस्वस्तिक और निरक्षखस्वस्तिक के मध्य में याम्योत्तर वृत्त में रवि है तो रवि से स्वखस्तिक पर्यन्त नतांश है। खस्वस्तिक निरक्ष खस्वस्तिक अन्तर अक्षॉश है इसलिये यहां अक्षाश − नतांश = — रवि से निरक्षखस्वस्तिक पर्यन्त क्रान्त्यंश। यदि खस्वस्तिक से रवि उत्तर है तदा अक्षांश + नतांश = क्रान्त्यंश = रवि से निरक्ष खस्वस्तिक पर्यन्त। क्रान्ति ज्ञान से $\frac{\text{त्रि. क्रांज्या}}{\text{जिज्या}}$ = रवि भुजज्या, इसका चाप = रविभुजांश। एवं क्रान्त्यंश और मध्यनतांश के संस्कार से अक्षांश होता है इति॥४१-४२॥

इदानीं योऽग्रार्कज्ञो लम्बाऽक्षांशान् कथयतीत्यस्योत्तरमाह।

उदयज्येष्ठापक्रमजीवा कृत्यन्तरात्पदं क्षितिजा।
व्यासार्धगुणा क्षितिजा भक्तोदयजीवयाऽक्षज्या॥४३॥
उदयज्यया विभक्ता क्रान्तिज्या व्यासदलगुणा लम्बः।
द्वादशगुणिता क्षितिजा विषुवच्छायाहृता क्रान्तिः॥४४॥

सु. भा.—उदयज्याया अग्राया इष्टक्रान्तिजीवायाश्च वर्गान्तरात् पदं मूलं क्षितिजा कुज्या भवति। सा क्षितिजा व्यासार्धगुणा ऽग्रया भक्ता ऽक्षज्या स्यात्। क्रान्तिज्या च व्यासदलगुणा अग्रया विभक्ता लम्बो लम्बज्या भवेत्। एवं कुज्या द्वादशगुणा विषुवच्छायाहृता फलं क्रान्तिः क्रान्तिज्या भवतीति।

अत्रोपपत्तिः। अक्षक्षेत्रानुपातेन स्फुटा॥ ४३। ४४॥

वि. भा.—उदयज्या शब्देनाग्रा बोध्या, तस्याः क्रान्तिज्यायाश्च वर्गान्तर-मूलं कुज्या स्यात्। सा कुज्या त्रिज्या गुणाऽग्रया भक्ता तदाऽक्षज्या भवति। क्रान्तिज्या त्रिज्या गुणाऽग्रया विभक्ता लम्बज्या स्यात्। क्षितिजा (कुज्या) द्वादश-गुणिता पलभया भक्ता तदा क्रान्तिज्या भवेदिति॥४३-४४॥

अत्रोपपत्तिः ।

अग्रा क्रान्तिज्या कुज्येति कर्णकोटिभुजैरुत्पन्नाक्षक्षेत्रे $\sqrt{\text{अग्रा}^2 - \text{क्रांज्या}^2}$ =कुज्या । तत अक्षज्या भुजः लम्बज्या कोटिः । त्रिज्याकर्णः, एतैर्भुजत्रयैरुत्पन्नमेकं त्रिभुजम् । कुज्या भुजः । क्रान्तिज्या कोटिः । अग्राकर्णः एतैर्भुजत्रयैरुत्पन्नं द्वितीयत्रिभुजम् । एतयोस्त्रिभुजयोः साजात्यादनुपातो यद्यग्राकर्णेन कुज्या भुजो लभ्यते तदा त्रिज्याकर्णेन कि समागच्छत्यक्षज्या तत्स्वरूपम् = $\frac{\text{कुज्या. त्रि}}{\text{अग्रा}}$ =अक्षज्या । तथाऽग्रा कर्णे यदि क्रान्तिज्या कोटिर्लभ्यते तदा त्रिज्याकर्णे कि समागच्छति लम्बज्या तत्स्वरूपम्= $\frac{\text{क्रांज्या. त्रि}}{\text{अग्रा}}$ =लंज्या तथा पलभाभुज. द्वादशाङ्गुलशङ्कुः कोटिः । पलकर्णः कर्णः, एतैर्भुजत्रयैरुत्पन्नमक्षक्षेत्रं कुज्या क्रान्तिज्याऽग्राभिर्भुजकोटिकर्णैरुत्पन्नाक्षक्षेत्रसजातीयमतोऽनुपातो यदि पलभाभुजे द्वादशकोटिर्लभ्यते तदा कुज्याभुजे कि समागच्छति क्रान्तिज्या= $\frac{\text{१२. कुज्या}}{\text{पभा.}}$ एतावताऽऽचार्योक्तमुपपन्नम् ॥४३-२४॥

अब 'योऽग्रार्कज्ञो लम्बाक्षांशान् कथयति' इस प्रश्न के उत्तर को कहते हैं ।

हि. भा.—अग्रा और क्रान्तिज्या का वर्गान्तर मूल कुज्या होती है । कुज्या को त्रिज्या से गुणाकर अग्रा से भाग देने से अक्षज्या होती है । क्रान्तिज्या को त्रिज्या से गुणाकर अग्रा से भाग देने से लम्बज्या होती है । कुज्या को बारह से गुणाकर पलभा से भाग देने से क्रान्तिज्या होती है इति ॥४३-४४॥

उपपत्ति ।

अग्रा कर्ण, क्रान्तिज्या कोटि, कुज्या भुज इन तीनों भुजों से उत्पन्न त्रिभुज में $\sqrt{\text{अग्रा}^2 - \text{क्रांज्या}^2}$ =कुज्या अक्षज्याभुज, लम्बज्या कोटि, त्रिज्या कर्ण इन तीनों भुजाओं से उत्पन्न त्रिभुज पूर्वोक्त त्रिभुज के सजातीय हैं इसलिए अनुपात करते हैं यदि अग्रा कर्ण में कुज्या भुज पाते हैं तो त्रिज्या कर्ण में क्या इस अनुपात से अक्षज्या आती है $\frac{\text{कुज्या. त्रि}}{\text{अग्रा}}$ =अक्षज्या । तथा अग्रा कर्ण में यदि क्रान्तिज्या कोटि पाते हैं तो त्रिज्या कर्ण में क्या इस से लम्बज्या आती है $\frac{\text{क्रांज्या. त्रि}}{\text{अग्रा}}$ =लंज्या । तथा पलभाभुज द्वादशाङ्गुलशङ्कुकोटि, पल कर्ण कर्ण इन तीनों भुजाओं से उत्पन्न त्रिभुज पूर्वोक्त त्रिभुज का सजातीय है इसलिये अनु-

पात करते हैं यदि पलभाभुज में द्वादश कोटि पाते हैं तो कुज्या भुज में क्या इससे क्रान्तिज्या आती है। $\frac{१२ \times \text{कुज्या}}{\text{पभा}}$ = क्रांज्या, इससे आचार्योक्त उपपन्न हुआ इति ॥४३–४४॥

इदानीं य उदयेऽस्ते वाऽग्रां वेत्तीत्यस्योत्तरमाह।

यष्टि व्यासार्धेऽग्रा प्राच्यपरा भास्करान्तरांशज्या।
द्विगुणमुदयास्तसूत्रं तत्त्रिज्याकृतिविशेषपदम् ॥४५॥

सु. भा.—अभीष्टयष्टिव्यासार्धेन जलवत्समीकृतायां भूमौ क्षितिजवृत्तमुत्पाद्योदये रविबिम्बं विध्येत्। तस्मिन् यष्टिव्यासार्धे वृत्ते यत्रोदये रविरुपलब्धो या च प्राच्यपरा रेखा तयोरन्तरांशज्या यष्टिव्यासार्धेऽग्रा भवति। तत् त्रिज्यावर्गान्तिरपदं द्विगुणमुदयास्तसूत्रं भवतीति।

अत्रोपपत्तिः। गोलयुक्त्याऽग्रासंस्थानेन स्फुटा ॥ ४५ ॥

वि. भा.—जलेन समीकृतभूमौ यष्टिव्यासार्धेन क्षितिजवृत्तं विधेयम्। उदयकाले च रविबिम्बं विध्वा तस्मिन् क्षितिजे यत्र रविर्दृष्टस्तस्य पूर्वापरसूत्रस्य चान्तरांशज्या यष्टिव्यासार्धेऽग्रा भवति। तस्यास्त्रिज्यायाश्च वर्गान्तरमूलं द्विगुणितं तदोदयास्तसूत्रं भवतीति ॥४५॥

अत्रोपपत्तिः।

यदि लम्बज्यया त्रिज्या लभ्यते तदा क्रान्तिज्यया किमित्यनुपातेन समागताऽग्रा "क्ष्माजे द्युरात्रसममण्डलमध्यभागजीवाऽग्रका भवति पूर्व पराशयोः सा" इति भास्करोक्तसंस्थाना क्षितिजेऽस्ति; अग्रावर्गोनात् त्रिज्यावर्गान्मूलमग्राकोटिज्या भवति सा द्विगुणिता तदोदयास्तसूत्रमिति "अग्राग्रयोः प्रगुणमत्रनिबद्धसूत्रं यत्तद्वदन्तिगणका उदयास्तसूत्रमिति भास्करोक्तसंस्थानेन स्पष्टम्॥ सिद्धान्तशेखरे "ज्ञात्वा दिशः समभुवि क्वचिदिष्टयष्ट्या वृत्तं विलिख्य भगणांशकलाङ्कताङ्कम्। पूर्वापराद् भवति भानुरिहांशकैर्यैस्तज्ज्यां तदन्हि समवैहि दिवाकराग्राम्" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति ॥४५॥

अब 'य उदयेऽस्तेग्रांवेत्ति' इस प्रश्न के उत्तर को कहते हैं।

हि. भा.—जल से समीकृत भूमि में यष्टिव्यासार्ध से क्षितिज वृत्त बना कर उदय काल में रवि बिम्ब को वेधद्वारा देखने से उस क्षितिज वृत्त में जहां उपलब्ध होते हैं, उसका और पूर्वापर रेखा के अन्तरांश की ज्या यष्टि व्यासार्ध में अग्रा होती है। अग्रा और त्रिज्या के वर्गान्तर मूल को द्विगुणित करने से उदयास्त सूत्र होता है ॥ ४५ ॥

उपपत्ति ।

यदि लम्बज्या में त्रिज्या पाते हैं तो क्रान्तिज्या में क्या इस अनुपात से अग्रा आती है "क्ष्माजे द्युरात्र समसमण्डल मध्यभाग जीवाऽग्रका" इत्यादि भास्करोक्त अग्रा की परिभाषा से वह अग्रा है, त्रिज्या वर्ग में अग्रावर्ग को घटा कर मूल लेने से अग्रा कोटिज्या होती है, उस को द्विगुणित करने से उदयास्त सूत्र होता है सिद्धान्त शिरोमणि में 'अग्रागुणो द्विगुणमत्र निबद्ध सूत्र' इत्यादि भास्करोक्त उपपत्ति से स्पष्ट है इति ॥ ४५ ॥

इदानीं यो दिनार्धे नतोन्नतज्ये नाभिर्विषुवच्छायाऽक्षज्या लम्बान् वेत्तीत्यादीनामुत्तरमाह ।

द्युदले शंकुनतज्ये प्राच्यपराया यदि स्थितः शंकुः ॥
उदगूना दक्षिणतस्तदन्तरेणाधिकाऽर्काग्रा ॥ ४६ ॥

उत्तर गोलेऽग्रोनं तदन्तरं याम्यगोलगे सूर्ये ।
शंकुतलं शंकुहृतं विषुवच्छाया द्विषट्कगुणम् ॥ ४७ ॥

शंकुतलशंकुगुणिते त्रिज्ये तद्वर्गयुतिपदविभक्ते ।
अक्षावलम्बकज्ये द्युदलस्थेऽर्केऽन्यदा द्युवलात् ॥ ४८ ॥

सु. भा.—द्युदले मध्याह्ने वेधेन शङ्कुनतज्ये उन्नतनतज्ये साध्ये । मध्याह्नच्छायामवगम्य पूर्वविधिना मध्या नतोन्नता भागा ज्ञेयाः । उन्नतज्या शङ्कुर्नतज्या च याम्योत्तररेखायां शङ्कुमूलाद्गोलगर्भावधिर्महाशङ्कोर्भुजः स्यादिति गोलयुक्त्या सर्वं स्फुटम् । उत्तरगोले यदि स माध्याह्निकः । शङ्कुप्राच्यपराया रेखाया उदक्स्थितस्तदा तदन्तरेण प्राक् प्रदर्शितभुजेनार्काग्रोना । यदि दक्षिणतः स्थितः शङ्कुस्तदा तदन्तरेणाग्रा ऽधिका कार्या सूर्ये याम्यगोलगे तदन्तरं भुजसंज्ञमस्योनमेवं शङ्कुतलं शङ्कुमूलोदयास्तसूत्रयोरन्तरं भवेत् । तच्छङ्कुतलं द्विषट्कगुणं द्वादशगुणं मध्याह्नशङ्कुना हृतं विषुवच्छाया भवति । त्रिज्या स्थानद्वये स्थाप्या । एकत्र शङ्कुतलगुणाऽन्यत्र शङ्कुना गुणिता । उभयत्र तयोः शङ्कुतलशङ्क्वोर्वर्गयुतिपदेन हृत्वा विभक्ता फले क्रमेणार्के द्युदलस्थेऽक्षज्यालम्बज्ये भवतः । द्युदलादन्यदा ऽन्यस्मिन् काले इत्यस्याग्रे सम्बन्धः ।

अत्रोपपत्तिः । गोलयुक्त्या शङ्कुतलभुजाग्रासंस्थानेन शङ्कुतलं भुजः शङ्कुः कोटिर्हृतिः कर्ण इत्यक्षक्षेत्रतो ऽनुपातेन च स्फुटा ॥ ४६-४८ ॥

वि. भा.—मध्याह्नकाले वेधेनोन्नत नतज्ये "पूर्वश्लोकोपपन्नौ लिखितयष्टिव्यासार्धोत्पन्नवृत्तस्य केन्द्रे यथावृत्तव्यासार्धरूपेष्टयष्टिर्नष्टच्छाया जायते तथा तिर्यक् रविबिम्बकेन्द्रगामिकर्णसूत्राकाराऽऽबद्धलम्बा गणकैर्धार्या । तद्वृत्त-

केन्द्रात् यावद्भिरंगुलैर्लम्बपातस्तदंगुलमान एव यष्टिव्यासार्धोत्पन्नवृत्ते नतांशज्या भवति, लम्बकश्चो (लम्बशलाकांगुलप्रमाणं) न्नतज्या भवति" इत्यनेन विधिना साध्ये, तत्र वृत्ते (यष्टि व्यासार्धोत्पन्नकृतदिक् साधने) वृत्त केन्द्रादुत्तरदिशि दक्षिणदिशि वा शंकुमूलनिपातो मध्याह्नकाल एव भवति तेनोत्तरगोले मध्याह्नसमये यदि वृत्तकेन्द्रादुत्तरदिशि शंकुमूलनिपातस्तदा शंकुमूलात्पूर्वापररेखापर्यन्तं लम्बरूपेण भुजेन रहिताऽग्रा शंकुतलं भवेत्। यदि वृत्तकेन्द्राद्दक्षिणदिशि शंकुमूलनिपातस्तदा शंकुमूलपूर्वापररेखयोरन्तरेण भुजेन सहिताऽग्रा शंकुतलं भवति। दक्षिणगोलेऽग्रया हीनं भुजमानं शंकुतलं भवति। एतच्छंकुतलं (शंकुमूलोदयास्तसूत्रयोरन्तरं) द्वादशगुणं दिनार्धशंकुभक्तं तदा पलभा भवेत्। त्रिज्या शंकुतलगुणा द्वितीयस्थाने शंकुना गुणिता उभयत्र शंकु शंकुतलयोर्वर्गयोगपदेन हृत्या भक्ता तदा क्रमेण दिनार्धेऽक्षज्यालम्बज्ये भवेताम्। अन्यदा द्युदलादित्यस्याऽग्रे सम्बन्ध इति ॥ ४६-४८ ॥

अत्रोपपत्तिः।

शंकुमूलात्स्वोदयास्तसूत्रोपरिलम्बः शंकुतलम्। शंकुमूलात्पूर्वापरसूत्रोपरिलम्बो भुजसञ्ज्ञकः। स्वोदयास्तसूत्रपूर्वापरसूत्रयोरन्तरमग्रा। "सौम्याग्रकाग्रान्नृतलं हि याम्यं याम्याग्रकाग्रात् पुनरेव याम्यम्। तदन्तरैक्यं समवृत्त खेटमध्यांशजीवां भुवि बाहुमाहुः॥" इति भास्करोक्त्योत्तरदक्षिणगोलयोर्यथानियमं भुजाग्रयोर्योगान्तराभ्यां शंकुतलं भवति। ततोऽनुपातो यदि मध्याह्नशङ्कौ शंकुतलं लभ्यते तदा द्वादशांगुलशङ्कौ किमिति समागच्छति पलभा। ततो यदि हृत्या शंकुतलं लभ्यते तदा त्रिज्यया किं समागच्छति दिनार्धेऽक्षज्या। तथा हृत्या यदि शंकुर्लभ्यते तदा त्रिज्यया किं समागच्छति दिनार्धे लम्बज्येति। एतावताऽऽचार्योक्तसर्वमुपपन्नम्। सिद्धान्त शेखरे "यष्टिर्नष्टद्युतिरिह यथा जायते वृत्तमध्ये धार्या तिर्यङ् निपुणगणकैस्तद्वदाबद्धलम्बा। यावद्भिस्तद्वलयजठरादंगुलैर्लम्बपातस्तद्वद्वृत्ते नतलवगुणो लम्बकश्चोन्नतज्या॥ ते[1] च त्रिज्या संगुणे यष्टिभक्ते त्रिज्यावृत्ते तत्परीणाहभाजौ। सौम्ये गोले यद्युदक्स्थस्य शङ्कोराशामध्यात् स्यादुदक्स्थः प्रपातः॥" शंकुप्राच्यपरान्तरेण रहिताऽर्काग्रा भवेन्नुस्तल याम्यस्थस्य तदन्तरेण सहिता याम्ये च गोलेऽग्रया। कार्यवर्जितमन्तरं नरतलं तत्र द्विषट्काहते मध्याऽह्नोद्भव शंकुना च विहृते स्यादक्षभा प्रस्फुटम्॥ शंकुशकुतलताडिते हि तद्वर्गयोगपदभाजिते पृथक्। त्रिज्यके दिन दलेऽवलम्बजा शिञ्जिनी भवनि चाक्षजा क्रमात्॥ श्रीपत्युक्त प्रकारोऽयमाचार्यप्रकारसदृश एवेति॥ ४६-४८॥

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१. ते यष्टि व्यासार्धोत्पन्ने नतांशोन्नतांशज्ये त्रिज्यया गुणिते यष्टिभक्ते तदा त्रिज्यावृत्ते तत्परिधिसम्बन्धिन्यौ नतांशोन्नतांशज्ये भवेतामिति।

अब "इदानीं यो दिशार्धे नतोन्नतांशे [illegible] लम्बज्ये इति" इन प्रश्नों के उत्तर कहते हैं।

हि. भा — मध्याह्न काल में वेध से उन्नतज्या और नतज्या साधन करना पश्चात् पूर्व-श्लोक की उपपत्ति मे लिखित यष्टिव्यासार्धोत्पन्न वृत्तकेन्द्र मे जैसे वृत्त के व्यासार्धाग्र अग्रयष्टि की नष्टच्छाया हो वैसे तिर्यक् रवि बिम्बकेन्द्रगामी कर्णसूत्राकार अवलम्ब धारण करना चाहिए। उस वृत्त के केन्द्र से जितने अङ्गुलो में लम्ब पतन हो वही अङ्गुलमान यष्टि व्यासार्धोत्पन्न वृत्त में नतांशज्या होती है, और लम्ब उन्नतांशज्या होती है। उस वृत्त मे वृत्त केन्द्र से उत्तर दिशा मे वा दक्षिण दिशा मे शंकुमूल निपात (गिरना) मध्याह्न काल ही मे होता है इसलिये उत्तरगोल में मध्याह्नकाल मे यदि वृत्त केन्द्र से उत्तर दिशा मे शङ्कुमूल पतित है तो शङ्कुमूल से पूर्वापर रेखा पर्यन्त लम्बरूप भुज को अग्रा मे से घटाने से शङ्कुमूल से स्वोदयास्त सूत्रपर्यन्त शङ्कुतल होता है। यदि वृत्तकेन्द्र से दक्षिण दिशा मे शङ्कुमूल पतित हो तो अग्रा में भुज को जोड़ने से शंकुतल होता है। दक्षिण गोल मे भुज मे से अग्रा को घटाने से शङ्कुतल होता है। इस शङ्कुतल को बारह से गुणाकर दिनार्धशङ्कु से भाग देने से पलभा होती है। त्रिज्या को दो स्थानो मे स्थापन करना एक स्थान में शङ्कुतल से गुणा करना, द्वितीय स्थान में शङ्कु से गुणा करना, दोनों स्थानों मे हृति (शङ्कु और शङ्कुतल के वर्गयोग मूल) से भाग देने से क्रम से मध्याह्न काल में अक्षज्या लम्बज्या होती है इति ॥ ४६–४८ ॥

उपपत्ति।

शङ्कुमूल से स्वोदयास्त सूत्र के ऊपर लम्ब शङ्कुतल है। शङ्कुमूल से पूर्वापर सूत्र के ऊपर लम्ब भुज है। स्वोदयास्त सूत्र और पूर्वापर सूत्र का अन्तर अग्रा है। 'सौम्याग्रकाग्रान्तृतलं हि याम्यं' इत्यादि संस्कृतोपपत्ति में लिखित भास्करोक्ति से यथानियम भुज और अग्रा के योग और अन्तर से शङ्कुतल होता है। तब अनुपात करते हैं यदि मध्यशङ्कु में शङ्कुतल पाते है तो द्वादशाङ्गुल शङ्कु में क्या इस अनुपात से पलभा आती है। तब फिर अनुपात करते हैं यदि हृति (शङ्कु और शङ्कुतल के वर्गयोग मूल) में शङ्कुतल पाते हैं तब त्रिज्या में क्या इससे मध्याह्न काल में अक्षज्या होती है। तथा यदि हृति में शङ्कु पाते है तो त्रिज्या में क्या इससे मध्याह्न काल में लम्बज्या आती है। इससे आचार्योक्त उपपन्न हुआ ॥ सिद्धान्त शेखर में 'यष्टिर्नष्टद्युतिरिह यथा ज्ञायते वृत्तमध्ये' इत्यादि श्लोकों से श्रीपति ने आचार्योक्त प्रकार के अनुरूप ही कहा है इति ॥ ४६–४८ ॥

इदानीं द्युदलादन्यदापलभासाधनार्थमाह।

छाया वृत्तेऽर्काग्रा कर्णगुणा व्यासदलहृताऽर्काग्रा।

[illegible]

उत्तरगोले याम्ये विषुवच्छायाऽग्रयाऽन्तरं हीनम् ।
एवं विषुवच्छाया युक्तविहीनाऽन्तरेणाग्रा ॥ ५० ॥

सु. भा.—प्रथमार्याया पूर्वार्धं त्रिप्रश्नाध्यायस्य चतुर्थार्यापूर्वार्धसमं व्याख्यातमेव । अन्यत् सर्वं च त्रिप्रश्ना ५८-६० आर्याभिः स्फुटम् ॥ ४९-५० ॥

वि. भा.—दिनार्धादन्यकाले अर्काग्रा छायाकर्णगुणा त्रिज्याभक्ता तदा छायाकर्णगोलीया रवेरग्रा भवेत् । शङ्कुमूलपूर्वापररेखयोरन्तरं भुजः । तेन भुजेनोनयुता कर्णवृत्ताग्राऽर्थादुत्तरेण भुजेनोनादक्षिणेन भुजेन युता तदोत्तरगोले विषुवच्छाया (पलभा) भवेत् । याम्ये (दक्षिण गोले) तया कर्णवृत्तीयाग्रयाऽन्तरं (भुजमान) हीनं तदा पलभा भवेत् । एवमन्तरेण (भुजेन) युक्तविहीनाऽग्रऽर्थादुत्तरभुजेन युता दक्षिणभुजेन हीना तदा पलभा भवेदिति ॥ ४९-५० ॥

अत्रोपपत्तिः ।

छायाकर्ण गोले पलभा शङ्कुतलयोस्तुल्यत्वं भवति कथमिति प्रदर्श्यते यदि द्वादशाङ्गुलशङ्कौ पलभा भुजो लभ्यते तदेष्टशङ्कौ किमिति जातं शंकुतलम् $=\frac{\text{पभा. शंकु}}{१२}$, परन्तु शंकु $=\frac{१२\times\text{त्रि}}{\text{छाक}}$ अत उत्थापनेन शंकुतलम् $=\frac{\text{पभा. १२. त्रि}}{\text{१२. छाक}}$

ततश्छायाकर्णगोले शंकुतलम् $=\frac{\text{पभा. १२. त्रि. छाक}}{\text{१२. छाक. त्रि}}=\text{पभा}$

∴ सिद्धं कर्णगोले शंकुतलम् = पलभा । कर्णवृत्ताग्रा व्यस्तगोला भवति । पलभा च सदोत्तरा । तथोः संस्कारतश्छायाग्रपूर्वापरसूत्रमध्यं भुजः कथ्यतेऽतस्तद्वैपरीत्येन कर्णवृत्ताग्रा भुजयोः संस्कारेण पलभा भवतीति । सिद्धान्तशेखरे "अन्यदा तु नरपूर्वपश्चिमाशान्तरेण रुचिवृत्तजाग्रका । दक्षिणोत्तरभुवा युतोनिता सौम्यवर्त्तिनि रवौ पलप्रभा ॥ दक्षिणेन पुनरिनाग्रया तथा हीनमेव हि तदन्तरं सदा । एवमन्तरयुतोनिता भवेद-क्षभा नियतमंगुलाऽग्रका ॥" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति ॥ ४९-५० ॥

अब द्युदल (दिनार्ध) से भिन्न समय में पलभा साधन के लिये कहते हैं ।

हि. भा.—दिनार्ध से भिन्न समय में रवि की अग्रा को छायाकर्ण से गुणा कर त्रिज्या से भाग देने से छायाकर्ण गोलीय अग्रा होती है, शंकुमूल और पूर्वापर रेखा का अन्तर भुज है । उत्तर गोल में कर्णवृत्ताग्रा में उत्तर भुज को घटाने से और दक्षिण भुज को जोड़ने से पलभा होती है । दक्षिण गोल में भुज में कर्णवृत्तीय अग्रा को घटाने ही से पलभा होती है इति ॥ ४९-५० ॥

उपपत्ति ।

छाया कर्णगोल में शंकुतल और पलभा बराबर होती है जैसे यदि द्वादशाङ्गुल शङ्कु में पलभा पाते है तो इष्टशङ्कु में क्या इसमें शङ्कुतल आता है $\frac{\text{पभा. श}}{१२}$ = शङ्कुतल।

परन्तु $\frac{१२ \times \text{त्रि}}{\text{छाक}}$ = शङ्कु, इससे शङ्कु को उत्थापन देने से शङ्कुतल = $\frac{\text{पभा. १२. त्रि}}{\text{१२ छाक}}$

अतः छाया कर्ण गोल में परिणामन करने से शङ्कुतल = $\frac{\text{पभा. १२. त्रि. छाक}}{\text{१२. छाक त्रि}}$ = पभा,

अतः सिद्ध हुआ छाया कर्ण गोल में शङ्कुतल = पलभा। उत्तर गोल में कर्णवृत्ताग्रा — उत्तर भुज = पलभा। तथा कर्णवृत्ताग्रा + दक्षिणभुज = पलभा। दक्षिणगोल में सर्वदा भुज — कर्णवृत्ताग्रा = पलभा होती है। इससे आचार्योक्त उपपन्न हुआ। सिद्धान्त शेखर में 'अन्यदा नु नर पूर्व पश्चिमाशान्तरेण रूचिवृत्तजाग्रका' इत्यादि से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥ ४९–५० ॥

इदानी क्रान्तिज्यादीनां संस्थानमाह।

बाहुः क्रान्तिः कोटिः क्षितिजा तद्वर्गयुतिपदं कर्णः।
अग्रोदयास्तसूत्राद्दक्षिणतो दृश्यशङ्कुतलम् ॥ ५१ ॥

सु. भा.—क्रान्तिः क्रान्तिज्याभुजः। कुज्या कोटिः। तद्वर्गयुतिपदमग्रा कर्ण इत्यक्षक्षेत्रम्। भास्करेण क्रान्तिज्या कोटिः कुज्या भुज इति कथितं तत्र न कश्चिद्विशेषो भुजकोट्योः संस्थानभेदाभावात्। दृश्यशङ्कुतलं दिवाशङ्कुतलमुदयास्तसूत्राद्दक्षिणतो भवति।

अत्रोपपत्तिः। अक्षक्षेत्रसंस्थानेन 'सूत्राद् दिवा शङ्कुतलं यमाशम्'—इत्यादिभास्करविधिना स्फुटा ॥ ५१ ॥

वि. भा.—क्रान्तिः (क्रान्तिज्या) बाहुः (भुजः), क्षितिजा (कुज्या) कोटिः। एतयोर्वर्गयोगमूलमग्रा कर्णः। दृश्यशङ्कुतलं (दिवाशंकुतलं) उदयास्तसूत्राद्दक्षिणतो भवतीति ॥ ५१ ॥

अत्रोपपत्तिः

पूर्वस्वस्तिकात् क्षितिजाहोरात्रवृत्तयोः सम्पातं यावत् क्षितिजेऽग्रा चापांशाः पूर्वस्वस्तिकादेवोन्मण्डलाहोरात्रवृत्तयोः सम्पातं यावदुन्मण्डले क्रान्तिः। क्षितिजोन्मण्डलयोरन्तरेऽहोरात्रवृत्ते कुज्या चापांशाः। इति भुजत्रयैर्जायमानस्य त्रिभुजस्य ज्याक्षेत्रमग्रा कर्णः। क्रान्तिज्या कोटिः। कुज्या भुजः। भास्करेण सिद्धान्तशिरो-

मणावित्थमेव कथ्यते । अत्राचार्येण कुज्या कोटिः । क्रान्तिज्याभुजः कथ्यते । अत्र न कश्चिद्दोषो भुजकोटयोर्नाम एव भेदो न हि स्वरूपभेदः । ग्रहात् क्षितिजधरातलोपरि यो लम्बः स शंकुः । शंकुमूलात् स्वोदयास्तसूत्रपर्यन्तं शंकुतलम् । तच्च क्षितिजादुपरि दक्षिणतोऽहोरात्रवृत्तस्य गतत्वादधश्चोत्तरतो गतत्वात् दिने स्वोदयास्त सूत्राद्दक्षिणतो रात्रावुत्तरतश्च भवतीति । सिद्धान्तशेखरे "याम्योत्तरं शङ्कुतलं भवेत्तद्दिवारजन्योरुदयास्तसूत्रात्" श्री पत्युक्तमिदमाचार्योक्तानुरूपमेव तथा सिद्धान्तशिरोमणौ "सूत्राद्दिवा शङ्कुतलं यमाशं याम्यां गतं हि द्युनिशं कुजोर्ध्वे । अधश्च सौम्यां निशि सौम्यमस्मात् सद्युक्तियुक्तं नृतलं निरुक्तम् ॥" भास्करेणेत्थं कथ्यते इति ॥ ५१ ॥

अब क्रान्तिज्या आदि की स्थिति को कहते हैं ।

हि. भा. - क्रान्तिज्या भुज, कुज्या कोटि, और दोनों का वर्गयोगमूल अग्रा कर्ण, यह अक्षक्षेत्र है । दिवाशंकुतल स्वोदयास्त सूत्र से दक्षिण होता है इति ॥ ५१ ॥

उपपत्ति ।

पूर्व स्वस्तिक से क्षितिज और अहोरात्र वृत्त के सम्पात पर्यन्त क्षितिज में अग्राचापांश है, पूर्वस्वस्तिक ही से उन्मण्डल और अहोरात्रवृत्त के सम्पात पर्यन्त उन्मण्डल में क्रान्ति चाप है तथा क्षितिज और उन्मण्डल के अन्तर्गत अहोरात्रवृत्त में कुज्या चाप है । इन तीनों भुजों से उत्पन्न त्रिभुज का ज्याक्षेत्र करने से अग्रा कर्ण, क्रान्तिज्या कोटि, और कुज्याभुज होता है, सिद्धान्त शिरोमणि में भास्कराचार्य ने इसी तरह कहा है । यहाँ आचार्य कुज्या कोटि, क्रान्तिज्याभुज कहते है इससे कोई दोष नही है क्योंकि भुज और कोटि के नाम मे भेद है स्वरूप में भेद नही है । ग्रह से क्षितिज धरातल के ऊपर जो लम्ब होता है वह शङ्कु है । शङ्कुमूल से स्वोदयास्त सूत्र पर्यन्त शङ्कुतल है । वह क्षितिज से ऊपर अहोरात्रवृत्त के दक्षिण होने से तथा अधोभाग में उत्तर होने से दिन में स्वोदयास्त सूत्र से दक्षिण और रात्रि में उत्तर होता है । सिद्धान्तशेखर में 'याम्योत्तर शंकुतलं भवेत्तद्दिवारजन्योरुदयास्तसूत्रात्' इससे श्री पति ने आचार्योक्ति के अनुरूप ही कहा है सिद्धान्त शिरोमणि में 'सूत्राद्दिवाशङ्कुतलं यमाशं याम्यां गतं' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक के अनुसार भास्कराचार्य ने कहा है । इति ॥ ५१ ॥

इदानीं यश्चरदलैर्विना दिनरात्र्यर्धे करोतीत्यस्योत्तरमाह ।

त्रिज्या क्षयवृद्धिज्यैक्यान्तरमुदगितरयोर्दिनार्धान्त्या ।
व्यासार्धचरार्धज्यान्तरसंयोगेऽर्धरात्र्यन्त्या ॥ ५२ ॥

उत्क्रमजीवा चापं क्रमजीवा चापसहितमधिकं चेत् ।
दिनरात्र्यर्धप्राणाः पृथक् विना चरदलप्राणैः ॥ ५३ ॥

सु. भा.—उदगितरयोरुत्तरदक्षिणगोलयोस्त्रिज्यायाः क्षयवृद्धिज्यायाः चर-ज्यायाश्चैक्यमन्तरं च दिनार्धेऽन्त्या स्यात्। एवमुदग्दक्षिणगोलयोस्त्रिज्यायाश्च-रज्यायाश्चान्तरसंयोगे रात्र्यर्धेऽन्त्या स्यात्। द्वयोरन्त्ययोरुत्क्रमचापं पृथक् पृथक् चरदलप्राणैर्विना दिनरात्र्यर्धप्राणा भवन्ति। चेत् त्रिज्यातोऽधिकमुत्क्रमज्यामानं भवेत् तदा यदधिकं तत्क्रमचापेन त्रिज्याचापं (खखवेदबाणमितं ५४००) सहितं कार्यमेवमुत्क्रमचापमानं तदा ज्ञेयमिति।

अत्रोपपत्तिः। अन्त्यासंस्थानेन स्फुटा त्रिज्याधिकोत्क्रमज्या चापं ज्योत्पत्त्या स्फुटमिति। एवं चरज्याज्ञानतो दिनरात्रिप्रमाणानयनमिह मन्दानन्दकरम्। वस्तुतश्चरज्याज्ञाने तत्क्रमचापतश्चरासवो लाघवेन विदिता भवन्ति, तेभ्यो दिनरात्र्यर्धमाने च सुखेन भवत इति सुधीभिश्चिन्त्यम् ॥ ५२-५३ ॥

वि. भा.—क्षयवृद्धिज्याशब्देन चरज्या। उदगितरयोः (उत्तरदक्षिण-गोलयोः) त्रिज्या चरज्ययोर्योगान्तरं क्रमेण दिनार्धेऽन्त्या भवति, तथा तयोरेव गोलयोस्त्रिज्या चरज्ययोरन्तरं योगश्च क्रमेण रात्र्यर्धेऽन्त्या भवति। तयोरन्त्य-योरुत्क्रमज्या विधिना यच्चापं पृथक्-पृथक् चरदलप्राणैर्विना दिनरात्र्यर्धप्राणाः स्युः। यद्युत्क्रमज्यामानं त्रिज्याधिकं तदा त्रिज्यातो यन्मितमधिकं तत्क्रमचापेन सहितं त्रिज्याचापं (९०×६०=५४००) उत्क्रमचापमानं भवेदिति ॥ ५२-५३ ॥

अत्रोपपत्तिः

क्षितिजाहोरात्रवृत्तसम्पातोपरिगतं ध्रुवप्रोतवृत्तं नाडीवृत्ते पूर्वस्वस्ति-काच्चरार्धान्तरेऽधो लगत्युत्तरगोले, दक्षिणगोले तूपरि तावत्येवान्तरे लगति, ताभ्यां बिन्दुभ्यां (क्षितिजाहोरात्र-वृत्तसम्पातोपरिगत-ध्रुवप्रोतवृत्तनाडीवृत्त-सम्पाताभ्यां) पूर्वापररेखायाः समानान्तरे रेखे कार्ये तदुपरि ग्रहोपरिगत ध्रुव-प्रोतवृत्त नाडीवृत्तयोः सम्पाततो लम्बरेखाऽन्त्या भवति, परन्तु दिनार्धकाले ग्रहो-परिगतं ध्रुवप्रोतवृत्तं याम्योत्तरवृत्तमेव तन्नाडीवृत्ते निरक्षखस्वस्तिके लगति निरक्षखस्वस्तिकात्पूर्वोक्तपूर्वापररेखायाः समानान्तररेखयोर्गतरा लम्बरेखा निरक्षोर्ध्वाधरसूत्रमेवाऽर्थान्निरक्षोर्ध्वाधर - सूत्रसमानान्तररेखयोर्योगान्निरक्षखस्व-स्तिकं यावद्दिनार्धेऽन्त्या भवति भूकेन्द्रतो निरक्षखस्वस्तिकं यावन्निरक्षोर्ध्वाधर-सूत्रखण्डं त्रिज्याऽस्ति, भूकेन्द्रात्समानान्तररेखां यावन्निरक्षोर्ध्वाधरसूत्रखण्डं चरज्याऽस्त्यत उत्तरदक्षिणगोलयोः क्रमेण दिनार्धेऽन्त्ये = त्रि + चरज्या, त्रि—चरज्या। एवमेवोत्तरगोले त्रि—चरज्या = रात्र्यर्धेऽन्त्या, दक्षिणगोले च त्रि+चरज्या =रात्र्यर्धेऽन्त्या। दिनार्धान्त्यायाा उत्क्रमज्यातश्चापानयनविधिना यच्चापं तद्दिनार्धमानम्। एवं रात्र्यर्धान्त्याया उत्क्रमचापं रात्र्यर्धमानं भवेत्। यद्युत्क्रमज्यामानं त्रिज्याधिकं तदा त्रिज्यातो यन्मितमधिकं तस्य क्रमचापेन सहितं

त्रिज्याचापं ५४०० उत्क्रमचापमानं भवेत्। सिद्धान्तशिरोमणौ 'त्रिज्याधिकस्य क्रमचाप लिप्ता' खखाब्धिबाणा ५४०० धनुरुत्क्रमात् स्यात्।' इत्यनेन भास्करेणापि तदेव कथ्यते। सिद्धान्त शेखरे 'व्यासार्धं चरजीवया भवति सा चान्त्यार्कगोल क्रमात्॥ मध्याह्नान्त्योत्क्रमविरचितं चापमाहुर्दिनार्ध तच्च त्रिशच्च्युतमिह दलं जायते याममत्याः, एतेन श्रीपतिनाऽप्याचार्योक्तानुरूपमेव कथ्यत इति ॥५२-५३॥

अब 'चरदलैर्विना दिनरात्र्यर्धे करोति' इस प्रश्न के उत्तर को कहते हैं।

हि भा.—उत्तर गोल मे त्रिज्या और चरज्या के योग करने से दिनार्ध मे अन्त्या होती है। दक्षिण गोल मे त्रिज्या मे चरज्या को घटाने से दिनार्ध मे अन्त्या होती है। तथा उत्तर गोल में तथा दक्षिण गोल में त्रिज्या और चरज्या के अन्तर और योग क्रम से रात्र्यर्ध मे अन्त्या होती है। दोनों अन्त्याओं की उत्क्रमज्या विधि से पृथक् पृथक् जो चाप होता है वे चरार्धासु के बिना दिनार्ध और रात्र्यर्ध के मान होते है। यदि उत्क्रमज्या मान त्रिज्या से अधिक हो तो त्रिज्या से जितना अधिक है उस के क्रमचाप को त्रिज्याचाप (९०×६० $= ५४००$) में जोड़ने से उत्क्रम चाप मान होता है इति ॥ ५२-५३ ॥

उपपत्ति।

उत्तर गोल में क्षितिजाहोरात्र वृत्त सम्पातोपरिगत ध्रुवप्रोतवृत्त नाडीवृत्त में पूर्व स्वस्तिक से चरार्धासु तुल्य अन्तर पर नीचे लगता है और दक्षिण गोल मे उतने ही अन्तर पर ऊपर लगता है। उन दोनों बिन्दुओं से पूर्वापर सूत्र की समानान्तर रेखा के ऊपर ग्रहोपरिगत ध्रुव प्रोतवृत्त नाड़ीवृत्त के सम्पात से जो लम्ब रेखाएं होती है वे दोनों गोलों में इष्टकाल में इष्टान्त्या होती हैं। दिनार्ध काल मे ग्रहोपरिगत ध्रुव प्रोतवृत्त (याम्योत्तर वृत्त) नाडीवृत्त के सम्पात बिन्दु (निरक्ष खस्वस्तिक) से समानान्तर रेखा के ऊपर लब रेखा निरक्षोर्ध्वाधर सूत्र है भूकेन्द्र से निरक्ष खस्वस्तिक पर्यन्त त्रिज्या है। तथा भूकेन्द्र से समानान्तर रेखा और निरक्षोर्ध्वाधर सूत्र के योग से बिन्दु पर्यन्त चरज्या है। अतः उत्तर गोल में त्रि + चरज्या = दिनार्धान्त्या, तथा दक्षिण गोल में त्रिज्या — चरज्या = दिनार्धान्त्या। एवं उत्तर गोल में त्रिज्या — चरज्या = रात्र्यर्ध में अन्त्या, दक्षिण गोल में त्रि + चरज्या = रात्र्यर्ध में अन्त्या। दिनार्धान्त्या के उत्क्रम चाप विधि से जो चाप होता है वह दिनार्ध का मान होता है। एवं रात्र्यर्धान्त्या के उत्क्रमज्या से चापानयन विधि से जो चाप होता है वह रात्र्यर्ध का मान होता है। यदि उत्क्रमज्या का मान त्रिज्या से अधिक हो तो त्रिज्या से जितना अधिक है उसके क्रमचाप को त्रिज्या चाप (५४००) में जोड़ देने से उत्क्रम चाप मान होता है सिद्धान्त शिरोमणि में 'त्रिज्याधिकस्य क्रमचापलिप्ताः खखाब्धिवाणा धनुरुत्क्रमात् स्यात्' इससे भास्कराचार्य भी इसी बात को कहते है। सिद्धान्त शेखर मे 'व्यासार्धं चरजीवया भवति सा चान्त्यार्कगोलक्रमात्। मध्यान्हान्त्योत्क्रमविरचितं' इत्यादि से श्रीपति ने आचार्योक्त के अनुसार ही कहा है। सूर्य सिद्धान्त में 'त्रिज्योदक् चरजा युक्ता-

याम्यायां तद्विवर्जिता। अन्त्या' इसमे सूर्य सिद्धान्ताकार भी उसी बात को कहते हैं इति ॥५२–५३॥

इदानीं ताभ्यामक्षावलम्बकौ य करोतीत्येतस्योत्तरमाह।

दिवसार्धोत्क्रमजीवाधिकक्रमज्याऽधिका दिनार्धान्त्या।
व्यासार्धदिनार्ध्यान्तिरं चरज्याऽक्षजीवाऽतः ॥५४॥

सु. भा.—दिवसार्धोत्क्रमजीवा दिनार्धान्त्या भवति। यदा दिवसार्धं खखाब्धिबाणासुतोऽधिकं तदा यदधिकं तत्क्रमज्यया त्रिज्याऽधिका कार्या। एवं दिनार्धान्त्या स्यात्। व्यासार्धस्य त्रिज्याया दिनार्धान्त्यायाश्चान्तरं चरज्या भवति। अतश्चरज्यायाः पूर्वोक्तेन विधिनाऽक्षज्या साध्या। अत्रार्कज्ञानेन चरज्यातोऽक्षज्याज्ञानं भवतीति ज्ञेयम्।

अत्रोपपत्तिः। अन्त्यासंस्थानेनैव स्फुटा ॥ ५४ ॥

वि. भा.—दिवसार्धोत्क्रमजीवा दिनार्धान्त्या स्यात्। यदि दिवसार्धं ५४०० मस्मादधिकं तदा यन्मितमधिकं तस्य या क्रमज्या तया त्रिज्या युता तदा दिनार्धेऽन्त्या भवति। दिनार्धान्त्यायास्त्रिज्यायाश्चान्तरं चरज्या स्यात्। ततश्चरज्यातः पूर्वोक्तनियमेनाक्षज्या भवतीति।

अत्रोपपत्तिः पूर्वश्लोकोपपतिविलोमेनैव स्पष्टेति ॥ ५४ ॥

अब 'ताभ्यामक्षावलम्बकौ यः करोति' इस प्रश्न के उत्तर को कहते हैं।

हि. भा.—दिनार्धोत्क्रमज्या दिनार्धान्त्या है। यदि दिनार्ध ५४०० असु से अधिक हो तो जितना अधिक है उस चाप की क्रमज्या को त्रिज्या में जोड़ने से दिनार्धान्त्या होती है। दिनार्धान्त्या और त्रिज्या का अन्तर चरज्या होती है। चरज्या से पूर्वोक्त विधि से अक्षज्या विदित होती है इति।

इसकी उपपत्ति पूर्वोक्त श्लोकोपपत्ति से स्पष्ट है ॥५४॥

इदानीं योऽनस्तमयार्कान् करोतीत्येतस्योत्तरमाह।

स्वाहोरात्रसमा यत्राक्षज्याऽवलम्बकः क्रान्त्या।
मेषादिगस्य तावत् यावत् कर्क्यादिगस्य रवेः ॥५५॥
नास्तमयस्तत्र तुलामकरादिस्थस्य नोदयोऽर्कस्य।
मन्मध्यान्तरलिप्ता मध्यमभुक्त्या हृता दिवसाः ॥५६॥

सु. भा.—मेषादिगस्य मेषादिराशित्रयस्थस्य रवेर्यत्र यस्मिन् प्रदेशेऽक्षज्या स्वाहोरार्धसमा स्वद्युज्या समा। अवलम्बको लम्बज्या च क्रान्त्या क्रान्तिज्यया समः। पुनः कर्क्यादिगस्य रवेर्द्युज्यासमाऽक्षज्या क्रान्तिज्यासमा लम्बज्या च यावत् तावत् तत्र देशेऽर्कस्य नास्तमयः। एवं तुलामकरादिस्थस्य रवेर्द्युज्या समाऽक्षज्या क्रान्तिज्यासमा लम्बज्या यावत् तावत् तत्र देशे ऽर्कस्य नोदयः। यदा मेषादिगस्य रवेः क्रान्तिज्या समालम्बज्या जाता तदा यो मध्यमरविस्तथा कर्क्यादिगस्य रवेः क्रान्तिज्यासमा यदा लम्बज्या तदा यो मध्यमरविस्तन्मध्ययोरन्तरे या लिप्तास्ता रविमध्यमगत्या हृता दिवसा भवन्ति। तावत् कालपर्यन्त मुत्तरक्रान्तेर्लम्बाधिकत्वात् तत्रार्कस्यानस्तमयः। दक्षिणक्रान्तेर्लम्बाधिकत्वात् तावत् तत्र रवेरनुदय इति।

अत्रोपपत्तिः। 'लम्बाधिका क्रान्तिरुदक् च यावत् तावद्दिनं सन्ततमेव तत्र'– इत्यादि भास्करविधिना स्फुटा॥ ५५-५६॥

वि. भा.—यत्र (यस्मिन् देशे) मेषादिराशित्रयगतस्य रवेर्द्युज्या तुल्याऽक्षज्या तथा क्रान्तिज्या तुल्या लम्बज्या। तथा कर्क्यादिगस्य रवेर्द्युज्या समाऽक्षज्या क्रान्तिज्या तुल्या लम्बज्या यावत् तावत्कालपर्यन्तं तत्र देशे रवेर्नोदयः। यदा मेषादिगस्य रवेः क्रान्तिज्यासमा लम्बज्या तदा यो मध्यमरविस्तथा कर्क्यादिगस्य रवेः क्रान्तिज्या समा यदा लम्बज्या तदा यो मध्यमरविस्तयोरन्तरे याः कलास्ता रविमध्यमगत्या भक्तास्तदा दिनानि भवन्ति। तावत्कालपर्यन्तमुत्तरक्रान्तेर्लम्बाधिकत्वात् तत्र रवेरनस्तमयः। दक्षिणक्रान्तेर्लम्बाधिकत्वात् तावत्तत्र रवेरनुदय इति॥५५-५६॥

अत्रोपपत्तिः

यत्र देशे षट्षष्टे ६६ रधिकाऽक्षांशास्तत्र रवेरुत्तरा क्रान्तिर्यावत्कालं लम्बांशाधिका भवति तावत्तत्र सर्वदा दिनमेव भवति। दक्षिणा क्रान्तिर्यावत् लम्बांशाधिका तावत् सर्वदा रात्रिरेव भवति। यतो लम्बांशैर्नाड़ी वृत्त दक्षिणक्षितिज.दुपरि भवति। तैरेवांशैरुत्तरक्षितिजादधो भवति। अतो लम्बांशाधिकामुत्तरां क्रान्ति नाड़ीवृत्ताद्दत्वा तदग्रे यदहोरात्रवृत्तं तदुत्तरक्षितिजादुपर्येव भवति। तथा तामेव दक्षिणां क्रान्ति दत्वा तदग्रे यदहोरात्रवृत्तं तद्दक्षिणक्षितिजादध एव भवति। अतः क्षितिजादुपरि-अहोरात्रवृत्तेषु भ्रमन् रविः सर्वदा दृश्यो भवति। क्षितिजादधःस्थेष्वहोरात्रवृत्तेषु भ्रमन् रविः सर्वदाऽदृश्य एव। सिद्धान्त शिरोमणौ ''षट्षष्टिभागाभ्यधिकाः पलांशा यत्राथ तत्रास्त्यपरो विशेषः। लम्बाधिका क्रान्तिरुदक् च यावत्तावद्दिनं सन्ततमेव तत्र। यावच्च याम्या सततं तमिस्रा ततश्च मेरौ सततं समार्धम्॥'' अनेन भास्कराचार्येण स्पष्टीकरणपूर्वकमाचार्योक्तं कथ्यते। सिद्धान्त-

शेखरे "यत्राऽक्षज्यादिनगुणसमालम्बकः क्रान्तितुल्यस्तस्मिन् मेषप्रभृतिषु रविः कर्कटाद्येषु यावत्। नास्तं गच्छत्युदयति तुलानक्रपूर्वेषु नासौ तन्मध्यार्कान्तर-भवकला भुक्तिभक्ता दिनानि ॥" श्रीपतिनाप्याचार्योक्तानुरूपं कथितमिति ॥

अब 'योऽस्तमयार्कान् करोति' इस प्रश्न के उत्तर को कहते हैं।

हि. भा —जिस देश में मेषादि तीन राशियों मे स्थित रवि की द्युज्या अक्षज्या के बराबर होती है तथा लम्बज्या क्रान्तिज्या के बरावर होती है। फिर कर्क्यादि गत रवि की द्युज्या अक्षज्या के बराबर और लम्बज्या क्रान्तिज्या के बराबर तब तक रहती है जब तक उस देश में रवि अस्तमय नहीं होते है। इस तरह तुलादि और मकरादि गत रवि की द्युज्या अक्षज्या के बराबर और क्रान्तिज्या के बराबर लम्बज्या जब तक रहती है तब तक उस देश में रवि का उदय नहीं होता है। जब मेषादि गत रवि की क्रान्तिज्या लम्बज्या के बरावर हुई तब जो मध्यम रवि है तथा कर्क्यादि गत रवि की क्रान्तिज्या के बराबर होती है तव जो मध्यम रवि है उन दोनों मध्यम रवि के अन्तर में जो कला है उसको रवि मध्यम गति से भाग देने से दिन प्रमाण होते है, तावत्कालपर्यन्त लम्बांश से रवि की उत्तर क्रान्ति के अधिक होने के कारण वहाँ रवि अस्त नहीं होते हैं। दक्षिण क्रान्ति के लम्बांशाधिक होने से तब तक वहां रवि का उदय नहीं होता है इति ॥

उपपत्ति।

जिस देश में ६६ से अधिक अक्षाँश है वहां रवि की उत्तराक्रान्ति जब तक लम्बांशाधिक रहती है तब तक सर्वदा दिन ही रहता है। दक्षिण क्रान्ति जब तक लम्बांशाधिक रहती हैं तब तक सर्वदा रात्रि ही रहती है। क्योंकि दक्षिणक्षितिज से ऊपर नाड़ीवृत्त लम्बाँशान्तरित पर रहता है। लम्बांशान्तरित ही पर उत्तर क्षितिज से नीचा रहता है। इसलिये नाड़ीवृत्त से लम्बांशाधिक उत्तराक्रान्ति को देकर उसके अग्र में जो अहोरात्र वृत्त होता है वह उत्तर क्षितिज से ऊपर ही रहता है। नाडी वृत्त से उसी दक्षिणा क्रान्ति को देकर उसके अग्र में जो अहोरात्र वृत्त होता है वह दक्षिण क्षितिज से नीचे ही रहता है अतः क्षितिज से उपरिस्थ अहोरात्र वृत्तों में भ्रमण करते हुए रवि सर्वदा दृश्य होते हैं। क्षितिज से अधः स्थित अहोरात्र वृत्तों में भ्रमण करते हुए रवि सतत अदृश्य होते हैं। सिद्धान्त शिरोमणि में 'षट्षष्टि भागाभ्यधिकाः पलांशा' इत्यादि संस्कृतोपपति में लिखित पद्यों से भास्कराचार्य ने इन्हीं विषयों का स्पष्टीकरण किया हैं। सिद्धान्त शेखर में 'यत्राक्षज्या दिनगुण समा लम्बकः क्रान्तितुल्यः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा हैं इति ॥५५-५६॥

इदानीं कोणच्छायातोऽर्कानयनमाह।

कोणच्छाया कृतिदलपदविषुवच्छाययोरुदग् नृतलम्।
प्राच्यपराया यद्यैक्यमन्तरं याम्यदिक्स्थं चेत् ॥५७॥

कोणच्छाया कर्णेन भक्तमवलम्बकेन सङ्गुणितम् ।
इष्टापक्रमजीवा त्रिप्रश्नोक्त्या स्फुटोऽर्कोऽतः ॥५८॥

सु. भा.—कोणवृत्तस्थे रवौ या द्वादशाङ्गुलशङ्कुच्छाया मा कोणच्छाया। तद्वर्गार्धस्य यत् पदं तच्छङ्कुमूल प्राच्यपररेखान्तरं भुजो भवति कोणवृत्तस्थे रवौ भुजकोटचोस्तुल्यत्वात्। यदि प्राच्यपराया रेखाया उदक् नूतनं शङ्कुमूलं भवेत् तदा भुजविषुवच्छाययोरैक्यं चेद्यमदिक्स्थं शङ्कुमूलं तदा तयोरन्तर कर्णवृत्ताग्रा भवति। तदैक्यमन्तरं वा लम्बकेन लम्बज्यया सङ्गुणितं कोणच्छायाकर्णेन भक्तमिष्टापक्रमजीवा भवति अतस्त्रिप्रश्नोक्त्या स्फुटोऽर्कः साध्यः।

अत्रोपपत्तिः। कर्णवृत्ताग्राज्ञानं व्याख्यातः। स्फुटम्। कर्णवृत्ताग्रा त्रिज्यागुणा छायाकर्णेन भक्ता ऽग्रा स्यात्। सा लम्बज्या गुणा त्रिज्याभक्ता क्रान्तिज्या स्यादेवमत्र त्रिज्यातुल्ययोर्गुणहरयोस्तुल्यत्वान्नाशे कृते चाचार्योक्तमुपपद्यते ॥ ५७-५८ ॥

वि. भा.—कोणवृत्तस्थिते रवौ द्वादशाङ्गुलशङ्कोश्छाया कोणच्छाया कथ्यते। तद्वर्गार्धस्य यन्मूलं तच्छङ्कुमूलपूर्वापररेखयोरन्तरं भुजो भवति। यदि नूतलं (शङ्कुमूलं) पूर्वापररेखात उत्तर दिशि पतेत् तदा भुजपलभयोर्योगः कर्णवृत्ताग्रा भवति। यदि शङ्कुमूलं पूर्वापररेखातो दक्षिणस्यां दिशि पतेत् तदा भुजपलभयोरन्तरं कर्णवृत्ताग्रा भवति। तदैक्यमन्तरं (कर्णवृत्ताग्रामानं) वा लम्बज्यया गुणितं कोणच्छायाकर्णेन भक्तं तदेष्टक्रान्तिज्या भवति ततो रविज्ञानं सुलभमेवेति ॥

अत्रोपपत्तिः।

अथ कोणवृत्तस्थरविकेन्द्रात् क्षितिजधरातलोपरि यो लम्बः स कोणशङ्कुः। तन्मूलं दृक्कुजसूत्रोपरि पतति। तन्मूलाद् भूकेन्द्रं यावद् दृग्ज्या कोणच्छाया वा। कोणशङ्कुमूलात्पूर्वापररेखोपरि यो लम्बः स भुजसंज्ञकः। भुजाग्राद् भूकेन्द्रं यावत् कोटिः। एतावतैकं जात्यत्रिभुजमुत्पन्नं यत्र कोणच्छायाकर्णः। भुजसंज्ञको भुजः। कोटिः कोटिः। त्रिभुजेऽस्मिन् कोणच्छाया पूर्वापररेखयोरुत्पन्नभूकेन्द्रलग्नकोणः $=४५^\circ$। भुजकोटचोरुत्पन्नः कोणः $=९०^\circ$। अतस्तृतीय कोणः $=४५^\circ$ तदाऽत्र भुजकोटी समे जातेऽतः $भु^२+को^२=२भुज^२=कोणच्छाया^२ \therefore भु^२=\frac{कोणच्छाया^२}{२}$

मूलग्रहणेन $भु=\sqrt{\frac{कोणच्छा^२}{२}}$ अग्राशङ्कुतलयोर्योगान्तरेण शङ्कुतलं भवति। परन्तु छायाकर्णगोले शङ्कुतलम् $=$ पलभा अतः पूर्वापररेखातो यद्युत्तरदिशि

शङ्कुमूलं तदा भुजपलभयोर्योगोऽन्यथा तयोरन्तरं कर्णवृत्ताग्रा भवति । ततो यदि छाया कर्णेनकर्णवृत्ताग्रा लभ्यते तदा त्रिज्यया किमिति जाताऽग्रा $=\frac{\text{त्रि. कवृत्ताग्रा}}{\text{छाक}}$

ततस्त्रिज्यया यदि लम्बज्या लभ्यते तदाऽग्रया किं लब्धा क्रान्तिज्या $=\frac{\text{लंज्या}\times\text{अग्रा}}{\text{त्रि.}}$ –

अत्राग्राया उत्थापनेन $\frac{\text{लंज्या. त्रि. कर्णवृत्ताग्रा}}{\text{त्रि. छाक}}=\frac{\text{लंज्या. कर्णवृत्ताग्रा}}{\text{छाक}}=$ क्रान्तिज्या,

ततः $\frac{\text{त्रि. क्रांज्या}}{\text{जिज्या}}=$ रविभुजज्या, अस्याश्चापं रविभुजांशाः स्युरिति ॥ सिद्धान्त-शेखरे भिन्न प्रकारेणास्योत्तरं श्रीपतिना कृतमस्तीति ॥५७-५८॥

यथा कोणवृत्तस्थरविकेन्द्रात्क्षितिजधरातलोपरिलम्बः कोणशङ्कुः । तन्मूलं कोणसूत्रे पतति । शङ्कुमूलात्पूर्वापरसूत्रोपरिलम्बः कार्यः स च भुजसंज्ञकः । भुजाग्राद् भूकेन्द्रं यावत्कोटि संज्ञकः । भूकेन्द्रात्कोण शङ्कुमूलं यावत् दृग्ज्या । दृग्ज्या भुजकोटिभिरुत्पन्नत्रिभुजे भुजकोट्योरुत्पन्नकोणः $=$ ९० । दृग्ज्या कोट्योरुत्पन्नः कोणः $=$ ४५ । अतस्तृतीय कोणोऽपि दृग्ज्याभुजयोरुत्पन्नः $=$ ४५, तेन भुजकोटी समे जाते । तत्र त्रिभुजे कोणानुपातः क्रियते यदि त्रिज्यया दृग्ज्या लभ्यते तदा भूकेन्द्र-लग्न कोणज्यया (ज्या ४५) किं समागच्छति भुजस्तत्स्वरूपम् $=\frac{\text{दृज्या. ज्या ४५}}{\text{त्रि.}}$ $=$ कोटिः इयमेव त्रिराशिगुणवृत्तभवा कोटिः कथ्यते । पुनस्त्रिज्याकर्णेन शरवेदांशज्या (ज्या ४५) भुजो लभ्यते कोणच्छायाकर्णेन किं समागच्छति छायाकर्ण-वृत्तसम्बन्धिनी कोटिः $=\frac{\text{कोणछा. ज्या ४५}}{\text{त्रि.}}$ इयमेव कर्णभवा कोटिः कथ्यते । अत्र

त्रि $=$ ३४१५, ज्या ४५ $=$ २४१५ अतस्त्रिराशिगुणवृत्तभवा कोटिः $=\frac{\text{दृज्या. २४१५}}{\text{३४१५}}$

$=\frac{\text{दृज्या. ४८३}}{\text{६८३}}$, कर्णवृत्तभवा कोटिश्च $=\frac{\text{कोणछा. २४१५}}{\text{३४१५}}=\frac{\text{कोछा. ४८३}}{\text{६८३}}$ अत्र

त्रिराशिगुणवृत्तभवया कोट्या द्युज्यानयने कोणवृत्तस्थरव्युपरिगतध्रुवप्रोतवृत्त-नाड़ीवृत्तसम्पातात् निरक्षोर्ध्वाधर सूत्रोपरि लम्बो नतकालज्या त्रिज्यावृत्ते। द्युज्यावृत्तपरिणता कोणशङ्कोरग्रात् याम्योत्तरवृत्तधरातलोपरिलम्बरूपा नतकाल-ज्या भवति । सा च पूर्वानीतयात्रिराशिगुणवृत्तभवयाकोट्या समा, अतः—

$\frac{\text{दृज्या. ज्या ४५}}{\text{त्रि}}=\frac{\text{नकाज्या. द्युज्या}}{\text{त्रि}}$ ततो द्युज्या $=\frac{\text{दृज्या. ज्या ४५ त्रि}}{\text{त्रि. नकाज्या}}$

$=\frac{\text{दृज्या. २४१५ त्रि.}}{\text{३४१५. नकाज्या}}=\frac{\text{दृज्या. ४८३ त्रि}}{\text{नकाज्या ६८३}}=\frac{\text{त्रिगुणजा कोटि. त्रि}}{\text{नकाज्या}}$ अस्यास्त्रिज्यायाश्च वर्गान्तर मूलं क्रान्तिज्या भवेत् ।

अथवा

कोणवृत्तस्थरविगत ध्रुवप्रोतवृत्ते ध्रुवाद्रविपर्यन्तं द्युज्याचापांशा एको भुजः। ध्रुवात्खस्तिकावधि लम्बांशा द्वितीयो भुजः। कोणवृत्ते खस्वस्तिकाद्रविपर्यन्तं नतांशास्तृतीयो भुजः। त्रिभुजेऽस्मिन् रविगतध्रुवप्रोतवृत्तयाम्योत्तरवृत्ताभ्यामुत्पन्नकोणो नतकालः। याम्योत्तरवृत्तकोणवृत्ताभ्यामुत्पन्नकोणः = ४५ ततोऽनुपातः क्रियते यदि नतकालज्यया दृग्ज्या लभ्यते तदाशरवेदांगज्यया (ज्या ४५) किमिति समागच्छति द्युज्या $= \frac{\text{दृग्ज्या. ज्या ४५}}{\text{नकाज्या}} = \frac{\text{दृग्ज्या. त्रि. ज्या ४५}}{\text{नतकाज्या. त्रि.}} = \frac{\text{दृग्ज्या. त्रि. २४१५}}{\text{३४१५ नकाज्या.}}$

$\frac{\text{दृज्या. त्रि. ४८३}}{\text{नकाज्या ६८३}}$ अत्र $\frac{\text{दृज्या. ४८३}}{\text{६८३}}$ = त्रिगुणजा कोटिः, अतो द्युज्या

$= \frac{\text{त्रिगुणजाकोटि. त्रि}}{\text{नकाज्या}}$, ततः $\sqrt{\text{त्रि}^2\text{-द्यु}^2}$=क्रांज्या।

एतावता श्रीपत्युक्तसूत्रमुपपन्नं भवति।

कोणद्युतिं गुणगजश्रुतिभिर्निहत्य दृग्ज्यां च पावकभुजङ्गरसैरवाप्तम्। कर्णत्रिराशिगुणवृत्तभवा क्रमेण कोटिर्भवेत् त्रिगुणजा त्रिगुणेन निघ्नी॥ नतक्रमज्या विहृता द्युजीवा स्यात्तत्त्रिजीवाकृतिजान्तरस्य। पदं भवेत् क्रान्तिरतो विवस्वानक्षद्युतिश्चाभिमता प्रकल्प्या। साध्या ततोऽग्राऽथ भुजाग्रयोस्तु योगान्तरं भिन्नसमाशयोर्यत्। तदर्कनिघ्नं निजशङ्कुभक्तमक्षद्युतिः स्यादमकृद्विधानात् इति॥

सिद्धान्तशेखर में इसका उत्तर दूसरी ही तरह किया गया है।

कोणवृत्तस्थ रविकेन्द्र से क्षितिज धरातल के ऊपर लम्ब कोणशङ्कु है। उसका मूल कोण सूत्र के ऊपर पतित होता है। शङ्कुमूल से पूर्वापर सूत्र के ऊपर लम्ब भुज संज्ञक है। भुजाग्र से भूकेन्द्र पर्यन्त कोटि संज्ञक है भूकेन्द्र से कोण शङ्कुमूल तक दृग्ज्या है। दृग्ज्या-भुज-कोटि इन तीनों भुजों से उत्पन्न त्रिभुज में भुज और कोटि से उत्पन्न कोण=९०। दृग्ज्या तथा कोटि से उत्पन्न कोण=४५ इसलिये तीसरा कोण भी दृग्ज्या और भुज से उत्पन्न कोण=४५ इसलिये यहां भुज और कोटि बराबर हुई। उस त्रिभुज में कोणानुपात करते हैं यदि त्रिज्या में दृग्ज्या पाते है तब भूकेन्द्रलग्न कोणज्या (ज्या ४५) में क्या इस अनुपात से भुज आता है $\frac{\text{दृज्या. ज्या ४५}}{\text{त्रि}}$ यही त्रिराशिगुणवृत्तभवकोटि कही जाती है। पुनः अनुपात करते हैं यदि त्रिज्या कर्ण में ज्या ४५ पाते हैं तो कोणच्छाया कर्ण में क्या इससे आती है छायाकर्णवृत्तसम्बन्धिनीकोटि $= \frac{\text{कोणछा. ज्या ४५}}{\text{त्रि}}$ यह कर्ण भवकोटि कही जाती है।

यहां त्रि = ३४१५, ज्या ४५ = २४१५ अतः त्रिराशिगुणवृत्तभवकोटि $= \frac{\text{दृज्या२४१५}}{\text{३४१५}}$

$= \frac{\text{दृज्या. ४८३,}}{\text{६८३}}$ कर्णवृत्तभवकोटि $= \frac{\text{कोणछा २४१५}}{\text{३४१५}} = \frac{\text{कोणछा. ४८३}}{\text{६८३}}$ यह त्रिराशि गुणवृत्तभवकोटि से द्युज्यानयन के लिये कोणवृत्तस्थ रव्युपरिगत ध्रुवप्रोतवृत्त नाडीवृत्त के सम्पात से निरक्षोर्ध्वाधर सूत्र के ऊपर लम्ब ननकालज्या है त्रिज्यावृत्त मे। द्युज्यावृत्त में परिणत करने से कोणशङ्कु के अग्र से याम्योत्तर वृत्त धरातल के ऊपर लम्बरूप नतकालज्या होती है। वह पूर्वानीत त्रिराशिगुणवृत्त भव कोटि के समान है। अतः $\frac{\text{दृज्या. ज्या ४५}}{\text{त्रि}}$

$= \frac{\text{नकाज्या. द्युज्या}}{\text{त्रि}}$ इसलिये द्युज्या $= \frac{\text{दृज्या. ज्या ४५. त्रि}}{\text{३४१५. नकाज्या}} = \frac{\text{दृज्या २४१५. त्रि}}{\text{३४१५. नकाज्या}}$

$\frac{\text{दृज्या. त्रि. ४८३}}{\text{६८३ नकाज्या}} = \frac{\text{त्रिगुणजाकोटि. त्रि}}{\text{नकाज्या}}$ $\therefore \sqrt{\text{त्रि}^2 - \text{द्युज्या}^2} = \text{क्रांज्या}$।

अथवा

कोणवृत्तस्थरविगत ध्रुवप्रोतवृत्त में ध्रुव से रविपर्यन्त द्युज्याचापांश एक भुज। ध्रुव से खस्वस्तिक पर्यन्त लम्बांश द्वितीय भुज। कोणवृत्त में खस्वस्तिक से रविपर्यन्त नतांश तृतीय भुज। इस त्रिभुज में रविगत ध्रुव प्रोतवृत्तयाम्योत्तरवृत्त से उत्पन्न कोण नतकाल है। याम्योत्तरवृत्त कोणवृत्त से उत्पन्न कोण = ४५ तब अनुपात करते हैं यदि नतकालज्या में दृग्ज्या पाते हैं तो ज्या ४५ में क्या इस अनुपात से द्युज्या आती है द्युज्या $= \frac{\text{दृज्या. ज्या ४५}}{\text{नकाज्या}} = \frac{\text{दृज्या. त्रि. ज्या ४५}}{\text{नकाज्या. त्रि}} = \frac{\text{दृज्या. त्रि. २४१५}}{\text{नकाज्या. ३४१५}} = \frac{\text{दृज्या. त्रि. ४८३}}{\text{नकाज्या. ६८३}}$ यहां $\frac{\text{दृज्या. ४८३}}{\text{६८३}}$ = त्रिगुणजाकोटि $\therefore$ द्युज्या $= \frac{\text{त्रिगुणजा कोटि. त्रि}}{\text{नकाज्या}}$ अतः $\sqrt{\text{त्रि}^2 - \text{द्युज्या}^2}$ = क्रांज्या, इससे संस्कृतोपपत्ति में लिखित श्रीपत्युक्त सूत्र उपपन्न हुआ ॥

अब कोणच्छाया से रवि का आनयन करते हैं।

हि. भा.—कोणवृत्त में रवि के रहने से द्वादशांगुल शंकु की जो छाया होती है वह कोणच्छाया कहलाती है। उस के वर्गार्ध का जो मूल होता है वह शंकुमूल और पूर्वा पर रेखा के अन्तर में भुज होता है। यदि शंकुमूल पूर्वापर रेखा से उत्तर दिशा में पतित हो तब भुज और पलभा का योग कर्णवृत्ताग्रा होती है। यदि शङ्कुमूल पूर्वापर रेखा से दक्षिण दिशा में पतित हो तब भुज और पलभा का अन्तर कर्णवृत्ताग्रा होती है। उस योग और अन्तर (कर्णवृत्ताग्रा) को लम्बज्या से गुणाकर कोणच्छाया कर्ण से भाग देने से इष्ट क्रान्तिज्या होती है, उससे रविज्ञान करना चाहिए इति ॥ ५७-५८ ॥

उपपत्ति ।

कोणवृत्तस्थ रविकेन्द्र से क्षितिज धरातल के ऊपर जो लम्ब होता है वह कोणशङ्कु है। उसका मूल दृक्कुज सूत्र के ऊपर पतित होता है। उसके मूल से भूकेन्द्र पर्यन्त दृग्ज्या वा कोणच्छाया है। कोण शंकुमूल से पूर्वापर रेखा के ऊपर जो लम्ब होता है वह भुजसंज्ञक है। भुजाग्र से भूकेन्द्र पर्यन्त कोटि संज्ञक है। इससे एक जात्य त्रिभुज बना जैसे कोणच्छाया कर्ण, भुज-भुज, और कोटि-कोटि, इस त्रिभुज में कोणच्छाया और पूर्वापर रेखा से उत्पन्न कोण $=४५^\circ$ है। भुज और कोटि से उत्पन्न कोण $=९०$ है। अतः तृतीय कोण $=४५^\circ$ तब यहां भुज और कोटि बराबर हुई इसलिए $भु^2 + को^2 = २भु^2 = कोणच्छाया^2$

$\therefore भु^2 = \frac{कोणच्छाया^2}{२}$ मूल लेने से $\sqrt{\frac{कोणच्छाया^2}{२}} = भुज$। अग्रा और शङ्कुतल के संस्कार से भुज होता है, इसके विपरीत शङ्कुतल और भुज के संस्कार से अग्रा होती है। परन्तु छाया कर्णगोल में शङ्कुतल=पलभा अतः यदि शङ्कुमूल पूर्वापर रेखा से उत्तर तरफ पतित है तब भुज और पलभा का योग अन्यथा दक्षिण तरफ (पतित) हो दोनों का अन्तर करने से कर्णवृत्ताग्रा होती है। तब अनुपात करते है यदि छाया कर्ण में कर्णवृत्ताग्रा पाते है तो त्रिज्या में क्या इससे अग्रा आती है। उसका स्वरूप $= \frac{त्रि. कवृत्ताग्रा}{छाक}$ फिर अनुपात करते है यदि त्रिज्या में लम्बज्या पाते है तो अग्रा में क्या इससे क्रान्तिज्या आती है $\frac{लंज्या. अग्रा}{त्रि}$ $=$ क्रांज्या, इसमें अग्रा को उत्थापन करने से $\frac{लंज्या. त्रि. कवृत्ताग्रा}{छाक. त्रि} = क्रांज्या = \frac{लंज्या. कर्णवृत्ताग्रा}{छाक}$, तब $\frac{त्रि. क्रांज्या}{जिज्या} =$ रविभुजज्या, इस के चाप करने से रविभुजांश होता है, इससे आचार्योक्त उपपन्न हुआ इति ॥ ५७-५८ ॥

इदानीं स्वप्रशंसामाह ।

मध्यगतिस्पष्टगतित्रिप्रश्नान् सोत्तरान् विजानाति ।
स भवत्याचार्यो वै ब्रह्मोक्तान् योऽन्यतन्त्रज्ञः ॥ ५९ ॥

सु. भा.—योऽन्यतन्त्रज्ञ आर्यभटादितन्त्रज्ञो गणको ब्रह्मोक्तान् सोत्तरान् मध्यगति-स्पष्टगति-त्रिप्रश्नान् विजानाति विशेषेण जानाति । स वै निश्चयेन गणितस्कन्धेचाचार्यो भवतीति ॥ ५९ ॥

वि. भा.—योऽन्यतन्त्र ज्ञोऽर्थादार्यभटादितन्त्र पण्डितो ज्योतिर्विन् ब्रह्मगुप्त-

कथितान् उत्तरसहितान् मध्यगति-स्पष्टगति-त्रिप्रश्नान् विशेषरूपेण जानाति सोऽत्रशास्त्रे (ज्यौतिषे) आचार्यो भवतीति ।। ५९ ।।

अब अपनी प्रशंसा कहते हैं ।

हि. भा.— जो ज्योतिषी आर्य भटादितन्त्रों के पण्डित ब्रह्मगुप्त कथित उत्तर सहित मध्यगति-स्पष्टगति और त्रिप्रश्न को विशेषरूप से जानते हैं वे उस ज्योतिष शास्त्र में आचार्य होते हैं इति ।। ५६ ।।

इदानीमध्यायोपसंहारमाह ।

अध्यायः पञ्चदशस्त्रिप्रश्नस्योत्तरं यदिह नोक्तम् ।
तच्चार्याषष्ट्याऽयं गोलादुत्प्रेक्ष्य बुद्धिमता ।। ६० ।।

सु. भा.—त्रिप्रश्नस्योत्तरं नामायं पञ्चदशोऽध्याय आर्याषष्ट्या मया कृत इति । इहास्मिन्नध्याये यत् किञ्चिन्मया नोक्तं बुद्धिमता गोलात् तदुत्प्रेक्ष्य ज्ञेयम् । गोलयुक्त्योत्प्रेक्षां कल्पनां कृत्वा तत् सर्वं बोध्यं यतो गोलबोध इदमेव फलं यदनुक्तमपि बुद्धिमता ज्ञायत इति ।

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते ।
हृदि तं विनिधाय नूतनोऽयं रचितः प्रश्नविधौ सुधाकरेण ।।

इति श्रीकृपालुदत्तसुतसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्त नूतनतिलके त्रिप्रश्नोत्तराध्यायः पञ्चदशः ।। १५ ।।

वि. भा.—आर्याषष्ट्या त्रिप्रश्नोत्तरनामकोऽयं पञ्चदशोऽध्यायः कृतः । अत्राध्याये यन्मया न कथितं तद्बुद्धिमता गोलादुत्प्रेक्ष्य अर्थादर्थाद्गौलिक युक्त्या कल्पनां कृत्वा ज्ञेयमिति ।। ६० ।।

इति ब्राह्मस्फुट सिद्धान्ते त्रिप्रश्नोत्तराध्यायः पंचदशः

अब अध्याय के उपसंहार को कहते है ।

हि. भा.— साठ आर्याओं से त्रिप्रश्नोत्तर नामक पन्द्रहवां अध्याय हमने किया है । इस अध्याय में जो बात हम ने नही कहा है वह बुद्धिमान् ज्योतिषी गोलयुक्ति से कल्पना कर समझे इति ।। ६० ।।

इति ब्राह्मस्फुट सिद्धान्त में पन्द्रहवां त्रिप्रश्नोत्तराध्याय समाप्त हुआ ।। १५ ।।

ब्राह्मस्फुटसिद्धान्तः

ग्रहणोत्तराध्यायः

ब्राह्मस्फुटसिद्धान्तः

ग्रहणोत्तराध्यायः

तदारम्भ प्रयोजनार्थंप्राह

ग्रहणग्रहसंयोगग्रहर्क्षतन्त्रेषु सर्वविदाम् ।
आचार्यश्छेद्यकविद् यतस्ततश्छेद्यकं वक्ष्ये ॥ १ ॥

सु. भा.—यतो ग्रहण-ग्रहसंयोग-ग्रहर्क्षतन्त्रेषु सर्वविदां मध्ये छेद्यकविदाचार्यो भवति ततस्तस्माच्छेद्यकं वक्ष्ये । संशयं छेदयतीति छेद्यकः । येन क्षेत्ररचनया ग्रहणादिकं प्रदर्श्यते स छेद्यक इति ॥ १ ॥

वि. भा.—यतश्छेद्यकवित् (छेद्यकज्ञाता) स्पर्शमोक्षादौ ग्रहसंयोगे (ग्रासादौ) ग्रहयुतौ वा ग्रहनक्षत्रतन्त्रेषु-एतेषां सर्वेषां विषयाणां पण्डितानां मध्येऽऽचार्यो भवति । तस्मात्कारणात् छेदचकं कथयामि । येन ग्रहणे स्पर्शमोक्षादिकं क्षेत्ररचनया स्फुटं ज्ञातं भवेत् स छेद्यक इति ॥ १ ॥

अब ग्रहणोत्तराध्याय आरम्भ किया जाता ।

उसके आरम्भ करने के प्रयोजन को कहते है ।

हि. भा.—क्यों कि छेद्यकज्ञाता स्पर्श-मोक्ष आदियों मे ग्रासादियों में, वा ग्रहयुति में ग्रह नक्षत्रतन्त्रों में इन सब विषयों के ज्ञाताओं में आचार्य होते हैं । इस कारण से छेद्यक को कहता हूं । जिस से ग्रहण में स्पर्श मोक्ष आदि क्षेत्र रचना से स्फुट विदित हो वह छेद्यक है इति ॥ १ ॥

इदानीं छेद्यकं केभ्यो न देयमित्याह ।

दुर्जनकृतघ्नशत्रुप्रतिकंचुककारिपतितमूर्खेभ्यः ।
छेद्यकमदेयमेभ्यो ददतः सुकृतायुषोर्नाशः ॥ २ ॥

सु. भा.—प्रतिकंचुककारी पिशुनः। शेषं स्पष्टम् ॥ २ ॥

वि. भा.—दुर्जनः प्रसिद्धः (दुष्टः) कृतघ्नः (कृतमुपकार यो न मन्यते) प्रतिकञ्चुककारी (पिशुनः) पतितः (गोहत्यादिनिन्दितकार्यकर्त्ता) मूर्खं प्रसिद्धः, एभ्य एतत् छेद्यकं न दातव्यम्। ददतः पुरुषस्य सुकृतायुषोर्नाश इति ॥ सिद्धान्त शिरोमणेष्टिप्पण्याम् "दिव्यं ज्ञानमतीन्द्रियं यदृषिभिर्ब्राह्म वशिष्ठादिभिः पारं पर्यवशाद्रहस्यमवनी नीतं प्राकाश्यं ततः। नैतद् द्वेषिकृतघ्नदुर्जनदुराचाराचिरवासिनां स्यादायुः सुकृतक्षयो मुनिकृतां सीमामिमामुज्झतः ॥' कस्यचित् पद्यमिदं बहुधा आचार्योक्तानुरूपमेवेति ॥ २ ॥

अब छेद्यक किनको नही देना चाहिये सो कहते है।

हि. भा.—दुर्जन (दुष्ट) कृतघ्न (किये हुए उपकार को जो नहीं मानता है), चुगलखोर, पतित (अति निन्दित कार्य कर्त्ता) मूर्ख प्रसिद्ध ही है इन सबों के लिये छेद्यक नही देना चाहिये। देने वाले पुरुष के सुकृत और आयु का नाश होता है ॥ सिद्धान्त शिरोमणि की टिप्पणी में 'दिव्य ज्ञानमतीन्द्रियं यदृषिभिर्ब्राह्म वशिष्ठादिभिः' इत्यादि विज्ञान भाष्य में लिखित किसी का पद्य बहुत अंशों में आचार्योक्त के अनुरूप ही है ॥ २ ॥

इदानीं छेद्यकं कस्मै देयमित्याह।

उषिताय दीर्घकालं शिष्याय गुणाधिकाय भक्ताय।
पात्रे वा सुहृदे वा सुताय वा छेद्यकं देयम् ॥ ३ ॥

सु. भा.—स्पष्टार्थम् ॥ ३ ॥

वि. भा.—आत्मनिकटे बहुकालं वासिने बहुगुणयुताय भक्ताय शिष्याय (छात्राय) वा सुपात्रे मित्राय वा स्व बालकाय वा एतत् च्छेद्यकं दातव्यम्। सूर्यसिद्धान्ते 'रहस्यमेतद्देवानां न देयं यस्य कस्यचित्। सुपरीक्षितशिष्याय देयं वत्सरवासिने" तत्कत्रैवं कथ्यते ॥ ३ ॥

अब छेद्यक किसको देना चाहिये कहते हैं।

हि. भा.—जो बहुत दिनों तक अपने सम्पर्क में रहा हो या अधिक गुणों से युत भक्त हो ऐसे विद्यार्थी को और सुपात्र कों वा अपने सुत (बालक को) यह छेद्यक देना चाहिये ॥ सूर्य सिद्धान्त में 'रहस्य मेतद्देवानां न देयं यस्य कस्यचित्। सुपरीक्षित शिष्याय देयं वत्सर वासिने' इस तरह कहा गया है ॥ ३ ॥

इदानीं प्रश्नानाह।

विषुवदपमण्डलदिशो वलनज्याभिस्त्रिगृहवृत्ते ।
सम्पर्के ग्रासं वा यो वेत्ति छेद्यकज्ञः सः ॥ ४ ॥

सु. भा.—यो वलनज्याभिस्त्रिगृहवृत्ते ग्रहत्रिज्यावृत्ते विषुवद्वृत्तस्य क्रान्ति-वृत्तस्य च दिशो वेत्ति। वा सम्पर्के छाद्यछादकयुतौ वेत्ति स एव छेद्यकज्ञ इति। एवमत्र प्रश्नद्वयम् ॥ ४ ॥

वि. भा.—यो ग्रहत्रिज्यावृत्ते वलनज्याभिर्नाडीक्रान्तिवृत्तयोर्दिशो जानाति वा छाद्यच्छादकयुतौ ग्रासं जानाति स च्छेद्यकपण्डितोऽस्तीति ॥ ४ ॥ अत्र प्रश्न-द्वयमस्ति ॥

अब प्रश्नों को कहते हैं।

हि. भा.—जो ग्रहत्रिज्यावृत्त मे वलनज्या से नाडीवृत्त और क्रान्तिवृत्त की दिशा को जानते हैं। वा छाद्य और छादक के योग में ग्रास को जानते है वे छेद्यकज्ञ हैं इति ॥ ४ ॥ यहां दो प्रश्न हैं।

इदानीमन्यान् प्रश्नानाह।

सम्पर्क मण्डले यः प्रग्रहमोक्षौ पृथक् स्वविक्षेपात् ।
मध्यान्मध्यग्रासं परिलिखति च्छेद्यकज्ञः सः ॥ ५ ॥

सु. भा.—यः सम्पर्कमण्डले मानैक्यार्धमण्डले स्वस्वविक्षेपात् पृथक् पृथक् प्रग्रहमोक्षौ स्पर्शमोक्षौ परिलिखति। मध्यात् मध्यकालिकाद्विक्षेपाच्च मध्यग्रासं परिलिखति स एव छेद्यकज्ञः। एवमत्र प्रश्नत्रयम् ॥ ५ ॥

वि. भा.—सम्पर्कमण्डले (मानैक्यार्धवृत्ते) स्व स्व शरात् पृथक् पृथक् यः स्पर्शमोक्षौ परिलिखति, मध्यात् (मध्यकालिकात्) शरान्मध्यग्रासं परिलिखति सछेद्यकपण्डितोऽस्तीति ॥ अत्र प्रश्नत्रयमस्ति ॥ ५ ॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—जो व्यक्ति मानैक्यार्ध वृत्त में अपने अपने शर से पृथक् पृथक् स्पर्श और मोक्ष को लिखते हैं एवं मध्यकालिक शर से मध्यग्रास को लिखते है वे छेद्यक के पण्डित है। यहां तीन प्रश्न है ॥ ५ ॥

इदानीमन्यान् प्रश्नानाह ।

परिलिखतीष्ट ग्रासं तात्कालिक बाहुकोटिकर्णैर्यः ।
अथवा निमीलनोन्मीलनद्वयं छेद्यकज्ञः सः ।। ६ ।।

सु. भा.—यस्तात्कालिकबाहुकोटिकर्णैर्ग्रहणकालोद्भवैरिष्टग्रासं परिलिखति । अथवा निमीलनमुन्मीलनं चेति द्वयं यः परिलिखति स एव छेद्यकज्ञः । एवमत्र प्रश्नत्रयम् ।। ६ ।।

वि. भा.—ग्रहणकालिकभुजकोटिकर्णैर्य इष्टग्रासं परिलिखति । अथवा निमीलनमुन्मीलनं चेति द्वयं लिखति सछेद्यकपण्डितोऽस्तीति । अत्र प्रश्नत्रय-मस्ति ।। ६ ।।

अब अन्य प्रश्नों को कहते है ।

हि. भा.—ग्रहण कालिक भुज कोटि कर्णों से जो इप्ट ग्रास को लिखते है । अथवा निमीलन और उन्मीलन को लिखते हैं वे छेद्यक के पण्डित हैं । यहां तीन प्रश्न हैं ।।

इदानी मन्यान् प्रश्नानाह ।

ग्राह्यं परिलिख्यैक्यं परिलिखति ग्रहगृहादिकं तत्र ।
भूमौ यः फलके वा परिवर्त्यच्छेद्यकज्ञः सः ।। ७ ।।

सु. भा.—यो ग्राह्यं छाद्यबिम्बमैक्यं मानैक्यार्धवृत्तं च परिलिख्य तत्र-भूमौ वा परिवर्त्य विपरीतं कृत्वा फलके पीठे ग्रहगृहादिकं परिलिखति स एव छेद्यकज्ञः । एवमत्र प्रश्नद्वयम् ।। ७ ।।

वि. भा.—ग्राह्यं (छाद्यबिम्बं) ऐक्यं (मानैक्यार्धवृत्तं) परिलिख्य तत्र पृथिव्यां वा परिवर्त्य (विपरीतं कृत्वा) फल के (पीठे) ग्रहगृहादिकं यः परिलि-खति सछेद्यकपण्डितोऽस्ति । अत्र प्रश्नद्वयमस्ति ।। ७ ।।

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—जोव्यक्ति छाद्य बिम्ब को और मानैक्यार्ध वृत्त को लिखकर पृथिवी ऊपर परिवर्त्तन (विपरीत) कर फलक (पीठ) पर ग्रह के गृहादिक को लिखते हैं वे छेद्यक के पण्डित है । यहां दो प्रश्न हैं ।। ७ ।।

इदानीमन्यान् प्रश्नानाह ।

देशान्तरं यथा गतदृक्प्रग्रहणान्तराद्विजानाति ।
यो रेखातोऽध्वानं पर्वेष्टदिनात् स तन्त्रज्ञः ॥ ८ ॥

सु. भा.—यो यथागतदृक्प्रग्रहणान्तराद् गणितागतदृष्टिजन्यस्पर्शकालयोरन्तराद्देशान्तरं विजानाति । यो रेखातो रेखादेशादध्वानं देशान्तरयोजनानि विजानाति । इष्टदिनात् पर्व विजानाति । इष्टदिनादग्रे कतिभिर्दिनैः पर्वग्रहणं भविष्यतीति वा इष्टदिनस्य पश्चात् कतिभिर्दिनैः पर्वगतमिति । एवमत्र प्रश्नत्रयम् ॥ ८ ॥

वि. भा.—यथागत दृक्प्रग्रहणान्तरात् (गणितागतवेधागतस्पर्शकालयोरन्तरात्) यो देशान्तरं विजानाति । रेखादेशाद्देशान्तरयोजनानि विजानाति, इष्ट दिनात् पर्व विजानात्यर्थादिष्टदिनादग्रे कतिभिर्दिनैः पर्वग्रहणं भविष्यति वेष्टदिनात्पूर्वं कतिभिर्दिनैः पर्वगतमिति जानाति स तन्त्रज्ञः । अत्र प्रश्नत्रयमस्ति ॥ ८ ॥

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—जो व्यक्ति गणितागत और वेधागत स्पर्श काल के अन्तर से देशान्तर को जानते है । रेखा देश से देशान्तर योजन को जानते हैं । इष्ट दिन से पर्व को जानते है अर्थात् इष्ट दिन से आगे कितने दिनों में गृहण होगा वा इष्टदिन से पहले कितने दिनों मे हुआ, वे तन्त्रज्ञ है । यहा तीन प्रश्न है ॥ ८ ॥

इदानीमन्यान् प्रश्नानाह ।

यो वेत्ति राहुमार्गं तेनेष्टग्रासमिष्टकालाद्वा ।
ग्रासं ग्रासात्कालं जानाति छेद्यकज्ञः सः ॥ ९ ॥

सु. भा.—यो ग्रहणे राहुमार्गं भूभामार्गं वेत्ति । तेन मार्गेणेष्टग्रासं वेत्ति वेष्टकालाद् ग्रासं वेत्ति ग्रासाच्च कालमिष्टकालं जानाति स एव छेद्यकज्ञः । एवमत्र प्रश्नचतुष्टयम् ॥ ९ ॥

वि. भा.—यो ग्रहणे भूभामार्गं जानाति । तेन (भूभामार्गेण) इष्टग्रासं जानाति । इष्ट कालाद् ग्रासं जानाति ग्रासादिष्ट कालं जानाति सच्छेद्यक पण्डितोऽस्तीति । अत्र प्रश्न चतुष्टयमस्ति ॥ ९ ॥

अब अन्य प्रश्नों को कहते है ।

हि. भा.—जो व्यक्ति गृहण में राहुमार्ग (भूभामार्ग) को जानते हैं । उस मार्ग

(भूभामार्ग) से इष्टग्रास को जानते है। इष्टकाल से ग्रास को जानते है। ग्रास से इष्टकाल को जानते हैं वे छेद्यक के पण्डित है। यहां चार प्रश्न है ॥ ९ ॥

इदानीं पूर्वोक्तानां प्रश्नानामुत्तरार्थं विशेपमाह।

ग्रासप्रमाणयोगग्राह्यग्राहकदलानि वलनज्या।
विक्षेपश्चापरतो भवति रवेः पूर्वतः शशिनः ॥ १० ॥

सु. भा.—ग्रासप्रमाणयोगो मानैक्यम्। ग्राह्यदलं छाद्यबिम्बार्धम्। ग्राहक-दलं ग्राहकबिंबार्धम्। इति वस्तुत्रयं ग्रहणपरिलेखे चावश्यकम्। अथ वलनज्या। विक्षेपः स्पर्शकालिकः शरश्च। खेग्रहणेऽपरतः पश्चिमतः शशिनश्चन्द्रस्य ग्रहणे पूर्वतो भवति ॥ १० ॥

वि. भा.—ग्रास प्रमाणयोगो (ग्राह्यग्राहकयोर्मानैक्यम्)। ग्राह्यबिम्बार्धम्। ग्राहकबिम्बार्धम्, इति ग्रहणपरिलेखोपयोगीनि वस्तूनि सन्ति। वलनज्या-स्पर्श-कालिकः शरश्च सूर्यग्रहणे पश्चिमतः, चन्द्रग्रहणे पूर्वतो भवति ॥ १० ॥

अब पूर्वोक्त प्रश्नों के उत्तर के लिये विशेष कहते है।

हि. भा.—मानैक्यार्ध-ग्राह्य बिम्बार्ध, ग्राहक बिम्बार्ध ये ग्रहण परिलेखोपयोगि वस्तु हैं। वलनज्या, स्पर्श कालिक शर सूर्य ग्रहण में पश्चिम से, चन्द्र ग्रहण में पूर्व से होता है इति ॥ १० ॥

इदानीमङ्गुललिप्तार्थमाह।

दिनदलविभक्तजिनगुणदिनगतशेषाल्पजीवयेषु गुणम्।
त्रिज्यार्धमधिकमङ्गुललिप्तास्त्रिग्रहज्यया भक्तम् ॥११॥

सु० भा०—दिनगतशेषयोर्मध्ये या अल्पा घट्यस्ता जिनगुणा दिनदलभक्ता या लब्धिस्तत्सङ्ख्या ज्या ग्राह्या तयेषुगुणितं पञ्चगुणं त्रिज्यार्धमधिकं त्रिग्रहज्यया त्रिज्यया भक्तमङ्गुललिप्ता अङ्गुले लिप्ता भवन्ति। ताभिर्लिप्ताभिरेकमङ्गुलं भवतीत्यर्थः।

अत्रोपपत्तिः। 'त्रिज्योद्धृतस्तत्समयोत्थशङ्कुः' इत्यादि भास्करविधिना। तत्राचार्येण दिनदले नवत्यंशास्तदेष्टोन्नतकालेन किमित्यनुपातेनोन्नतांशाः स्थूलाः कल्पिताः। एवमुन्नतांशाः $= \frac{९० \times उका}{दिद}$। एते षष्टिगुणाः कलाः। कलास्तत्त्वा-

शिवहृता लब्धा जीवा $= \frac{६० \times ९० \times उका}{२२५ \times दिद} = \frac{२४ \times उका}{दिल}$ अत्र या निग्ना न्विध-स्तत्संख्यका जीवैव स्वल्पान्तरात् शङ्कुस्ततोऽङ्गुललिप्ता भास्कर विधिना $= \frac{५}{२} + \frac{शं}{त्रि} = \frac{\frac{५ त्रि}{२} + शं}{त्रि}$ । अत्र उपपन्नम् ।

वि. भा.— दिनगतशेषयोर्मध्ये या अल्पा घटयस्ताश्चतुर्विंशतिगुणा दिनार्धभक्ता या लब्धिस्तत्तुल्या ज्या ग्राह्या तया पञ्चगुणितं त्रिज्यार्धं युत त्रिज्यया भक्तं तदाऽङ्गुलकला भवन्ति ताभिः कलाभिरेकमङ्गुलं भवतीति ॥

अत्रोपपत्तिः ।

यदि दिनार्धतुल्येनोन्नतकालेन नवत्यंशा उन्नतांशा लभ्यन्ते तदेष्टोन्नतकालेन किमित्यनुपातेन स्थूला उन्नतांशाः $= \frac{९० \times उका}{\frac{दि}{२}}$ षष्ट्या गुणनेनोन्नत-

कलाः $= \frac{९० \times उका \times ६०}{\frac{दि}{२}}$ ततस्तत्त्वाश्विभक्ता असवः कला वेति भास्करोक्त्योन्नतकलज्या $= \frac{९० \times उका \times ६०}{\frac{दि}{२} \times २२५} = \frac{२४ \times उका}{\frac{दि}{२}}$ $\therefore \frac{९० \times ६०}{२२५} = २४$

$=$ स्वल्पान्तरात् शङ्कुः । ततस्त्रिज्योद्धृतस्तत्समयोत्थशङ्कुरित्यादि भास्करोक्त्याऽङ्गुललिप्तिकाः $= \frac{५}{२} + \frac{शङ्कु}{त्रि} = \frac{\frac{५ त्रि}{२} + शं}{त्रि}$ एतावताऽऽचार्योक्तमुपपन्नम् ।

सिद्धान्त शेखरे "स्वोन्नताज्जिनगुणात् द्युदलाप्ताज्ज्याऽनया समधिके त्रिगुणार्धे । सायकैरभिहते त्रिभमौर्व्या भाजितेऽत्रफलमङ्गुललिप्ताः ॥" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव । सूर्यसिद्धान्ते "सोन्नतं दिनमध्यर्धं दिनार्धाप्तं फलेन तु । छिन्द्याद्विक्षेपमानानि तान्येषामङ्गुलानि तु ॥" सूर्यसिद्धान्त कारेणेत्थं कथितम् । अत्रोपपत्तिः— गगनमध्यस्थं यद्ग्रहबिम्बं तस्याखिलकरनिकरपिहितपरिधित्वात् किञ्चित् सूक्ष्मं दृश्यते । उदये तु क्षितिजस्थं क्षितिव्यवहिततत्करनिकरं भूवायुना वलितं विशालमिव प्रतिभाति । तत्सूक्ष्मत्वं विशालत्वं चोपलब्ध्याऽऽचार्यैः कल्पितम् । तच्च गगनमध्ये चतुःकलम् । उदये त्रिकलमङ्गुलं कल्पितम् । अवान्तरेऽनुपातेन यदि दिनार्धसम उन्नतकालेऽङ्गुललिप्तान्तरं रूपं १ लभ्यते तदेष्टोन्न-

कालेन किमिति फलं त्रियुक्तमङ्गुललिप्तिकाः स्युः । पूर्वानुपातेनाङ्गुल लिप्ताः $=३+\frac{उका}{\frac{दि}{२}}=\frac{\frac{३ दि}{२}+उका}{\frac{दि}{२}}$ एतेन सूर्यसिद्धान्तोक्तसूत्रमुपपन्न मेव । सिद्धान्त-शिरोमणौ "त्रिज्योद्धृतस्तत्समयोत्थशङ्कुः सार्धद्वियुक्तोऽङ्गुललिप्तिकाः स्युः । स्थूलाः सुखार्थं द्युदलेन भक्तं समुन्नतं सार्धयमान्वितं वा" भास्करोक्तप्रकार ईदृशोस्ति । भास्करेण गगनमध्ये सार्धत्रिकलं उदये सार्धद्विकलमङ्गुलं कल्पितम् । अवान्तरे शङ्कुना सूक्ष्मोऽनुपातश्च कृतः । अङ्गुललिप्ता साधनार्थं भास्करेण शङ्कुनोन्नतकालेन चानुपातः कृतस्तत्र कतरः सूक्ष्म इत्यस्य ज्ञानं वास्तवप्रकार-ज्ञानं विना न भवति । अतो भास्करस्य "शङ्क्वनुपातः सूक्ष्मः" इति कथनं न युक्तिमत् । इति सूर्यसिद्धान्तस्य सुधावर्षिण्यां टीकायां सुधारकरद्विवेदिनः कथयन्ति । वस्तुतो यदि ग्रहकर्णेन तत्संमुखकोणज्या त्रिज्या लभ्यते तदा बिम्ब-व्यासार्धेन किं समागच्छति बिम्बकलार्धज्या । अस्याश्चापं द्विगुणितं तदा दृष्टिलग्न-कोणमानं बिम्बकलामानं भवेत् । अथ यावन्मितं बिम्बं दृश्यते तदङ्गुल प्रमाणा-दनुपातः क्रियते । यद्येतावताङ्गुलेन दृष्टिलग्नकोणमानं (बिम्बकलामानं) लभ्यते तदैका ङ्गुलेन किमित्यनुपातेन वास्तवमङ्गुल लिप्ता प्रमाणमागच्छति । एतस्याऽऽसन्नत्वं भास्करोक्तोन्नतकालानुपातजनितफलापेक्षया शङ्क्वनुपातजनित-फलस्यैव भवतीत्येतस्य ज्ञानमतीव दुर्घटमतो म. म. सुधाकरद्विवेदिकथनं युक्तियु-क्तमिति मन्मतम् ॥ ११ ॥

अब अङ्गुल लिप्ता के लिये कहते हैं ।

हि. भा.—दिनगत और दिन शेष में जो अल्प घटी है उसको चौबीस से गुणाकर दिनार्ध से भाग देने से जो लब्धि हो तत्तुल्य ज्या ग्रहण करनी चाहिये । उसको पांच से गुणित त्रिज्यार्ध में जोड़कर त्रिज्या से भाग देने से अङ्गुल लिप्ता होती है । अर्थात् उतनी कला का एक अङ्गुल होता है इति ॥

उपपत्ति ।

यदि दिनार्धं तुल्य उन्नत काल में नवत्यंशतुल्य उन्नतांश पाते हैं तो इष्ट उन्नत काल में क्या इस अनुपात से स्थूल उन्नतांश प्रमाण आता है उसका स्वरूप $\frac{९०\times उका}{\frac{दि}{२}}$ इसको साठ से गुणा करने से उन्नतकला $=\frac{९०\times उका\times ६०}{\frac{दि}{२}}$ तब 'तत्त्वाश्विभक्ता असवः कला वा'

इत्यादि भास्करोक्त प्रकार से उन्नत कलज्या $= \frac{९० \times उका \times ६०}{\frac{दि}{२} \times २२५} = \frac{२४ \times उका}{\frac{दि}{२}}$, यहां

$\frac{९० \times ६०}{२२५} = २४$ = स्वल्पान्तर से शङ्कु है। तब 'त्रिज्योद्धृत स्तत्समयोत्थशङ्कुः' इत्यादि

भास्करोक्त प्रकार से अङ्गुलकला $= \frac{५}{२} + \frac{शं}{त्रि} = \frac{\frac{५ त्रि}{२} + शं}{त्रि}$ इसमें आचार्योक्त उपपन्न

हुआ ॥ सिद्धान्त शेखर में 'स्वोन्नताज्जिनगुणात् द्युदलाप्तात्' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है। सूर्यसिद्धान्त में 'सोन्नतं दिनमध्यर्ध दिनार्धाप्तं फलेन तु' इत्यादि से सूर्यसिद्धान्तकार ने अङ्गुलकलानयन किया है। उनके प्रकार की युक्ति यह है—दिनार्ध काल में ग्रहबिम्ब किञ्चित् सूक्ष्म देखने में आता है, तथा उदय काल में कुछ विशाल देखने में आता है। उसकी सूक्ष्मता और विशालता की उपलब्धि से आचार्य ने दिनार्ध काल में चार कला और उदय काल में त्रिकला अङ्गुल कल्पना की हैं। इन दोनों के मध्य में अनुपात से 'यदि दिनार्ध तुल्य उन्नत काल में अङ्गुल कलान्तर एक पाते है तो इष्ट उन्नत काल में क्या इससे जो फल हो उसमें तीन जोड़ने से अङ्गुल कला होती है। इस अनुपातागत अङ्गुल कला का स्वरूप $= ३ + \frac{उका}{\frac{दि}{२}}$

$= \frac{\frac{३ दि}{२} + उका}{\frac{दि}{२}}$ इससे सूर्य सिद्धान्तकारोक्त सूत्र उपपन्न होता है। इसमें क्या स्थूलता है

उपपत्ति देखने ही से स्फुट है। सिद्धान्त शिरोमणि में भास्कराचार्य ने दिनार्ध काल में साढ़े तीन अङ्गुल लिप्ता और उदय काल में अढ़ाई($२\frac{१}{२}$)अङ्गुललिप्ता कल्पनाकर दोनो के मध्य में शङ्कु से सूक्ष्म अनुपात किया है। अङ्गुल लिप्ता साधन के लिये भास्कराचार्य शङ्कु से और उन्नत काल से भी अनुपात किया है। उनमें कौन प्रकार सूक्ष्म है इसका ज्ञान वास्तव प्रकार के ज्ञान बिना नही हो सकता है। इसलिये 'शङ्क्वनुपात जनित फल सूक्ष्म है' यह भास्कराचार्य का कथन ठीक नहीं है। यह बात सूर्य सिद्धान्त की सुधा वर्षिणी टीका में म. म. सुधाकर द्विवेदी कहते है। वस्तुतः दृष्टि स्थान से ग्रह बिम्ब केन्द्रगत रेखा, दृष्टिस्थान से बिम्बस्पर्शरेखा, ग्रह बिम्ब केन्द्र से स्पर्श बिन्दुगत ग्रह बिम्बव्यासार्ध इन तीनों भुजों से जो जात्य त्रिभुज बनता है उसमें अनुपात करते हैं यदि ग्रहदृग् कर्ण में तत्संमुख कोणज्या त्रिज्या पाते हैं तो ग्रहबिम्बव्यासार्ध में क्या इस अनुपात से दृष्टिलग्न कोणार्धज्या (बिम्ब-कलार्धज्या) आती है इसके चाप को दूना करने से दृष्टिलग्नकोण (बिम्बकला) प्रमाण होना है। जितना बिम्ब प्रदेश देखने में आता है उसके अङ्गुल प्रमाण से अनुपात करते हैं। यदि

इतने अङ्गुल में दृष्टिलग्न कोणमान (बिम्बकला) पाते हैं तो एक अङ्गुल में क्या इस अनुपात से वास्तव अङ्गुल लिप्ता प्रमाण आता है। परन्तु इसकी आसन्नता उन्नत कालानुपातजनित फल की अपेक्षा शङ्क्वनुपातजनित फल ही की होती है इसका ज्ञान अतिशयेन दुर्घट है। इसलिये म. म. सुधाकर द्विवेदी का कथन युक्तियुक्त है यह मेरा मत है इति ॥ ११ ॥

इदानीं प्रकारान्तरेणाङ्गुललिप्ता आह।

ज्या ना चेज्ज्याद्वितयादङ्गुललिप्तास्त्रिसङ्गुणात् त्रियुतात् ।
ज्याद्वितयद्वययुक्तभक्तात् सतुषकयवोदरैः षड्भिः ॥ १२ ॥

सु. भा.—(ज्या ना चेज्ज्याद्वितयादङ्गुल लिप्तास्त्रिसङ्गुणात्रियुतात् । ज्याद्वितययुक्तभक्ताद्वा सतुषयवोदरैः षड्भिः ॥ १२ ॥) अयं साधुपाठो विभाति।

चेन्नाशङ्कुरेव ज्या तदा ज्याद्वितयाद् द्विघ्नशङ्कोः किंविशिष्टात् त्रिसङ्गुणत्रियुतात् त्रिघ्नत्रिज्या युतात् पुनः किंविशिष्टात् ज्याद्वितयभक्तयुक्तात् द्विगुणत्रिज्यायुतात् ततो द्विगुणत्रिज्यया भक्ताच्च वाऽङ्गुललिप्ता भवन्ति। अङ्गुलं तु षड्भिः सतुषयवोदरैस्तुषसहितयवमध्यवर्त्तिप्रदेशैः प्रसिद्धमिति।

अत्रोपपत्तिः। पूर्वप्रकारेणाङ्गुललिप्ताः $= \dfrac{\dfrac{५ \text{ त्रि}}{२} + \text{शं}}{\text{त्रि}} = \dfrac{५ \text{ त्रि} + २ \text{ शं}}{\text{त्रि}}$

$= \dfrac{२ \text{ त्रि} + (३ \text{ त्रि} + २ \text{ शं})}{२ \text{ त्रि}}$। अत उपपन्नम् ॥१२॥

वि. भा.—चेद्यदि ना (शङ्कुः) ज्या तदा द्विगुणितशङ्कोः त्रिगुणित त्रिज्यायुतात् पुनर्ज्याद्वितययुक्तभक्तात् (द्विगुणत्रिज्यायुतात् द्विगुणत्रिज्यया भक्ताच्च वाऽङ्गुललिप्ताः स्युः) तुष (उपरितनांशत्वक्) सहितैः षड्भिर्यवोदरैरेकमङ्गुलं भवति ॥

अत्रोपपत्तिः।

पूर्वश्लोकेनाङ्गुललिप्ताः $= \dfrac{\dfrac{५ \text{ त्रि}}{२} + \text{शं}}{\text{त्रि}}$ हरभाज्यौ द्वाभ्यां गुणितौ तदा

$\dfrac{५ \text{ त्रि} + २ \text{ शं}}{२ \text{ त्रि}} = \dfrac{२ \text{ त्रि} + (३ \text{ त्रि} + २ \text{ शं})}{२ \text{ त्रि}}$ = अङ्गुललिप्ताः। एतावताऽऽचार्योक्तसूत्रमुपपन्नम्। सिद्धान्तशेखरेऽपि प्रकारान्तरेण "स्वदिवसगतशेषाल्पज्यया स्वद्यु-

खण्डोन्नतलवभवजीवा ताडिता त्रिज्ययाप्ता। फलमहितमिषुघ्नं त्रिज्यकार्धं विभक्तं त्रिभवनभवमौर्व्या मोर्विका द्व्यङ्गुलस्य ॥ श्रीपतेरस्मिन् अस्य व्याख्या- स्वदिवसगतशेषाल्पज्यया (इष्टोन्नतकालज्यया) स्वदिनार्धकोन्नतांशज्या (दिनार्ध-शङ्कुः) गुणिता त्रिज्यया भक्ता पञ्चगुणितं त्रिज्यकार्धं त्रिज्याभक्तलब्धफलेन सहितं त्रिज्यया भक्तं तदाऽङ्गुलस्य ज्या भवति। अर्थात्तावतीभिर्ज्याकलाभिरेक-मङ्गुलं भवतीति ॥

अस्योपपत्तिः।

त्रिज्यातुल्ययोन्नतकालज्यया यदि दिनार्धकालिकोन्नतांशज्या लभ्यते तदेष्टोन्नतकालज्यया किं समागच्छति शङ्कुः। उदयकाले सार्धद्वितयकलाभ्यामेक-मङ्गुलं दिनार्धकाले सार्धत्रिकलाभिरेकमङ्गुलं भवति द्वयोरन्तरमेकमङ्गुल-लिप्तान्तरम्। ततोऽनुपातो यदि त्रिज्यातुल्यशङ्कौ अङ्गुल लिप्तान्तरमेकं लभ्यते तदेष्टशङ्कौ किमिति फलं सार्धद्विकलासु योज्यं तदाऽङ्गुललिप्ता भवन्ति।

$$\text{यथा पूर्वानुपातेन} = \frac{\text{दिनार्धकालिकोन्नतांशज्या} \times \text{इष्टोन्नतकाज्या}}{\text{त्रि}} = \text{शङ्कु}$$ ।

$$\text{ततः शङ्क्वनुपातेन यत्फलं तत्सार्धद्विकलासु युक्तं तदा } २\tfrac{१}{२} + \frac{\text{फल}}{\text{त्रि}} = \frac{५}{२} + \frac{\text{फल}}{\text{त्रि}}$$

$$= \frac{\frac{५\,\text{त्रि}}{२} + \text{फल}}{\text{त्रि}} = \text{अङ्गुललिप्ता, एतावता श्रीपत्युक्तमूत्रमुपपद्यते ॥}$$

अब प्रकारान्तर से अङ्गुललिप्ता को कहते हैं।

हि. भा.—यदि शङ्कु ही ज्या है तब द्विगुणित शङ्कु में त्रिगुणित त्रिज्या जोड़कर जो हो उसमें द्विगुणित त्रिज्या को जोड़कर द्विगुणित त्रिज्या से भाग देने से प्रकारान्तर से अङ्गुललिप्ता होती है छः छिलकास सहित यव का मध्यभाग स्थित पदार्थ एक अङ्गुल होता है। भास्कराचार्य ने लीलावती में 'यवोदरैरङ्गुलमष्ट संख्यैः' इससे आठ यवोदर का एक अङ्गुल कहा है इति ॥

उपपत्ति।

$$\text{पूर्वश्लोक से अङ्गुललिप्ता} = \frac{\frac{५\,\text{त्रि}}{२} + \text{शं}}{\text{त्रि}}$$ हर और भाज्य को दो से गुणा करने से

$$\frac{५\,\text{त्रि} + २\,\text{शं}}{२\,\text{त्रि}} = \frac{२\,\text{त्रि} + (३\,\text{त्रि} + २\,\text{शं})}{२\,\text{त्रि}} = \text{अङ्गुललिप्ता}$$ । इससे आचार्योक्त उपपन्न

हुआ। सिद्धान्त शेखर में भी प्रकारान्तर से 'स्वदिवस गत शेषाल्पज्यया स्वद्युखण्डोन्नतलवभव-जीवा' इत्यादि से श्रीपति ने कहा है। श्रीपत्युक्त सूत्र का तात्पर्य है—इष्टोन्नत कालज्या से दिनार्धकालिक उन्नतांशज्या (शङ्कु) को गुणा कर त्रिज्या से भाग देना, पञ्च गुणित त्रिज्यार्ध में त्रिज्या भक्त फलको जोड़कर त्रिज्या से भाग देनेसे अङ्गुलज्या होती हैं। अर्थात् उतनी ज्याकला का एक अङ्गुल होता है इति ॥

उत्पपत्ति।

यदि त्रिज्या तुल्य उन्नत कालज्या में दिनार्धकालिक उन्नतांशज्या पाते है तो इष्ट उन्नत कालज्या में क्या इससे शङ्कु प्रमाण आता है। उदय काल में २।३० कला मे एक अङ्गुल होता हैं। दिनार्ध काल में ३।३० कला में एक अङ्गुल होता है दोनों का अन्तर एक अङ्गुल लिप्तान्तर है। तब अनुपात करते है यदि त्रिज्या तुल्य शङ्कु मे अङ्गुल लिप्तान्तर एक पाते हैं तो इष्ट शङ्कु में क्या फल को २।३० इसमे जोड़ने से अङ्गुललिप्ता होती है। जैसे पूर्वानुपात से $\frac{\text{दिनार्धकालिकोन्नतांशज्या} \times \text{इष्टोन्नतकाज्या}}{\text{त्रि}}$ = शङ्कु। तब शङ्क्वनुपात से जो फल है उसको २।३० में जोड़ने से $(२।३०) + \frac{\text{फल}}{\text{त्रि}} = \frac{५}{२} + \frac{\text{फल}}{\text{त्रि}} = \frac{\frac{५\,\text{त्रि}}{२} + \text{फल}}{\text{त्रि}}$ = अङ्गुललिप्ता, इससे श्रीपत्युक्त सूत्र उपपन्न होता है इति ॥१२॥

इदानीमङ्गुललिप्तायाः प्रयोजनमाह।

व्यासवलनापवर्त्तनमेकेनेष्टेन कार्यमितरेषाम्।
अङ्गुलकलाभिरेवं शशिसितपरिलेखसूत्राणाम् ॥१३॥

सु. भा.—एकेन केनचिदिष्टेन व्यासवलनापवर्त्तनं ग्राह्यग्राहकबिम्बमानानां वलनादीनामपवर्त्तनं कार्य लाघवेन स्वल्पस्थान एव परिलेखप्रदर्शनाय। इतरेषां शशिसितपरिलेखसूत्राणां शशिनो बिम्बार्धस्य सितकलानां परिलेखसूत्रस्य स्वभासूत्रस्य चाङ्गुलकलाभिः प्रागानीताभिर्लघूकरणायापवर्त्तनं कार्यमिति।

'विषुवदपमण्डलदिशो वलनज्याभिः'—इत्यादिप्रश्नद्वयस्योत्तरं ग्रहणाधिकारे प्रदर्शितमेव। अन्योत्तरार्थमग्रे वक्ष्यति ॥ १३ ॥

वि. भा.—ग्राह्यग्राहक बिम्बमानानां वलनादीनां केनचिदेकेनेष्टेनापवर्तनं कार्यं लाघवार्थम्। इतरेषां चन्द्रबिम्बार्धस्य सितकलानां परिलेखसूत्राणां पूर्वोक्ताङ्गुलकलाभिरपवर्त्तनं कार्य लाघवार्थमिति ॥ वस्तुतस्तु अङ्गुललिप्ता प्रयासेन किम्। केनापि समेनाङ्केन परिलेखे लाघवार्थं शरादयोऽपवर्त्याः। अत एव

गणेशदैवज्ञादिभिर्बहुभिराचार्यैस्त्रिभिरपवर्त्तिताः शरादय एवाङ्गुलत्वेन कल्पिताः। सिद्धान्तशेखरे "ग्राह्यबिम्बशकलस्य शराणां मानसंयुतिदलस्य भुजानाम्। ग्राहकार्धवपुषः श्रवणानां भाजको नियतमङ्गुललिप्ताः।।" श्रीपतिनेत्थं कथितम्। सूर्यसिद्धान्ते "सोन्नतं दिनमध्यर्ध दिनार्धाप्तं फलेन तु। छिन्द्याद्विक्षेपमानानि तान्येषामङ्गुलानि तु।।" सूर्यसिद्धान्तकारेणेत्थं कथ्यते। सिद्धान्तशिरोमणौ "आभिर्विभक्ता वलनेषु बिम्बदोश्छन्नलिप्ताः स्युरथाङ्गुलानि" भास्कराचार्येणैत्र कथ्यते। आचार्येण विषयविभागं कृत्वा परिलेखे लाघवार्थं कथं भिन्नोभिन्नोऽपवर्त्तनाङ्कः कथितस्तत्कारणं मन्मनसि नागच्छति। अन्यैराचार्यैस्तथा न कथ्यत इति ।।१३।।

अब अङ्गुल लिप्ता के प्रयोजन को कहते हैं।

हि. भा.—ग्राह्यग्राहक बिम्बमानों को तथा वलनादिको को लाघव के लिये किसी एक इष्टाङ्क से अपवर्त्तन करना चाहिये। इनमें अन्य चन्द्र विम्बार्ध-मितकला-परिलेख सूत्रों को पूर्वसाधित अङ्गुल कला से अपवर्त्तन करना चाहिये। वस्तुतः अङ्गुल लिप्तार्थ प्रयास की क्या जरूरत है परिलेख में लाघवार्थ किसी समान अङ्क से शरादियों को अपवर्त्तन देना चाहिये इसी से गणेश दैवज्ञादि बहुत आचार्यो ने शर आदि को तीन से अपवर्त्तन देकर जो फल होता है उसका अङ्गुलत्व स्वीकार किया है। सिद्धान्त शेखर में 'ग्राह्यबिम्बशकलस्य शराणां मानसंयुतिदलस्य भुजानाम् 'इत्यादि विज्ञान भाष्य में लिखित श्लोक के अनुसार श्रीपति ने कहा है। सूर्य सिद्धान्त में 'सोन्नत दिनमध्यर्ध' दिनार्धाप्तं फलेन तु' इत्यादि विज्ञान भाष्य में लिखित श्लोकानुसार कहा है। सिद्धान्त शिरोमणि में 'आभिर्विभक्तावलनेषु बिम्ब' दोश्छन्नलिप्ताः स्युरथाङ्गुलानि' इत्यादि भास्कराचार्य कहते हैं। आचार्य ने विषय विभाग कर परिलेख में लाघव के लिये क्यों भिन्न भिन्न अपवर्त्तनाङ्क कहा है इसका कारण हमारे मन मे नहीं आता है। अन्य आचार्यो ने उनके (आचार्य ब्रह्मगुप्त) कथनानुसार नही कहा है इति ।।१३।।

विषुवदपमण्डलदिश इत्यादि प्रश्नद्वयस्योत्तरं ग्रहणाधिकारे प्रतिपादितमेव, तदुत्तरार्धमग्रे कथयति।

इदानीं सम्पर्कमण्डले य इत्यादि प्रश्नोत्तरमाह।

प्रथमे वलनज्याभिर्दिशो द्वितीये यथादिशं भानोः।
आद्यन्तौ विक्षेपौ मध्यान्मध्योऽन्यथा शशिनः ।।१४।।

शशिविक्षेपाग्रेभ्यः परिलिख्य ग्राहकप्रमाणेन।
प्रग्रहमोक्षग्रासा भूपरिलेखे भवन्त्येवम् ।।१५।।

सु. भा.—प्रथमे ग्राह्यवृत्ते वलनज्याभिस्तात्कालिकक्रान्तिवृत्तचापस्य स्व-

ल्पान्तरात् सरलाकारस्य वलनसूत्रस्य वलनज्याभिर्दिशो ज्ञेयाः। द्वितीये मानैक्यार्धवृत्ते वलनसूत्रोपरि लम्बरूपौ भानोर्यथादिशमाद्यन्तौ स्पर्शमोक्षकालिकौ विक्षेपौ देयौ। मध्यवलनसूत्रे च मध्याद् ग्राह्यकेन्द्रान्मध्यो विक्षेपो देयः। शशिनश्चन्द्रस्यान्यथा विपरीताशा विक्षेपा देयाः। ततः शशिविक्षेपाग्रेभ्यो ग्राहकप्रमाणेन व्यासेन वृत्तं परिलिख्य प्रग्रहमोक्षग्रासा ज्ञेयाः। एवं भूपरिलेखे भूमौ लिखिते परिलेखे स्पर्शमोक्षग्रासा भवन्तीति।

अत्रोपपत्तिः। 'ग्राह्यार्धसूत्रेण विधाय वृत्तम्'-इत्यादिभास्करविधिना ज्ञेया। यथाऽऽचार्येण ग्रहणकाले क्रान्तिवृत्तचापादीनि सरलानि कल्पितानि तथा भास्करेणापि स्वीकृतानि अन्यथा समभूमौ चापाकाररेखाभिः परिलेखरचनाऽसम्भव एवेति सुधीभिश्चिन्त्यम् १४। १५।

वि. भा.—प्रथमे (ग्राह्यवृत्ते) वलनज्याभिस्तात्कालिकक्रान्तिवृत्तचापस्य स्वल्पान्तरात्सरलाकारस्य वलनसूत्रस्य वलनज्याभिर्दिशो ज्ञेयाः। द्वितीये (मानैक्यार्धवृत्ते) वलनसूत्रोपरि लम्बरूपौ सूर्यस्य यथा दिशं स्पर्शमोक्षकालिकौ शरौ देयौ। मध्यवलनसूत्रे ग्राह्यकेन्द्रान्मध्यः शरो देयः। चन्द्रशराग्रेभ्यो ग्राहकप्रमाणेन व्यासेन वृत्तं विलिख्य स्पर्शमोक्षग्रासा ज्ञातव्याः। एवं भुवि लिखिते परिलेखे स्पर्श मोक्षग्रासा भवन्तीति॥

अत्रोपपत्तिः।

मानैक्यार्धवृत्ते ग्राहकवृत्तस्य केन्द्रं यदा भवति तदा ग्राह्यग्राहकयोर्बिम्बप्रान्तौ संलग्नौ भवतोऽतो मानैक्यार्धवृत्तं लिखितं तच्च दिगङ्कितं तत्र या प्राची सा सममण्डलप्राची ततस्तस्या वलने दत्ते या केन्द्राद्वलनाग्रगारेखा सा क्रान्तिवृत्तप्राची, वलनसूत्राज्ज्यावच्छरो देयः। यतः क्रान्तिवृत्तप्राच्याः शरो दक्षिणोत्तरः। एवं स्पर्शमोक्षयोः खलु। मध्यशरः केन्द्राद्वलनसूत्रेऽतो दत्तो यतो मध्यवलनं नाम तत्कालिकक्रान्तिवृत्तप्राच्या दक्षिणोत्तरा दिक्। शराग्रे ग्राहकवृत्तकेन्द्रमतस्तत्र कृतैर्वृत्तैः स्पर्शमोक्षमध्या भवन्तीति सिद्धान्तशेखरे मानैक्यार्धालिखित वलये तत्परीणामिनीर्वा दत्वा जीवा वलनजनिताः पूर्ववज्ज्यानिपातात्। कुर्यात् तज्ज्ञः कथितविधिनैवात्रवृत्तद्वयेऽपि मध्याद्यन्तग्रहणजनिता संस्थितिश्चन्द्रभान्वोः॥" श्रीपत्युक्त स्पर्शमध्यमोक्षकालिकपरिलेखप्रकारोऽयमाचार्योक्तानुरूपमेव सिद्धान्तशिरोमणौ "ग्राह्यार्धसूत्रेण विधाय वृत्तं मानैक्यखण्डेन च साधिताशम्। बाह्येऽत्रवृत्ते वलनं ज्यकावत् प्राक् चिह्नतः स्पर्शभवं हिमांशोः॥ सव्यापसव्यं खलु याम्यसौम्यं मौक्षं तदा पश्चिमतश्च देयम्। रविग्रहे पश्चिमपूर्वतस्ते विक्षेपदिक् चिह्नत एव माध्यम्॥ सूत्राणि केन्द्राद्वलनाग्रसक्तान्यङ्कान्यतः स्पर्श विमुक्तवाणौ। ज्यावन्निजाभ्यां वलनाग्रकाभ्यां देयौ यथाशामथ मध्यवाणः॥ केन्द्रात्प्रदेयो

वलनस्यसूत्रे तेभ्यः पृथग् ग्राहक खण्डकेन। वृत्तैः कृतैः स्पर्शविमुक्तिमध्यग्रासाः क्रमेणैवमिहावगम्याः ॥" भास्कराचार्येण श्रीपतिप्रकार एव विशदरूपेण प्रतिपादितः ॥१४-१५॥

विषुवदपमण्डलदिश इत्यादि दो प्रश्नों के उत्तर ग्रहणाधिकार में बता दिये गये है। उसके उत्तरार्ध को आगे कहते है।

अब 'सम्पर्क मण्डलेय' इत्यादि प्रश्न के उत्तर कहते है।

हि. भा.—ग्राह्यवृत्त में स्वल्पान्तर से सरलाकार तत्कालिक क्रान्तिवृत्तीय चाप वलन सूत्र का वलनज्या से दिशाज्ञान समझना चाहिये। मानैक्यार्धवृत्त में वलन सूत्र के ऊपर रवि के स्पर्श कालिक शर और मोक्ष कालिक शर को जिस दिशा के शर है उसी दिशा में देना। मध्यवलन सूत्र में ग्राह्य बिम्ब केन्द्र से मध्यशर देना चाहिये। चन्द्र शराग्रों से ग्राहक प्रमाण व्यास से वृत्त लिखकर स्पर्श मोक्ष और ग्रास समझना चाहिये, एवं पृथिवी पर परिलिख लिखने से स्पर्श मोक्ष और ग्रास होता है इति ॥

उपपत्ति।

मानैक्यार्ध वृत्त में जब ग्राहकवृत्त का केन्द्र होता है तब ग्राह्य बिम्बप्रान्त और ग्राहक बिंबप्रान्त संलग्न रहता है। इस लिये लिखित मानैक्यार्ध वृत्त में दिशा को अङ्कित करना चाहिये। सममण्डल और मानैक्यार्ध वृत्त का सम्पात बिन्दु मानैक्यार्ध वृत्त में प्राची चिह्न है। वहां से वलनज्या दान देने से केन्द्र से बलनज्याग्रगत रेखा क्रान्तिवृत्त प्राची है वलनसूत्र से ज्यावत् शरदान देना चाहिये। क्योंकि क्रान्तिवृत्त प्राची से शर दक्षिण और उत्तर रहता है। इस तरह स्पर्श और मोक्ष में होता है। मध्यवलन तात्कालिकक्रान्तिवृत्त प्राची से दक्षिणोत्तर दिशा में होता है इसलिये केन्द्र से वलन सूत्र में देना चाहिये। शराग्र में ग्राहक वृत्तका केन्द्र होता है इसलिये वहां से तत्तत्कालिकग्राहकार्ध प्रमाण से रचित वृत्तों से स्पर्श मोक्षमध्य होते हैं सिद्धान्त शेखर में 'मानैक्यार्धालिखितवलये तत्परीणामिनीर्वा' इत्यादि संस्कृतोपपत्तिमें लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है। सिद्धान्त शिरोमणि में 'ग्राह्यार्धसूत्रेण विधाय वृत्तं मानैक्यखण्डेन च साधिताशम्' इत्यादि से भास्कराचार्य ने श्रीपति प्रकार ही को विशद रूप से प्रतिपादित किया है इति ॥ १४-१५ ॥

इदानीं यः परिलिखतीष्टग्रासमित्यादि प्रश्नस्योत्तरमाह ।

पश्चात् प्रगृहणे प्राग्मोक्षे रविबिम्बतो बाहुः।
स्ववलनसिद्धज्यादिशि विपरीतः शीतकरमध्यात् ॥ १६ ॥

भानुमतो बाह्वग्राद्यथा दिशं कोटिरन्यथा शशिनः।
रविशशिमध्यात् कर्णस्तिर्यक् कर्णाग्रकोटियुतेः ॥ १७ ॥

परिलेखं ग्राह्यस्य ग्राहकमानेन पूर्ववत् कृत्वा ।
तात्कालिकसंस्थानं निमीलनोन्मीलने चैवम् ।। १८ ।।

सु० भा०—इष्टकाले ग्रहणाधिकारविधिना बाहुः कोटिः कर्णश्चानेयः । तत्र वलनज्या च साध्या तद्वशेन ग्राह्यकेन्द्राद्वलनसूत्रं च ज्ञेय ततः स्ववलनसिद्धज्या-दिशि वलनसूत्रे प्रग्रहणे स्पार्शिकेष्टकाले रविबिम्बमध्यतो रविकेन्द्रात् पश्चात् पश्चिमायां दिशि मोक्षे मौक्षिकेष्टकाले प्राक् प्राच्यां दिशि बाहुर्भुजो देयः । शीतकरमध्यात् चन्द्रग्रहणे चन्द्रकेन्द्राद्विपरीतो बाहुर्देयः । स्पार्शिकः प्राच्यां मौक्षिकः प्रतीच्यां दिशि-इत्यर्थः । भानुमतः सूर्यस्य बाह्वग्राद्यथादिशं शशिनश्चन्द्रस्यान्यथा विपरीतदिक्का कोटिर्देया । ततो रविशशिमध्याद्रवेर्वा चन्द्रस्य केन्द्रात् कोट्यग्रपर्यन्तं तिर्यक् कर्णो देयः । कर्णाग्रकोटियुतेः केन्द्रात् ग्राहकमानेन व्यासेन वृत्तं विलिख्य पूर्ववत् परिलेखं कृत्वा ग्राह्यस्य खण्डितच्छाद्यबिम्बस्य तात्कालिकसंस्थानं ज्ञेयं । एवं निमीलनोन्मीलनकालिकभुजकोटिकर्णादिभिर्निमीलनोन्मीलने च ज्ञेये इति ।

अत्रोपपत्तिः । इष्टकालिकभुजकोटिकर्णसंस्थानेन भास्करेष्टग्रासपरिलेखेन च स्फुटा ।। १६-१७-१८ ।।

वि. भा.—इष्टकाले ग्रहणाधिकारोक्त्या भुजकोटिकर्णा आनेतव्याः । वलनज्यां संसाध्य तद्वशतो ग्राह्यकेन्द्राद्वलनसूत्रं ज्ञातव्यम् । स्पार्शिकेष्टकाले वलनसूत्रे रविकेन्द्रात् पश्चिमायां दिशि भुजो देयः । मौक्षिकेष्टकाले पूर्वदिशि भुजो देयः । चन्द्रग्रहणे चन्द्रकेन्द्राद्विपरीतो भुजो देयः । अर्थात् पूर्वदिशि स्पार्शिको भुजः पश्चिमदिशि मौक्षिको भुजो देयः । भुजाग्रात् रवेर्यथा दिशं चन्द्रस्य विपरीत-दिक्का कोटिर्देया । ततो रवेश्चन्द्रस्य वा केन्द्रात् कोट्यग्रपर्यन्तं तिर्यक् कर्णो देयः । कर्णाग्रकोटियोगबिन्दोः केन्द्रात् ग्राहकमानेन व्यासेन वृत्तं विलिख्य पूर्ववत् परिलेखं कृत्वा खण्डितच्छाद्य बिम्बस्य तात्कालिकसंस्थानं ज्ञातव्यम् । एवं निमीलतोन्मीलनकालिकभुजकोटिकर्णादिभिर्निमीलनोन्मीलने ज्ञेये इति ।।

अत्रोपपत्तिः ।

भुजो हि ग्राहकमार्गखण्डम् । तत्र शरः कोटिस्तद्वर्गपदं कर्णः । कर्णाग्राद्-ग्राहकबिम्बे लिखिते संमीलनादिकं भवतीति युक्तं कथितम् । ननु ग्राह्य बिम्ब-केन्द्राद्वलनसूत्रे भुजो दत्तस्तत्कथं भुजो ग्राहकमार्गखण्डमित्युच्यते । सत्यम् । यत्र कुत्रचिद् भुजकोटिकर्णैस्त्रिभुजमुत्पद्यते तदवश्यमेवायतचतुर्भुजार्धम् । तदत्र भुजाग्राच्छरः कोटिः । एवं भुजमूलादपि, शरमूलयोरन्तरे यावान् भुजस्तावानेव शराग्रयोरपि । अतो ग्राहकमार्गखण्डं भुजः कथ्यते । संमीलनोन्मीलनयोः परिले-

खोपपत्तिरियमिष्टग्रासपरिलेखोपपत्तिरप्येता दृश्येव बोध्येति । सिद्धान्त शेखरे "स्ववलनदिशि बाहुः प्राङ्मुखः शीतरश्मेर्भवति खलु निमीले प्रत्यगुन्मीलने तु । सवितुरपरथा तु स्वस्वकोटयौ तदग्राच्छ्रुतिरपि भुजकोटयोरग्रसक्ताऽथ तिर्यक् ॥ कोटिकर्णयुतिचिह्नितस्ततो ग्राहकार्धवपुषः परिभ्रमात् । दृश्यते शशि दिवाकर-ग्रहोन्मीलनोन्मिषणसंस्थितिः स्फुटम् ॥" श्रीपत्युक्त संमीलनोन्मीलनयोः परि-लेख ईदृशः। सिद्धान्त शिरोमणौ "केन्द्राद् भुजं स्वे वलनस्य सूत्रे शरं भुजाग्राच्छ्र-वणं च केन्द्रात् । प्रसार्य कोटिश्रुतियोगचिह्नाद्वृत्ते कृते ग्राहकखण्डकेन ॥ संमी-लनोन्मीलनकेष्टकालग्रासाश्च वेद्या यदि वाऽन्यथाऽमी ।" भास्कराचार्येणै-वमुक्तम् । सिद्धान्त शेखरे-"दिश्यभीष्टवलनस्य कोटिदोः कर्णदान विधिनैवमेव हि । विद्धयभीष्टवलनस्य संस्थितिं ग्राहक ग्रहणतः शशीनयोः ॥" श्रीपतिनेष्ट ग्रास परि-लेखार्थ मयमेव विधिः प्रदर्शितः । अस्याप्युपपत्तिः 'केन्द्राद् भुजं स्वे वलनस्य सूत्रे इत्यादि भास्कर प्रकारोपपत्त्या पूर्वोक्तपरिलेखप्रकार युक्तता च स्फुटा । सूर्य-सिद्धान्ते "मानान्तरार्धेन मितां शलाकां ग्रासदिङ्मुखीम् । निमीलनाख्यां दद्यात् सा तन्मार्गे यत्र संस्पृशेत् ॥ ततो ग्राहकखण्डेन प्राग्वन्मण्डलमालिखेत् । तद्ग्रा-ह्यमण्डलयुतिर्यत्र तत्र निमीलनम् ॥ एवमुन्मीलने मोक्षदिङ्मुखीं संप्रसारयेत् । विलिखेन्मण्डलं प्राग्वदुन्मीलनमथोक्तवत् ॥" संमीलनोन्मीलनयोः केन्द्रान्तरं मानान्तरार्धसममत इष्टग्रासपरिलेखवत् संमीलनोन्मीलनपरिलेखो भवेदिति ॥ १६-१७-१८ ॥

अब 'यः परिलिखितीष्टग्रास मित्यादि' प्रश्न के उत्तर को कहते है ।

हि. भा.—इष्टकाल में ग्रहणाधिकारोक्त विधि से भुज कोटि और कर्ण लाना चाहिये, वलनज्या साधन कर उसकी सहायता से वलन सूत्र का ज्ञान करना चाहिये । स्पार्शिक इष्टकाल में वलन सूत्र में रविकेन्द्र से पश्चिम दिशा में भुज देना चाहिये । मौक्षिक इष्टकाल मे पूर्व दिशा में भुज देना चाहिये । चन्द्र ग्रहण में चन्द्र केन्द्र से विपरीत भुज देना चाहिये अर्थात् पूर्व दिशा में स्पार्शिक भुज और पश्चिम दिशा में मौक्षिक भुज देना चाहिये । भुजाग्र से रवि की जिस दिशा की कोटि है उसी दिशा में कोटि देना चाहिये और चन्द्र के विपरीत दिशा की कोटि देनी चाहिये । तब रवि केन्द्र से वा चन्द्र केन्द्र से कोट्यग्र पर्यन्त तिर्यक्रूप कर्ण देना चाहिये । कर्णाग्र और कोटि के योग बिन्दु से ग्राहक मानव्यास से वृत्त बनाकर पूर्ववत् परिलेख कर खण्डित छाद्य बिम्ब की तात्कालिक संस्थिति समझनी चाहिये । इसी तरह निमीलन और उन्मीलन कालिक भुज—कोटि कर्णो से निमीलन और उन्मीलन समझना चाहिये ।

उपपत्ति ।

ग्राहक मार्ग खण्ड भुज है, शर कोटि और दोनों का वर्ग योग मूल कर्ण है, कर्णाग्र से

ग्राहक बिम्ब लिखने से संमीलनादिक होता है। शङ्का यह होती है कि ग्राह्य बिम्ब केन्द्र में वलन सूत्र में भुज दिया गया है तब भुज ग्राहक मार्ग खण्ड क्यो है। इसका उत्तर यह है—जहाँ कहीं भुज कोटि कर्णों से जो जात्य त्रिभुज बनता है वह आयत चतुर्भुज का आधा होता है, यहां भुजाग्र से शर कोटि है, एव भुजमूल से भी, शरद्वय के मूलान्तर में जितना भुज है उतना ही दोनों शराग्र के अन्तर मे भी है, इसलिये ग्राहक मार्ग खण्ड भुज कहा जाता है। यह समीलन और उन्मीलन की उपपत्ति है। इष्टग्रास परिलेखोपपत्ति भी इसी तरह की समझनी चाहिये। सिद्धान्त शेखर में "स्ववलन दिशि बाहुः प्राङ्मुखः शीतरश्मेर्भवति खलु निमीले प्रत्यगुन्मीलने तु" इत्यादि श्लोकों से श्रीपति ने समीलन और उन्मीलन परिलेख प्रकार प्रदर्शित किया है। सिद्धान्त शिरोमणि में 'केन्द्राद् भुजं स्वे वलनस्य सूत्रे शर भुजाग्राच्छ्रवणं च केन्द्रात्' इत्यादि संस्कृतोपपत्ति मे लिखित पद्यों से भास्कराचार्य ने कहा है। सिद्धान्त शेखर में 'दिश्यभीष्ट वलनस्य कोटिदोः कर्णदानविधिनैवमेव हि' इत्यादि श्लोक से श्रीपति ने इष्टग्रास परिलेख के लिये यही विधि प्रदर्शित की। इष्टग्रास परिलेखोपपत्ति भी पूर्वोक्त परिलेख प्रकार युक्ति से तथा 'केन्द्राद् भुजं स्वे वलनस्य सूत्रे शर भुजाग्रात्' इत्यादि भास्कर प्रकारोपपत्ति से स्पष्ट है। सूर्य सिद्धान्त में "मानान्तरार्धेन मितां शलाका ग्राम दिङ्मुखीम्" इत्यादि श्लोकों से सूर्य सिद्धान्तकार ने समीलन और उन्मीलन परिलेख प्रकार लिखा है और कहा है कि इष्टग्रास परिलेखवत् संमीलन और उन्मीलन परिलेख होना है। ठीक ही है समीलन और उन्मीलन काल में केन्द्रान्तर मानान्तरार्ध के बराबर होता है इसलिये इष्टग्रास परिलेख ही की तरह संमीलन और उन्मीलन परिलेख होता है इति ॥१६–१७–१८॥

इदानीं प्रकारान्तरेण परिलेखमाह।

विक्षेपगुणा त्रिज्या मानैक्यार्धोद्धृताप्तचापांशाः।
आद्यन्तयोर्यथादिशमर्कस्येन्दोर्विपर्यस्ताः ॥१९॥

तत्स्ववलनांशयोगान्तरजीवा ग्राह्यमानदलघातात्।
त्रिज्यालब्धज्याग्रे ग्रहमोक्षौ प्राग्वदर्केन्द्वोः ॥२०॥

हृतया व्यासार्धेनार्कचन्द्रमानार्धलिप्तिका गुणया।
मध्यमवलनज्या दक्षिणोत्तरा दिग्गमनया मध्या ॥२१॥

प्राग्वत् प्रसार्य विक्षेपलिप्तिका ग्राहकप्रमाणेन।
विक्षेपाग्रात् ग्राह्यं परिलिख्य ग्राससंस्थानम् ॥२२॥

सु. भा.—त्रिज्या विक्षेपगुणा मानैक्यार्धेनोद्धृता। आप्तचापांशा आद्यन्तयोः स्पर्शमोक्षयोरर्कस्य यथादिशमिन्दोश्चन्द्रस्य विपर्यस्ताः शराज्ञातो विपरीता ज्ञेयाः। तेषामाप्तचापांशानां वलनांशानां समदिक्त्वे योगो भिन्नदिश्यन्तरं कार्यम्। ततस्तज्ज्याया ग्राह्यबिम्बार्धस्य च घातात् त्रिज्यया या लब्धिस्तत्समा जीवा पूर्वापररेखोपरि यथादिक्का लम्बरूपा कार्या यथा ज्याग्रं ग्राह्यं बिम्बपरिधौ भवेत्।

एवं ज्याग्रस्थाने स्पर्शो वा मोक्षो भवेदर्केन्द्वोरिति । मध्यमवलनज्या मध्यकालिक-वलनज्यैव दक्षिणोत्तरा दिग्गमनयेति । मध्यमवलनज्या दक्षिणोत्तरा दिग्गमना । सा सूर्यग्रहणे रविमानार्धेन चन्द्रग्रहणे चन्द्रमानार्धेन हृता त्रिज्या भक्ता तया लब्ध्या दक्षिणोत्तररेखातो मध्या मध्यग्रहसंस्था भवति । एतदुक्तं भवति ग्राह्यबिम्बार्धपरिणता मध्यवलनज्या दक्षिणोत्तररेखातो ज्यारूपा यथा दिक्का देया यथा ज्याग्रं ग्राह्यबिम्बपरिधौ भवेत् । ग्राह्यकेन्द्रान्मध्यज्याग्रं प्राग्वद्रेखां प्रसार्य तत्र ग्राह्यकेन्द्रात् विक्षेपलिप्तिकाश्च प्रसार्य विक्षेपाग्राद् ग्राहकप्रमाणेन व्यासेन वृत्तं विलिख्य ग्राह्यं ग्राह्यबिम्बसंबंधि ग्रामसंस्थानं ज्ञेयम् ।

अत्रोपपत्तिः । मानैक्यवृत्ते पूर्वापरवलनसूत्रयोर्मध्ये वलनांशाः । वलनसूत्रं मानैक्यार्धवृत्तपरिधौ यत्र लग्नं यत्र च स्पार्शिकस्य वा मौक्षिकस्य शरस्य चाग्रं तदन्तरांशानयनार्थमनुपातः । यदि मानैक्यार्धेन शरस्तदा त्रिज्यया कि लब्धचापांशस्तदन्तरांशाः । चन्द्रग्रहे शरो विपरीतदिक्को भवति तेन तदा ते विपरीताः । एवं तच्चाप वलनांशसंस्कारतः केन्द्राच्छराग्रगतरेखापूर्वापररेखयोरन्तरांशास्तज्ज्या ग्राह्यबिम्बार्धपरिणता कृता । अतस्तज्ज्याग्रे ग्राह्यबिम्बपरिधौ स्पर्शो वा मोक्षो भवेत् । दक्षिणोत्तररेखामध्यवलनसूत्रयोरन्तरे मध्यवलनांशाः । ग्राह्यबिम्बपरिधौ मध्यसंस्थानज्ञानार्थं तज्ज्या ग्राह्यबिम्बार्धपरिणता कृता । ततो केन्द्रान्मध्यवलन-सूत्रे मध्यशरं प्रसार्य तदग्रकेन्द्राद् ग्राहकवृत्तं विलिख्य ग्रामसंस्थानं प्रदर्शित-मिति ॥ १९-२२ ॥

वि. भा.—त्रिज्या स्पर्शमोक्षकालिकशरेण पृथक् गुणिता मानैक्यार्धेन भक्ता लब्धेश्चापांशाः स्पर्शमोक्षयोः सूर्यस्य यथाश (शरदिक्काः) चन्द्रस्य व्यस्तदिक्काः (शराशातो विपरीदिक्काः) ज्ञेयाः । लब्धेश्चापांशानां वलनांशानां तुल्यदिक्त्वे योगो भिन्नदिक्त्वेऽन्तरंकार्यं । ततस्तज्ज्याया ग्राह्यबिम्बार्धस्य च घातात् त्रिज्यया भक्ताद्या लब्धिस्तत्तुल्या ज्या पूर्वापररेखोपरि यथादिक्का लम्बरूपा कार्या यथा ज्या ग्राह्य-बिम्बपरिधौ भवेत् । ज्याग्रबिन्दौ सूर्यचन्द्रयोः स्पर्शो वा मोक्षो भवेत् । मध्यग्रहणका-लिकवलनज्या दक्षिणोत्तरा दिग्गमना । सा सूर्यग्रहणे रविबिम्बार्धेन चन्द्रग्रहणे चन्द्रबिम्बार्धेन गुणिता त्रिज्यया भक्ता या लब्धिस्तया दक्षिणोत्तररेखातो मध्य-ग्रहणसंस्था भवति । ग्राह्यबिम्बार्धपरिणता मध्यमवलनज्या दक्षिणोत्तररेखातो ज्यारूपा यथादिक्का देया यथाज्याग्रं ग्राह्यबिम्बपरिधौ भवेत् । ग्राह्य केन्द्रान्म-ध्यज्याग्रं प्राग्वद्रेखां प्रसार्य ग्राह्यकेन्द्राच्छरकलाश्च प्रसार्य शराग्रात् ग्राहकप्रमाणेन व्यासेन वृत्तं विलिख्य ग्राह्यबिम्बसम्बन्धि ग्राससंस्थानं ज्ञातव्यम् ॥

अत्रोपपत्तिः ।

मानैक्यार्धवृत्ते पूर्वापरवलनसूत्रयोर्मध्ये वलनांशाः । वलनसूत्रं मानैक्या-

र्धवृत्तपरिधौ यत्र लग्नं यत्र च स्पार्शिकस्य मौक्षिकस्य वा शरस्य चाग्रं तदन्तरांशानयनार्थमनुपातो यदि मानैक्यार्धेन शरस्तदा त्रिज्यया कि लब्धचापांशास्तदन्तरांशाः। चन्द्रग्रहे शरो विपरीतदिक्को भवति तेन तदा ते विपरीताः। एवं तच्चाप वलनांशसंस्कारतः केन्द्रच्छराग्रगतरेखा पूर्वापररेखयोरन्तरांशास्तज्ज्या ग्राह्यबिम्बार्धपरिणता कृता। अतस्तज्ज्याग्रे ग्राह्यबिम्बपरिधौ स्पर्शो मोक्षो वा भवेदिति। सिद्धान्त शेखरे "बाणक्षुण्णा त्रिजीवा तनुयुतिशकलेनोद्धृता स्पर्शमुक्त्योस्तच्चापांशा यथाशं सवितुरुडुपतेर्व्यस्तदिक्का युतोनाः। तैर्भागैर्वलनैर्ज्या स्वतनुदलहता व्यासखण्डेन भक्ता लब्धज्याग्राद्रवीन्दोः स्ववपुषि लिखिते स्पर्शमोक्षाववेहि॥" श्रीपत्युक्तप्रकारोऽयं तथा "क्षुण्णा मध्यग्रहणवलनज्या तुषारोष्णरश्म्योर्मानार्धेन त्रिगृहभवया जीवयाऽऽप्ताऽनया तु। याम्योदीच्याविह खलु दिशौ सारयित्वा तु मध्यात् क्षेपं दत्वा कथितविधिना विद्धि मध्यग्रहं च॥" अयं प्रकारश्चाचार्योक्तप्रकारानुरूप एवेति ॥१९-२०-२१-२२॥

अब प्रकारान्तर से परिलेख को कहते हैं।

हि. भा.—त्रिज्या को स्पर्श कालिकशर से और मोक्षकालिक शर से पृथक् गुणाकर मानैक्यार्ध से भाग देने से जो लब्ध हो उसका चापांश स्पर्श और मोक्ष में सूर्य की शर दिशा में और चन्द्र की शर दिशा से विपरीत दिशा में समझना चाहिये। एक दिशा में लब्धचापांश और वलनांश के योग तथा दोनों की भिन्न दिशा रहने में अन्तर करना चाहिये। तब उसकी ज्या और ग्राह्यबिम्बार्ध के घात को त्रिज्या से भाग देने से जो लब्धि हो तत्तुल्यज्या पूर्वापर रेखा के ऊपर यथादिक् लम्बरूप करनी चाहिये जिससे ज्या ग्राह्यबिम्ब परिधि में हो। ज्याग्र बिन्दु में सूर्य और चन्द्र का स्पर्श वा मोक्ष होता है। मध्यग्रहणकालिक वलनज्या को सूर्य ग्रहण में रवि बिम्बार्ध से तथा चन्द्र ग्रहण में चन्द्र बिम्बार्ध से गुणाकर त्रिज्या से भाग देने से जो लब्धि हो उससे दक्षिणोत्तर रेखा से मध्य ग्रहण संस्था होती है। ग्राह्य बिम्बार्ध परिणत मध्यवलनज्या दक्षिणोत्तर रेखा से ज्यारूप यथादिक् देनी चाहिये जिसमें ज्याग्र ग्राह्यबिम्ब परिधि में हो। ग्राह्य केन्द्र से मध्यज्याग्र पर्यन्त रेखा को पूर्ववत् फैलाकर ग्राह्य केन्द्र से शर कला को फैलाकर शराग्र से ग्राहक प्रमाण व्यास से वृत्त लिखकर ग्राह्य बिम्बसम्बन्धिग्राससंस्था समझनी चाहिये इति।

उपपत्ति।

मानैक्यार्धवृत्त में पूर्वापर सूत्र और वलनसूत्र के मध्य में वलनांश है। वलनसूत्र मानैक्यार्धवृत्त परिधि में जहां लगा है और जहां स्पार्शिक वा मौक्षिक शर का अग्र है उनके अन्तरांशानयनार्थ अनुपात करते हैं। यदि मानैक्यार्ध में शर पाते हैं तो त्रिज्या में क्या इससे जो लब्ध हो उसका चापांश अन्तरांश होता है। चन्द्र ग्रहण में विपरीत दिशा का होता है। इसलिये तब वह विपरीत होता है एवं उस चाप और वलनांश के संस्कार से केन्द्र से शराग्रगत रेखा

और पूर्वापर रेखा का अन्तरांश होता है उसकी ज्या को ग्राह्यबिम्बार्ध व्यासार्ध में परिणत किया। इसलिये उस ज्याग्र में ग्राह्यबिम्ब परिधि में स्पर्श वा मोक्ष होना है। सिद्धान्तशेखर में 'बाणक्षुण्णा त्रिजीवा तनुयुतिशकलेनोद्धृता स्पर्शमुक्त्योस्तच्चापांशा' इत्यादि संस्कृतोपपत्ति मे लिखित श्रीपत्युक्त प्रकार तथा 'क्षुण्णा मध्यग्रहणवलनज्या तुषारोष्णरश्म्योः' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपत्युक्त प्रकार भी आचार्योक्त प्रकार के अनुरूप ही है इति ॥१९—२२॥

इदानीं प्रकारान्तरेणेष्टग्रासार्थं परिलेखमाह।

त्रिज्याविक्षेपगुणा भक्तेष्ट ग्रासकर्णलिप्ताभिः।
प्राग्वत् फलचापस्ववलनांशयोगान्तरं तथा जीवा ॥ २३ ॥

मानार्धगुणा व्यासार्धभाजिता पूर्ववत् प्रसार्या स्यात्।
कर्णं प्रसार्य मध्यादग्रं कर्णेन मध्याग्रात् ॥ २४ ॥

तात्कालिकसंस्थानं परिलिख्य ग्राहकप्रमाणेन।
एवं निमीलनोन्मीलने च परिलेख एवं वा ॥ २५ ॥

सु. भा.—त्रिज्येष्टकालिकशरेण गुणा इष्टग्राससम्बन्धिन्यो याः कर्णलिप्तास्ताभिर्भक्ता फलं प्राग्वत् सूर्यग्रहणे शरदिक् चन्द्रग्रहणे व्यस्तशरदिक् ज्ञेयम्। ततः फलचापस्य तात्कालिकस्ववलनांशस्यैकदिशि योगो भिन्नदिश्यन्तरं कार्यम्। योगान्तरे कृते यज्जातं तज्ज्या मानार्धेन ग्राह्यबिम्बार्धेन गुणा व्यासार्धेन भक्ता लब्धिः पूर्ववत् पूर्वापररेखोपरिज्यावल्लम्बरूपा प्रसार्या स्याद्यथा ज्याग्रं ग्राह्यबिम्बपरिधौ भवेत्। ततो ग्राह्यबिम्बमध्यादयं तज्ज्याग्रं प्रतिकर्णं कर्णसूत्रं प्रसार्य मध्याग्रात् ग्राह्यबिम्बकेन्द्राग्रात् तस्मिन् कर्णसूत्रे कर्णेन समां रेखां दत्वा तदग्राद् ग्राहकप्रमाणेन ग्राहकबिम्बमानेन वृत्तं परिलिख्य तात्कालिकसंस्थानं ज्ञेयम्। एव तात्कालिकशरात् मानान्तरार्धकर्णात् निमीलनोन्मीलनसंस्थाने भवतः। एवं वा प्रकारान्तरेण परिलेखो भवति।

अत्रोपपत्तिः इष्टकाले पूर्वापरवलनसूत्रयोरन्तरे वलनांशसमः। कोणो ग्राह्यबिम्बकेन्द्रे। वलनसूत्रे केन्द्राद्बाहुः। बाह्वग्रात् शरः कोटिः। केन्द्रात् कोट्यग्रपर्यन्तं कर्णः। कर्णकोटियुतौ च ग्राहककेन्द्रम्। त कर्णाग्रे शरस्तदा त्रिज्याग्रे किम्। लब्धस्य चापं वलनकर्णसूत्रयोरन्तरे केन्द्रलग्नकोणः। तद्वलनांशयोः संस्कारेण कर्णसूत्रपूर्वापररेखयोरन्तरे कोणो जातः। तज्ज्याग्राह्यबिम्बार्धपरिणता कृता। पूर्वापररेखोपरि लम्बरूपतन्निवेशेन ज्याग्रं यत्र ग्राह्यबिम्बपरिधौ लग्नं केन्द्रात् तदुपरिगा कर्णरेखैवेहाचार्येण साधिता तत्र कर्णप्रमाणं केन्द्रात् प्रसार्य कर्णाग्रेण ग्राहककेन्द्रेण तात्कालिकग्राससंस्थानमानीतमिति सर्वं प्राक् परिलेखत एव स्फुटमिति ॥ २३-२५ ॥

वि. भा.—त्रिज्येष्टकालिकशरेण गुणा इष्टग्राससम्बन्धिनीभिः कर्णकलाभिर्भक्ता फलचापं पूर्ववत् सूर्यग्रहणे शरदिक् चन्द्रग्रहणे व्यस्तशरदिक् बोध्यम् । फलचापस्य तात्कालिकस्ववलनांशस्यैकदिशायां योगः कार्यः । भिन्नदिशायां तयोरन्तरं कार्यम् । योगान्तरकरणेन यत् स्यात्तज्ज्या ग्राह्यबिम्बार्धेन गुणा त्रिज्यया भक्ता लब्धं पूर्ववत् पूर्वापररेखोपरि ज्यावल्लम्बरूप प्रसार्यम् यथा ज्याग्रं ग्राह्यबिम्बपरिधौ भवेत् । ग्राह्यबिम्बकेन्द्रात् तज्ज्याग्रं प्रतिकर्णसूत्रं प्रसार्य ग्राह्यबिम्बकेन्द्राग्रात् तस्मिन् कर्णसूत्रे कर्णतुल्यां रेखां दत्वा तदग्रात् ग्राहकबिम्बमानेन वृत्त विलिख्य तात्कालिक संस्थानं ज्ञेयम् । एवं तात्कालिकशरात् माना-न्तरार्धकर्णात् निमीलनोन्मीलनसंस्थाने भविष्यतः ।

अत्रोपपत्तिः ।

पूर्वापरसूत्रवलनसूत्रयोरन्तरे इष्टकाले ग्राह्यबिम्बकेन्द्रलग्नकोणो वलनांशतुल्यः । वलनसूत्रे केन्द्राद्भुजः । भुजाग्राच्छरः कोटिः । केन्द्रात्कोटयग्रपर्यन्तं कर्णः । कर्णकोटियुतौ ग्राहककेन्द्रम् । कर्णाग्रे शरस्तदा त्रिज्याग्रे किम् । लब्धफलस्य चापं तदा वलनकर्णसूत्रयोरन्तरे केन्द्रलग्नकोणः । तद्वलनांशयोः संस्कारेण कर्णसूत्रपूर्वापरसूत्रयोरन्तरे कोणो भवति । तज्ज्याग्राह्यबिम्बार्धपरिगणना कृत्य-पूर्वापरसूत्रोपरि लम्बरूपतन्निवेशेन ज्याग्रं ग्राह्य बिम्बपरिधौ यत्र लग्नं तदुपरिगना कर्णरेखैव साधिता आचार्येण । तत्र कर्णप्रमाणं केन्द्रात् प्रसार्य कर्णाग्रेण ग्राहककेन्द्रेण तात्कालिकग्राससंस्थानमानीतम् सिद्धान्त शेखरे "विक्षेपाङ्कद्वितयविवरं वर्त्मनि ग्राहकस्य यत्स्यादस्मिन्नभिमतघटीताड़िते चाङ्गुलाद्यम् । स्थित्यर्धाप्ते भवति हि फलं तच्च मार्गे ग्रहीतुर्युक्तया दत्वा भ्रमणविधिना ग्रास इष्टो भवेद्वा ॥ श्रीपत्युक्तेष्ट ग्रासपरिलेखप्रकार ईदृशोस्तीति ॥

अब प्रकारान्तर से इष्ट ग्रास के लिये परिलेख को कहते हैं ।

हि. भा.—त्रिज्या को इष्ट कालिक शर से गुणा कर इष्टग्रास सम्बन्धिनी कर्णकला से भाग देने से जो लब्धि सो उसका चाप पूर्ववत् सूर्य ग्रहण में शरदिक् और चन्द्र ग्रहण में व्यस्तशरदिक् समझना चाहिए । फलचाप के और तात्कालिक स्ववलनांश की एक दिशा में योग और भिन्न दिशा में दोनों का अन्तर करना चाहिये । योग और अन्तर से जो होता है उसकी ज्या को ग्राह्य बिम्बार्ध से गुणाकर त्रिज्या से भाग देने से जो लब्ध हो उसको पूर्व-वत् पूर्वापर रेखा के ऊपर ज्या की तरह लम्बरूप फैलाना चाहिए जिससे ज्याग्र ग्राह्य बिम्ब-परिधि में हो । ग्राह्यबिम्ब केन्द्र से उस ज्याग्र को कर्ण सूत्र पर्यन्त फैलाकर ग्राह्य बिम्ब-केन्द्र से उस कर्ण सूत्र में कर्णतुल्य रेखा देकर उसके अग्र से ग्राहक बिम्बमान से वृत्त लिख कर तात्कालिक संस्थान समझना चाहिये इसी तरह तात्कालिक शर से मानान्तरार्ध कर्ण से निमीलन संस्थान और उन्मीलन संस्थान होता है इति ॥

उपपत्ति

पूर्वापर सूत्र और वलनसूत्र के अन्तर में इष्ट काल मे ग्राह्य बिम्बकेन्द्र लग्न कोण वलनांशतुल्य है। वलनसूत्र में केन्द्र से भुज, भुजाग्र से शरकोटि, केन्द्र से कोटयग्र पर्यन्त कर्ण। कर्ण और कोटि के योग बिन्दु में ग्राहक केन्द्र है। तब कर्णाग्र मे शर पाते हैं तो त्रिज्याग्र में क्या लब्ध का चाप वलन और कर्णसूत्र के अन्तर में केन्द्र लग्नकोण है। उसके और वलनाग के सस्कार से कर्णसूत्र और पूर्वापर सूत्र के अन्तर मे कोण होता है उसकी ज्या ग्राह्य बिम्बार्ध में परिणत की गई। पूर्वापर रेखा के ऊपर लम्बरूप उसके निवेश मे ज्याग्र जहां ग्राह्य बिम्बपरिधि में लगे केन्द्र से तदुपरिगत कर्णरेखा ही का यहाँ आचार्य ने साधन किया है। कर्ण प्रमाण को केन्द्र से फैलाकर कर्णाग्ररूप ग्राहक केन्द्र से तात्कालिक ग्रास संस्थान लाया गया है इति ॥ २३-२५ ॥

इदानीं फलकोपरि कथं परिलेखो भवतीत्यस्योत्तरमाह।

प्राच्यपरे विपरीते विपरीतं मध्यवलनमर्कैन्द्वोः।
पूर्ववदन्यत् सर्वं फलके स्वे ग्रहणपरिलेखाः ॥ २६ ॥

सु. भा.—फलके प्राच्यपरे विपरीते कार्ये। भूमौ यः प्राग्बिन्दुः पश्चिमबिन्दुश्च फलके स पश्चिमबिन्दुः प्राग्बिन्दुः कार्य इति। अर्केन्द्वोर्मध्यवलनं यथादिशमागतं विपरीतं कार्यम्। अन्यत्सर्वं पूर्ववदेव कर्म कर्त्तव्यम्। एवं स्वेऽभीष्टे फलके ग्रहणपरिलेखाः प्रग्रहमोक्षग्रासा भवन्तीति।

अत्रोपपत्तिः। फलके प्राच्यपरे विपरीते ये कृते मध्यवलनं च यद्विपरीतं कृतं तत्सर्वं पूर्वापरमार्गेण परिवर्त्त्याकाशे फलकनिवेशने यथादिशं परिलेखार्हमुत्पद्यत इति स्फुटम् ॥ २६ ॥

वि. भा.—फलके पूर्वापरबिन्दू विपरीते कार्येऽर्थात्पृथिव्यां यः पूर्वबिन्दुः स फलके पश्चिमबिन्दुः। यश्च पश्चिमबिन्दुः स फलके पूर्वबिन्दुः कार्यः। रविचन्द्रयोर्यथादिशमागतं मध्यवलनं विपरीतं कार्यं, अन्यत् सर्वं कर्म पूर्ववत्कार्यं तदा स्वे फलके (इष्टफलके) स्पर्शमोक्षग्रासा भवन्तीति ॥

अत्रोपपत्तिः।

फलके पूर्वापरे विपरीते ये कृते मध्यवलनमपि विपरीतं यत्कृतं तत्सर्वं पूर्वापरमार्गेण परिवर्त्त्य आकाशे फलकनिवेशने यथादिशं परिलेखार्हमुत्पद्यते इति ॥२६॥

अब फलक के ऊपर कैसे परिलेख करना चाहिये इस प्रश्न के उत्तर को कहते हैं।

हि. भा.—फलक में पूर्व बिन्दु और पश्चिम बिन्दु को विपरीत करना चाहिये अर्थात्

पृथिवी में जो पूर्व बिन्दु है वह फलक में पश्चिम बिन्दु, तथा पश्चिम बिन्दु को फलक में पूर्व बिन्दु करना चाहिए । रवि और चन्द्र के यथादिक् समागत मध्यवलन को भी विपरीत करना चाहिए। अन्य सब कर्म पूर्ववत् ही करना चाहिये । तब अपने अभीष्ट फलक मे स्पर्श मोक्ष ग्रास होते हैं इति ।।

उपपत्ति।

फलक में पूर्व बिन्दु और पश्चिम बिन्दु को विपरीत किया गया है, तथा रवि चन्द्र के मध्यवलन को विपरीत किया गया है उन सबों के पूर्वापर मार्ग में परिवर्त्तन कर आकाश में फलक को निवेश करने से यथा दिक् परिलेख योग्य होता है इति ।। २६ ।।

इदानी देशान्तरं यथागतमित्यादि प्रश्नद्वयोत्तरमाह ।

दृग्गणितप्रग्रहयोरन्तरघटिका फलं ग्रहे मध्ये ।
देशान्तरं धनं तत् प्रग्रहणे क्षयं पश्चात् ।। २७ ।।
प्रग्रहणान्तरघटिका भूपरिधिहृता विभाजयेत् षष्टया ।
फलयोजनेष्ववन्त्याः प्राग्वत् प्रागपरयोर्देशः ।। २८ ।।

सु. भा.—दृष्टया वेधेन यः प्रग्रहणः स्पर्शकालो यश्च गणितेन तयोरन्तरं घटयात्मकं देशान्तरं तद्वशेन फलं चालनफलं देशान्तरं मध्ये ग्रहे प्राक् प्रग्रहणे दृश्ये धनं पश्चात् क्षयं कार्यम् । गणितोत्थकालादादौ प्रग्रहणे दृश्ये धनं पश्चात् क्षयमित्यर्थः । अथ देशान्तरयोजनान्याह । प्रग्रहणयोर्दृग्गणितस्पर्शकालयोरन्तरघटिका भूपरिधिहताः स्पष्टभूपरिधिहता घातं षष्ट्या विभाजयेत् फलयोजनेषु प्राग्वत् गणितोत्थकालादनन्तरमादौ च वेधोपलब्धस्पर्शे अवन्त्याः प्रागपरयोर्देशो भवतीति ।

अत्रोपपत्तिः । 'प्राग्भूविभागे गणितोत्थकालादनन्तरं प्रग्रहणं विधोः स्यात्' इत्यादि भास्करविधिना स्फुटा ।। २७-२८ ।।

वि. भा.—वेधेन यः स्पर्शकालो यश्च गणितेन तयोरन्तरं घटयात्मकं देशान्तरम् । तद्वशेन यच्चानफलं स्पर्शकाले पूर्वदृश्ये तदा मध्ये ग्रहे धनं प चाद्दणं कार्यम् । अथ देशान्तरयोजनं कथयति । वेधगणितस्पर्शकालयोरन्तरघटिकाः स्पष्टभूपरिधिगुणिताः षष्टया भक्ता फलयोजनेषु पूर्ववत् गणितोत्थकालानन्तरं पूर्वं च वेधोपलब्धस्पर्शे अवन्त्याः पूर्वापरयोर्देशो भवतीति ।।

अत्रोपपत्तिः ।

अत्र देशान्तराज्ञानाद्देशान्तरसंस्काररहिताभ्यां स्फुटरविचन्द्राभ्यां चन्द्रग्रहणविधिना सर्वग्रहणे संमीलनकाल उन्मीलनकालश्च साध्यः । तत्र दिने

दृष्ट्या च संमीलनकालो ज्ञेयः स च गणितागतसंमीलनकालाधिकस्तदा द्रष्टा रेखातः प्राग्भागेऽन्यथा पश्चिमभागे स्थित इति ज्ञातव्यः। यतः प्राचि प्रथमं स्वदेशे ततो रेखादेशे मध्यान्हकालोऽतो रेखादेशेष्टसंमीलनकालात् स्वदेशीयसंमीलनकालोऽधिकः पश्चिमेऽतोऽन्यथा। एवं परीक्षोन्मीलनकालादिष्टग्रासकालात् स्पर्शकालान्मोक्षकालाद्वा भवति। स्पर्शकालमोक्षकालपरीक्षा च दृष्ट्या दुर्घटाऽतः "प्राग्भूविभागे गणितोत्थकालादनन्तरं प्रग्रहणम्" इत्यादि भास्करयुक्तितः 'अतीत्योन्मीलनादिन्दोर्द्दक् सिद्धिर्गणितागतात्' इत्यादि सूर्यसिद्धान्तोक्तयुक्तिरुत्तमाऽस्ति। आचार्योक्तादपि सौरी युक्तिर्विलक्षणास्ति। इष्टग्रासकाले चेष्टग्रासपरीक्षातदिष्टकालपरीक्षाऽपेक्षितेति परीक्षाद्वये गौरवं विलोक्य संमीलनोन्मीलनकालावेव दृष्टिसुलभौ गृहीतौ सूर्यसिद्धान्तकारेण। तयोर्गणितागतवेधोपलब्धकालयोरन्तरनाड्यो देशान्तर नाड्यः। ततो यदि षष्टि घटीभिः स्फुट भूपरिधिर्लभ्यते तदा देशान्तरघटीभिः किं लब्धैः प्रागपरयोजनै रेखातः स्वस्फुट परिधौ स्वदेशो ज्ञेयः। आचार्येण तु वेधागत गणितागतस्पर्शकालयोरन्तरघटिकातोऽनुपातेन 'यदि षष्टिघटीभिः स्फुटभूपरिधियोजनानि लभ्यन्ते तदाऽन्तरघटीभिः किं लब्धयोजनेषु पूर्ववत् गणितोत्थकालानन्तरं पूर्वं च वेधोपलब्धे स्पर्शे अवन्त्याः पूर्वापरयोर्देशो भवतीति कथ्यत इति ॥ २७-२८ ॥

अब 'देशान्तरं यथागतमित्यादि' दोनों प्रश्नों के उत्तर को कहते हैं।

हि. भा.—वेध से जो स्पर्श काल है तथा गणित से जो स्पर्श काल है इन दोनों का अन्तर देशान्तर घटी है। उसके वश से जो चालन फल होता है उसको मध्य ग्रहण से स्पर्शकाल पूर्व दृश्य होने पर धन अन्यथा ऋण करना चाहिये। अब देशान्तर योजन कहते हैं। वेधागत और गणितागत स्पर्शकाल की अन्तर घटी को स्पष्ट भूपरिधि से गुणा कर साठ से भाग देने से जो लब्ध योजन हो उतने योजन पर गणितागत स्पर्श कालानन्तर वा पूर्व वेधोपलब्ध स्पर्शकाल में अवन्ती से पूर्व और पश्चिम देश होता है इति ॥

उपपत्ति।

यहाँ देशान्तर विदित नहीं है इसलिये देशान्तर संस्कार से रहित स्फुट रवि और स्फुट चन्द्र से चन्द्र ग्रहण विधि से सर्वग्रहण में संमीलन काल और उन्मीलन काल साधन करना चाहिये। उस दिन में दृष्टि से भी संमीलन काल समझना चाहिये वह यदि गणितागत संमीलन काल से अधिक हो तो द्रष्टा रेखा से पूर्व भाग में अन्यथा पश्चिम भाग में स्थित है यह समझना चाहिये। क्योंकि रेखा से पूर्व स्वदेश मे पहले स्वदेश में पश्चात् रेखा देश में मध्यान्ह काल होता है। अतः रेखा देशीय इष्ट संमीलन काल से स्वदेशीय समीलन काल अधिक होता है पश्चिम मे इसके विपरीत होता है। इस तरह उन्मीलन काल से इष्ट ग्रास काल से स्पर्श काल से या मोक्ष काल से परीक्षा होती है, स्पर्श काल परीक्षा और मोक्ष काल परीक्षा दृष्टि

से दुर्घट है अतः 'प्राग्भू विभागे गणितोत्थकालात्' इत्यादि भास्करोक्तयुक्ति से 'अतीन्द्रियोन्मीलनादिन्दो र्दृक् सिद्धिर्गणितागतात्' इत्यादि सूर्य सिद्धान्तोक्त युक्ति अच्छी है। आचार्योक्त से भी अच्छी है। उस गणितागत काल और वेधोपलब्ध काल की अन्तर घटी देशान्तर घटी है। तब अनुपात करते है। यदि साठ घटी में स्फुट भूपरिधियोजन पाते है तो देशान्तर घाटी में क्या इस से लब्ध प्रागपर योजन पर रेखा से अपनी स्फुट परिधि में स्वदेश समझना चाहिये। आचार्य वेधागत स्पर्शकाल और गणितागत स्पर्श काल के अन्तर घटी से 'यदि साठ घटी में स्फुट भूपरिधि योजन पाते है तो अनर घटी में क्या इससे लब्ध योजन में पूर्ववत् गणितागत स्पर्श कालानन्तर तथा पूर्व वेधोपलब्ध स्पर्श काल होने से अवन्ती से पूर्वदेश होता है और पश्चिम देश होता है ।।२७–२८।।

इदानीमिष्टदिनाद्यः पर्व विजानातीत्यस्योत्तरमाह ।

पातार्क युतिर्भार्धात् चक्राद्वोनाधिका कला भक्ता ।
तद्गतियुत्याप्तदिनैरासन्नोऽर्कस्य मासान्ते ।। २९ ।।

पर्वेन्दोः पक्षान्ते प्रागधिकोना भवति पश्चात् ।
तन्मध्येन ग्रहणं यदि भानोः पञ्चजिन भरसाः ।।५।२४।२७।६।।३०।।

इन्दोर्विषया द्वियमा दिवाकरास्त्रिविषयास्तदुच्चस्य ।५।१२।१२।१३।
व्योमातिधृतिर्द्वियुगानि रसशराश्चन्द्र पातस्य ।।०।१६।४२।५६।।३१।।

खंनन्दा द्वियमाः खाब्धयो ०।६।२२।४०। गृहाद्यास्तथेष्ट पर्वगुणाः ।
क्षेप्याः पर्वण्येष्ये शोध्या मध्ये त्वतिक्रान्ते ।।३२।।

ग्रहणे यथा रवीन्द्वोः स्पष्टीकरणाद्यमुक्तवज्ज्ञात्वा ।
एवं पर्वज्ञानं ग्रहणज्ञानं स्फुटं गणितात् ।।३३।।

सु. भा.—पातस्यार्कस्य रवेश्च युतिर्भार्धाच्चक्राद्वा यावदूना वाऽधिका सोऽनाधिककला। अत्र जात्यैकवचनम्। सा तयोः पातार्कयोर्गतियुत्या भक्ता आप्तदिनैर्मासान्ते दर्शान्ते आसन्नेऽर्कस्य पर्वपक्षान्ते चासन्ने हीन्दोः पर्वेष्ट-दिनात् प्राग्भवति यदि अधिका कला यद्यूना तदाऽऽप्तदिनैः पश्चात् पर्व भवति। यदि तन्मध्ये दर्शान्ते वा पूर्णान्ते आसन्ने ग्रहणं न स्यात् तदा तदग्रे वा पश्चात् षण्मासे ग्रहणसम्भवोऽतो रव्यादिषु षाण्मासिकं चालनमाह। पञ्चजिनभेत्यादि सुगमम्। षण्मासोत्तरवृद्धया पर्व सम्भवोऽतो गृहाद्या इष्टपर्वसंख्यागुणा एष्यपर्वणि मध्ये निर्णीतमध्यग्रहणकालिक रव्यादौ क्षेप्याः अतिक्रान्ते व्यतीते ग्रहणे च शोध्यास्तदा तत्पर्वणि मध्यमौ रविचन्द्रौ पातश्च भवति। ततो यथा रवीन्द्वोः स्पष्टीकरणाद्यमुक्तमस्ति तथा सर्वमुक्तवज्ज्ञात्वा तिथ्यन्तमानादिकं साध्यम्। एवं तदा गणितात् पर्वज्ञानं ग्रहणज्ञानं च स्फुटं भवतीति।

अत्रोपपत्तिः। यदा सपातार्कश्चक्रार्धेन वा चक्रेण समस्तदा शराभावादवश्यमेव ग्रहणं यदि स च सपातार्को मासान्ते व पक्षान्ते। अन्यथा यदा न ग्रहणसम्भवस्तदा षाण्मासिकचालनेन पुनः पुनरग्रे पृष्ठे वा दर्शान्तपूर्णान्तकालयोः सपातार्कयुक्तिश्चक्रार्धेन चक्रेण वा समाऽन्वेषणीया। यदा ग्रहणसम्भवस्तदा स्पष्टीकरणाद्यं कर्म स्फुटार्थं कर्तव्यम्। अत्र विशेषविचारचातुरीप्रपञ्चार्थं 'षण्मासैरुत पक्षवर्जितयुतैः पक्षेऽथवालोकये' दित्यादि ग्रहलाघवश्लोकस्य मत्कृता वासना विलोक्येति ॥ २९-३३ ॥

वि. भा.—पातस्य रवेश्च युतिः षड्राशितो द्वादश राशितो वा यावदूनाऽधिका वा सोनाधिककला, सा पातरव्योर्गतियोगेन भक्ता लब्धदिनैर्मासान्ते (दर्शान्तेऽमायां वा) आसन्ने रवेः पर्वपूर्णान्ते चासन्ने चन्द्रस्य पर्वेष्ट दिनात्पूर्वं भवति यद्यधिका कला। यद्यूना तदा लब्धदिनैः पश्चात् पर्व भवति। यदि तन्मध्येऽमान्ते पूर्णान्ते वा आसन्ने ग्रहणं न स्यात्तदा तदग्रे पश्चाद्वा षण्मासे ग्रहणसम्भवोऽतो रव्यादिषु ग्रहेषु षाण्मासिकं चालनं कथ्यते। पञ्चजिनभरसा-इत्यादिभिः। षण्मासोत्तरवृद्धया पर्वसम्भवोऽतो गृहाद्या इष्टपर्वसंख्या गुणा एष्यपर्वणि मध्ये निर्णीतमध्यग्रहणकालिकरव्यादौ क्षेप्याः। व्यतीते ग्रहणे च शोध्यास्तदा तत्पर्वणि मध्यमौ रविचन्द्रौ पातश्च भवति। ततो रविचन्द्रयोः स्पष्टीकरणादिकं यथोक्तमस्ति तथोक्तवत्सर्वं ज्ञात्वा तिथ्यन्तमानादिकं साध्यम्। तदा गणितात् ग्रहणज्ञानं स्फुटं भवतीति ॥

अत्रोपपत्तिः।

यदि स पातरविः षड्राशिसमो द्वादशराशिसमो वा सच यद्यमान्ते पूर्णान्ते वा भवेत्तदाऽवश्यमेव ग्रहणं शराभावात्। यदि ग्रहण सम्भवो न तदा षाण्मासिकचालनेन पुनः पुनरग्रे पृष्ठे वा दर्शान्तपूर्णान्तकालयोः सपातरविः षड्राशिसमो द्वादशराशिसमो वाऽन्वेषणीयः। यदि ग्रहणसम्भवस्तदा स्फुटार्थं स्पष्टीकरणादिकं कर्म कार्यम् ॥२९-३३॥

अब 'इष्टदिनाद्यः पर्व विजानाति' इस प्रश्न के उत्तर को कहते हैं।

हि. भा.—पात और रवि का योग छः राशि से वा बारह राशि से जब तक ऊन वा अधिक रहता है उस ऊनाधिक कला को पात और रवि के गतियोग से भाग देने से जो लब्ध दिन हो उतने दिनों में अमान्तासन्न में रवि का पर्व और पूर्णान्तासन्न में चन्द्र का पर्व इष्ट दिन से पहले होता है यदि अधिक कला रहती है तब। ऊन कला रहने से लब्ध दिनों में पश्चात् पर्व होता है। यदि उसके मध्य में अमान्त वा पूर्णान्त आसन्न में ग्रहण न हो तब उसके आगे वा पीछे छः महीने में ग्रहण सम्भव होता है अतः रव्यादिग्रहों में षाण्मासिक

चालन को कहते हैं। 'पञ्च जिन भरसा' इत्यादि श्लोकों से षण्मासोत्तर वृद्धि से पर्व सम्भव होता है इसलिये गृहादिकों इष्ट पर्व संख्या से गुणा करना गम्य पर्व में, मध्य में निर्णीत मध्यग्रहण कालिक रव्यादि ग्रहों में जोडना चाहिये। व्यतीत (गत) ग्रहण में घटाना चाहिये तब उस पर्व में मध्यम रवि-चन्द्र और पात होते हैं। तब रवि और चन्द्र का स्पष्टी करणादिक जैसा कथित है वैसा उक्तवत् सब जानकर तिथ्यन्त मानादिक साधन करना चाहिये। तब गणित से स्फुट ग्रहण ज्ञान होता है इति ॥

उपपत्ति

यदि सपात रवि छः राशि के बराबर वा बारह राशि के बराबर हो और वह यदि अमान्त वा पूर्णान्त में हो तो अवश्य ही ग्रहण होता है क्यो कि शराभाव है। यदि ग्रहण सम्भव न हो तो षाण्मासिक चालन से पुनः पुनः आगे वा पीछे दर्शान्त काल में पूर्णान्त काल में छः राशि के बराबर वा बारह राशि के बराबर सपात रवि का खोज करना चाहिये। यदि ग्रहण सम्भव हो तो स्फुटार्थ स्पष्टीकरणादिक कर्म करना चाहिये इति ॥२९-३३॥

इदानीं विशेषमाह।

चत्वार्यत्रापवर्त्तग्रहणान्यर्कस्य शीतरश्मेश्च।
दृष्ट्वोदयास्तसमये द्युरात्रिदलयोश्च केन्द्रस्य ॥३४॥

सु. भा.—(चत्वार्यत्रापवर्त्तग्रहणान्यर्कस्य शीतरश्मेश्च।
दृष्टोदयास्तसमये द्युरात्रि दलयोश्च केन्द्रस्य ॥)

अयं साधुपाठो विभाति।

उदयसमये ऽस्तसमये दिनार्धे रात्रिदले च अर्कस्य रवेः शीतरश्मेश्चन्द्रस्य चात्र चत्वारि अपवर्त्तग्रहणानि लघुग्रहणानि दृष्ट्वा रवेश्चन्द्रस्य च केन्द्रस्य गणकैः परीक्षा कार्येत्यध्याहार्यमिति ॥ ३४ ॥

वि. भा.—उदयसमयेऽस्तसमये च दिनार्धे रात्र्यर्धे च रवेश्चन्द्रस्य चात्र चत्वारि लघुग्रहणानि दृष्ट्वा रविचन्द्रयोः केन्द्रस्य परीक्षा कार्येति ॥३४॥

अब विशेष कहते हैं।

हि. भा.—उदय समय में और अस्त समय में दिनार्ध में रात्र्यर्ध में रवि और चन्द्र के चार अपवर्त्त ग्रहण (लघुग्रहण) को देखकर रवि और चन्द्र के केन्द्र की परीक्षा करनी चाहिये इति ॥३४॥

इदानीं स्वप्रशंसामाह ।

सर्वपदानामन्ते तिथ्यन्ते ज्ञानमिन्दुभास्करयोः ।
ग्रहणे च कृते स्पष्टे जिष्णुसुतब्रह्मगुप्तेन ॥३५॥

सु. भा.—सर्वपदानां सर्वपादकरणानामन्ते विनाशे जिष्णुसुतब्रह्मगुप्तेन तिथ्यन्ते इन्दुभास्करयोः स्पष्टं ज्ञानं कृतं तद्वशतो रवीन्द्वोर्ग्रहणे च स्पष्टे कृते । ग्रहणस्पष्टार्थं सर्वपादकरणानां दृग्गणितैक्याभावादन्तो विनाशो जातस्तस्माद्ब्रह्मगुप्तेन सर्वं स्फुटं कृतमित्यर्थः ॥ ३५ ॥

वि. भा.—सर्वपादकरणानां विनाशे तिथ्यन्ते चन्द्ररव्योः स्फुटं ज्ञानं जिष्णुसुतब्रह्मगुप्तेन कृतं तद्वशतो रविचन्द्रयोर्ग्रहणे स्पष्टे कृते । ग्रहणस्फुटार्थं दृग्गणितैक्याभावात्सर्वपादकरणानां विनाशो जातस्तस्मात्कारणात् ब्रह्मगुप्तेन सर्वं स्फुटं कृतमिति ॥३५॥

अब अपनी प्रशंसा को कहते हैं ।

हि. भा.—सर्वपादकरणों के विनाश होने से जिष्णुसुत ब्रह्मगुप्त ने तिथ्यन्त में चन्द्र और रवि का स्फुट ज्ञान किया । उसके वश से रवि ग्रहण और चन्द्र ग्रहण स्फुट किया, ग्रहण स्फुटार्थ दृग्गणितैक्य के अभाव के कारण सर्वपाद करणों का विनाश हुआ इस कारण से ब्रह्मगुप्त ने उपर्युक्त सब विषयों का स्फुटीकरण किया इति ॥३५॥

इदानीं श्रीषेणादितन्त्राणां निन्दां करोति ।

दूरभ्रष्टे ग्रहणे श्रीषेणार्यभटविष्णुचन्द्रेषु ।
ग्रहगणितविसंवादात् संवादः काकतालीयः ॥३६॥

सु. भा.—श्रीषेणार्यभटविष्णुचन्द्रेषु तदुक्ततन्त्रेषु ग्रहगणितविसंवादाद् ग्रहगणितस्याशुद्धत्वाद्रविचन्द्रयोर्ग्रहणे दूरभ्रष्टे स्तः । यदि कदाचित् संवादोऽर्थाद् ग्रहणद्वयं घटते तर्हि स संवादः काकतालीयो ज्ञेय इति । यथा काकागमनसमये यदि तालपतनं भवेत् तर्हि दैवात् तत्पतनं ज्ञेयं न काकागमनकारणेनेति ॥ ३६ ॥

वि. भा.—श्रीषेणार्यभटविष्णुचन्द्रेष्वर्थात्तदुक्ततन्त्रेषु ग्रहगणितस्याशुद्धत्वाद्रविचन्द्रयोर्ग्रहणे दूरभ्रष्टे जाते । यदि संवादो ग्रहणद्वयं घटते कदाचित्तदा स काकतालीयो ज्ञेयोऽर्थात्काकागमनसमये यदि तालवृक्षस्य पतनं भवेत्तदा दैवात्तत्पतनं ज्ञेयं नहि काकागमनकारणेनेति ॥ ३६ ॥

अब श्रीषेण आदि आचार्यकृत तन्त्रों की निन्दा करते हैं ।

हि. भा.—श्रीषेण-आर्यभट-विष्णु-चन्द्रोक्त तन्त्रों में ग्रहगणित की प्रयुक्तता के कारण रविग्रहण और चन्द्रग्रहण बहुत भ्रष्ट हो गया । यदि कदाचित् दोनों ग्रहण घटते हैं तो उसको काकतालीय समझना चाहिये अर्थात् काक (कौआ) के आने के समय यदि ताल वृक्ष का पतन (गिरना) हो जाय तो दैवात् उस पतन को समझना चाहिये । काक के आगमन के कारण से नहीं इति ।। ३६ ।।

इदानी पुनः स्वप्रशंसां करोति ।

स्फुटतिथ्यन्तज्ञानं यन्नार्यभटादिभिः कृतमतीतैः ।
ब्राह्मे स्फुटं कृतं तज्जिष्णुसुतब्रह्मगुप्तेन ।।३७।।

सु. भा.—अतीतैः प्राचीनैरार्यभटादिभिर्यत् स्फुटतिथ्यन्तज्ञान पर्वसाधनार्थं न कृतं तद्ब्राह्मे सिद्धान्ते जिष्णुसुतब्रह्मगुप्तेन स्फुटं कृतमिति ।। ३७ ।।

वि. भा.—अतीतैः (प्राचीनैः) आर्यभटादिभिराचार्यैः पर्वसाधनार्थं यत्स्फुटतिथ्यन्तज्ञानं न कृत तत् ब्राह्मसिद्धान्ते (ब्राह्मस्फुट सिद्धान्ते) जिष्णुसुतब्रह्मगुप्तेन स्फुटं कृतमिति ।।३७।।

अब पुनः अपनी प्रशंसा करते हैं ।

हि. भा.—प्राचीन आर्यभट आदि आचार्यों ने पर्व साधन के लिये जो स्फुट तिथ्यन्त ज्ञान नहीं किया उसको ब्राह्म सिद्धान्त (ब्राह्मस्फुट सिद्धान्त) में जिष्णुसुत ब्रह्मगुप्त ने स्फुट किया है इति ।।३७।।

इदानीं स्वसिद्धान्तप्रशंसां करोति ।

ब्राह्मोक्तार्केन्दुतदुच्चपातदेशान्तरस्फुटीकरणैः ।
स्फुटमिन्द्वर्कग्रहणद्वितयं न स्फुटमतीतोक्तम् ।।३८।।

सु. भा.—अतीतोक्तं प्राचीनोक्तमार्यभटादिभिरुक्तमिन्द्वर्कग्रहणद्वितयं न स्फुटम् । शेषं स्पष्टार्थम् ।। ३८ ।।

वि. भा.—ब्राह्मसिद्धान्तोक्तरविचन्द्रतदुच्चपातदेशान्तरस्फुटीकरणैश्चन्द्रर-व्योर्ग्रहणद्वयस्फुटमस्ति । अतीतोक्तं (प्राचीनार्यभटादिकथितं) ग्रहणद्वयं स्फुटं नास्तीति ।।३८।।

अब अपने सिद्धान्त की प्रशंसा करते है।

हि. भा.—ब्राह्मसिद्धान्त कथित रवि चन्द्र और उनके उच्च पात-देशान्तर के स्फुटीकरण से रवि और चन्द्र के ग्रहण स्फुट हैं। प्राचीन आर्य भटादि कथित दोनों ग्रहण (सूर्य ग्रहण और चन्द्र ग्रहण) स्फुट नहीं हैं इति ।।३८।।

इदानीं यो वेत्ति राहुमार्गमित्यस्योत्तरमाह।

विक्षेपाग्रेषु त्रीन् बिन्दून् प्रगृहणमध्यमोक्षेषु।
कृत्वा तन्मत्स्यद्वयमध्यगयोः सूत्रयोर्योगात् ।। ३९ ।।
बिन्दुपरिलेखरेखाग्राहकमार्गः प्रसार्य सूत्रे द्वे।
आद्यन्ताभ्यां मध्यगमुच्छाद्य स्थूलमेवं वा ।। ४० ।।

सु. भा.—पूर्वसाधितपरिलेखे स्पर्शमध्यमोक्षशराग्रेषु त्रीन् बिन्दून् कृत्वा तैर्मत्स्यद्वयमुत्पादयेत्। ततस्तन्मत्स्यद्वयमध्यगयोस्तन्मुखपुच्छगयोः सूत्रयोर्योगस्तस्मात् केन्द्राद् बिन्दुत्रयशिरोऽवगाहि वृत्तं यद्भवति सा बिन्दु परिलेखरेखा ग्राहकमार्गो भूभामार्गो भवति। वाऽऽद्यन्ताभ्यां स्पर्शमोक्षचिह्नाभ्यां मध्यगं मध्यशराग्रगं द्वे सूत्रे उच्छाद्य प्रसार्य चैवं स्थूलं यथा स्यात् तथा ग्राहकमार्गो ज्ञेयः।

अत्रोपपत्तिः। स्पर्शमध्यमोक्षशराग्रेषु त्रीन् बिन्दून् ग्राहकमार्गस्थान् विज्ञाय ग्राहकमार्गं च वृत्तचापखण्डं स्थूलं परिकल्प्य त्रिस्पृग्वृत्तस्य केन्द्रं मत्स्यद्वयसूत्रयुतिरेवानीतमिति प्रसिद्धम्। वा स्पर्शमध्यचिह्नगतरेखैकं मार्गखण्डं मध्यान्मोक्षचिह्नपर्यन्तमन्यत् मार्गखण्डं च स्थूलं प्रसाधितम्। 'ये स्पर्शमुक्तयोर्विशिखाग्रचिह्ने'—इत्यादि भास्करोक्तमेतदनुरूपमेव। वृत्तचापाकारो ग्राहकमार्गः प्रसिद्धसूर्यसिद्धान्तेऽपि कल्पित—इति ।। ३९-४० ।।

वि. भा.—स्पर्शमध्यमोक्षशराग्रेषु त्रीन् बिन्दून् कृत्वा तत्र स्पर्शमध्यबिन्द्वोस्तथा मौक्षिकमध्यबिन्द्वोर्मध्ये मत्स्यद्वयमुत्पादयेत्। तन्मत्स्ययोर्मुखपुच्छगतयोः सूत्रयोर्योगात्केन्द्राद्बिन्दुत्रयशिरोऽवगाहि वृत्तं यद् भवति सा बिन्दुपरिलेखरेखा भूभामार्गो भवति। वा स्पर्शमोक्षचिह्नाभ्यां मध्यशराग्रगे द्वे सूत्रे प्रसार्य चैवं स्थूलो ग्राहकमार्गो ज्ञेय इति ।।

अत्रोपपत्तिः।

स्पर्शमध्यमोक्षशराग्रेषु तत्तत्काले ग्राहककेन्द्रम्। यथा त्रिप्रश्नाधिकारे छायात्रयाग्रगतं मत्स्यद्वयेन वृत्तखण्डं कृतं तथाऽत्रापि मत्स्यद्वयेन बिन्दुत्रयोपरि-

गतं वृत्तचापं भवति । तत्र स्पर्शमध्यमोक्षविन्दुषु ग्राहको गमिष्यति परन्तु तच्चाप एव ग्राहको गच्छेदित्यत्र न काचिद्युक्तिः । चन्द्रग्रहणाधिकारे यथा कल्पित विमण्डलं स्थिरभूभातः सरलरेखाकारं सिध्यति तथाऽत्रापि यदि पूर्णान्तकालिकं चन्द्रबिम्बं स्थिरीकृत्य कल्पितभूभामार्गः साध्यते तदा सोऽपि सरलाकार एव भविष्यति । अतोऽत्र शरादिकानां सरलत्वे नैव वृत्तचापाकारो नापि भास्करोक्तो 'ये स्पर्श-मुक्त्योर्विशिखाग्रचिह्ने' इत्यादिना वक्राकारो ग्राहकमार्गः । प्राचीनैर्ग्रहणे यथा शरादिकानां सरलत्वं रविचन्द्रयोर्गती चैक रूपे कल्पिते तत्कल्पनातो ग्राहकमार्गः कल्पितविमण्डलवत् सरलाकार एवेति । सूर्यसिद्धान्ते "स्वसंज्ञितास्त्रयः कार्या विक्षेपाग्रेषु बिन्दवः । तत्र प्राङ्मध्ययोर्मध्ये तथा मौक्षिकमध्ययोः ॥ विलिखेन्मत्स्यौ तयोर्मध्यान्मुखपुच्छविनिःसृतम् । प्रसार्य सूत्रद्वितय तयोर्यत्र युतिर्भवेत् ॥ तत्र सूत्रेण विलिखेच्चापं बिन्दुत्रयस्पृशा । स पन्था ग्राहकस्योक्तो येनासौ सम्प्रया-स्यति ॥" सूर्यसिद्धान्तोक्तानुरूप एवा" चार्योक्तः ॥ सिद्धान्तशेखरे 'विक्षेपाग्रत्रयकृत-मितिद्वन्द्वमध्यस्थरज्वोर्योगाद्वृत्तं कृतशरशिरो वर्त्म तद् ग्राहकस्य । तत्समस्ता श्रुतिमपि नयेद्युक्तितो मध्यकेन्द्रादिष्टग्रासाद्यवगमविधिज्ञप्तये चन्द्रभान्वोः ॥" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति ॥ ३९-४० ॥

अब 'यो वेत्तिराहुमार्गं' इस प्रश्न के उत्तर को कहते हैं ।

हि. भा.—स्पर्श मध्य और मोक्ष शराग्रों में तीन बिन्दु (चिह्न) कर स्पर्श बिन्दु और मध्य बिन्दु के मध्य में तथा मौक्षिक बिन्दु और मध्य बिन्दु के मध्य में मत्स्योत्पादन करना चाहिये । इन दोनों मत्स्यो के मुख और पुच्छगत सूत्र द्वय के योग बिन्दु केन्द्र से तीनों बिन्दुगत जो वृत्त होता है वह बिन्दुपरिलेख रेखा भूभामार्ग होता है । वा स्पर्श मोक्ष चिह्नों से मध्यशराग्रगत दो सूत्रों को फैला कर स्थूल ग्राहक मार्ग समझना चाहिये इति ॥

उपपत्ति ।

स्पर्श मध्य मोक्ष शराग्रों में तत्तत्काल में ग्राहककेन्द्र होता है । जैसे त्रिप्रश्नाधिकार मे छायात्रयाग्रगत मत्स्यद्वय से वृत्तखण्ड किया गया वैसे ही यहां भी मत्स्यद्वय से बिन्दु-त्रयोपरिगत वृत्तचाप होता है । वहां स्पर्श-मध्य-मोक्ष बिन्दुओं में ग्राहक जायगा परन्तु उस चाप ही में ग्राहक जायगा इस में कुछ युक्ति नहीं है । चन्द्रग्रहणाधिकार में स्थिरभूभा से जैसे कल्पित विमण्डल सरल रेखाकार सिद्ध होता है वैसे यहां भी यदि पूर्णान्तकालिक चन्द्रबिम्ब को स्थिर मानकर कल्पित भूभामार्ग साधन किया जाता है तो वह भी सरला-कार ही होगा । इसलिये यहां शरादियों के सरलत्व में वृत्त चापाकार ग्राहक मार्ग नहीं होता है । 'ये स्पर्शमुक्त्योर्विशिखाग्रचिह्ने' इत्यादि भास्करोक्त से भी वक्राकार ग्राहकमार्ग नहीं होता है । प्राचीनाचार्यो ने ग्रहण में जैसे शरादियों का सरलत्व और रवि-चन्द्र की गति एक रूप कल्पना की है उनकी कल्पना से कल्पित विमण्डल की तरह ग्राहकमार्ग सरलाकार

ही होता है। सूर्य सिद्धान्त में 'स्वसञ्ज्ञितास्त्रयः कार्या विक्षेपाग्रेषु बिन्दवः' इत्यादि सूर्य सिद्धान्तोक्त के अनुरूप ही आचार्योक्त है। सिद्धान्त शेखर में 'विक्षेपाग्रत्रयकृत मिति द्वन्द्वमध्यस्थरज्वोः' इत्यादि श्रीपत्युक्त आचार्योक्तानुरूप ही है इति ॥ ३९-४० ॥

इदानीमिष्टकालादिष्टग्रासं यो जानातीत्यस्योत्तरमाह।

बिन्दुद्वयान्तरं स्थितिदलेन हृतमिष्टनाड़िकागुणितम्।
ग्राह्यं फलाङ्गुलस्थं ग्राहकमानेन परिलिख्य ॥ ४१ ॥

इष्टग्रासोऽर्केन्द्वोर्निमीलनोन्मीलने च भानुमतोः।
उर्वरितः प्राग्मध्यात् पश्चाद्वेष्टाङ्गुलस्थेन ॥ ४२ ॥

मध्यस्याद्येनान्तेन वाऽन्तरं गुणितमिष्टघटिकाभिः।
स्थित्यर्धनाड़िका हृतमृणधनमूनाधिके मध्ये ॥ ४३ ॥

आद्यन्ते च पृषत्के विक्षेपः कोटिरुक्तवद्ग्रासः।
विक्षेपान्तरमेवं गुणमिष्टग्रासलिप्ताभिः ॥ ४४ ॥

सु. भा.—स्पार्शिकेष्टकाले स्पर्शमध्यबिन्द्वोरन्तरं ग्राहकमार्गे ग्राह्यं मौक्षिकेष्टे च मध्यमोक्षबिन्दुद्वयान्तरं ग्राह्यं तत् स्वस्वस्थितिदलेन नाडिकाद्येन हृतमिष्टनाडिकागुणितं कार्यम्। फलमङ्गुलात्मकं स्पार्शिकेष्टे स्पर्शचिह्नादग्रे मध्यचिह्नोन्मुखं ग्राहकमार्गे देयमेवं फलाङ्गुलस्थं चिह्नं ग्राह्यम्। मौक्षिकेष्टे मोक्षचिह्नान्मध्योन्मुखं देयम्। एवं तत्र ग्राहक केन्द्रं तस्माद्ग्राहकमानेन वृत्तं परिलिख्यार्केन्द्वोरिष्टग्रासः संमीलनोन्मीलने च भानुमतो रविचन्द्रयोर्ज्ञेये। अथ प्रकारान्तरेणेष्टकालादिष्टग्रासमानयति। वा स्पार्शिकेष्टे पूर्वानीताङ्गुलफलदानेन यो मध्यात् प्राग्मार्ग उर्वरितो मौक्षिकेष्टे च मध्यात् पश्चाद्यो मार्ग उर्वरितः स वीष्टस्थितिखण्डसम्बन्धी मार्गो भुज इति। अथोभयोरिष्टयोः क्रमेण मध्यस्य बाणस्याद्येन स्पार्शिकबाणेन सह मध्यबाणस्यान्तेन मौक्षिकबाणेन सह यदन्तरं तदिष्टघटिकाभिर्गुणं स्वस्थित्यर्धनाडिकाहृतं फलमाद्यन्ते स्पर्शशरे मोक्षशरे च मध्ये मध्यशरे ऊनाधिके ऋणं धनं कार्यमेवं तात्कालिको विक्षेपः कोटिर्भवेत्। भुजस्तु पूर्वं साधित एव। तत उक्तवद्ग्रहणाधिकारविधिना भुजकोटिभ्यां कर्णमानीय कर्णोनं मानैक्यखण्डमिष्टग्रास आनेय इति विक्षेपान्तरमित्यस्याग्रे सम्बन्ध इति।

अत्रोपपत्तिः। परिलेखसंस्थानेनानुपातेन च स्फुटा ॥ ४१-४४ ॥

वि. भा.—ग्राहकमार्गे स्पार्शिकेष्टकाले स्पर्शमध्यबिन्द्वोरन्तरं मौक्षिकेष्टे च मध्यमोक्षबिन्दुद्वयांतरं ग्रहीतव्यम्। तत् इष्टनाड़ीभिर्गुणितं स्वस्व स्थित्यर्धे

भक्तमङ्गुलाद्यं यत्फलं भवति तच्च स्पार्शिकेष्टे स्पर्शचिह्नादग्रे मध्यचिह्नोन्मुखं ग्राहकमार्गे देयम् । मौक्षिकेष्टे च मोक्षचिह्नान्मध्योन्मुखं देयम् तत्र ग्राहककेन्द्रं तस्माद् ग्राहकमानेन वृत्तं परिलिख्य रविचन्द्रयोरिष्टग्रासः संमीलनोन्मीलने च ज्ञेये । प्रकारान्तरेणेष्टकालादिष्टग्रासं साध्यते । वा स्पार्शिकेष्टे पूर्वानीतांगुलफलदानेन मध्यात्प्राग्मार्गे उर्वरितः स वीष्टस्थितिखण्डसम्बन्धी भुजः । मौक्षिकेष्टे मध्यात्पश्चाद्योमार्ग उर्वरितः स वीष्टस्थितिखण्डसम्बन्धी भुजः । द्वयोरिष्टयोः क्रमेण स्पार्शिकशरस्य मध्यशरेण सह यदन्तरं मध्यशरस्य मौक्षिकशरेण सह यदन्तरं तदिष्टघटीभिर्गुणितं स्व स्थित्यर्धघटीभिर्भक्तं फलं स्पर्शशरे मोक्षशरे च मध्यशरे ऊनाधिके ऋणं धनं कार्यं तदा तात्कालिकः शरः कोटिर्भवेत् । ततः पूर्वोक्त ग्रहणाधिकारविधिना भुजकोटिभ्यां 'मानैक्यखण्डं श्रुतिवर्जितमित्यादि' भास्करोक्त्या कर्णेन हीनं मानैक्यार्धमिष्टग्रासो भवेत् । विक्षेपान्तरमित्यस्याग्रे सम्बन्धः । सिद्धान्तशेखरे 'विक्षेपाङ्कद्वितयविवरं वर्त्मनि ग्राहकस्य यत्स्यादस्मिन्नभिमतघटीताड़िते चाङ्गुलाद्यम् । स्थित्यर्धाप्ते भवति हि फलं तच्चमार्गे ग्रहीतुर्युक्त्या दत्वा भ्रमणविधिना ग्रास इष्टो भवेद्वा" श्रीपत्युक्तप्रकारोऽयमाचार्योक्तप्रकारानुरूप एवेति ॥

अत्रोपपत्तिः ।

यदि स्थित्यर्धघटीभिः स्पर्शमध्यसम्बन्धिनोः शरयोर्मध्यमोक्षसम्बन्धिनोर्वा शरयोरन्तरं लभ्यते तदेष्टघटीभिः किमन्तरमिति तस्य यथारीतिदानेन ग्राहककेन्द्रं ततस्तन्मानार्धेन लिखिते वृत्ते इष्टग्रासस्वरूपमिति परिलेख संस्थानानुसारेण स्फुटमिति ॥ ४१-४४ ॥

अब 'इष्टकालादिष्टग्रासं यो जानाति' इस प्रश्न के उत्तर को कहते हैं ।

हि. भा.—स्पार्शिक इष्टकाल में स्पर्श और मध्य बिन्दु के अन्तर मौक्षिक इष्ट में मध्य बिन्दु और मोक्ष बिन्दु के अन्तर को ग्राहक मार्ग में ग्रहण करना चाहिए । उन अन्तरों को इष्ट घटी से गुणा कर अपने अपने स्थित्यर्ध से भाग देने से जो अङ्गुलादि फल होता है । उसको स्पार्शिक इष्ट में स्पर्शचिह्न से आगे मध्य चिह्नोन्मुख ग्राहक मार्ग में देना चाहिए । मौक्षिक इष्ट में मौक्षिक चिह्न से मध्योन्मुख देना चाहिए वहाँ ग्राहक केन्द्र होता है । उस केन्द्रबिन्दु से ग्राहकमान से वृत्त लिखकर रवि और चन्द्र का इष्ट ग्रास तथा संमीलन और उन्मीलन समझना चाहिये । प्रकारान्तर से इष्टकाल से इष्टग्रासानयन करते हैं । स्पार्शिक इष्ट में पूर्वानीत अङ्गुलादि फलदान से मध्य से पूर्व मार्ग उर्वरित (फाजिल) । वह वीष्टस्थिति खण्ड सम्बन्धी भुज है । मौक्षिक इष्ट में मध्य के पश्चात् जो मार्ग उर्वरित है वह वीष्टस्थितिखण्डसम्बन्धी भुज है । दोनों इष्ट के क्रम से स्पार्शिक शर का मध्यम शर के साथ जो अन्तर है तथा मध्यम शर का मौक्षिक शर के साथ जो अन्तर है उसको इष्ट घटी से

गुणाकर अपनी स्थित्यर्ध घटी से भाग देने से जो फल हो उसको मध्यशर से ऊन या अधिक रहने पर स्पार्शिकशर में और मौक्षिक शर में ऋण और धन करना तब तात्कालिक शर कोटि होती है। तब पूर्वोक्त ग्रहणाधिकार विधि से भुज और कोटि से कर्ण लाकर मानैक्यार्ध में कर्ण से इष्टग्रास होता है इति।

उपपत्ति।

यदि स्थित्यर्ध घटी में स्पार्शिक शर और मध्यशर का अन्तर पाते हैं तो इष्ट घटी में क्या इससे जो फल होता है उसको यथारीति दान देने से ग्राहक केन्द्रज्ञान होता है। एवं स्थित्यर्ध घटी में मौक्षिक शर मध्यशर का अन्तर पाते है तो इष्ट घटी में क्या इससे जो फल होता है उसे रीति के अनुसार दान देने से ग्राहक केन्द्र होता है तब उस केन्द्र से ग्राहक मानार्ध से जो वृत्त होगा उसमें इष्ट ग्रास स्वरूप परिलेख संस्थानुसार स्फुट है इति ।।४१-४४।।

इदानीं ग्रासात्कालानयनमाह।

मध्यग्रासकलाहृतमृणं धनं चोक्तवत् स्वविक्षेपः।
तेन ग्रासात्कालः कालादसकृच्च विक्षेपः ।। ४५ ।।

सु. भा.—एवं स्पार्शिकेष्टे स्पर्शमध्यशरान्तरं मौक्षिकेष्टे मध्यमोक्षशरान्तरमिष्टग्रासलिप्ताभिर्गुणं मध्यग्रासकलाहृतं फलं चोक्तवत् 'ऋणधनमूनाधिके मध्ये आद्यन्ते च पृषत्के' इत्यादिविधिना ऋणं धनं कृत्वा तात्कालिकः स्वविक्षेपः साध्यः। तेन विक्षेपेण स्वेष्टग्रासाच्च ग्रहणाधिकारविधिना कालः साध्यः। ग्रासोनमासैक्य दलं कर्णः। विक्षेपः कोटिः। तद्वर्गान्तरपदं ग्राहकमार्गखण्डं भुजो वीष्टस्थितिखण्डभुक्तयन्तरांशघातसमस्ततो विलोमेन कालानयनं कार्यमित्यर्थः। कालादसकृच्च विक्षेपः। लब्धकालाद्ग्रहणाधिकारविधिना तात्कालिकौ चन्द्रपातौ कृत्वा पुनः शरः साध्यस्तस्मात् पुनः काल एवमसकृत् कालः स्फुटो भवति।

अत्रोपपत्तिः। मध्यग्रासेन विक्षेपान्तरं तदेष्टग्रासेन किमित्यनुपातेन समानवेगेन विक्षेपान्तरं प्रसाध्य तत्संस्कारतस्तात्कालिकविक्षेपः स्थूलः साधितस्तद्वशात् कालश्च प्रथमं स्थूल आगतस्ततोऽसकृद्विधिना सूक्ष्मः कालो भवतीति ।। ४५ ।।

वि. भा.—स्पार्शिकेष्टे स्पर्शमध्यशरान्तरं मौक्षिकेष्टे मध्यमोक्षशरान्तरमिष्टग्रासकलाभिर्गुणितं मध्यग्रासकलाभक्तं फलमुक्तवत् 'ऋणधनमूनाधिके मध्ये । आद्यन्ते च पृषत्के' इत्यादि विधिना ऋणं धनं कृत्वा तात्कालिकः स्वशरः साध्यः। तस्माच्छरात् स्वेष्टग्रासाच्च ग्राहणाधिकारविधिना कालः साध्यः। ग्रासोनमानैक्यार्धं कर्णः। शरः कोटिः तद्वर्गान्तरमूलं ग्राहकमार्गखण्डं भुजो वीष्टस्थितिखण्डगत्यन्तरांशघातसमः। ततो विलोमेन कालानयनं कार्यं कालाद-

सकृच्छरः। लब्धकालात् ग्रहणाधिकारविधिना तात्कालिको चन्द्रपातौ प्रसाध्य पुनः शरः साध्यस्तस्मात् पुनः काल एवमसकृत् कालः स्फुटो भवेदिति ।।

अत्रोपपत्तिः ।

यदि मध्यग्रासेन शरान्तरं लभ्यते तदेष्टग्रासेन किमित्यनुपातेन समागतेन शरान्तरं प्रसाध्य तत्संस्कारतस्तात्कालिकः शरः स्थूलः साधितस्तद्वशात् कालश्च प्रथमं स्थूलः समागतस्ततोऽसकृद्विधिना सूक्ष्मः कालो भवतीति । सिद्धान्तशेखरे "वीष्ट ग्रासात् तनुयुतिदलाद्वर्गितात् क्षेपकृत्या हीनान्मूलं यत्समगुणितं भुक्ति-विश्लेषभक्तम् । स्वात् स्थित्यर्धात् फलमपनयेदिष्टकालोऽसकृत्स्यात् स्पर्शादूर्ध्वं भवति हि गतो मुच्यमाने तु शेषः ।।" अर्थात् ग्राह्यग्राहकयोर्बिम्बयोगार्धात् इष्टग्रासेन रहितात् वर्गितात् शरवर्गेण हीनात् मूलं यत् तत् षष्ट्या गुणितं रविचन्द्रयोर्गत्यन्त-रेण भक्तं फलं स्वात् स्थित्यर्धात् (स्पार्शिकस्थित्यर्धात् मौक्षिकस्थित्यर्धाद्वा शोधयेत् तदेष्टग्राससम्बन्धी कालः स्यात् । एवमसकृत् शरवर्गेण हीनान्मूलं षष्ट्या गुणितं रविचन्द्रगत्यन्तरभक्तं फलकालेन रविचन्द्रपातान् प्रचाल्य तात्कालिकशरं संसाध्य पुनः 'वीष्टग्रासात् तनुयुतिदला' दित्यादिना वारं वारं कृते यः कालः स्थिरो भवति तं स्पार्शिकस्थित्यर्धात् शोधयेत् स्पर्शानन्तरं गतः कालः इति तावतीष्टकाले तावानिष्टग्रासो भवति । तमेव कालं मौक्षिकस्थित्यर्धाद्विशोध्य शेषं मोक्षात् प्राक् तावतीष्टकाले तावानिष्टग्रासो भवतीति । सिद्धान्तशिरोमणौ 'ग्रासोनमानैक्य-दलस्य वर्गाद्विक्षेपकृत्या रहितात्पदं यत्' इत्यादिना भास्कराचार्येण श्रीपत्युक्तानु-सारमेव कथितम् । सूर्य सिद्धान्ते 'मध्यग्रहणतश्चोर्ध्वमिष्टनाड़ी विशोधयेत्' दित्या-दिना सूर्यसिद्धान्तकारेणापि तदेव कथ्यत इति ।। ४५ ।।

अब ग्रास से कालानयन को कहते हैं ।

हि. भा.—स्पार्शिक इष्ट में स्पर्श शर और मध्यशर के अन्तर को मौक्षिक इष्ट में मध्यशर और मौक्षिक शर के अन्तर को इष्ट ग्रास कला से गुणाकर मध्यग्रास कला से भाग देने से जो फल हो उसको पूर्ववत् ऋणधन मूनाधिके मध्ये' इत्यादि विधि से ऋण-धन कर तात्कालिक शर साधन करना चाहिये । उस शर से और इष्ट ग्रास से ग्रहणाधिका-रोक्त विधि से काल साधन करना चाहिये । ग्रासोनमानैक्यार्ध कर्ण शर कोटि, इन दोनों के वर्गान्तरमूल ग्राहक मार्गखण्ड वीष्टस्थितिखण्ड और गत्यन्तरांश के घात के बराबर भुज होता है । तब विलोम से कालानयन करना चाहिये । काल से असकृत् शर साधन करना, लब्ध काल से ग्रहणाधिकारोक्त विधि से तात्कालिक चन्द्र और पात साधन कर पुनः शर-साधन करना, उस से काल साधन करना इसतरह असकृत् कर्म करने से स्फुटकाल होता है इति ।।

उपपत्तिः ।

यदि मध्य ग्रास मे शरान्तर पाते हैं तो इष्ट ग्रास मे क्या इस अनुपात से समान वेग से शरान्तर साधन कर उस के संस्कार से तात्कालिक शर स्थूल होता है उस के वश से काल भी पहले स्थूल होता है तब असकृत् विधि से सूक्ष्म काल होता है। सिद्धान्त शेखर में 'वीष्ट-ग्रासात् तनु युति दलार्द्धगितात् क्षेपकृत्या' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने कालानयन किया है। श्रीपत्युक्त श्लोक का अभिप्राय यह है कि ग्राह्य और ग्राहक बिम्ब योगार्ध में इष्टग्रास को घटा कर जो हो उस के वर्ग में शर वर्ग को घटा कर शेष का मूल जो हो उस को साठ से गुणा कर रवि और चन्द्र के गत्यन्तर से भाग देने से जो फल हो उस को स्पार्शिक स्थित्यर्ध में वा मौक्षिक स्थित्यर्ध में घटाने से इष्टग्रास सम्बन्धी काल होता है। इस तरह असकृत् ग्रासोन मानैक्यार्ध वर्ग में शरवर्ग को घटाकर जो शेप रहे उस के मूल को साठ से गुणा कर रवि और चन्द्र के गत्यन्तर से भाग देने से जो फल हो उस फल काल में रवि चन्द्र और पात को चलाकर तात्कालिक शर साधन कर पुनः 'वीष्ट-ग्रासात् तनु युति दलात्' इत्यादि से बार बार करने पर जो काल स्थिर होता है उसको स्पार्शिक स्थित्यर्ध में से घटा देना, तब स्पर्श के अनन्तर गतकाल होता है अर्थात् उतने इष्ट काल मे उतना इष्टग्रास होता है। उसी काल को मौक्षिक स्थित्यर्ध मे से घटा कर शेप मोक्ष से पहले उतने काल में उतने इष्ट ग्रास होता है सिद्धान्त शिरोमणि में 'ग्रासोन मानैक्य दलस्य वर्गात् विक्षेप कृत्या रहितात्पदं यत्' इत्यादि से भास्कराचार्य ने श्रीपत्युक्त के अनुसार ही कहा है। सूर्य सिद्धान्त में 'मध्यग्रहणतश्चोर्ध्वमिष्ट नाड़ी विशोधयेत्' इत्यादि से सूर्य सिद्धान्त कार भी उसी बात को कहते है इति ॥ ४५ ॥

इदानीमध्यायोऽयं यत्नेन गोपनीय इत्याह ।

ग्रहणोत्तरं न देयं शपथैरपि दत्तसुकृतनाशाय ।
गृहणं स्फुटमार्यभटश्रीषेणाद्यैर्यतस्तन्न ॥ ४६ ॥

सु. भा.—शपथैरपि गृहणोत्तरमिदं न देयं यतो दत्तमुकृतनाशाय भवति । दत्तस्य सुकृतनाशाय भवतीत्यर्थः । किमर्थमिदं गोपनीयमित्याह । यत आर्यभट-श्रीषेणाद्यैस्तत् स्फुटं गृहणं न भवतीति ॥ ४६ ॥

वि. भा.—इदं गृहणोत्तरं शपथै रपि न देयं यतो दत्तस्य सुकृतनाशाय भवति । यत आर्यभटश्रीषेणाद्यैस्तत् स्फुटं गृहणं न कृतमत इदं गोपनीय-मिति ॥ ४६ ॥

अब यह अध्याय गोपनीय है इस बात को कहते है।

हि.भा.—शपथ से भी इस ग्रहणोत्तर अध्याय को नही देना चाहिये। क्योंकि देने

वाले के वह सुकृत नाश के लिये होता है। आर्यभट श्रीषेण आदि आचार्यों ने स्फुट ग्रहण नहीं किया है इसलिये यह ग्रहणोत्तर गोपनीय है इति ॥ ४६ ॥

इदानीमध्यायोपसंहारमाह।

परिलेख वलनजीवा विक्षेपाद्येषु षोड़शोऽध्यायः।
ग्रहणोत्तरमर्केन्द्वोः षट्चत्वारिंशदार्याणाम् ॥ ४७ ॥

सु. भा.—स्पष्टार्थम् ॥ ४७ ॥

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते।
हृदि तं विनिधाय नूतनोऽयं रचितः पर्वविधौ सुधाकरेण ॥

इति श्रीकृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्त नूतनतिलके ग्रहणोत्तराधिकारः षोडशः।

वि भा.—परिलेखवलनज्या शराद्येपु-आर्याणां षट्चत्वारिंशद्रविचन्द्रयो ग्रहणोत्तरं नाम षोड़शोध्यायः समाप्त इति

इति श्री ब्राह्मस्फुटसिद्धान्ते ग्रहणोत्तराध्यायः षोड़शः।

अब अध्याय के उपसंहार को कहते हैं।

हि. भा.—परिलेख-वलनज्या शर आदियों में छयालीस आर्याओं से गुप्त, रवि और चन्द्र का ग्रहणोत्तर नाम का सोलहवां अध्याय समाप्त हुआ ॥ ४७ ॥

इति श्री ब्राह्मस्फुटसिद्धान्त में ग्रहणोत्तर नामक सोलहवां अध्याय समाप्त हुआ।

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प्रकाशक—
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२२३६, गुरुद्वारा रोड, करौल बाग़,
नई दिल्ली-५ (भारत)

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भारत सरकार के शिक्षा मन्त्रालय द्वारा प्रदत्त ग्रनुदान से प्रकाशित।

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एम. ए., एम. ग्रो. एल.

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प्रथम संस्करण
१९६६

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मूल्य रु० ६०.००

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मुद्रक :
पद्म श्री प्रकाशन एण्ड प्रिण्टर्स
१२, चमेलियन रोड,
दिल्ली।

समर्पण :

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यूनियन मिनिस्टर फ़ार रेल्वेज़
को
सादर समर्पित

Dedicated to

Shri S. K. Patil

Union Minister for Railways

भूमिका

ब्रह्मगुप्त और ब्राह्मस्फुटसिद्धान्त

श्रीचापवंशतिलके श्रीव्याघ्रमुखे नृपे शकनृपाणाम् ।
पञ्चाशत्संयुक्तै र्वर्षशतैः पञ्चभिरतीतैः ॥
ब्राह्मः स्फुटसिद्धान्तः सज्जनगणितज्ञगोलवित्प्रीत्यै ।
त्रिंशद्वर्षेण कृते जिष्णुसुतब्रह्मगुप्तेन ॥

ब्राह्मस्फुट सिद्धान्त के संज्ञाध्याय में आचार्य की इस उक्ति के अनुसार ५२० शाकवर्ष में आचार्य ब्रह्मगुप्त का जन्म हुआ। तीस वर्ष की आयु में ही उन्होंने ब्राह्मस्फुट सिद्धान्त नामक ज्योतिष के इस महान् सिद्धान्त ग्रन्थ का प्रणयन किया। इनके नाम के अन्त में लगा 'गुप्त' शब्द प्रकट करता है कि इनका जन्म वैश्य कुल के एक संपन्न परिवार में हुआ था। ज्योतिषशास्त्र के यह प्रकाण्ड पण्डित थे—इसी से रींवां नरेश व्याघ्रभटेश्वर ने इन्हें अपना प्रधान ज्योतिषी बनाकर सम्मानित किया।

जन्म काल

इनके जन्म स्थान के सम्बन्ध में कोई मत विभिन्नता नहीं। पाश्चात्य विद्वानों की इस दिशा में खोज की जो उपलब्धि हुई है, उसके अनुसार इनका जन्म गुर्जर देशान्तर्गत भिनमाल नामक गाँव में हुआ। गुर्जर प्रदेश के ज्योतिषियों की मुखकथा से भी इस बात का समर्थन होता है। गुर्जर प्रदेश की उत्तर सीमा में मालव (मारवाड़) देश से दक्षिण दिशा की ओर आबू पर्वत और लूणी नदी के मध्यवर्ती पर्वत से वायुकोण में भिनमाल नाम का गाँव अब भी स्थित है।

जन्म स्थान

ब्रह्मोक्तं ग्रहगणितं महता कालेन यत् खिलीभूतम् ।
अभिधीयते स्फुटं तज्जिष्णुसुतब्रह्मगुप्तेन ॥

रचना—

आचार्य की इस उक्ति से स्पष्ट ज्ञात होता है कि नलिकादि से वेधद्वारा दृग्गणितैक्य (वेधागत और गणितागत ग्रहादिकों की तुल्यता) कारक ग्रहादि साधन के कारण विष्णुधर्मोत्तर पुराण के अन्तर्गत अति प्राचीन सिद्धान्त को ही आगम मानकर उसका संशोधन करके आचार्य ब्रह्मगुप्त ने नवीन ब्राह्मस्फुट सिद्धान्त की रचना की।

इस (ब्राह्मस्फुट सिद्धान्त) की चतुर्वेदाचार्य कृत 'तिलक' नाम की टीका प्रसिद्ध थी—वह इस समय संपूर्ण उपलब्ध नहीं है। 'कोलब्रूक' नामक पाश्चात्य विद्वान् को वह

सम्पूर्ण टीका उपलब्ध थी। इसी कारण उसके आधार पर इस ग्रन्थ के बारहवें (व्यक्त) अध्याय और अठारहवें (अव्यक्तगणित) अध्याय का कोलब्रूक महाशय कृत, आङ्ग्ल भाषा में अनुवाद सन् १८१७ (१७३९ शाकवर्ष) ई० में ही उपलब्ध हो गया था।

इस ग्रन्थ (ब्राह्मस्फुट सिद्धान्त) में १००८ श्लोक (आर्यावृत्त) हैं। पूर्वार्ध और उत्तरार्ध नामक दो भागों में बंटा हुआ है। पूर्वार्ध में (१) मध्यगति

ग्रन्थ का विषय विभाजन

(२) स्फुटगति (३) त्रिप्रश्नाध्याय (४) चन्द्रग्रहणाध्याय (५) सूर्यग्रहणाध्याय, (६) उदयास्तमयाध्याय, (७) चन्द्रशृंगोन्नत्यध्याय, (८) चन्द्राच्छायाध्याय, (९) ग्रहयुत्यध्याय और (११) भग्रहयुत्यध्याय, ये दस अध्याय हैं। उत्तरार्ध में (१) तन्त्र परीक्षाध्याय, (२) गणिताध्याय, (३) मध्यमत्युत्तराध्याय, (४) स्फुटगत्युत्तराध्याय, (५) त्रिप्रश्नोत्तराध्याय, (६) ग्रहणोत्तराध्याय, (७) छेद्यकाध्याय, (८) शृंगोन्नत्युत्तराध्याय, (९) कुट्टाकाराध्याय, (१०) छन्दश्चित्युत्तराध्याय, (११) गोलाध्याय, (१२) यन्त्राध्याय, (१३) मानाध्याय और (१४) संज्ञाध्याय। ये चौदह अध्याय हैं। दोनों पूर्वार्ध और उत्तरार्ध को मिला कर १०+१४ इस ग्रन्थ में कुल चौबीस अध्याय हैं।

इन अध्यायों में तन्त्रपरीक्षाध्याय बहुत विचारणीय है क्योंकि इस अध्याय में आचार्य ने और अनेक आचार्यों के नामों और उनके मतों का उल्लेख किया है।

लाटात् सूर्यशशाङ्कौ मध्याविन्दू च चन्द्रपातौ च।
कुजबुध शीघ्रबृहस्पतिसितशीघ्र शनैश्चरान् मध्यान् ॥

युगपातवर्षभगणान् वासिष्ठाद्विजयनन्दिकृतपादात्।
मन्दोच्चपरिधिपातस्पष्टीकरणाद्यमार्यभटात् ॥

श्रीषेणेन गृहीत्वा रत्नोच्चयरोमकः कृतः कन्था।
एतानेव गृहीत्वा वासिष्ठो विष्णुचन्द्रेण ॥

अनयोर्न कदाचिदपि ग्रहणादिषु भवति दृष्टिगणितैक्यम्।
यद्भवति तद्घुणाक्षरमतोऽस्फुटाभ्यां किमेताभ्याम् ॥

इन श्लोकों के द्वारा श्रीषेणाचार्यकृत 'रोमकसिद्धान्त' है और विष्णुचन्द्रकृत 'वासिष्ठसिद्धान्त।' दोनों के दोष कहते हैं, यह टीकाकार चतुर्वेदाचार्य का कथन है। 'पञ्चसिद्धान्तिका' में श्रीषेण और विष्णुचन्द्र के नामों का उल्लेख नहीं है। इससे मालूम होता है कि वराहमिहिराचार्य के बाद और ब्रह्मगुप्त से पूर्व ४२६ और ५५० शाकवर्ष के मध्य इन दोनों आचार्यों (श्रीषेण और विष्णुचन्द्र) ने ज्योतिषसिद्धान्त के विशाल ग्रन्थों की रचना की। इस बात को स्वयं वेध द्वारा स्थिर करके आचार्य ने 'यद् भवति तद्घुणाक्षरम्' इत्यादि प्रौढोक्ति से पुष्ट किया है।

आर्यभट के मत का खण्डन

आर्यभट के सिद्धान्त सर्वथा दोषपूर्ण हैं, यह कहते हुए आचार्य ने उनकी उक्तियों का नाना प्रकार से खण्डन करने के लिए इस ग्रन्थ की रचना की। आचार्य भूभ्रमणखण्डन में कहते हैं—

> यः प्राणेनैति कलां भूर्यदि तर्हि कुतो व्रजेत् कमध्वानम् ।
> आवर्त्तनमुर्व्याश्चेन्न पतन्ति समुच्छ्रयाः कस्मात् ॥

आर्यभट तो पृथिवी के चलत्व और भगणों के स्थिरत्व को स्वीकार कर अहोरात्रासु में पृथिवी के भ्रमण को अपने अक्ष के ऊपर मानते हैं, परन्तु ब्रह्मगुप्त ने आवर्त्तनमुर्व्याश्चेदित्यादि उक्ति के द्वारा, तथा अन्यत्र अनेक अत्युक्तियों द्वारा भूभ्रमण का जो खंडन किया है वहदुराग्रहपूर्ण और केवल वाग्बल है।

> स्वयमेव नाम यत्कृतमार्यभटेन स्फुटं स्वगणितस्य ।
> सिद्धं तदस्फुटत्वं ग्रहणादीनां विसंवादात् ॥
> जानात्येकमपि यतो नार्यभटो गणितकाल गोलानाम् ।
> न मया प्रोक्तानि ततः पृथक् पृथक् दूषणान्येषाम् ॥
> आर्यभटदूषणानां संख्या वक्तुं न शक्यते यस्मात् ।
> तस्मादयमुद्देशो बुद्धिमताऽन्यानि योज्यानि ॥

जिस रीति से, जिन शब्दों द्वारा ब्रह्मगुप्त ने आर्यभट के मत का खण्डन किया है उसी रीति से उन्हीं शब्दों में वटेश्वराचार्य ने वटेश्वर सिद्धान्त में ब्रह्मगुप्त के मत का खण्डन किया है। इसके विस्तृत विवरण के लिए वटेश्वर सिद्धान्त का अवलोकन अपेक्षित है।

ब्राह्मस्फुट-सिद्धान्त

ग्रहग्रहणादि के वेधकर्ता ब्रह्मगुप्त स्वयं तो प्राचीनाचार्यों की अपेक्षा अनेक विशिष्ट ग्रहादिसाधन विधियों का, तथा गणित के सत्य और असत्य की परीक्षा के लिए वेध विधियों का अपने ग्रन्थ में प्रौढोक्ति के साथ प्रतिपादन करते हैं।

> ज्ञातं कृत्वा मध्यं भूयोऽन्यदिने तदन्तरं भुक्तिः ।
> त्रैराशिकेन भुक्त्या कल्पग्रहमण्डलानयनम् ॥
> यदि भिन्नाः सिद्धान्ता भास्करसंक्रान्तयोऽपि भेदसमाः ।
> स स्पष्टः पूर्वस्यां विषुवत्यर्कोदयो यस्य ॥

इत्यादि वास्तव विचारों में प्रवृत्त विशिष्ट विवेचनायुक्त सिद्धान्त ग्रन्थ को रचना सबसे पहले ब्रह्मगुप्त ही ने की। यह बात इस समय उपलब्ध ज्यौतिष सिद्धान्तों के ग्रन्थों से विदित होती है।

'कृती जयति जिष्णुजो गणकचक्रचूडामणिः ।' इस उक्ति द्वारा भास्कराचार्य ने अपने सिद्धान्त शिरोमणि के गणिताध्याय के आरम्भ में आचार्य ब्रह्मगुप्त को अभिवादन किया। उसके पश्चात् अनेक स्थानों पर ब्रह्मगुप्त के मत का उल्लेख करते हुए भास्कराचार्य ने लिखा—

यथाऽत्र ग्रन्थे ब्रह्मगुप्त स्वीकृतागमोऽङ्गीकृतः ।

इससे यह बात स्पष्ट हो जाती है कि भास्कराचार्य ने अपने ग्रन्थ में ब्रह्मगुप्त का ही अनुकरण किया। ब्रह्मगुप्त को अयन चलन की उपलब्धि नहीं हुई, यह बात 'ब्राह्मस्फुट सिद्धान्त' से समझी जाती है। अत एव ब्रह्मगुप्तकृत अयन चलोपलब्धि का खण्डन देखा जाता है। तन्त्रपरीक्षाध्याय में ब्रह्मगुप्त ने कहा है—

परमाल्पा मिथुनान्ते द्युरात्रिनाड्योऽर्क गतिवशादृतवः ।
नायनयुगमयनवशात् स्थिरमयनद्वितयमपि तस्मात् ॥

वराह मिहिराचार्य अयनचलन के विषय में सन्दिहान थे। इसीलिए उन्होंने 'नूनं कदाचिदासीद्येनोक्तं पूर्वशास्त्रेषु' कहा है। उस समय अश्विन्यादि में क्रान्तिपात था, इसलिए अश्विन्यादि से नक्षत्रों की गणना प्रवृत्त हुई। ब्रह्मगुप्त के पश्चात् आज तक गणना की यही प्रक्रिया प्रचलित है। क्रान्तिपात पश्चिम दिशा में प्रायः ६५ वर्ष में एक अंश चलता है। अतः उसका ज्ञान अल्पसमय में असम्भव प्राय है। इसीलिए तो ब्रह्मगुप्त भी अयनचलन की उपलब्धि नहीं कर सके। आर्यभट का विरोधी होकर भी ब्रह्मगुप्त ने ब्राह्मस्फुट सिद्धान्त की रचना की।

खण्डखाद्यक की रचना

३७ वर्ष की अवस्था में ब्रह्मगुप्त ने 'खण्डखाद्यक' नाम के करण ग्रन्थ का प्रणयन किया। उसके प्रारंभ में ही ब्रह्मगुप्त ने लिखा—

प्रणिपत्य महादेवं जगदुत्पत्ति स्थितिप्रलयहेतुम् ।
वक्ष्यामि खण्डखाद्यकमाचार्यार्यभटतुल्यफलम् ॥
प्रायेणार्यभटेन व्यवहारः प्रतिदिनं यतोऽशक्यः ।
उद्वाहजातकादिषु तत्समफल लघुतरोक्तिरतः ॥

यह उनके ग्रन्थ की पर्यालोचन से समझा जाता है कि सर्वत्र मनुष्यों के व्यवहारों में प्रचलित आर्यभट मत का निराकरण करना अत्यन्त कठिन था। इसलिए आर्यभट मतानुसार व्यवहार करते हुए मनुष्यों के उपकारार्थं व्यावहारिक 'खण्डखाद्यक' नामक करण-ग्रन्थ की रचना ब्रह्मगुप्त ने की। जिस प्रकार उपलब्ध प्राचीन ज्यौतिषसिद्धान्त ग्रन्थों में ब्राह्मस्फुटसिद्धान्त एक आदर्श ग्रन्थ माना जाता है उसी पकार सब करणग्रन्थों में सर्व प्रथम आदर्श आज से तेरह सौ वर्ष पूर्व लिखित यही 'खण्डखाद्यक' है।

भारतीय ज्योतिषियों में आर्यभट ही सब से पहले दिन और रात्रि के कारण-स्वरूप पृथिवी के आवर्तन को कहते हैं जैसे गीतिकापाद के प्रथम श्लोक में एक महायुग (४३२००००) में भूमि के १५८२२३७५०० भगण होते हैं। पहले इसको कह कर दृष्टान्त द्वारा भूभ्रमण को—

अनुलोमगतिर्नौस्थः पश्यत्यचलं विलोमगं यद्वत्।
अचलानि भानि तद्वत् समपश्चिमगानि लङ्कायाम् ॥

उक्ति से दृढ़ करते हैं। परन्तु यहाँ विचित्रता देखने में आती है कि आर्यभटीय टीकाकार परमेश्वर ने इस श्लोक की व्याख्या के समय—भूमेः प्राग्गमनं नक्षत्राणां गत्यभावश्चेच्छन्ति केचित्तन्मिथ्याज्ञानवशादुत्पन्नां प्रत्यग्गमनप्रतीतिमङ्गीकृत्य भूमेः प्राग्गतिरभिधीयते। परमार्थतस्तु स्थिरैव भूमिः—कहा है। अर्थात् कोई-कोई पृथिवी के पूर्वाभिमुख चलन और नक्षत्रों के गत्यभाव (अर्थात् नक्षत्रों की गति नहीं है) कहते हैं वह मिथ्या अज्ञानवश पश्चिमाभिमुख चलन की प्रतीति स्वीकार कर पृथिवी की पूर्वाभिमुख गति को कहते हैं। वस्तुतः पृथिवी स्थिर ही है।

उदयास्तमयनिमित्तं नित्यं प्रवहेण वायुना क्षिप्तः।
लङ्कासमपश्चिमगो भपञ्जरः स ग्रहो भ्रमति ॥

इससे स्वयं आर्यभटाचार्य भी भू भ्रमण को अस्वीकार करते हैं। आर्यभटाचार्य के मन में यह निश्चय नहीं था कि पृथिवी चलती है या नहीं ! ऐसा उनके लेख से प्रतीत होता है। अस्तु ॥

'ब्रह्माह्वय श्रीधरपद्मनाभबीजानि यस्मादति विस्तृतानि' अपने बीजगणित में भास्कराचार्य की इस उक्ति से मालूम होता है, कि ब्रह्मगुप्त का बहुत बड़ा बीजगणित का ग्रन्थ था, परन्तु यह ग्रन्थ आज प्राप्य नहीं है।

श्रीपति द्वारा ब्रह्मगुप्त का अनुकरण

ब्रह्मगुप्त हीं औरों की अपेक्षा श्रीपति का श्रेष्ठतर आदर्श है। ब्राह्मस्फुट सिद्धान्त और सिद्धान्तशेखर की पर्यालोचना से ज्ञात होता है। कि ब्रह्मगुप्त द्वारा रचित सार्थक आर्याओं (इस नाम का श्लोक) का ही श्रीपति ने बड़े-बड़े छन्दों में अनुवाद किया है। वस्तुतः ब्रह्मगुप्तोक्त ग्रहगणित को ही सत्य परन्तु दुरूह समझ कर श्रीपति ने उसे अपनी सुन्दर रचना द्वारा सुगमतर ग्रन्थान्तर (सिद्धान्तशेखर) के रूप में हमारे सन्मुख रखा। इसमें किसी को कोई आपत्ति नहीं है। ग्रन्थ रचना के विषय में लल्लाचार्य ही श्रीपति के विशेष रूप से श्रेष्ठ आदर्श है। जो विषय ब्रह्मगुप्त ने नहीं कहा है वह लल्लाचार्य ने कह दिया है। उन सभी विषयों को उसी प्रकार श्लोका-

न्तरों से श्रीपति ने कह दिया है । सारांश यह है कि श्रीपति ने दोनों (ब्राह्मस्फुट सिद्धान्त और शिष्यधीवृद्धिद) ग्रन्थों का परिशीलन करने के पश्चात् ही सिद्धान्तशेखर की रचना की ।

ब्रह्मगुप्त ने एक बहुत विलक्षण विषय को अपनी रचना में स्थान दिया है । यह है 'नतकर्म' । मन्दफल शीघ्रफल भुजान्तरादि संस्कार करने से जो स्पष्टग्रह आते हैं वे स्वगोलीय (ग्रहगोलीय) स्पष्ट ग्रह होते हैं । उन स्वगोलीय स्पष्ट ग्रहों को हम लोग जहां देखते हैं वे हम लोगों के लिए स्पष्ट ग्रह होते हैं । स्वगोलीय स्पष्टग्रह में जितना संस्कार करने से हम लोगों के स्पष्टग्रह होते हैं उसी संस्कार का नाम 'नतकर्म' है ।

ब्रह्मगुप्त का 'नतकर्म'

ब्रह्मगुप्त से पूर्व किसी भी अन्य प्राचीनचार्य ने कुछ भी नहीं लिखा । नतकर्म साधन की बात तो दूर रही, उसके नाम तक का भी किसी ने उल्लेख नहीं किया । भास्कराचार्य ने सिद्धान्तशिरोमणि (गणिताध्याय) के स्पष्टाधिकार में इस नतकर्म के साधन का प्रकार लिखा है । 'मुहुः स्फुटाऽतो ग्रहणे रवीन्द्वोस्तिथिस्त्विदं जिष्णुसुतो जगाद' भास्कर की इस उक्ति से स्पष्ट ज्ञात होता है—कि इस 'नतकर्म' के आविष्कर्त्ता ब्रह्मगुप्त ही हैं । सिद्धान्त-शिरोमणि (गणिताध्याय) के स्पष्टाधिकार में भास्कराचार्य ने 'भोग्यखण्डस्पष्टीकरण' में जो लिखा है उसका मूल भी ब्रह्मगुप्तकृत ब्राह्मस्फुट सिद्धान्त के ध्यान ग्रहोपदेशाध्याय में ही है । और आचार्यों ने इस विषय में कुछ नहीं लिखा है । सिद्धान्त तत्व विवेक में कमलाकर ने भास्करोक्त भोग्यखण्ड स्पष्टीकरण प्रकार का खण्डन किया है । वस्तुतः यह खण्डन कमलाकर का दुराग्रह ही है । अतः यह खण्डन ठीक नहीं है ।

ब्राह्मस्फुट सिद्धान्त के त्रिप्रश्नाधिकार में दिक्साधन में—

पूर्वापरयोर्विन्दू तुल्यच्छायाग्रयोर्दिगपराद्यः ।
पूर्वान्यः क्रान्तिवशात् तन्मध्याच्छङ्कुतलमितरे ॥

यहाँ क्रान्तिवश से दिक्साधन में कैसे भेद उत्पन्न होता है इसके लिए चतुर्वेदाचार्य ने कर्णवृत्ताग्रान्तर का जो साधन किया है उसी को 'छाया निर्गमन प्रवेश समयार्कक्रान्ति-जीवान्तरं' आदि द्वारा श्रीपति ने कहा है । उसके पश्चात् 'तत्कालापमजीवयोस्तु विवरात्' इत्यादि से सिद्धान्तशिरोमणि में भास्काचार्य ने कहा है । सूर्यसिद्धान्त आदि प्राचीन ग्रन्थों में इस विषय का उल्लेख नहीं है ।

'मन्दफलानयन' के लिए मन्दकर्णानुपात ही आवश्यक साधन है । यद्यपि इस विषय में भास्कराचार्य ने अपना कुछ भी मत व्यक्त नहीं किया है, तथापि चन्द्रग्रहणाधिकार में स्फुट रवि चन्द्रकर्णसाधन में 'मन्दश्रुतिर्द्राक् श्रुतिवत्प्रसाध्या' इत्यादि से ब्रह्मगुप्त ही के मत को स्वीकार किया है । यह भी ब्रह्मगुप्त की उक्ति की ही विलक्षणता है ।

लल्लाचार्य ने वलन और दृक्कर्म के आनयन को उत्क्रमज्या द्वारा किया है। ब्रह्मगुप्त की उक्ति में चतुर्वेदाचार्य की 'अत्रज्याशब्देनोत्क्रमज्या ग्राह्या' व्याख्या को लक्ष्य कर भास्कराचार्य ने 'ब्रह्मगुप्तकृतिरत्र सुन्दरी साऽन्यथा तदनुगैर्विचार्यते' कहा है। ब्राह्मस्फुट सिद्धान्त के बहुत से स्थलों में वर्णन की स्थूलता अवश्य है, तथापि इसमें नाना प्रकार के विषयों का अपूर्व समावेश है। अतएव 'ब्राह्मस्फुटसिद्धान्त' सर्वश्रेष्ठ सिद्धान्त ग्रन्थ है, इस कथन में किसी प्रकार की विप्रतिपत्ति (विरोध) प्रतीत नहीं होती है। इस ग्रन्थ में 'छन्दश्चित्युत्तराध्याय' नाम का एक अध्याय है। इसके अन्तर्गत श्लोकों की उपपत्ति तो दूर की बात है, आज तक किसी विद्वान् ने इनकी व्याख्या तक नहीं की।

प्रश्नाध्याय का जैसा क्रम इस ग्रन्थ में है वैसा अन्य ग्रन्थों में नहीं है। इसमें मध्यगति आदि (मध्यगत्युत्तराध्याय-स्पष्टगत्युत्तराध्याय-त्रिप्रश्नाध्याय-ग्रहणाध्याय तथा शृङ्गोन्नत्युत्तराध्याय) पांच अध्यायों में पृथक्-पृथक् उत्तर सहित प्रश्नों का विवेचन किया गया है। इसके अभ्यास से छात्रवृन्द सिद्धान्त विषय में निपुणता प्राप्त कर सकते हैं।

प्रश्नाध्याय

सिद्धान्त शिरोमणि की भूमिका में 'जीवा साधनं विनैव यद् भुजज्यानयनं कृतवान् श्रीपतिस्तत्त्वपूर्वमेव स्यात् यथा तत्प्रकारो विदां विनोदाय प्रदर्श्यते—

दोः कोटि भागरहिताभिहृताः खनागचन्द्रास्तदीयचरणेन शरार्कदिग्भिः।
ते व्यासखण्डगुणिता विहृताः फलं तु ज्याभिर्विनापि भवतो भुजकोटिजीवे ॥
इति केनापि लिखितमस्ति तन्नैव युक्तियुक्तम् ॥

कहने का भाव यह है कि शिद्धान्त शिरोमणि की भूमिका में जीवासाधन विना ही श्रीपति ने जो भुजज्यानयन किया है वह अपूर्व ही है, उनके प्रकार को पंडितों के बिनोद के लिए दर्शाते हैं 'दोः कोटि भागरहिताः' इत्यादि ही उनका प्रकार है। भूसिका लेखक का यह उक्त लेख ठीक नहीं हैं, क्योंकि ज्याविना भुजज्या और भुजकोटिज्या का आनयन और ज्या द्वारा चापानयन सर्वप्रथम ब्रह्मगुप्त ही ने किया है। ब्राह्मस्फुट सिद्धान्त में कथित प्रकार अधोलिखित है—

सिद्धान्त शिरोमणि तथा सिद्धान्तशेखर में सादृश्य

भुजकोट्यंशोनगुणा भार्धांशास्तच्चतुर्थभागोनैः।
पञ्चद्वीन्दुखचन्द्रैर्विभाजिता व्यासदलगुणिता ॥
तज्ज्ये परमफलज्या सङ्गुणिता तत्फले विना ज्याभिः।
इष्टोच्चनीचवृत्तव्यासार्धं परमफलजीवा ॥

इष्टज्या से चापानयन प्रकार—

इष्टज्या संगुणिताः पञ्चकयमलैकशून्यचन्द्रमसः।
इष्टज्या पादयुतव्यासार्धविभाजिता लब्धम् ॥

नवतिकृतेः प्रोह्य पदं नवतेः संशोध्य शेषं भागकलाः ।
एवं धनुरिष्टाया भवति ज्याया विना ज्याभिः ॥

बहुत पहले से ज्याविना भुजज्या और भुजकोटिज्या का आनयन 'दोः कोटिभागरहिताभिहताः' इत्यादि प्रकार से श्रीपति द्वारा कथित है, यह बात ज्योतिषियों में प्रसिद्ध है। इसी का अवलम्बन करके 'ग्रहलाघव' नामक अपने करणग्रन्थ में विस्तार से लिखा है। परन्तु वस्तुतः यह प्रकार ब्रह्मगुप्त ही का है। उनके उपर्युक्त श्लोकों से यह बात सर्वथा स्पष्ट हो गई है। अब यह सन्देह का विषय नहीं रहा। वटेश्वर सिद्धान्त में वटेश्वराचार्य ने भी ब्रह्मगुप्तोक्त इसी प्रकार को श्लोकान्तरों में लिख दिया है। सिद्धान्तशेखर में सर्वत्र श्रीपति का अपना निजी प्रकार थोड़ा ही है, उन्होंने भी ब्रह्मगुप्तोक्त प्रकार को ही श्लोकान्तरों में वर्णित किया है। उदाहरण के लिए देखिये सिद्धान्तशेखर के सूर्यग्रहणाधिकार में—

तिथ्यन्तात् स्थितिखण्डहीनसहितात् प्राग्वत्ततो लम्बनं ।
कुर्यात् प्रग्रहमोक्षयोः स्थितिदलं युक्तं विधायासकृत् ॥
तन्मध्यग्रहणोत्थलम्बनभुवा विश्लेषणानेहसा ।
मर्दार्धोनयुतात्तिथेरपि तथा संमीलनोन्मीलने ॥
अधिकमृणयोराद्यं मध्यात्तथाऽन्त्यमिहाल्पकं ।
भवति धनयोश्चाद्यं हीनं यदाऽधिकमन्तिमम् ॥
नमनविवरेणैवं कुर्याद्विहीनमतोऽन्यथा ।
स्थितिदलमृणस्वस्थे भेदे तदैक्ययुतं पुनः ॥

यह श्रीपत्युक्त प्रकार ब्रह्मगुप्त के अधोलिखित प्रकार के सर्वथा अनुरूप ही है—

प्राग्वल्लम्बनमसकृत् तिथ्यन्तात् स्थितिदलेन हीनयुतात् ।
अधिकोनं तन्मध्याद्दृणयोरूनाधिकं धनयोः ॥
यद्यधिकं स्थित्यर्धं तदाऽन्तरेणान्यथोनमृणमेकम् ।
अन्यद्धनं तदैक्येनाधिकमेवं विमर्दार्धे ।

इसी प्रकार प्रकारान्तर से कहा गया श्रीपत्युक्त स्फुटस्थिति दल साधन प्रकार—

स्थित्यर्धोनयुतात् परिस्फुटतिथेः स्याल्लम्बनं पूर्ववत् ।
तन्मध्यग्रहवे च मध्यमतिथो ततस्तु तिथौ ॥
स्थित्यर्धेन परिस्फुटेषु जनितेनोनाधिकाद्वाऽसकृत् ।
तत्तिथ्यन्तरनाडिकाः स्थितिदलेस्तः स्पर्शमुक्त्योः स्फुटे ।

इस श्लोक का द्वितीयचरण शुद्ध नहीं है। यह प्रकार ब्रह्मगुप्त के अधोलिखित प्रकार के अनुरूप ही है।

स्फुटतिथ्यन्ताल्लम्बनमसकृत् स्थित्यर्धहीनयुक्ताद्वा।
तत्स्फुटविक्षेपकृतस्थित्यर्धोनयुततिथ्यन्तात् ॥
तत्स्पष्टतिथिच्छेदान्तरे स्फुटे दिनदले विहीनयुतात्।
स्वविमर्दार्धेनासकृदेवं स्पष्टे विमर्दार्धे ॥

सिद्धान्तशिरोमणि में भी भास्कराचार्य ने अधोलिखित शब्दों में—

तिथ्यन्ताद् गणितागतात् स्थितिदलेनोनाधिकाल्लम्बनं
तत्कालोत्थनतीषु संस्कृतिभवस्थित्यर्धहीनाधिके।
दर्शान्ते गणितागते धनमृणं वा तद्विधायासकृज्ज्ञेयौ
प्रग्रहमोक्षसंज्ञसमयावेवं क्रमात् प्रस्फुटौ ॥

ब्रह्मगुप्तोक्त प्रकार का ही वर्णन किया है। इसी प्रकार सिद्धान्तशेखरे के सूर्यग्रहणाध्याय के उपसंहार में —

स्फुटं भवति पञ्चजीवया लम्बनं न हि यतस्ततः कृतम्।
युक्तियुक्तमिति जिष्णुसूनुना तन्मयाऽपि कथितं परिस्फुटम् ॥

कथित आशय ब्रह्मगुप्त की अधोलिखित उक्ति के सदृश ही है—

दृग्गणितैक्यं न भवति यस्मात् पञ्चज्यया रविग्रहणे।
तस्माद्यथा तदैक्यं तथा प्रवक्ष्यामि तिथ्यन्ते ॥

मध्यगत्यध्याय से ग्रन्थसमाप्ति पर्यन्त सादृश्य की यही स्थिति है। यह बात दोनों ग्रन्थों (ब्रह्मस्फुट सिद्धान्त और सिद्धान्तशेखर) के अवलोकन से स्पष्ट हो जाती है।

केवल श्रीपति ने ही अपने पूर्ववर्ती आचार्यों के ग्रन्थों से उनके कथित विषयों को श्लोकान्तरों द्वारा अपने ग्रन्थ में अपनी उक्ति के रूप में लिखा है, सो नहीं है अपितु उनके पूर्ववर्ती आचार्यों की भी यही रीति रही है। श्रीपति के परवर्ती भास्कराचार्य आदि विद्वानों ने भी उसी रीति को अपनाया है। उदाहरणार्थ भास्कराचार्य द्वारा-गणिताध्याय के मध्यमाधिकार में सिद्धान्त लक्षण—वेद के अंग ज्योतिःशास्त्र का निरूपण—वेदांगों में ज्योतिःशास्त्र की प्रधानता—वेद वेदांग पढ़ने का द्विजों (ब्राह्मण-क्षत्रिय-वैश्य) का ही अधिकार–शूद्रादिकों का नहीं–भचक्रचलन–कालप्रवृत्ति–कालमानों की परिभाषाएं–ग्रहों का भगणपाठ–युगों तथा मन्वादि के नाम–तथा ब्रह्मा के गत वर्षादि के प्रयोजनाभाव इत्यादि मध्यमाधिकारोक्त सब विषयों का निरूपण श्रीपति कृत साधनाध्यायोक्त श्लोकों का श्लोकांतर मात्र है। ज्यौतिष शास्त्र के पाठकों को दोनों ग्रन्थों का अवलोकन करना

चाहिए जिससे उनके सादृश्य की जानकारी हो सके। प्राचीनोक्त विषयों का आश्रय लेकर अनेक विशिष्ट विषयों को कहने के लिए श्रीपति ने प्रथम साधनाध्याय, तथा ग्रहभगणाध्याय की रचना की। उसके पश्चात् मध्यमाध्याय में-सात प्रकार से अहर्गणानयन-वार प्रवृत्ति के विषय में विभिन्न आचार्यों के मत का प्रतिपादन-तद्गत दोष निरूपण करके अपने मतानुसार वार प्रवृत्ति का प्रतिपादन-मध्यम ग्रह साधन के लिए नाना प्रकार का नूतन प्रकारान्तर वर्णन-तथा रवि आदि सब ग्रहों के राश्यादिमन्दोच्च का प्रतिपादन-आदि नाना प्रकार के विषयों का दिग्दर्शन श्रीपति के सिद्धान्तशेखर में मिलता है। ब्राह्म-स्फुट सिद्धान्त में अहर्गणानयन बहुत प्रकार से किया गया है, उन प्रकारों का अनुकरण श्रीपति ने किया है। आचार्य ने लघ्वहर्गणानयन भी किया है परन्तु श्रीपति ने उसकी चर्चा नहीं की। अहर्गण से अभीष्ट वार ज्ञान के लिए अहर्गण में एक जोड़ना चाहिए—यह बात ब्रह्मगुप्त ने लिखी हैं। उसके पश्चात् सिद्धान्तशेखर में भी श्रीपति ने उनका अनुकरण किया है।

सिद्धान्तशिरोमणि में भास्कराचार्य ने अहर्गण से अभीष्टवार ज्ञानार्थ अहर्गण में सैक निरेक करना लिखा है यथा—

अभीष्टवारार्थमहर्गणश्चेत्सैको निरेकस्थितयोऽपि तद्वत्।

ब्रह्मगुप्त ने अहर्गण में निरेक करण की चर्चा क्यों नहीं की, नहीं कहा जा सकता। वटेश्वर सिद्धान्त में भी नाना प्रकार से अहर्गणानयन और लघ्वहर्गणानयन किया गया है। ब्रह्मगुप्त द्वारा अनेक प्रकार से किये गये अहर्गणानयन को देख कर वटेश्वराचार्य ने भी उन्हीं के मार्ग का अवलम्बन किया है। अर्वाचीन आचार्यों (भास्कराचार्य-कमलाकर आदि) के ग्रन्थों में अनेक प्रकार से साधित अहर्गणानयन देखने में नहीं आता है। यद्यपि लघ्वहर्गणानयन में स्थूलता है, तथापि एक अपूर्व वस्तु का प्रतिपादन किया गया है। वटेश्वराचार्यकृत लघ्वहर्गणानयन भी स्थूलरूप में कहा गया है। इन आचार्यों के अतिरिक्त और किसी आचार्य के ग्रन्थ में लघ्वहर्गणानयन के सम्बन्ध में कुछ भी नहीं लिखा गया है। सिद्धान्त तत्त्व विवेक में कमलाकर ने भास्करोक्त लघ्वहर्गणानयन में वार गणना का खण्डन किया है।

स्फुटगत्यध्याय में आर्यभट-ब्रह्मगुप्त-लल्ल आदि आचार्यों ने वृत्त परिधि के चतुर्थांश (नवत्यंश) में दो सौ पच्चीस कलावृद्धि से चौबीस क्रमज्या और उत्क्रमज्या का साधन

स्फुटगत्यध्याय

किया है। आर्यभट और लल्ल की त्रिज्या=३४३८, ब्रह्मगुप्त मत में त्रिज्या ३२७०, इन सबों से भिन्न श्रीपति की त्रिज्या=३४१५, ब्रह्मगुप्तोक्त भूपरिधि=५०००। 'पादोन गोऽक्षधृतिभूमितयोजनानि' इन भास्करोक्ति से ग्रहों की योजनात्मक गति=११८५८।४५, 'गतियोजनतिथ्यंशः कुदलस्य

यतो मितिः' से भूव्यास=१५८१, भू परिधि=४९६७। यही बात 'प्रोक्तो योजनसंख्यया कुपरिधिः सप्ताङ्गनन्दाब्धयस्तद्व्यासः कुभुजङ्गसायकभुवः' से भास्कराचार्य ने कही है। भास्कराचार्य ने बहुत से स्थलों में ब्रह्मगुप्त के मत का ही अनुसरण किया है। परन्तु ब्रह्मगुप्तोक्त त्रिज्या से भिन्न त्रिज्या स्वीकार करने में उनका क्या अभिप्राय है सो नहीं कह सकते हैं। ब्रह्मगुप्तोक्त भुजान्तर कर्म के अनुसार ही सिद्धान्तशेखर और सिद्धान्त शिरोमणि में भी कहा गया है। इसके अतिरिक्त ब्राह्मस्फुट सिद्धान्त के स्फुटगत्यध्याय में और भी अनेक विषय वर्णित हैं जो दर्शनीय और पढ़ने के योग्य हैं।

त्रिप्रश्नाधिकार

त्रिप्रश्नाधिकार में रवि के मध्याह्न कालिक नतांश जान कर, उसके आधार पर रवि के आनयन के लिए पहले क्रान्तिज्या का ज्ञान होता है। तब अनुपात से रवि के भुजांश का ज्ञान होता हैं। भुजांश से राश्यादि रवि का ज्ञान पदाधीन है। किसी भी प्राचीनाचार्य ने पदज्ञान के लिए विधि नहीं लिखी है। यहाँ आचार्य ने—

क्रान्तिर्व्यासार्धगुणा जिनभागज्याहृता धनुरजादौ,
कर्क्यादौ चक्रार्धात्प्रोह्य तुलादौ स चक्रार्धम्॥
चक्रार्धात् प्रोह्य मृगादौ स्फुटो सकृत् व्यस्तमृणं धनं मध्यम्।

अर्कोऽस्मात्' इत्यादि से रवि का आनयन किया है। लेकिन यह साधित रवि किस पद का है इसके ज्ञान के लिए कोई युक्ति नहीं लिखी है। सिद्धान्तशेखर में श्रीपति ने—'अजतुलादिगतस्य विवस्वतो दिनदल प्रभयोर्युतिरर्धिता। भवति वैषुती निजदेशजेति से पलभा के मान का पता लगाकर—

आद्ये पदेऽपचयिनी पलभाऽल्पिका स्यात्,
छायाल्पिका भवति वृद्धिमती द्वितीये।
छायादिका भवति वृद्धिमती तृतीये,
तुर्ये पुनः क्षयवती तदनल्पिका च।
वृद्धिं प्रयान्ती यदि दक्षिणाग्रच्छाया तथापि प्रथमं पदं स्यात्।
ह्रासं व्रजन्तीमथ तां विलोक्य रवेर्विजानीहि पदं द्वितीयम्॥

से गोल युक्ति सिद्ध पद का ज्ञान किया है यहाँ भास्कराचार्य ने—

क्रान्तिज्या त्रिज्याघ्नी जिनभागज्योद्धृता दोर्ज्या।
तद्धनुराद्ये चरणे वर्षस्यार्कः प्रजायतेऽन्येषु॥

भार्धाच्च्युतः सभार्धो भगणात्पतितोऽब्द चरणानाम्।
ऋतुचिह्नैर्ज्ञानं स्यात्तु चिह्नान्यग्रतो वक्ष्ये॥

से आचार्योक्तवत् ही कहा है। केवल 'ऋतुवर्णनम्' नामक एक अधिकार सिद्धान्त शिरोमणि के गोलाध्याय में लिखा है। भास्कराचार्य के पश्चवर्ती और कमलाकर के पूर्ववर्ती सब आचार्यों ने ऋतुवर्णन को ज्यौतिष सिद्धान्त का एक अङ्ग समझकर अपने अपने सिद्धान्तग्रन्थ में निश्चित रूप से 'ऋतुवर्णनाध्याय' नाम देकर लिखा हैं। सिद्धान्त तत्त्व विवेक में—'आद्ये पदेऽपचयिनी पलभाल्पिका स्यात्' इत्यादि श्रीपत्युक्त पदज्ञानबोधक श्लोक द्वय को लिख कर कमलाकर ने—

ऋतुचिह्नै रिदं पूर्वैरुक्तं सर्वत्र तन्नहि।
केवलं कुकविप्रीत्यै पदज्ञप्त्यै न तद्रवेः॥

से भास्करोक्त ऋतुवर्णन की निन्दा की है। वस्तुतः कमलाकर का कथन ठीक है। भिन्न भिन्न देशों में ऋतु भिन्न भिन्न होती है; इसलिए ऋतुचिह्न से पदज्ञान ठीक नहीं हो सकता है। परन्तु—आद्ये पदेऽपचयिनी पलभाल्पिका स्यात्' इत्यादि पदज्ञानबोधक पद्य ठीक सिद्धान्तशेखर में हैं। इसको कमला कर ने अपने नाम से लिखा है। जब तक सिद्धान्तशेखर उपलब्ध नहीं था, तब तक लोग यही समझते थे कि यह पदज्ञान प्रकार कमलाकरोक्त ही है। परन्तु अब वह बात नहीं रही। वस्तुतः यह प्रकार श्रीपत्युक्त ही है। कमलाकर को अपनी रचना में यह मानना चाहिए था कि यह प्रकार श्रीपति कथित है। वास्तविक बात यह है कि प्राचीन आचार्यों ने पदज्ञान के लिए कोई प्रकार नहीं लिखा है। इस स्थिति में श्रीपति ही इस प्रकार को लिखने के कारण ज्योतिषियों के प्रशंसापात्र हैं, यह बात अवश्य ही निःसन्दिग्ध है। आश्चर्य की बात तो यह है कि श्रीपतिकृत गोलयुक्तियुक्त पद ज्ञान को छोड़कर भास्कराचार्य ने जो काव्यमय ऋतुवर्णन किया है वह बिल्कुल असंगत है।

चन्द्रग्रहणाध्याय

आचार्य ब्रह्मगुप्त ने चन्द्र ग्रहणाध्याय में रवि, चन्द्र औरपृथिवी का योजनबिम्ब, रवि और चन्द्र के योजनात्मक कर्ण का स्पष्टीकरण, भूभा बिम्बानयन, ग्रासमानाद्यानयन तथा परिलेख प्रकार लिखा है। श्रीपति और भास्कराचार्य ने भी कथनक्रम को लेकर विशेष रूप से वैसा ही अनुवाद किया है। ब्रह्मगुप्तकृत सम्पूर्ण सूर्यग्रहणाध्याय को श्रीपति ने प्रायः अपने श्लोकान्तरों द्वारा किया है, उदयास्तमयाध्याय में आचार्य ने आयन दृक्कर्मानयन किया है, परन्तु वह ठीक नहीं है। श्रीपति ने आयन दृक्कर्मानयन करके—

खनभोधृतिभिः समाहतं प्रथमं दृक्फलमायनाह्वयम्।
द्युचराश्रितभोदयासुभिर्विहृतं स्पष्टमिह प्रजायते॥

से उनका स्पष्टीकरण किया हैं। इसको देख कर भास्कराचार्य ने "आयनं वलनमस्फुटेषुणा संगुणम्" इत्यादि से उसके अनुसार ही कहा है। चन्द्राध्याय में आचार्य ने अनेक विषयों का प्रतिपादन किया है। परन्तु श्रीपति ने केवल वराह ब्रह्मगुप्त तथा लल्लाचार्य के बहुत से श्लोकों का अनुवादमात्र ही किया है। अपनी ओर से कोई विशेष बात नहीं लिखी। केवल चन्द्र के स्पष्ट चरानयन में तथा परिलेख सूत्र प्रमाणानयन में बहुत ही प्रकारान्तर से प्रतिपादन किया है॥

ग्रहयुत्यध्याय

आचार्य वराह ब्रह्मगुप्त और लल्लाचार्य ने ग्रहयुत्यध्याय (ग्रहयुद्धाध्याय या ग्रहयोगाध्याय) में उदयान्तर कार्य के विषय में कुछ भी नहीं कहा है। परन्तु—

अन्त्यभ्रमेण गुणिता रविबाहुजीवाऽभीष्टभ्रमेण विहृता फलकार्मुकेण।
बाहोः कलासु रहिता रहितास्ववशेषकं ते यातासवो युगयुजोः पदयोर्धनर्णम् ॥

के द्वारा श्रीपत्युक्त दृग्गणितैक्यकारक कर्म ही को भास्कराचार्य ने 'उदयान्तर कर्म' नाम से कहा है। जब तक सिद्धान्तशेखर उपलब्ध नहीं था तब तक आधुनिक गणकों को यही विश्वास था कि यह उदयान्तरकर्म सर्वप्रथम भास्कराचार्य ने ही लिखा है। परन्तु इस उदयान्तर को दृष्टि में रख कर सर्व प्रथम श्रीपति ने ही अपने विचार व्यक्त किये थे। तथा—

त्रिभविरहितचन्द्रोच्चेन भास्वद् भुजज्या
गगननृपविनिघ्नी भत्रयज्याविभक्ता।
भवति चर फलाख्यं तत् पृथक्स्थं शरघ्नं
हृतमुडुपतिकर्णत्रिज्ययोरन्तरेण ॥१॥
परमफलमवाप्तं तद्धनर्णं पृथक्स्थे
तुहिनकिरणकर्णे त्रिज्यकोनाधिकेऽथ।
स्फुटदिनकर हीनादिन्दुतो या भुजज्या
स्फुट परमफलघ्नी भाजिता त्रिज्ययाऽऽप्तम् ॥२॥
शशिनि चरफलाख्यं सूर्यहीनेन्दुगोलात्
तदृणमुत धनं चेन्दूच्चहीनार्क गोलम्।
यदि भवति हि साम्यं व्यस्तमेतद्विधेयं
स्फुटगणितदृगैक्यं कर्त्तुमिच्छद्भिरत्र ॥३॥

इन तीनों श्लोकों के द्वारा श्रीपति ने दृग्गणितैक्य के लिए चन्द्र में संस्कार विशेष को कहा है। किसी भी प्राचीन ग्रन्थ में यह संस्कार नहीं लिखा है। यद्यपि—

इन्दूच्चोनार्ककोटिघ्ना गत्यंशा विभबा विधोः।
गुणो व्यर्केन्दुदोः कोटचोरूप पञ्चाप्तयोः क्रमात् ॥
फले शशाङ्कतद्गत्योर्लिप्ताद्ये स्वर्णयोर्वधे।
ऋणं चन्द्रे धनं भुक्तौ स्वर्णसाम्यवधेऽन्यथा ॥

के द्वारा इसी प्रकार (श्रीपत्युक्त चन्द्रसंस्कार की भांति) के चन्द्रसंस्कार का उल्लेख 'लघुमानस' नामक करण ग्रन्थ में मुञ्जालाचार्य ने किया है। परन्तु इन दोनों में सादृश्या-भाव के कारण, श्रीपति ने वेधद्वारा देख कर उस (लघुमानसोक्त) से भिन्न कहा है,

ऐसा ज्ञात होता है। भास्कराचार्य ने इस श्रीपत्युक्त संस्कार को बार-बार देख कर विचार करने से उपलब्ध ज्ञान के विस्तार पूर्वक प्रतिपादन के लिए सिद्धान्त शिरोमणि ग्रन्थ की रचना की। इस रचना के एक वर्ष पश्चात् ५६ श्लोकों का 'बीजोपनय' नामक ग्रन्थ सिद्धान्त शिरोमणि की भांति 'वासना भाष्य' सहित बनाया। जैसा कि निम्नोक्ति में सिद्ध है—

मयाथ बीजोपनये यदन्ते सूर्योक्तमाद्यं परमं रहस्यम्।
प्रकाशये गोप्यमपीह देवं प्रणम्य बीजं जगतां हितार्थम् ॥१॥

यद्यपि पूर्वमपीदं संक्षेपादुक्तमागमोक्तदिशा।
नैतावतैव कश्चित् दृक्करणैक्याय कल्पते गणकः ॥२॥

दृक्करणैक्यविहीनाः खेटाः स्थूला न कर्मणामर्हाः।
अत इह तदर्हतायै तात्कालिकबीजविस्तरं वक्ष्ये ॥३॥

पाता रवेस्तामसकीलकाख्यास्तेषां समाकर्षणतः शशाङ्कः।
तत्तुङ्गशक्तिश्च निजस्वभावं विहाय नित्यं विषमत्वमेति ॥४॥

चद्राच्च तद्योगवियोगतश्च साध्यं हि भाद्यं विषमं यतः स्यात्।
तस्माद्विधोरत्र विशुद्धिशुद्ध्यै विस्तार्यते बीजफलक्रियेयम् ॥५॥

एकेन पुंसा निखिलग्रहाणामन्तं प्रबोधो न हि शक्यतेऽतः।
व्यासात्समासाच्च यथोपलब्धं प्रोक्तं मयेत्यादरणीय मेतत् ॥६॥

भग्रहयोगाध्याय] भग्रहयोगाध्याय में—

कृत्वापि दृष्टिकर्म श्रीषेणार्यभटविष्णुचन्द्रोक्तम्।
प्रतिदिनमुदयेऽस्ते वा न भवति दृग्गणितयोरैक्यम् ॥१॥

भमुनिमृगव्याधानां यतस्ततो दृष्टिकर्म वक्ष्यामि।
दृग्गणितसमं देयं शिष्याय चिरोषितायेदम् ॥२॥

ब्राह्मस्फुट सिद्धान्त के उत्तरार्ध में—परिकर्म विंशति (सङ्कलित, व्यवकलित, गुणन, भागहार, वर्ग, वर्गमूल, पञ्चजाति, त्रैराशिक, व्यस्तत्रैराशिक, सप्तराशिक, नवराशिक, एकादशराशिक, भाण्डप्रतिभाण्ड (अदला बदली)—आदि विषयों का उल्लेख है। प्रत्येक स्थान में चतुर्वेदचार्योक्त उदाहरण हैं। सिद्धान्त शेखर में भी परिकर्म विंशति (अभिन्नाङ्कों के छः गुणन, भजन, वर्ग, वर्गमूल, घन, तथा घनमूल; भिन्नाङ्कों के योग, अन्तर, गुणन, भजन, वर्ग, वर्गमूल छः; भाग, प्रभाग, भागानुबंध, भागापवाह जातिचतुष्टय; विलोमकर्म, त्रैराशिक, व्यस्तत्रैराशिक और

ब्राह्मस्फुटसिद्धांत का उत्तरार्ध

पञ्चराशिक)। ब्रह्मगुप्त और श्रीपति के बीस कर्मों के विषय वर्णन में बहुत भेद है। उन बीस परिकर्मों के नामों में भी बहुधा भिन्नता है। भास्कर द्वारा प्रकीर्ण विषय (योगान्तर से लेकर भाण्ड प्रतिभाण्ड पर्यन्त) जिस स्पष्टता के साथ प्रतिपादित हैं। वैसी स्पष्टता ब्रह्मगुप्त और श्रीपति द्वारा प्रतिपादित परिकर्म विंशति में नहीं पाई जाती। जहां तक विषयों का सम्बन्ध है वहां तक तीनों आचार्य—ब्रह्मगुप्त, श्रीपति तथा भास्कर समान हैं। केवल विषयों के प्रतिपादन की रीति में भिन्नता है।

इसके अतिरिक्त मिश्रक व्यवहार, श्रेढी व्यवहार, क्षेत्र व्यवहार, खात व्यवहार, चितिव्यवहार, क्राकचिक व्यवहार राशिव्यवहार, और छाया व्यवहार ये आठ व्यवहार ब्राह्मस्फुट सिद्धान्त, सिद्धान्त शेखर तथा भास्करीय लीलावती में वर्णित हैं। इन आठों व्यवहारों के प्रतिपादन में असादृश्य पाया जाता है। इन व्यवहारों में से ब्रह्मगुप्त और श्रीपति की अपेक्षा भास्कर ने अधिक विषयों का प्रतिपादन किया है, और अपेक्षा कृत अधिक स्पष्टता के साथ। यह बात उक्त तीनों को देखने से स्फुट हो जाती है।

इसके पश्चात् प्रश्नाध्याय में मध्यमगत्युत्तराध्याय, स्पष्टगत्युत्तराध्याय, त्रिप्रश्नोत्तराध्याय, ग्रहणोत्तराध्याय, शृंगोन्नत्युत्तराध्याय-इन पांचों उत्तराध्यायों में सोत्तर प्रश्न समूह का समावेश है। प्रश्न सभी विलक्षण हैं। इनके अभ्यास से पाठक लोग ज्यौतिष के सिद्धान्त ग्रन्थों में अतिशय निपुण हो सकते हैं। ब्राह्मस्फुट सिद्धान्त के प्रत्येक अध्याय में प्रदर्शित इस प्रकार के सोत्तर प्रश्नक्रम का लेख कुछ-कुछ सिद्धान्त शेखर और बटेश्वर सिद्धान्त में भी दृष्टिगोचर होता है। सिद्धान्त शिरोमणि आदि ग्रन्थों में यह क्रम नहीं है। ब्रह्मगुप्तोक्त कुट्टाकाराध्याय में बहुत से ऐसे प्रश्न हैं जिनके उत्तरों से चित्त प्रसन्न हो जाता हैं। श्रीपति और भास्कर की अपेक्षा ब्रह्मगुप्त ने कुट्टाध्याय में अधिक विषयों का समावेश किया है। किन्तु विषय के प्रतिपादन की स्फुटता भास्करोक्ति में ही है। धन ऋण आदि के सङ्कलित व्यवकलितादि विषय भास्करोक्ति के सदृश ही ब्राह्मस्फुट सिद्धान्त और सिद्धान्त शेखर में भी विद्यमान हैं। उसके पश्चात् एक समीकरण बीज है। यह भास्करोक्त एक वर्ण समीकरण बीज की अपेक्षा छोटा है। तत्पश्चात् ब्रह्मगुप्तोक्त अनेक वर्ण समीकरण बीज है। यह बहुत ही विलक्षण है। इसमें विषय भी बहुत अधिक है। भास्करोक्त अनेकवर्ण समीकरण बीज में भी बहुत विषय हैं। परन्तु सिद्धान्तशेखर में बहुत कम विषयों का उल्लेख है। ब्रह्मगुप्त की अपेक्षा भास्कर ने भावितबीज का अपने ग्रन्थ में अधिक समावेश किया है परन्तु श्रीपति ने कुछ कम। तो भी इन सबके विषयों में कोई विशेष अन्तर नहीं है, केवल भास्करोक्ति में अधिक वैशद्य है।

इसके पश्चात् वर्ग प्रकृति का वर्णन है, यहाँ ब्रह्मगुप्त ने कनिष्ठ, ज्येष्ठ और क्षेप की योग भावना और अन्तरभावना का प्रतिपादन किया है। सिद्धान्तशेखर में श्रीपति ने तथा भास्कराचार्य ने अपने बीजगणित में यहीं से लेकर केवल श्लोकान्तरों में रख दिया

है। गणित क्रिया एक ही हैं। श्रीपति ने भावना का स्वरूप नहीं कहा है। वर्गात्मक प्रकृति में कनिष्ट और ज्येष्ठ के आनयन को ब्रह्मगुप्त ही से लेकर भास्कराचार्य ने अपने बीज-गणित में 'इष्टभक्तो द्विधाक्षेप इष्टोनाढचो दलीकृतः' आदि श्लोकों द्वारा कहा है। परन्तु श्रीपति ने इसके विषय में कुछ भी नहीं लिखा है। ब्रह्मगुप्तोक्त 'शङ्कुच्छायादि ज्ञानाध्याय' अपूर्व है। इस अध्याय में जो विषय प्रतिपादित है वह सिद्धान्त शेखर और भास्करीय सिद्धान्तशिरोमणि में नहीं है। वस्तुतः यह अध्याय दर्शनीय और पठनीय है। छन्दश्चित्युत्तराध्याय ऐसा विचित्र है; कि इसमें लिखित श्लोकों की उपपत्ति की बात तो अलग रही उनकी तो साधारण व्याख्या भी अभी तक किसी ने नहीं की। गोलाध्याय में भूगोल संस्थान, देवासुरसंथान, चक्रभ्रमणव्यवस्था, देवादिकों की रविभ्रमण स्थिति, देवों और दैत्यों का राशि संस्थान, देवादिकों का रवि दर्शन काल, भूगोल में लङ्का और अवन्ती का स्थान, आदि आदि विषय वर्णित हैं।

भूपरिधि तुर्यभागे लङ्का भूमस्तकात् क्षितितलाच्च।
लङ्कोत्तरतोऽवन्ती भूपरिधेः पञ्चदश भागे॥

के द्वारा लङ्का से भूपरिधि के पञ्चदशांश पर अवन्ती की स्थिति को आचार्य ने बतलाया हैं। परन्तु आचार्य के अनुयायी भास्कराचार्य ने सिद्धान्त शिरोमणि के गोलाध्याय में 'निरक्षदेशात् क्षितिषोडशांशे भवेदवंती गणितेन यस्मात्' कहा है। चतुर्वेदाचार्य सम्मत पाठ 'पञ्चदशभागे' ही है। सिद्धान्त शेखर में 'सत्र्यंशरामाग्निगुणैरवन्त्याः स्याद्योजनैर्दक्षिणतो हि लङ्का' कहा गया है। श्रीपति के मत से उज्जयिनी (अवन्ती) का अक्षांश = २४° तथा भूपरिधिमान = ५००० है, अतः $\frac{\text{भूपरिधि}}{१५}$ = ३३३$\frac{१}{३}$ एतत्तुल्य लङ्का और अवन्ती के मध्य में योजनात्मक दूरी हुई। यहां 'भूपरिधेरष्टयंशेऽवन्ती स्यात् सौम्यदिग्भागे' लल्ल की इस उक्ति से तथा भास्कर की पूर्वोक्ति से उज्जयिनी का अक्षांश = २२°।३०' है, वराहमिहिराचार्य के मत से अक्षांश परमक्रान्त्यंश के बराबर = २४ है। पञ्चसिद्धान्तिका में—

प्रोद्यद्रविरमराणां भ्रमत्यजादौ कुवृत्तगः सव्यम्।
उपरिष्टाल्लङ्कायां प्रतिलोमश्चामरारीणाम्॥
मिथुनान्ते च कुवृत्तादंश चतुर्विंशतिं विहायोच्चैः।
भ्रमति हि रविरमराणां समोपरिष्टात्तदाऽवन्त्याम्॥

श्रीपति के मत से अवन्ती का अक्षांश = २४, इसके आधार पर योजमान = ३३३$\frac{१}{३}$ योजना होता है। आचार्योक्त के अनुसार ही श्रीपति के मत से भी लङ्का, उज्जयिनी के दक्षिण में परिधि के पञ्चदशांश पर स्थित है। लल्लाचार्य और भास्कराचार्य के मत से लङ्का, अवन्ती के दक्षिण में भूपरिधि के षोडशांश पर स्थित सिद्ध होती है। इस

अध्याय के बहुत से विषय सूर्यसिद्धान्त के गोलाध्याय में वर्णित विषयों के सदृश ही हैं। बीच बीच में दोनों ब्राह्मस्फुटीय गोल अध्याय तथा सूर्य सिद्धान्तीय भूगोलाध्याय में कुछ विषायान्तर भी है। सिद्धान्त शेखर के गोलाध्याम में श्रीपति ने भी कितने ही विषय आचार्योक्त विषयों के सदृश ही कहे हैं। 'यन्मूलं तद्व्यासो मण्डललिप्ताकृतेर्दशहृतायाः, द्वारा श्रीपति ने भी 'व्यासः स्यात् परिधेर्वर्गाद् दिग्भक्ताच्च पदंत्विह' प्रकार के अनुकूल ३४१५ त्रिज्या स्वीकार की है। भास्कराचार्य ने 'व्यासे भनन्दाग्निहते विभक्ते खवाण-सूर्यैः" के द्वारा परिध्यानयन का विस्तार से प्रतिपादन किया है। इसके विलोम द्वारा परिधि से व्यासानयन होता है। परन्तु व्यास से परिध्यानयन या परिधि से व्यासानयन किसी का भी ठीक नहीं है। क्योंकि व्यास और परिधि का सम्बन्ध स्थिर नहीं है। ज्या प्रकरण में जैसे चापार्धांशज्या आदि का आनयन आचार्य ने किया है वैसे ही सिद्धान्त शेखर में और सिद्धान्त शिरोमणि के गोलाध्याय में किया गया है। ब्राह्मस्फुट सिद्धान्त में चापार्धांशज्यानयनप्रकार—

तुल्यक्रमोत्क्रमज्यासमखण्डक वर्ग युति चतुर्भागम्।
प्रोह्यानष्टं व्यासार्धवर्गतस्तत्पदे प्रथमम्॥

तद्दलखण्डानि तदूनजिनसमानि द्वितीयमुत्पत्तौ।
कृतयमलैक दिगीशेषु सप्तरसगुणनवादीनाम्॥

सिद्धान्तशेखर में—

उत्क्रमक्रमसमानसमज्या खण्डवर्गयुतिवेदविभागम्।
व्यासखण्डकृतितस्तमनष्टं शोधयेदथ पदे भवतो ये॥

आद्यमूलमिह तद्दलसंख्यं तद्विहीन जिनसम्मितमन्यत्।
ज्यार्धमेवमपराणि समेभ्यो ज्यादलानि न भवन्त्यसमेभ्यः॥

सिद्धान्तशिरोमणि में—

क्रमोत्क्रमज्या कृतियोगमूलाद्दलं तदर्धांशकशिञ्जिनी स्यात्।

इस प्रकार प्रकारान्तर से भी चापार्धज्यानयन प्रकार तीनों ग्रन्थों (ब्राह्मस्फुटसिद्धान्त-सिद्धान्तशेखर-सिद्धान्तशिरोमणि) में समान ही है। भास्करीय अन्त्यज्योत्पत्ति में अनेक विषयों का विशिष्ट प्रतिपादन देखने में आता है।

स्फुटगतिवासना

मन्द फल साधन में भी कर्णानुपात से जो फल होता है वही समीचीन होता है, तब कर्णानुपात न करने का कारण क्या है? यह बात अधोलिखित उक्ति से प्रकट होती है—

त्रिज्याभक्तः परिधिः कर्णगुणो बाहुकोटिगुणकारः ।
असकृन्मान्दे तत्फलमाद्यसमं नात्र कर्णोऽस्मात् ॥

सिद्धान्त शेखर में—

त्रिज्याहृतः श्रुतिगुणः परिधिर्यतो दोः
कोटयोर्गुणोमृदुफलानयनेऽसकृत्स्यात् ।
स्यान्मन्दमाद्यसममेव फलं ततश्च
कर्णः कृतो न मृदुकर्मणि तन्त्रकारैः ॥

यह श्रीपत्युक्त श्लोक आचार्योक्त श्लोक का ही अनुवाद है । भास्कराचार्य ने भी—

स्वल्पान्तरत्वान्मृदुकर्मणीह कर्णः कृतो नेति वदन्ति केचित् ।
त्रिज्योद्धृतः कर्णगुणः कृतेऽपि कर्णे स्फुटः स्यात्परिधिर्यतोऽत्र ॥
तेनाद्यतुल्यं फलमेति तस्मात् कर्णः कृतो नेति च केचिदूचुः ।
नाशङ्कनीयं न चले किमित्थं यतो विचित्रा फल वासनाऽत्र ॥

यहाँ कर्ण से जो फल आता है वही समीचीन है । मन्द कर्म में स्वल्पान्तर से कर्णानुपात नहीं किया गया है, यह कहते हैं मन्दकर्म में मन्दकर्ण तुल्य व्यासार्ध से जो वृत्त होता वह कक्षावृत्त है । जो पाठ पठित मन्द परिधि है वह त्रिज्या परिणत है । अतः उसको कर्ण व्यासार्ध में परिणामन करते हैं, यदि त्रिज्यावृत्त में यह पाठ पठित परिधि पाते हैं, तो कर्णवृत्त में क्या इससे स्फुट परिधि होती है । 'तत्र स्वेनाहते परिधिना भुजकोटिजीवे' इत्यादि से जो फल होता है उसको त्रिज्या से गुणा कर कर्ण से भाग देने जो उपलब्ध होता है तो वह पूर्व फल के तुल्य ही होता है । यह आचार्य ब्रह्मगुप्त का मत है । यदि इस कर्णानुपात से परिधि की स्फुटता होती है तो शीघ्रकर्म में क्यों नहीं किया जाता है ? यहाँ चतुर्वेदाचार्य कहते हैं कि ब्रह्मगुप्त ने औरों को ठगने के लिग ऐसा कहा है, परन्तु यह ठीक नहीं है । शीघ्रकर्म में क्यों नहीं किया जाता, यह आशंका नहीं करनी चाहिए, क्योंकि फल की उपपत्ति विचित्र है ।

ग्रहणवासना

छादक का निर्णय करके राहुकृत ग्रहण नहीं होता है । यह आचार्य ने प्रथम वराहमिहिरादिकों के मत का प्रतिपादन किया फिर संहितामत का अवलम्बन कर, उस (वराह मिहिरादिक) मत का निराकरण किया है ।

राहुकृतं ग्रहणद्वयमागोपालाङ्गनादिसिद्धमिदम् ।
बहुफलमिदमपि सिद्धं जपहोमस्नानफलमत्र ॥

इसे लोक प्रथा बताकर राहुकृत ग्रहण के समर्थन में आचार्य ने वेद और स्मृति के वाक्यों का उल्लेख किया है । युक्ति से राहुकृत ग्रहण सिद्ध नहीं होता है, परन्तु वेदों में,

स्मृतियों में और पुराणों में राहुकृत ग्रहण का प्रतिपादन विद्यमान है। अतः दोनों मतों का समन्वय करते हुए आचार्य ने कहा है—

राहुस्तच्छादयति प्रविशति यच्छुक्लपञ्चदश्यन्ते ।
भूछाया तमसीन्दोर्वरप्रदानात् कमलयोनेः ॥

चन्द्रोऽम्बुमयोऽधःस्थो यदग्निमयभास्करस्य मासान्ते ।
छादयति शमिततापो राहुश्छादयति तत् सवितुः ॥

सिद्धान्तशिरोमणि के गोलाध्याय में भी अधोलिखित भास्करोक्ति—

दिग्देशकालावरणादि भेदान्न छादको राहुरिति ब्रुवन्ति ।
यन्मानिनः केवलगोलविद्यास्तत्संहिता वेदपुराणबाह्यम् ॥

राहुः कुभामण्डलगः शशाङ्कं शशाङ्कगश्छादयतीव बिम्बम् ।
तमोमयः शम्भुवरप्रदानात् सर्वागमानामविरुद्धमेतत् ॥

से समन्वय किया गया है। सिद्धान्तशेखर में राहुकृत ग्रहण के खण्डनार्थ 'राहुनिराकरणाध्याय' नाम का एक अध्याय रक्खा गया है। इसमें श्रीपति ने भी निम्नलिखित श्लोकों ने समन्वय किया है—

विष्णुलूनशिरसः किल पङ्कोर्दत्तवान् वरमिमं परमेष्ठी ।
होमदानविधिना तवतृप्तिस्तिग्मशीतमहसोरुपरागे ॥

भूमेश्छायां प्रविष्टः स्थगयति शशिनं शुक्लपक्षावसाने ।
राहुर्ब्रह्मप्रसादात् समधिगतवरस्तत्तमो व्यासतुल्यः ॥

ऊर्ध्वस्थं भानुबिम्बं सलिलमयतनोरप्यधोवर्त्ति बिम्बम् ।
संसृत्यैवं च मासव्युपरतिसमये स्वस्य साहित्यहेतोः ॥

गोलबन्धाधिकार में महद्वृत्तों (पूर्वापरवृत्त, याम्योत्तरवृत्त, क्षितिजवृत्त आदि) की रचना तथा लघुवृत्तों (मेषादिक द्वादश राशियों के अहोरात्रवृत्त) की रचना करके परमलम्बन-नति का स्वरूप प्रतिपादन कर आचार्य ने दृक्कर्म का आनयन किया है। ब्राह्मस्फुटसिद्धान्त में आचार्य ने जैसे गोलबन्ध कहा है वैसे ही सिद्धान्त शेखर में श्रीपति और सिद्धान्त शिरोमणि के गोलाध्याय में भास्कराचार्य ने कहा है। ग्रहगोल और नक्षत्रगोल में पांच स्थिरवृत्त (पूर्वापरवृत्त, क्षितिजवृत्त, याम्योत्तरवृत्त, उन्मण्डल, विषुवद्वृत्त) कहे हैं। ये सब कक्षामण्डल के बराबर हैं। तथा ग्रहों के चलवृत्त मन्दनीचोच्चवृत्त=७, भौमादि ग्रहों के शीघ्रनीचोच्चवृत्त=५। मन्दप्रतिवृत्त=७, शीघ्रप्रतिवृत्त=५। सात ग्रहों के दृग्मण्डल दृक्क्षेप

गोलाध्याय

मण्डल, कक्षामण्डल = २१ चन्द्रादि ग्रहों के विमण्डल = ६, सबों का योग ५१ एकावन चलवृत्तों की संख्या है। सिद्धान्तशेखर में भी ऐसा ही है—

मन्दोच्चनीचवलयानि भवन्ति सप्तशैघ्रचारिणि, पञ्च च तथा प्रतिमण्डलानि।
दृक्क्षेप दृष्टयपमजानि च खेचराणामर्कं विनैव खलु षट् च विमण्डलानि॥

पञ्चाशदेकसहितानि च मण्डलानि पूर्वापरं वलयमुत्तरदक्षिणगं च।
क्ष्माजं तथा विषुवदुद्वलयाभिधाने पञ्चस्थिराणि कथितान्युडुखेचराणाम्॥

यन्त्राध्याय—

सप्तदश कालयन्त्राण्यतो धनुस्तुर्यगोलकं चक्रम्।
यष्टिः शङ्कुर्घटिका कपालकं कर्त्तरी पीठम्॥

सलिलं भ्रमोऽवलम्बः कर्णश्छायादिनार्धमर्कोऽक्षः।
नतकालज्ञानार्थं तेषां संसाधनान्यष्टौ॥

इससे धनुर्यन्त्र, तुरीययन्त्र, चक्रयन्त्र, यष्टियन्त्र, शङ्कुयन्त्र, घटी यन्त्र, कपालयन्त्र, कर्त्तरीयन्त्र, पीटसंज्ञक (फलक) यन्त्र, सलिल (जल), भ्रम (शाण), अवलम्बसूत्र, छाया-कर्ण, शङ्कुछाया, दिनार्धमान, सूर्य, अक्षर (अक्षांश), ये नतकाल के लिए सत्रह काल यन्त्र हैं। इन यन्त्रों में सलिल आदि आठ यन्त्र रचना के उपकरण हैं! सिद्धान्त-शेखर में—

गोलश्चक्रं कार्मुकं कर्त्तरी च कालज्ञाने यन्त्रमन्यत्कपालम्।
पीठं शङ्कुः स्याद्घटी यष्टिसंज्ञं गन्त्री यन्त्राण्यत्र दिक्संमितानि॥

इससे गोलयन्त्र, चक्रयन्त्र, धनुर्यन्त्र, कर्त्तरी नामक यन्त्र, कपालयन्त्र, पीठ (फलक) यन्त्र, शङ्कुनामक यन्त्र, घटी नामक-यन्त्र, यष्टियन्त्र, गन्त्री (शकट) ये श्रीपति द्वारा वर्णित दस यन्त्र हैं। शिष्यधीवृद्धिदतन्त्र में अधो लिखित बारह यन्त्रों का उल्लेख है—

गोलो भगणश्चक्रं धनुर्घटी शङ्कुशकटकर्त्तर्यः।
पीठकपालशलाका द्वादशयन्त्राणि सहयष्ट्या॥

कर्णश्छाया द्युदलं रविरक्षो लम्बको भ्रमः सलिलम्।
स्युर्यन्त्रसाधनानि प्रज्ञा च समुद्यमाश्चैवम्॥

भास्कराचार्य ने गोलाध्याय में केवल दस यन्त्र कहे हैं—

गोलो नाडीवलयं यष्टिः शङ्कुर्घटीचक्रम्।
चापं तुर्यं फलकं धीरेकं पारमार्थिकं यन्त्रम्॥

सूर्य सिद्धान्त में अधो लिखित यन्त्र विवरण है—

तुङ्गबीजसमायुक्तं गोलयन्त्रं प्रसाधयेत् ।
गोप्यमेतत्प्रकाशोक्तं सर्वगम्यं भवेदिह ।।

कालसंसाधनार्थाय तथा यन्त्राणि साधयेत् ।
एकाकी योजयेद्बीजं यन्त्रे विस्मय कारिणि ।।

शङ्कुयष्टि धनुश्चक्रैश्छायायन्त्रैरनेकधा ।
गुरुपदेशाद्विज्ञेयं कालज्ञानमतन्द्रितैः ।।

तोययन्त्रकपालाद्यैर्मयूरनरवानरैः ।
ससूत्ररेणुगर्भैश्च सम्यक्कालं प्रसाधयेत् ।।

परदाराम्बुसूत्राणि शुल्वतैलजलानि च ।
बीजानि पांसवस्तेषु प्रयोगास्तेऽपि दुर्लभाः ।।

ताम्रपात्रमधश्छिद्रं न्यस्तं कुण्डेऽमलाम्भसि ।
षष्टिर्मज्जत्यहोरात्रे स्फुटं यन्त्रं कपालकम् ।।
नरयन्त्रं तथा साधु दिवा च विमले रवौ ।
छाया संसाधनैः प्रोक्तं कालसाधनमुत्तमम् ।।

मानाध्याय

मानानि सौरचान्द्रार्क्षसावनानि ग्रहानयनमेभिः ।
मानैः पृथक् चतुर्भिः संव्यवहारोऽत्र लोकस्य ।।

इससे सौरमान, चान्द्रमान, नाक्षत्रमान और सावनमान, ये चार प्रकार के मान कहे गये हैं । इन्हीं चारों मानों से लोगों के सब व्यवहार होते हैं । किस किस मान से कौन कौन पदार्थ ग्रहण किये जाते हैं यह सब प्रति पादित है । ब्राह्म, दिव्य, पित्र्य, प्राजापत्य, बार्हस्पत्य, सौर, सावन, चान्द्र, नाक्षत्र ये नौ मान हैं। इन मानों में से मनुष्यलोक में केवल सौर, चान्द्र, सावन और नाक्षत्र इन चार मानों की ही प्रधानता है । क्योंकि इन्हीं मानों से मनुष्यों के सब व्यवहार सम्पन्न होते हैं । सूर्यसिद्धान्त, सिद्धान्तशेखर, सिद्धान्त-शिरोमणि आदि सब ग्रन्थों में मानों के विषय में समान रूप से कहा गया है । ब्राह्मस्फुट सिद्धान्त के इस अध्याय में भूभादैर्घ्य के भी साधन है ।

संज्ञाध्याय में संज्ञा कहने के कारण दर्शाये हैं । सिद्धान्त इसका एक ही है । किस अंश में सूर्यसिद्धान्तादि भिन्न हैं। इसका प्रतिपादन कर आचार्य ने अपने सिद्धान्त के उत्तरार्ध में अनुक्रमणिका कही है । सूर्यसिद्धान्त, सिद्धान्तशेखर आदि

संज्ञाध्याय

अन्य सिद्धान्तग्रन्थों में संज्ञाध्याय नहीं हैं वस्तुतः इसकी आवश्यकता भी नहीं है । अध्याय के उपसंहार से पूर्व एक विशेष प्रश्न—

आग्नेये नैर्ऋत्ये वेष्टदिने संस्थितस्य योऽर्कस्य ।
शङ्कुच्छाये कथयति वर्षादपि वेत्ति सूर्यं सः ।।

रक्खा हुआ है। इसका उत्तर कोणशङ्कु के आनयन से स्फुट है।

ध्यान ग्रहोपदेशाध्याय-मूल ब्राह्मस्फुट सिद्धान्त का अंग नहीं है। ब्राह्मस्फुट सिद्धान्त तो चौबीसवें (संज्ञाध्याय) अध्याय पर समाप्त हो जाता है। ध्यान ग्रहोपदेशाध्याय भी ब्रह्मगुप्त की ही एक कृति हैं। अतः परिशिष्ट के रूप इसे यहाँ संलग्न कर दिया गया है।

ध्यानग्रहोपदेशाध्यात्र

इसके चैत्रादि में मासगणानयन, चैत्रादि में दिनादिक, तिथिध्रुवसाधन, इद्रमासादि में रवि के आनयन प्रकार, प्रतिमास में चन्द्रकेन्द्र, तिथि ध्रुवक्षेप के आनयन का प्रतिपादन है। प्रतिदिन चालन, चन्द्रसाधन, औदयिक रविसाधन, ज्याखण्ड तथा केन्द्रज्या साधन का वर्णन है—

त्रिंशत्सनवरसेन्दुर्जिनतिथिविषयागृहार्धचापानाम् ।
अर्धज्याखण्डानि ज्याभुक्तैक्यं स भोग्यफलम् ।।
गतभोग्यखण्डकान्तर दलविकलवधाच्छतैर्नवभिराप्तैः ।
तद्युतिदलं युतोनं भोग्यादूनाधिकं भोग्यम् ।।

यह आचार्योक्त भोग्यखण्ड स्पष्टीकरण है। भास्कराचार्य ने इसी को सिद्धान्तशिरोमणि के स्पष्टाधिकार में "यातैष्ययोः खण्डकयोर्विशेषः शेषांशनिघ्नः" इत्यादि द्वारा लिखा है। भास्कराचार्य ने १२० त्रिज्या ग्रहण की हैं। यहाँ आचार्य ब्रह्मगुप्त ने १५० त्रिज्या ग्रहण को हैं। यहाँ यह बात बड़ी विचित्र लगती है कि आचार्योक्त विषयों को ही सिद्धान्त शेखर में श्रीपति ने सर्वत्र श्लोकान्तरों में लिखा है, परन्तु पता नहीं क्यों उन्होंने आचार्योक्त इस अपूर्व भोग्य खण्ड स्पष्टीकरण की चर्चा तक नहीं की। चन्द्र में भुजफल संस्कार, तिथि फलसंस्कार आदि सभी विषय विलक्षण है। आचार्य ने इस अध्याय में जो विषय लिख दिये हैं, सूर्यसिद्धान्त-सिद्धान्तशेखर- तथा सिद्धान्त शिरोमणि में वे नहीं हैं।

ब्राह्मस्फुट सिद्धान्त में जिन आचार्यों के नाम आये हैं। उनके सम्बन्ध में कुछ विचार करते हैं। सब सिद्धान्तों में आदिम या सबसे प्राचीन सिद्धान्त ब्रह्मसिद्धान्त ही है। इसी को लोग पितामह सिद्धान्त के नाम से भी कहते हैं। पञ्चसिद्धान्त का में वराहमिहिर ने बारहवें अध्याय को जिसमें केवल पांच आर्याएँ हैं, पैतामह सिद्धान्त के नाम से पुकारते हैं, उदाहरणतः—

रविशशिनोः पञ्चयुगं वर्षाणि पितामहोपदिष्टानि ।
अधिमासस्त्रिंशद्भिर्मासैरवमस्त्रिषष्ट्याऽह्नम् ।।१।।

द्वयू नं शकेन्द्रकालं पञ्चभिरुद्धृत्य शेषवर्षाणाम् ।
द्विगुणमाद्यसिताद्यं कुर्याद् द्युगणं तदह्न्युदयात् ।।२।।
सैकषष्ट्यंशे गणे तिथिर्भमार्कं नवाहतेऽक्ष्यर्कैः ।
दिग्रसभागैः सप्तभिरूनं शशिभं धनिष्ठाद्यम् ।।३।।
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द्वयग्निनगेषूत्तरतः स्वमितमेष्यदिनमपि याम्यायनस्य ।
द्विघ्नं शशिरसभक्तं द्वादशहीनं दिनसमानम् ।।५।।

इसके अनुसार एक युग में सौर वर्ष = ५, सौरमाह ५ × १२ = ६०, अधिमास = २, चान्द्रमास = ६२, इसे तीस से गुणा करते से तिथि = १८६०, अवम = ३०, तिथियों में से इसे घटाने पर अहर्गण = १८३० ।।

आचार्य वराहमिहिर विक्रमादित्य के प्रसिद्ध नव रत्नों में से एक थे । इनके द्वारा बने ग्रन्थ 'लघुजातक, बृहज्जातक, विवाहपटल, बृहद्योगयात्रा, बृहत्संहिता, समास संहिता और पञ्चसिद्धान्तिका है ।

पौलिश सिद्धान्त, रोमक सिद्धान्त, वासिष्ठ सिद्धान्त, सौर (सूर्य) सिद्धान्त, और पैतामह सिद्धान्त, इन पाञ्च सिद्धान्तों के सार का संकलन रूप 'पञ्चसिद्धान्तिका' है । इस ग्रन्थ को को वराह मिहिराचार्य 'ताराग्रह कारिका तन्त्र' के नाम से पुकारते हैं । इस ग्रन्थ (पञ्चसिद्धान्तका) में 'पौलिश सिद्धान्त' नाम का एक अध्याय है । पौलिश सिद्धान्त के रचयिता के सम्बन्ध में बहुत मतमतान्तर हैं । वराहोक्त पौलिशसिद्धान्त में यवनपुर से उज्जयिनी का और वाराणसी का देशान्तर उल्लिखित है, जैसे —

यवनाच्चरजा नाड्यः सप्तावन्त्यां त्रिभागसंमिश्राः ।
वाराणस्यां त्रिकृतिः साधनमन्यत्र वक्ष्यामि ।।

शाकल्य संहितोक्त ब्रह्मसिद्धान्त में पौलिश सिद्धान्त का उल्लेख तथा पुलिशाचार्य के —

उज्जयिनी रोहीतक कुरुयमुना हिमनिवासमेरूणाम् ।
देशान्तरं न कार्यं तल्लेखामध्यसंस्थदेशेषु ।।

आदि विचार से 'पौलिश सिद्धान्त' सर्वमान्य था । परन्तु यह सिद्धान्त अभी उपलब्ध नहीं है ।

सूर्य सिद्धान्त ही प्राचीनतम सिद्धान्त ग्रन्थ है, यह बहुत विद्वानों का मत है ।

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*प्रागर्धे पर्व यदा तदोत्तराऽतोऽन्यथ तिथिः पूर्वा ।
अर्कघ्ने व्यतिपाताद्युगणे पञ्चाम्बरहुताशैः ।।४।।

केचित् प्रत्यक्षसूर्याच्च भिन्नोऽयमिति यद्बलात् ।
वदन्ति मूढवादस्याप्रामाण्यात्तदसद्ध्रुवम् ॥

कमलाकर की इस उक्ति से स्वयं भगवान् सूर्य ही इस के रचयिता सिद्ध होते हैं । आश्चर्य तो इस बात का है कि 'सूर्यसिद्धान्त में—

त्रिंशत्कृत्यो युगे भानां चक्रं प्राक् परिलम्बते ।
तद्गुणाद्भूदिनैर्भक्ताद् द्युगणाद्यदवाप्यते ॥
तद्दोस्त्रिघ्ना दशाप्तांशा विज्ञेया अयनाभिधाः ।
तत्संस्कृताद् ग्रहात् क्रान्तिच्छायाचरदलादिकम् ॥

आदि से अयांशानयन किया गया है, परन्तु सूर्य सिद्धान्त के पश्चात् ब्रह्मस्फुट सिद्धान्त के रचयिता आचार्य ब्रह्मगुप्त ने उसकी कोई चर्चा ही नहीं की । इस चर्चा न करने का कोई कारण भी समझ में नहीं आता है । सूर्यसिद्धान्त के उदयास्ताधिकार में "अभिजिद् ब्रह्म हृदयं स्वाती वैष्णव वासवाः" इत्यादि से भगवान् सूर्य को सदोदित नक्षत्र बतलाया गया हैं। इस श्लोक की सुधावर्षिणी टीका में जो—

देशज्ञानं बिना सदोदितनक्षत्राणां ज्ञानं न भवति, निरक्षे च सौम्य ध्रुवोऽप्यदृश्योऽतः केनचिद् गोलानभिज्ञेनायं श्लोक प्रक्षिप्त इति लिखा गया है, सो ठीक नहीं है । पाताधिकार में—

आद्यन्तकालयोर्मध्यः कालोज्ञे योऽतिदारुणः ।
प्रज्वलज्ज्वलनाकारः सर्वकर्मसु गर्हितः ॥
एकायनगतं यावदर्केन्द्वोर्मण्डलान्तरम् ।
सम्भवस्तावदेवास्य सर्वकर्म विनाशकृत् ॥
स्नानदानजपश्राद्धव्रतहोमादिकर्मभिः ।
प्राप्यते सुमहच्छ्रेयस्तत्कालज्ञानतस्तथा ॥

इत्यादि से पातस्थितिकाल सब कर्मो का विनाशकारक कहा गया है । पातकाल में स्नान, दान, जप, श्राद्ध, व्रत, होम आदि कार्यों से लोग कल्याण लाभ करते हैं । तथा—

रवीन्द्वोस्तुल्यता क्रान्त्योर्विषुवत्सन्निधौ यदा ।
द्विर्भवेद्धि तदा पातः स्यादभावो विपर्ययात् ॥

से अपूर्व विषयों का प्रति पादन हुआ है । अर्थात् रविगोल-संधि समीप में जब रवि और चन्द्र का क्रान्तिसाम्य हो तब अल्प समय में ही दो बार पात होता है । जब रवि की अयनसन्धि समीप में क्रान्ति साम्याभाव होता तब बहुत कालपर्यन्त क्रान्ति साम्याभाव होता है, ब्राह्मस्फुट सिद्धान्त में भी पातस्थिति काल फल सूर्य सिद्धान्त में कथित के अनु-

ही कहा गया है। श्रीषेण, आर्यभट तथा विष्णुचन्द्र के विषय में संक्षेपरूप से पहले लिख चुके हैं !

इलाहाबाद विश्वविद्यालय के रसायन विभाग के अध्यक्ष डाक्टर सत्य प्रकाश जी डी. एस. सी महोदय का मैं अत्यन्त अनुगृहीत हूं, जिन्होंने आंगल भाषा में इस ग्रन्थ की प्रस्तावना लिख कर कृतार्थ किया।

सम्पादक मण्डल के अन्य सहयोगी ज्योतिषाचार्य श्री मुकुन्दमिश्र, श्री विश्वनाथ झा, श्री दयाशंकर दीक्षित एवं श्री ओंदत्तशर्मा शास्त्री एम. ए. एम. ओल. भी धन्यवाद के पात्र हैं जिनके सहयोग के बिना इस महान् ग्रन्थ का सम्पादन अति कठिन था।

नव प्रिंटर्स पद्म श्री प्रकाशन के स्वामी श्री रमेशचन्द्र जी का परिश्रम भी सराहनीय है। इसके अतिरिक्त उन सभी लोगों के प्रति मैं अपना हार्दिक आभार प्रदर्शन करता हूं जिन्होंने अल्पमात्र भी सहयोग देकर मुझे कृतार्थ किया।

भृगु-आश्रम
३०-३-१९६६

विदुषामनुचर
रामस्वरूप शर्मा:

विषयानुक्रमणिका

२४. संज्ञाध्यायः १५१५-१५२३

ध्यानग्रहोपदेशाध्यायः १५२७-१५९८

परिशिष्ट

ब्राह्मस्फुटसिद्धान्तः

शृंगोन्नत्युत्तराध्यायः

ब्राह्मस्फुटसिद्धान्तः

७

शृंगोन्नत्युत्तराध्यायः

अथ शृङ्गोन्नत्युत्तराध्यायः प्रारभ्यते ।
अथ प्रश्नमाह ।

भुजकोटिकर्णशशिमानशुक्लसितसूत्रपरिलेखात् ।
प्रतिदिवसं प्रतिघटिकं यो वेत्ति स तन्त्रहृदयज्ञः ॥१॥

सु. भा.—शृङ्गोन्नतौ प्रतिदिवसं वा प्रतिघटिकं यो भुजं कोटिं कर्णं शशिमाने चन्द्रबिम्बे शुक्लं सितसूत्रं स्वभासूत्रं परिलेखं च वेत्ति स एव तन्त्रहृदयज्ञः सिद्धान्तग्रन्थमर्मज्ञ इति ॥ १ ॥

वि. भा.—प्रतिदिनं प्रतिघटिकं भुजं कोटिं कर्णं चन्द्रबिम्बे शुक्लं सितसूत्रं (स्वभासूत्रं) परिलेखं च शृंङ्गोन्नतौ यो जानाति स सिद्धान्तग्रन्थमर्मज्ञ इति । शृंङ्गोन्नत्यधिकारे पूर्वं भुजादयः साधिता एवातः परिलेखमत्र कथयति ॥१॥

अब शृंङ्गोन्नत्युत्तराध्याय प्रारम्भ किया जाता है ।

अब प्रश्न को कहते हैं ।

हि. भा—प्रत्येक दिन में प्रत्येक घटी में भुज—कोटि-कर्णों को चन्द्रबिम्ब में शुक्ल को, स्वभा सूत्र को, परिलेख को, शृंङ्गोन्नति में जो जानते हैं वे सिद्धान्तग्रन्थ के मर्मज्ञ हैं इति । शृङ्गोन्नत्यधिकार में पहले भुजादि साधित ही हैं । इसलिये यहां परिलेख ही को कहते हैं ॥१॥

इदानीं परिलेखमाह ।

प्राच्यपरा दिगभिमुखं शुक्लेतरपक्षयोर्लिखेद् भूमौ ।
अपवर्त्यैकेनेष्टेन राशिना कोटिभुजकर्णान् ॥२॥

परिकल्प्यार्कं बिन्दुं तस्माद्बाहुं यथादिशं दत्त्वा ।
बाह्वाग्रात् प्राच्यपरां कोटिं तिर्यक् स्थितं कर्णम् ॥३॥
कर्णाग्रे चन्द्रमसं परिलिख्य सितं प्रवेश्य कर्णेन ।
शशिबिम्बे शुक्लाग्रात् परिलेखसमेन सूत्रेण ॥४॥
कर्णगतिस्थे नैशे शुक्ले परिलिख्य पश्चिमाभिमुखम् ।
राशिषु मेषतुलादिषु संशोध्य दिवाकरं चन्द्रात् ॥५॥
पूर्वाभिमुखं कर्कटमकरादिषु भवति शुक्लसंस्थानम् ।
एवं वा संस्थानं परिलिख्येन्दुं प्रसाध्य दिशिः ॥६॥

सु. भा.—एकेनेष्टेन राशिना प्रथमं कोटिभुजकर्णानपवर्त्य भूमौ शुक्लकृष्ण-पक्षयोः प्राच्यपरादिगभिमुखं लिखेत् । कथं लिखेदित्याह—परिकल्प्यार्कं बिन्दु-मिति—इष्टं बिन्दुमर्कं परिकल्प्य तस्माद्यथादिशं बाहुं बाह्वग्राद्यथादिशं प्राच्यपरां कोटिं तयोर्मध्ये तिर्यक् कर्णं च दत्त्वा कर्णाग्रे चन्द्रमसं परिलिख्य तत्र कर्णेन कर्णमार्गेण शशिबिम्बे सितं शुक्लं प्रवेश्य दत्त्वा ततः शुक्लाग्रात् परिलेखसमेन सूत्रेण स्वभासमेन मानेन कर्णेऽङ्कनं कृत्वा तत् केन्द्रात् स्वभया वृत्तं परिलिख्य कर्णगतिस्थे नैशे रात्रिसम्बन्धिनि शुक्ले शुक्लसंस्थानं भवति । शुक्लाग्रं कस्यां दिशि कर्णसूत्रे दत्त्वा परिलेखं कुर्यादित्याशङ्क्याह राशिषु मेषतुलादिष्विति । चन्द्राद्दिवाकरं विशोध्य शेषं कार्यम् । मेषादिराशित्रये तुलादिराशित्रये च शेषे पश्चिमाभिमुखं कर्कटादिराशित्रये मकरादिराशित्रये च शेषे पूर्वाभिमुखं शुक्लं देयमिति । एवं वा संस्थानमित्यस्याग्रे संबंधः ।

अत्रोपपत्तिः । 'यद्याम्योदक्तपनशशिनोरन्तरं सोऽत्र बाहुः'—इत्यादिना 'सूत्रेण बिम्बमुडुपस्य षडङ्गुलेन'—इत्यादिना च भास्करविधानेन ज्ञेया । यदा-ऽन्तरं राशित्रयाल्पं तदा शुक्लमानं च चन्द्रबिम्बार्धादल्पमतः शुक्लाङ्गुलं पश्चिमाभिमुखं कर्णसूत्रे दत्त्वा तस्मात् स्वभासूत्रेण परिलेखवृत्ते कृते शुक्लेन्दु-खण्डाकृतिरुत्पद्यते । यदा तदन्तरं तुलादित्रये तदा कृष्णं बिम्बार्धादल्पं तद्वशेनापि पश्चिमाभिमुखं युक्तम् । एवं कर्कटादित्रयेऽपि कृष्णेन्दुखण्डाकृतिर्मकरादिषु च मासस्य तुर्यचरणे शुक्लशृङ्गोन्नतिरुत्पद्यते तत्र पूर्वाभिमुखं शुक्ल संस्थानं भवति । अत्र का का स्थूलता वास्तवपरिलेखसाधनं च कथमित्येतदर्थं मत्कृता वास्तवचन्द्र-शृङ्गोन्नतिर्द्रष्टव्या ॥ २-६ ॥

वि. भा.—एकेनेष्टेन राशिना कोटिभुजकर्णानपवर्त्य भूमौ शुक्लकृष्ण-पक्षयोः पूर्वापरदिगभिमुखं लिखेत्, कथं लिखेदिति कथयति । इष्टं बिन्दुरविं परि-कल्प्य तस्माद् भुजं दत्वा भुजाग्राद्यथा दिशं पूर्वापरां कोटिं तयोर्मध्ये तिर्यक् कर्णं च दत्वा कर्णाग्रे चन्द्रबिम्बं विलिख्य तत्र कर्णमार्गेण चन्द्रबिम्बे शुक्लं दत्वा शुक्ला-

ग्रात् परिलेखतुल्येन सूत्रेण (स्वभा) समेन मानेन कर्णोऽङ्कनं कृत्वा तत्केन्द्रात् स्वभया वृत्तं परिलिख्य कर्णागतिस्थे रात्रिसम्बन्धिनि शुक्ले शुक्ल संस्थानं भवति शुक्लाग्रं कस्यां दिशि कर्णसूत्रे दत्वा परिलेखं कुर्यादित्याह। चन्द्रात्सूर्यं विशोध्य शेषं ग्राह्यम्। मेषादिराशित्रये तुलादिराशित्रये च शेषे पश्चिमाभिमुखं कर्कटादिराशित्रये मकरादिराशित्रये च शेषे पूर्वाभिमुखं शुक्लं देयमिति। एवं वा संस्थान मित्यस्याग्रे सम्बन्धः॥

अत्रोपपत्ति :

यदा रविचन्द्रयोरन्तरं राशित्रयाल्पं तदा शुक्लमानं च चन्द्र बिम्बार्धादल्पमतः शुक्लाङ्गुलं कर्णसूत्रे पश्मिाभिमुखं दत्वा तस्मात् स्वभासूत्रेण परिलेखवृत्ते कृते शुक्लचन्द्र खण्डाकृतिर्जायते। यदा तदन्तरं तुलादिराशित्रये तदा कृष्णं बिम्बार्धादल्पं तद्वशेनापि पश्चिमाभिमुखं युक्तम्। एवं कर्कटादित्रयेऽपि कृष्णचन्द्रखण्डाकृतिः। मकरादिषु मासस्य चतुर्थचरणे शुक्लशृङ्गोन्नतिरुत्पद्यते तत्र पूर्वाभिमुखं शुक्ल संस्थानं भवतीति। सिद्धान्तशेखरे "आदर्शोदरसोदरेऽवनितले बिन्दुं प्रकल्प्योष्णगुं स्वाशायां भुजमुत्तरेतरदिशं कोटिं तदग्रात्ततः। प्राक्चन्द्रेऽपरदिङ्मुखीमपरगे पूर्वायतां दापयेत् दोः कोट्यग्रगतां श्रुतिं शशिवपुः कोटिश्रवः संयुतौ॥ शुक्लं च श्रुति सूत्रगाम्यपरतः शुक्लेऽसिते पूर्वतः कृष्णं व्यत्ययतोऽल्पकेन कृतयोः कार्यं परीलेखनम्। शुक्लाग्रात् परिलेखसूत्रविहिते वृत्तभ्रमे जायते संस्थानं नभसः स्थले प्रतिदिशं चण्डीशचूडामणेः॥" अस्यार्थः—आनीतं शुक्लमानं शुक्लपक्षे पश्चिमबिन्दोः कर्णसूत्रमार्गेण देयम्। कृष्णपक्षे पूर्वबिन्दोर्देयम्। कृष्णमानं व्यत्ययात् शुक्लपक्षे पूर्वबिन्दोः कृष्णपक्षे पश्चिमबिन्दोरित्यर्थः। आनीतयोः शुक्लकृष्णयोर्मध्ये न्यूनपरिमाणेन परिलेखनं कार्यम्। शुक्लकृष्णयोर्मध्ये योऽल्पस्तेनैव शृङ्गोन्नतिज्ञानार्थं परिलेखः कर्त्तव्य इति। शुक्लाग्रात् परिलेखसूत्रेण कृते वृत्ते चन्द्रस्य प्रतिदिशमाकाशस्य संस्थानं भूमौ ज्ञायते। शिष्यधीवृद्धिद तन्त्रे "यच्चिह्नं समभुवि भानुमान् स तस्मात् दातव्यः स्वदिशि भुजस्ततोऽपि कोटिः। प्रागिन्दावपरककुप्मुखी प्रतीच्यां प्रागग्रा दिनकरचिह्नतश्च कर्णः॥ श्रवणकोटियुतौ शशिमण्डलं श्रवणसूत्रमिहापरपूर्वकम्। झषवशेन च शेषदिशौ ततः खटिकया सुपरिस्फुटमालिखेत्॥ अपरतः श्रवणेन सितं नयेदसितमप्यसिते सितदीधितौ। धनददिग्भवदक्षिणदिग्भवैः परिधिभिर्जनयेच्च झषद्वयम्॥ तिमिभवमुखपुच्छसक्तरज्ज्वोर्भवति च यत्र समागमः प्रदेशे। तत उडुपतिशुक्लचिन्हलग्नं समभिलिखेत् सितसिद्धये सुवृत्तम्॥" लल्लोक्त प्रकार ईदृशोऽस्ति। सर्वेषां ब्रह्मगुप्त-लल्ल-श्रीपति-भास्कराचार्याणां शृङ्गोन्नति परिलेखः समान एव। सूर्य सिद्धान्ते "दत्वाऽर्क संज्ञितं बिन्दुं ततो बाहुं स्वदिङ्मुखम्। ततः पश्चान्मुखीं कोटिं कर्णं कोट्यग्रमध्यगम्॥ कोटिकर्ण युताद्बिन्दोर्बिम्बं तात्कालिकं लिखेत्। कर्णसूत्रेण दिक् सिद्धि प्रथमं परिकल्प-

येत् ।। शुक्लं कर्णेन तद्बिम्बयोगादन्तमु्खं नयेत् । शुक्लाग्रयाम्योत्तरयोर्मध्ये मत्स्यौ प्रसाधयेत् ।। तन्मध्यसूत्रसंयोगाद्बिन्दुत्रिस्पृग् लिखेद्धनुः । प्राग्बिम्बं यादृगेव स्यात् तादृक् तत्र दिने शशी ।। कोट्यादिक् साधनात् तिर्यक् सूत्रान्ते शृङ्ग-मुन्नतम् । दर्शयेदुन्नतां कोटिं कृत्वा चन्द्रस्य साकृतिः ।। कृष्णे षड्भयुतं सूर्यं विशोध्येन्दोस्तथा सितम् । दद्याद्वामं भुजं तत्र पश्चिमं मण्डलं विधोः ।।" ईदृशः परिलेख-विधिरस्ति ।।

अत्रोपपत्तिः ।

रविकेन्द्राद्याम्योत्तरवृत्तधरातले लम्बं कृत्वा लम्बमूले रविः कल्पितः । एवं चन्द्रकेन्द्राद्याम्योत्तरवृत्तधरातले यो लम्बस्तन्मूले चन्द्रः कल्पितः। ततो याम्योत्तर-वृत्तधरातले कल्पितरविचन्द्रयोर्याम्योत्तरमन्तरं तद् भुजयोः संस्कारात् स्पष्ट-भुजतुल्यम् । सूर्यस्यास्तकाले क्षितिजे स्थितत्वात् कल्पितरवियाम्योत्तरवृत्तधरातले याम्योत्तररेखायामेव भविष्यत्यतस्तयोरूर्ध्वाधरमन्तरं कोटिरूपं चन्द्रशङ्कुसमम् । तत्र परिलेखे लाघवार्थं शङ्कुद्वादशांशेन शङ्कुभु्जस्तद्वर्गयोगमूलसमः कर्णश्चा-पवर्त्तितः । अतो रविबिन्दुतो भुजं दत्वा तदग्रादूर्ध्वाधररूपां कोटिं दत्वा कोट्यग्र-रविबिन्दुगतं कर्णसूत्रं दत्तम् । कोट्यग्रे कल्पितचन्द्रबिम्बं तत्र कल्पितरविः कर्णमार्गेण शुक्लं ददाति । अतस्तत्सूत्रे शुक्लं दत्तम् । कर्णरेखोपरि या याम्योत्तरा तिर्यग्रेखा तया छिन्नमर्धं बिम्बं रविणा शुक्लं भवति । अतो दृश्यवृत्ते तत्प्रान्तयोश्च शुक्लम् । अतस्तद्बिन्दुत्रयोपरिगतेन वृत्तखण्डेन चन्द्रखण्डाकृतिरुत्पद्यते । अत्र कोट्यूर्ध्वाधररेखोपरि या तिर्यग्रेखा तद्वशतो भुजान्यदिशि शृङ्गमुन्नतं भवति । एवमेव परिलेखो भास्कराचार्यस्याप्यस्ति । परन्तु केषामपि प्राचीनाचार्याणां शृङ्गोन्नतिपरिलेखः समीचीनो नास्तीति ।।२-६।।

अब परिलेख को कहते हैं ।

हि. भा.—एक किसी इष्ट राशि से भुज कोटि और कर्ण को अपवर्त्तन देकर भूमि में शुक्ल पक्ष और कृष्णपक्ष में पूर्व पश्चिम दिशा की तरफ लिखना चाहिये । कैसे लिखना चाहिये सो कहते हैं । इष्ट बिन्दु को रवि कल्पना कर उससे भुज देकर भुजाग्र से यथादिक् पूर्वापर कोटि देकर उन दोनों के मध्य में तिर्यक् कर्ण को देकर कर्ण में चन्द्र को लिखकर वहाँ कर्णमार्ग से चन्द्रबिम्ब में शुक्ल देकर शुक्लाग्र से परिलेख तुल्य सूत्र (स्वभातुल्य सूत्र) से कर्ण में अङ्कित कर उस बिन्दु को केन्द्रमान कर स्वभाव्यासार्ध से वृत्त लिखकर कर्णगतिस्थ रात्रि सम्बन्धी शुक्ल में शुक्ल संस्थान होता है । कर्ण सूत्र में शुक्लाग्र को किस दिशा में देकर परिलेख करना चाहिये सो कहते हैं । चन्द्र में सूर्य को घटा कर जो शेष रहे उसको ग्रहण करना चाहिये । मेषादि तीन राशियों में और तुलादि तीन राशियों में शेष में पश्चिमाभिमुख शुक्ल देना चाहिये । तथा कर्कटादि तीन राशियों में और मकरादि तीन राशियों में शेष में पूर्वाभिमुख शुक्ल देना चाहिये ।। इति ।

उपपत्ति ।

जब रवि और चन्द्र का अन्तर तीन राशि से अल्प होता है तब शुक्लमान भी चन्द्र बिम्बार्ध से अल्प होता है अतः कर्ण सूत्र में शुक्लाङ्गुल को पश्चिमाभिमुख देकर वहां से स्वभासूत्र व्यासार्ध से परिलेख वृत्त करने से शुक्ल चन्द्रखण्डाकृति बनती है। जब वह अन्तर तुलादि तीन राशि में हो तब कृष्ण बिम्बर्धाल्प होता है उसके वश से पश्चिमाभिमुख युक्त है। एवं कर्क्यादि तीन राशियों में भी कृष्णचन्द्र खण्डाकृति होती है। मकरादि तीन राशियों में मास के चतुर्थचरण में शुक्ल शृङ्गोन्नति बनती है। वहां पूर्वाभिमुख शुक्ल संस्थान होता है। सिद्धान्त शेखर में 'आदर्शोदर सोदरेऽवनितले बिन्दुं प्रकल्प्योष्णगुं स्वाशायां' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने परिलेख प्रकार लिखा है। शिष्यधीवृद्धिद तन्त्र में 'यच्चिह्नं समभुवि भानुमान् स तस्मात् दातव्यः स्वदिशि भुजः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोकों से लल्लाचार्योक्त प्रकार भी आचार्यो (ब्रह्मगुप्त)क्त प्रकार और श्रीपत्युक्त प्रकार तथा भास्करोक्त शृङ्गोन्नति प्रकार के समान ही है। सूर्य सिद्धान्त में 'दत्वाऽर्क संज्ञितं बिन्दुं ततो बाहुं स्वदिङ्मुखम्' इत्यादि संस्कृतोपपत्ति में लिखित श्लोकों से सूर्य सिद्धान्तकार ने परिलेख प्रकार लिखा है इसी तरह के परिलेख भास्करोक्त भी हैं लेकिन कोई भी प्राचीनाचार्योक्त प्रकार समीचीन नहीं है इति ॥२–६॥

इदानीं प्रकारान्तरेण परिलेखमाह।

बाहुज्येन्दुदलगुणा कर्णविभक्ता भुजान्यदिक् चन्द्रे ।
कर्णोभुजाग्रतश्चन्द्रमध्यतः पूर्ववच्छेषम् ॥७॥

सु. भा.—वा एवं वक्ष्यमाणं संस्थानं शुक्लसंस्थानं ज्ञेयं। अभीष्टस्थाने केन्द्रं प्रकल्प्य चन्द्रबिम्बं परिलिख्य दिशश्च प्रसाध्य ततः पूर्वशृङ्गोन्नत्यध्यायविधिना बाहुज्या भुजा साध्या सा चन्द्रदलेन चन्द्रबिम्बार्धेन गुणा कर्णेन विभक्ता सा चन्द्रे चन्द्रबिम्बेऽन्यदिक् भुजा भवति। ततश्चन्द्रमध्यतश्चन्द्र केन्द्राद्भुजायतश्च कर्णसंस्थानं ज्ञेयम्। ज्ञाते कर्ण संस्थाने शेषं पूर्ववत् ज्ञेयम्।

अत्रोपपत्तिः। अत्र रवेर्यद्दिक् चन्द्रः स प्रथमं भुजः साधितो भुजाग्राच्चन्द्र-केन्द्रगता रेखा कोटिः। कोटिसूत्रमेव [चन्द्रबिम्बे पूर्वापररेखा। कर्णसूत्रं च चन्द्र-बिम्बपरिधौ कोटिसूत्राद् भुजविपरीतदिशि लग्नं तत्स्थानज्ञानार्थं चन्द्रबिम्बार्धे भुजः परिणीतस्ततः कर्णसंस्थानज्ञानं सुगमम् ॥ ७ ॥

वि. भा.–पूर्वोक्तपरिलेखश्लोकानामन्ते 'एवं वा संस्थानम्' इत्यस्ति एतस्यार्थः वा एवमग्रे कथितं शुक्लसंस्थानं बोध्यम्। इष्टस्थाने कमपि बिन्दुं केन्द्रं मत्वा चन्द्रबिम्बं विलिख्य दिक्साधनं कृत्वा शृङ्गोन्नत्यध्यायोक्तविधिना भुजज्या (भुजा) साध्या सा चन्द्रबिम्बार्धेन गुणा कर्णेन भक्ता तदा चन्द्र बिम्बेऽन्यदिक्

भुजा भवति। ततश्चन्द्रकेन्द्राद् भुजाग्रतश्च कर्णसंस्थानं ज्ञेयम्। अवशिष्टं पूर्ववदेव बोद्धव्यम् ॥

अत्रोपपत्तिः।

रवेर्यस्यां दिशि चन्द्रस्तत्र प्रथमंभुजः साधितः। भुजाग्राच्चन्द्रबिम्बकेन्द्रगता रेखाकोटिः। इयमेव कोटिरेखा चन्द्रबिम्बे पूर्वापररेखा। कर्णसूत्रं च चन्द्रबिम्ब-परिधौ कोटिसूत्राद् भुजविपरीतदिशि लग्नं तत्स्थानज्ञानार्थं चन्द्रबिम्बार्धे भुजः परिणतः कृतस्ततः कर्णसंस्थानज्ञानं सुलभम् ॥७॥

अब प्रकारान्तर से परिलेख को कहते हैं।

हि. भा.—अभीष्ट स्थान में केन्द्र मान कर चद्र बिम्ब को लिखकर दिशाओं का ज्ञान करना चाहिये तब पूर्वशृङ्गोन्नत्यध्यायोक्त विधि से भुजज्या साधन करना उसको चन्द्र बिम्बार्ध से गुणाकर कर्ण से भाग देने से फल चन्द्र बिम्ब में अन्य दिशा की भुजज्या होती है। तब चन्द्र केन्द्र से और भुजाग्र से कर्ण संस्थान समझना चाहिये। अवशिष्ट विषय पूर्ववत् समझना चाहिये इति ॥

उपपत्ति।

रवि से जिस दिशा में चन्द्र है वहाँ पहले भुज साधित है। भुजाग्र से चन्द्रकेन्द्र गत रेखा कोटि है। कोटि रेखा ही चन्द्रबिम्ब में पूर्वापर रेखा है। कर्णसूत्र चन्द्रबिम्ब परिधि में कोटिसूत्र से भुज विपरीत दिशा में लगता है उस स्थान के ज्ञान के लिये चन्द्र बिम्बार्ध में भुज को परिणत किया गया, तब कर्ण संस्थानज्ञान सुलभ ही है इति ॥७॥

इदानीं फलके परिलेखमाह।

प्राच्यपरे विपरीते फलकेऽन्यत् सर्वमुक्तवच्छेषम्।
शृङ्गोन्नतिपरिलेखाश्चत्वारः शीतकिरणस्य ॥८॥

सु. भा.—फलके गृहणपरिलेखवत् प्राच्यपरे दिशौ विपरीते कार्ये। अन्य-त्सर्वं शेषमवशिष्टं कर्मोक्तवत् कार्यम्। एवं शीतकिरणस्य चन्द्रस्य शृङ्गोन्नति-परिलेखाश्चत्वारो भवन्ति। भूमौ प्रकारद्वयं तद्वशतः फलके प्रकारद्वयमिति चत्वारः परिलेखप्रकारा भवन्तीति।

अत्रोपपत्तिः। ग्रहण परिलेखवत् फलकं परिवर्त्त्याकाशे संस्थाप्य सर्वा दिशो वास्तवा बोध्या इति ॥ ८ ॥

वि. भा.—फलके पर्वापरे दिशौ विपरीते कार्ये। अन्यत् सर्वं शेषं कर्मोक्तवत्

कर्त्तव्यम् । एवं चन्द्रस्य शृङ्गोन्नति परिलेखाश्चत्वारो भवन्ति । प्रकारद्वयं भूमौ तद्वशतः प्रकारद्वयं फलके इति परिलेखस्य चत्वारः प्रकारा भवन्तीति ॥

अत्रोपपत्तिः ।

पूर्वं २-६ श्लोकोक्तपरिलेखोपपत्तौ सूर्यसिद्धान्तोक्तप्रकारो योऽस्ति स फलके परिलेखप्रकारोऽस्ति तेनैव फलके परिलेखचमत्कृतिर्ज्ञातव्येति ॥८॥

अब फलक में परिलेख को कहते हैं ।

हि. भा.—फलक में पूर्वदिशा और पश्चिम दिशा को विपरीत करना चाहिये । अन्य सब अवशिष्ट कर्म पूर्ववत् करना चाहिये । इस तरह चन्द्र का शृङ्गोन्नतिपरिलेख चार प्रकार का होता है । दो प्रकार भूमि पर और उसके वश से दो प्रकार फलक पर ये चार प्रकार परिलेख के होते हैं इति ।

इदानीं विशेषमाह ।

ग्रहयोगेन्दुच्छायाग्रहोदयामयभग्रहमुनीनाम् ।
तत्क्रान्तिज्याप्रश्नोत्तराणि भग्रहयुतौ न पृथक् ॥९॥

सु. भा.—अत्र मध्यगति-स्पष्टगति-त्रिप्रश्न-ग्रहण-शृङ्गोन्नत्यध्यायेषु पंचस्वेवोत्तराधिकारा आचार्येणोक्ता अन्येषु किमु नेत्याशङ्क्याह-ग्रहयोगेन्दुच्छायेति ग्रहयोगो ग्रहयुतिः । इन्दुच्छाया चन्द्रच्छायासाधनम् । ग्रहोदयास्तमयाधिकारः । भानां गृहस्य लुब्धकस्य मुनेरगस्त्यस्य चोदयास्तादिसाधनम् । एतेषां तथा भगृहयुत्यधिकारे च मया पृथक्-पृथक् तत्क्रान्तिज्या प्रश्नोत्तराणि तेषां क्रान्तिज्यादिभिर्ये प्रश्नास्तथोत्तराणि च नोक्तानि तत्प्रश्नोत्तराणां पूर्वप्रतिपादितपञ्चाध्याय प्रश्नोत्तरान्तर्गतत्त्वादित्याचार्याशय इति ॥ ९ ॥

वि. भा.—ग्रहयुतिः । चन्द्रच्छायासाधनम् । ग्रहाणामुदयास्ताधिकारः । नक्षत्राणां ग्रहस्य लुब्धकस्य मुनेरगस्त्यस्यचोदयास्तादि साधनम् । एतेषां तथा भग्रहयुत्यधिकारे पृथक् पृथक् तत् क्रान्तिज्या प्रश्नोत्तराणि तेषां क्रान्तिज्यादिभिर्ये प्रश्नास्तथोत्तराणि च न कथितानि, अधोलिखितपञ्चाध्यायप्रश्नोत्तरान्तर्गतत्वात्-मध्यगति–स्पष्टगति–त्रिप्रश्न–ग्रहण–शृङ्गोन्नत्यध्यायेषु पञ्चस्वेवोत्तराधिकारा आचार्येण कथिताः ॥९॥

अब विशेष कहते हैं ।

हि. भा.—ग्रहयुति, चन्द्रच्छाया साधन, ग्रहों के उदयास्ताधिकार, नक्षत्रों के ग्रह के

लुब्धक मुनि, अगस्त्य के उदयास्तादि साधन। इन सबों के तथा भग्रहयुत्यधिकार में पृथक् पृथक् क्रान्तिज्यादि से प्रश्न और उत्तर नहीं कहा गया है, क्योंकि वे अधो लिखित पांच अध्यायों के प्रश्नोत्तरान्तर्गत है। मध्यगति–स्पष्टगति–त्रिप्रश्न–ग्रहण--शृङ्गोन्नति इन पांच अध्यायों में ही उत्तराधिकार को आचार्य ने कहा है इति ॥९॥

इदानीमध्यायोपसंहारमाह।

इति परिलेखाध्यायः शशाङ्कशृङ्गोन्नतेर्भुजाद्येषु।
शशिशृङ्गोन्नत्युत्तरमार्यादशकेन सप्तदशः ॥१०॥

सु. भा.—इति भुजाद्येषु साधनेषु शशिशृङ्गोन्नत्युत्तरं नाम शशिशृङ्गोन्नतेः परिलेखाध्याय आर्यादशकेन सप्तदशो जात इति ॥ १० ॥

मधुसूदनसूनुनोदितो यस्तिलकः
श्रीपृथुनेह जिष्णुजोक्ते।
हृदितं विनिध्याय नूतनोऽयं,
रचितः शृङ्गविधौ सुधाकरेण॥

इति श्रीकृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्तनूतनतिलके शृङ्गोन्नत्युत्तराध्यायः सप्तदश ॥ १७ ॥

वि. भा.—इति भुजाद्येषु साधनेषु चन्द्रशृङ्गोन्नत्युत्तरं नाम चन्शृङ्गोन्नतेः परिलेखाध्याय आर्यादशकेन सप्तदशः समाप्तो जात इति ॥१०॥

इति ब्राह्मस्फुट सिद्धान्ते चन्द्रशृङ्गोन्नत्युत्तराध्यायः सप्तदशः ॥१७॥

अब अध्याय के उपसंहार को कहते हैं।

हि. भा.—भुजादि साधनों में चन्द्रशृङ्गोन्नति का चन्द्रशृङ्गोन्नत्युत्तरनामक दश आर्याओं से युक्त सत्रहवां अध्याय समाप्त हुआ इति ॥१७॥

इति ब्राह्मस्फुट सिद्धान्त में चन्द्रशृङ्गोन्नति का उत्तराध्याय
(सत्रहवां अध्याय) समाप्त हुआ।

ब्राह्मस्फुटसिद्धान्तः

कुट्टकाध्यायः

ब्राह्मस्फुटसिद्धान्तः

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अथ कुट्टकाध्यायः

कुट्टकाध्यायः प्रारभ्यते। तदारम्भप्रयोजनं कथ्यते।

प्रायेण यतः प्रश्नाः कुट्टाकाराहृते न शक्यन्ते।
ज्ञातुं वक्ष्यामि ततः कुट्टाकारं सह प्रश्नैः ॥१॥

सु. भा.—कुट्टाकाराहृते विना यः प्रायेण बाहुल्येन गणकैः प्रश्ना ज्ञातुं न शक्यन्ते ततः प्रश्नैः सह कुट्टाकारं वक्ष्यामीति ॥ १ ॥

वि. भा.—यतः प्रायेण (बाहुल्येन) कुट्टाकारं (कुट्टकं) बिना गाणितिकैः प्रश्ना ज्ञातुं न शक्यन्ते ततः (तस्मात्कारणात्) प्रश्नैः सह कुट्टाकारं कथयामीति ॥१॥

अब कुट्टकाध्याय प्रारम्भ किया जाता है। उसके आरम्भ करने के प्रयोजन को कहते हैं।

हि. भा.—क्योंकि प्रायः कुट्टाकार बिना गणक प्रश्नों को समझने में समर्थन नही होते हैं इसलिये प्रश्नों के साथ कुट्टाकार (कुट्टक) को कहता हूं इति ॥१॥

इदानीं कुट्टकादीनां प्रशंसामाह।

कुट्टकखर्णधनाव्यक्तमध्यहरणैकवर्णभावितकैः।
आचार्यस्तन्त्रविदां ज्ञातैर्वर्गप्रकृत्या च ॥२॥

सु. भा.—कुट्टकेन। खेन शून्यसङ्कलनादिना। ऋणधनयोः सङ्कलनादिना। अव्यक्तसङ्कलनादिना। मध्यहरणेन मध्यमाहरणेन वर्गसमीकरणेन। एकवर्णसमीकरणेन। भावितेन। एतैर्ज्ञातैर्वर्गप्रकृत्या च ज्ञातया तन्त्रविदां मध्ये गणक आचार्यो भवत्यतस्तेषां ज्ञानमावश्यकमिति ॥ २ ॥

वि. भा.—कुट्टकेन गणितेन, खेन (शून्ययोगान्तरादिना) ऋणधनयोर्योगान्तरादिना, अव्यक्तानां योगान्तरादिना, मध्यमाहरणेन, एकवर्णसमीकरणेन, भावितसंज्ञकगणितेन एतैर्ज्ञातैर्वर्गप्रकृत्या च ज्ञातया ज्योतिर्विदां मध्ये गणक आचार्यो भवतीति ।। सिद्धान्तशेखरे "वस्वर्णकुट्टककृतिप्रकृति प्रभेदानव्यक्तवर्णसदृशे च बीजे । ते मध्यमाहरणभावितके च बुद्ध्वा निःसंशयं भवति दैवविदां गुरुत्वम् ।।" श्रीपतिनाऽप्यव्यक्तगणितभेदास्तत्प्रशंसा च कृतेति ।।२।।

अब कुट्टक आदियों की प्रशंसा को कहते हैं ।

हि. भा.—कुट्टकगणित, शून्य के सङ्कलनादि, ऋण और धन के सङ्कलनादि, अव्यक्तों के सङ्कलनादि, मध्यमाहरण, एक वर्णसमीकरण, भावितगणित, वर्ग प्रकृति इन सबों के समझदार गणक ज्योतिःशास्त्रज्ञों के मध्य में आचार्य होते हैं । सिद्धान्तशेखर में 'वस्वर्ण कुट्टककृतिप्रकृतिप्रभेदान्' इत्यादि वि. भा. में लिखितश्लोक से श्रीपति ने अव्यक्त गणित के भेद और उनकी प्रशंसा की हैं इति ।।२।।

इदानीं कुट्टकमाह ।

अधिकाग्रभागहाराद्गूनाग्रच्छेदभाजिताच्छेषम् ।
यत्तत् परस्परहृतं लब्धमधोऽधः पृथक् स्थाप्यम् ।।३।।
शेषं तथेष्टगुणितं यथाग्रयोरन्तरेण संयुक्तम् ।
शुध्यति गुणकः स्थाप्यो लब्धं चान्त्यादुपान्त्यगुणः ।।४।।
स्वोर्ध्वोऽन्त्ययुतोऽग्रान्तो हीनाग्रच्छेदभाजितः शेषम् ।
अधिकाग्रच्छेदहृतमधिकाग्रयुतं भवत्यग्रम् ।।५।।

सु. भा.—यत्र कोऽपि राशिरेकेन हरेण हृतोऽयं शेषः स एव राशिरपरेण हरेण हृतोऽयं शेष इति छेदद्वयं शेषद्वयं चोद्दिश्य तं राशिं कोऽपि पृच्छति तत्राधिकाग्रभागहारादधिकशेषसंबंधिहारात् किं विशिष्टादूनाग्रच्छेदभाजितादल्पशेषसंबंधिहारहृताच्छेषं यत् यत् परस्परहृतं लब्धं च पृथगधोऽधः स्थाप्यम् । एतदुक्तं भवति । अधिकाग्रभागहारेऽल्पाग्रभागहारेण हृते यच्छेषं तेनाल्पाग्रभागहारो विभक्तो यदत्र शेषं तेन प्रथमशेषं भक्तं पुनरत्र यच्छेषं तेन द्वितीयशेषं भक्तमेवं यथेच्छं कर्म कर्तव्यम् । फलानि चाधोऽधः स्थाप्यानि । एवमभीष्टं शेषं तथा केनापीष्टेन गुणितं यथाऽग्रयोरन्तरेण संयुक्तं तद्भाजकेनोपान्तिमशेषेण हृतं शुध्यति । एवं सति स गुणकः पूर्वस्थापितफलानामधः स्थाप्यो लब्धं च गुणकस्याधः स्थाप्यम् । ततोऽन्त्यात् कर्म कर्तव्यम् । कथमित्याहोपान्त्यगुण इति स्वोर्ध्वं उपान्त्यगुणोऽन्त्ययुतस्ततस्तदन्त्यं त्यजेदेवमग्रान्तोऽन्त्ये य ऊर्ध्वराशिः स हीनाग्रच्छेदभाजित ऊनशेषसम्बन्धिहरेण भक्तस्तत्र यच्छेषं तदधिकशेषहरेण गुणितमधिकशेष

युतं सराशिर्भवति। स एव छेदवधस्याग्रं भवति इति—अग्रिमसूत्रेण सम्बंधः। अत्रैतदुक्तं भवति। यदि स राशिश्छेदयोर्वधसमेन हरेण भक्तस्तदा तद्धरात्पत्वात् स राशिरेव शेषं भवतीति।

यथा मदुक्तमुदाहरणम्—

चतुस्त्रिंशद्धृतो द्व्यग्रः पंक्त्यग्रो विश्वभाजितः।
तं राशिं शीघ्रमाचक्ष्व यदि जानासि कुट्टकम्॥

अत्र ३४ छेदस्य शेषम् २।१३ छेदस्य शेषम् १०। अतोऽधिकाग्रभागहारः=१३। ऊनाग्रभागहारः=३४। अनेनाधिकाग्रभागहारे हृते शेषम्। ततः परस्परहृते न्यास :—

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अत्रैतावत् कर्मकृत्वा प्राप्तं शेषं २ यदीष्टद्वयेन गुण्यते तदा गुणनफलम्=४। इदमग्रान्तरेण ८ नेन युक्तम्=१२। इदं तद्धरेण ३ नेन भक्तं लब्धं निरग्रम्=४ अतः फलानामधो गुणकस्तदधो लब्धं च संस्थाप्योपान्तिमेन स्वोर्ध्वे हतेन्त्येन युते तदन्त्यं त्यजेदित्यादिनाऽग्रान्तः=३६। अग्रं हीनाग्रच्छेदेना ३४ नेन भाजितो जातं शेषम्=२। इदमधिकाग्रभागहारहतमधिकाग्रयुतं जातो राशिः=३६। अयं यदि छेदयोर्वधसमेन हारेणा—३४×१३=४४२ नेन विभज्यते तदा शेषं राशिसममेव भवति। यदि वल्ली समा स्यात् तदैवं कर्म कर्तव्यं यदि विषमा तदा गुणकाधो यल्लब्धं स्थापितं तद्दृणं प्रकल्प्य बीजप्रक्रियया योगान्तरन्तादि कर्म कर्तव्यम्। इदं वक्ष्यति चाचार्योऽग्रे १३ सूत्रेणेति। अभीष्टशेषं केन गुणमग्रान्तरयुतं तद्धरभक्तं शुध्यतीत्यत्र यदि शेषं रूपसमं भवेत् तदा तच्छेषमग्रान्तरसमेन गुणकेन गुणमग्रान्तरमेवातस्तत्राग्रान्तरशोधनेन तद्धरभक्तेन लब्धं निरग्रं शून्यं लाघवेन विदितं भवेदतो भास्कराचार्येण 'मिथो भजेत् तौ दृढभाज्यहारौ यावद्विभाज्ये भवतीह रूपम्'—इत्युक्तमिति सर्वं मत्कृतकुट्टकोपपत्त्या स्फुटम्। (द्रष्टव्ये मच्छोधिते भास्करलीलावतीबीजे)।

अत्रोपपत्तिः। कल्प्यतेऽधिकाग्रम्=$शे_1$ तद्धरश्च=$ह_1$। ऊनाग्रम्=$शे_2$।

तद्धरश्च $=$ ह$_2$ । अथ यथाऽधिकाग्रतद्धाराभ्यामालापो घटते तथा कल्पितं राशिमानम् $=$ हा$_1$ का $+$ शे$_1$ । इदमूनाग्रहारेण भक्तं लब्धं नीलकं तद्गुणितहरस्तच्छेष युतो जातः पूर्वराशिसमः ।

$$\text{ह}_2 \text{ नी} + \text{शे}_2 = \text{ह}_1 \text{ का} + \text{शे}_1 \text{ ।}$$

समशोधनादिना नीलकमानमभिन्नम् $=$ नी $= \dfrac{\text{ह}_1 \text{ का} + (\text{शे}_1 - \text{शे}_2)}{\text{ह}_2}$

अत्र ह$_1$, ह$_2$ भाज्यहाराभ्यां यदि कुट्टकक्रिया क्रियते तदा यद्राशियुग्मं स्यात् तत्राधरो राशिरेवाचार्यस्याग्रान्तः स ह$_2$ अनेनोनाग्रहरेण तष्टः शेषं कालकमानं 'ते भाज्यभाजकमाने भवतः' इति भास्करबीजेन कालकमानमूनाग्रहराल्पं जातं तदधिकाग्रहारेण हतं तच्छेषयुतं राशिमानं स्यादिति । अथ परमं कालकमानम् $=$ ह$_2$ $-$ १ । इद $-$ ह$_1$ मनेन गुणं शे$_1$ युतं जातम् $=$ ह$_1$ ह$_2$ $-$ ह$_1$ $+$ शे$_1$ $=$ ह$_1$ ह$_2$ $-$ (ह$_1$ $-$ शे$_1$) ।

अत्र प्रश्नानुसारेण ह$_1$ $>$ शे$_1$ । अत ह$_1$ $-$ शे$_1$ इदं धनात्मकं तेन पूर्वागतं राशिमानं सर्वदा $-$ ह$_1$ ह$_2$ ऽस्मादल्पमतश्छेदवधहरेण भक्तं राशिमानं शेषं राशिमानसममेवेत्युपपन्नं छेदवधस्य भवत्यग्रमिति ॥ ३–५ ॥

वि. भा.—कश्चित् भाज्यः केनचिद्धरेण भक्तोऽयं शेषः स एव भाज्योऽपरेण हरेण भक्तश्चायं शेष इति हरद्वयं शेषद्वयं चोक्त्वा स भाज्यः क इति प्रश्ने जायमाने, अधिकशेषसम्बन्धिहरमल्पशेषसम्बन्धिहरेण विभज्यावशेषं परस्परं विभजेत् अयमर्थः—अधिकशेष हरेऽल्पशेषहरेण भक्ते यच्छेषं तेनाल्पशेषहरे भक्ते यच्छेषं तेन प्रथम शेषे भक्ते यच्छेषं तेन द्वितीयशेषं भजेदिति क्रिया वारंवारं कार्या, फलानि चाधोऽधः स्थाप्यानि । एवमभीष्टं शेषं तथा केनापीष्टेन गुणितं यथा शेषयोरन्तरेण युतं तद्धरेणोपान्तिमशेषेण भक्तं शुध्यति । एवं सति स गुणकः पूर्वस्थापितफलानामधः स्थाप्यः । लब्धं च गुणकस्याधः स्थाप्यम् । ततोऽन्त्यात्कर्म कर्त्तव्यम् । स्वोर्ध्वे उपान्त्यगुणोऽन्त्ययुतस्तदन्त्यं त्यजेत् । एवमन्त्ये य ऊर्ध्वराशिः स हीनशेषसम्बन्धिहरेण भक्तो यच्छेषं तदधिकशेषेण गुणितं—अधिकशेषयुतं तदा स राशिर्भवति । स एव छेदवधस्याग्रं भवतीत्यस्याग्रिमसूत्रेण सम्बन्धः ।

अत्रोदाहरणं म. म. सुधाकरद्विवेद्युक्तम् ।

चतुस्त्रिशद्धृतोद्व्यग्रः पङ्क्त्यग्रो विश्वभाजितः । तं राशिं शीघ्रमाचक्ष्व यदि जानासि कुट्टकम् । अत्र ३४ हरस्य शेषम् $=$ २ । तथा १३ हरस्य शेषम् $=$ १० अतोऽधिकशेषहरः $=$ १३ । अल्पशेषहरः $=$ ३४ । अनेनाधिकशेषहरे भक्ते शेषम् $=$ १३, ततः परस्परभजनेन जाता वल्ली उपान्तिमेन स्वोर्ध्वे हतेऽन्त्येन युते तदन्त्यं

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त्यजेदित्यादिनाऽग्रान्तः=३६ अयं हीनाग्रच्छेदेना (हीनशेषहरेण) ऽनेन भक्तो जातं शेषम्=२। इदमधिकाग्रभागहार (अधिक शेषहर) गुणित-मधिकशेषयुतं जातो राशिः=३६ अयं यदि हरयोर्घातसमेन हरेण ३४×१३=४४२ नेन विभज्यते तदा शेषं राशिसममेव भवति। एवं वल्ली यदि समा स्यात् तदैवं कर्म कर्त्तव्यम्। यदि च विषमा तदा गुणकाधो यल्लब्धमस्ति तद्दृणं प्रकल्प्य बीजक्रियया योगान्तरादि कर्म कर्त्तव्यम्। अभीष्ट-शेषं केन गुणमग्रान्तर (शेषान्तर) युतं तद्धरभक्तं शुध्यतीत्यत्र यदि शेषं रूपसमं भवेत् तदा तच्छेषं शेषान्तरसमेन गुणकेन गुणं शेषान्तरमेवातस्तत्र शेषान्तर-शोधनेन तद्धरभक्ते न लब्धं निरग्रं शून्यं विदितं भवेदतो 'मिथो भजेत्तौ दृढ़भाज्य-हारौ यावद्विभाज्ये भवतीह रूपम्' भास्कराचार्येण कथितम्। सिद्धान्तशेखरे 'अल्पाग्रहृत्या बृहदग्रहारं छित्त्वाऽवशेषं विभजेन्मिथोऽतः। अग्रान्तरं तत्र युतिं प्रकल्प्य प्राग्वद्गुणः स्यादधिकाग्रहारः। तेनाहतः स्वाग्रयुतस्तदग्रं छेदाहृतिः। श्रीपत्युक्तप्रकारोऽयमाचार्योक्तप्रकारानुरूप एव। बीजगणिते लीलावत्यां च 'भाज्यो हारः क्षेपकश्चापत्र्यं' इत्यादिना आचार्योक्तापेक्षयाऽतीवस्पष्टरूपेण भास्कराचार्येण प्रदिपादितोऽस्तीति ॥

अत्रोपपत्तिः

कल्प्यतेऽधिक शेषम्=शे। तद्धरश्च=ह। अल्पशेषम्=शे′। तद्धरश्च=ह′, यदाऽधिकशेषतद्धराभ्यामालापो घटते तथा कल्पितं राशिमानम्=ह. क+शे इदमल्पशेषहरेण भक्तं लब्धं न तद्गुणितहरस्तच्छेषयुतो जातः पूर्वराशिसमः।

$$ह′. न+शे′=ह. क+शे \text{ समशोधनादिना न मानमभिन्नम्}=न=\frac{ह. क+(शे-शे′)}{ह′}$$

अत्र ह, ह′ भाज्यहाराभ्यां यदि कुट्टकक्रिया क्रियते तदा यद्राशिद्वयं तत्राधो ह′ अनेन अल्पशेषहरेण भक्तः शेषं गुणकरूपं क मानमल्पशेषहराल्पं जातं तदधिक-शेषहरेण गुणं तच्छेषयुतं राशिमानं भवति। अथ परमं क मानम्=ह′−१ इदं−ह अनेन गुणितं शे युतं जातम्=ह. ह′—ह+शे=ह. ह′—(ह—शे)। अथ प्रश्नानु-सारेण ह>शे अतः ह—शे इदं धनात्मकं तेन पूर्वागतं राशिमानं सर्वदा−ह, ह′ अस्मादल्पमतो हरघातहरेण भक्तं राशिमानं शेषं राशिमानसममेव। 'अधिग्रकाभाग-हारं छिन्द्यादूनाग्रभागहारेण। शेषपरस्परभक्तं मतिगुणमग्रान्तरे क्षिप्तम् ॥ अध उपरिगुणितमन्त्ययुगूनाग्रच्छेदभाजिते शेषम्। अधिकाग्रच्छेदगुणं द्विच्छेदाग्र-मधिकाग्रयुतम् ॥" इत्यार्यभटोक्तप्रकारस्यैव ब्रह्मगुप्तश्रीपत्योः प्रकारश्च पुनरूपपा-दनमिति ॥३—५॥

अब कुट्टक को कहते हैं ।

हि. भा.—किसी राशि को एक हर से भाग देने से जो शेष रहता हैं वही उसी राशि को दूसरे हर से भाग देने से रहता है । तब यह राशि क्या है । अधिक शेष सम्बन्धी हर में अल्पशेष सम्बन्धी हर से भाग देने से जो शेष रहता है उसको परस्पर भाग देने से लब्ध को पृथक् अधोऽधः स्थापन करना । अधिकशेष सम्बन्धी हर में अल्पशेष सम्बन्धी हर से भाग देने से जो शेष रहता है उससे अल्पशेष सम्बन्धी हार को भाग देने से जो शेष रहता है उससे प्रथम शेष को भाग देना । फिर यहां जो शेष रहे उससे द्वितीय शेष को भाग देना । इस तरह बराबर कर्म करना चाहिये । फलों को अधोऽधः स्थापन करना । इस तरह अभीष्ट शेष को किसी इष्ट से गुणा कर दोनों शेषों को जोड़ना जिससे वह भाजक (हर) उपान्तिम शेष से शुद्ध हो । इस तरह वह गुणक पूर्वस्थापित फलों के अधः स्थापन करना । तब अन्त से कर्म करना चाहिये । कैसे सो कहते हैं । ऊर्ध्वाङ्क को उपान्त्य से गुणाकर अन्त्य को जोड़ देना चाहिये, उस अन्त्य को त्याग देना चाहिये । इस तरह अन्त्य में जो ऊर्ध्व राशि होता है उसको अल्प शेष सम्बन्धी हर से भाग देने से जो शेष रहे उसको अधिक शेष सम्बन्धी हर से गुणाकर अधिक शेष को जोड़ने से राशि होता है ।।

यहां म. म. सुधाकर द्विवेदी का उदाहरण है ।

हि. भा.— किसी राशि को चौंतीस से भाग देने से दो शेष रहता है और तेरह से भाग देने से दश शेष रहता है उस राशि को कहो ।।

यहां ३४ हर का शेष=२ है । १३ हर का शेष=१० है । इसलिये अधिक शेष सम्बन्धी हर=१३ अल्प शेष सम्बन्धी हर=३४ है । इससे अधिक शेष सम्बन्धी हर को भाग भाग देने से शेष=१३ तब परस्पर भाग देने से वल्ली

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१	८
२	६

'उपान्तिमेन स्वोर्ध्वे हतेऽन्त्येन युतं तदन्त्यं त्यजेत्' इत्यादि से अग्रान्त=३६ इसको अल्प शेष सम्बन्धी ३४ इस हर से भाग देने से शेष=२, इसको अधिक शेष सम्बन्धी हर से गुणाकर अधिक शेष को जोड़ने से राशि=३६, इसको यदि दोनों हरों के घात के बराबर हर ३४×१३=४४२ से भाग देने से शेष राशि के बराबर होता है। यदि वल्ली सम रहे तब ही इस तरह कर्म करना । यदि वल्ली विषम रहे तब गुणक के नीचे जो लब्ध स्थापित है उसको ऋण कल्पना कर बीज क्रिया से योग अन्तर आदि कर्म करना चाहिये । इष्ट शेष को किस से गुणाकर दोनों शेषों के अन्तर को जोड़कर हर से भाग देने से शुद्ध होता है यहां यदि शेष रूप १ के बराबर हो तब शेष को शेष द्वय के अन्तर तुल्य गुणक से गुणा करने से शेषद्वय का अन्तर ही रहता है इसलिये उसमें शेषान्तर को घटाकर हर से भाग देने से लब्ध निःशेष शून्य होता है अतः लीलावती में 'मिथो भजेत्तौ दृढ़भाज्य हारौ' इत्यादि भास्कराचार्य ने कहा है ।

उपपत्ति।

कल्पना करते हैं अधिक शेष = शे। उसका हर = ह। अल्प शेष = शे', इसका हर = ह' जिस तरह अधिक शेष और उसके हर से आलाप घटे वैसे कल्पित राशिमान = ह. क + शे इसको अल्प शेष सम्बन्धी हर से भाग देनेसे लब्ध न तद्गुणित हर में शेष जोड़ने से पूर्व राशि के समान हुआ ह. क + शे = ह'. न + शे' समशोधन आदि करने से न मान अभिन्नात्मक = $\frac{\text{ह. क} + (\text{शे} - \text{शे'})}{\text{ह'}}$ यहां ह, ह' इन भाज्य और हर से यदि कुट्टक क्रिया की जाती है तो जो राशिद्वय होता है उनमें नीचे की राशि ही आचार्य का अग्रान्त है उसको ह' इस अल्प शेष हार से भाग देने से शेष क मान होता है 'ते भाज्य तद् भाजक वर्णमाने' इस भास्करोक्ति से क मान अल्प शेष सम्बन्धी हर से अल्प हुआ। उसको अधिक शेष सम्बन्धी हर से गुणाकर शेष जोड़ने से राशिमान होता है। परम क मान = ह' — १ इसको — ह से गुणाकर शे जोड़ने से ह. ह' − ह + शे = ह. ह' — (ह — शे)। यहां प्रश्न के अनुसार ह > शे इसलिये ह — शे यह धनात्मक है। अतः पूर्वागत राशिमान सदा — ह, ह' इससे अल्प होगा इसलिये शेष घात तुल्य हर से राशि मान को भाग देने से शेष राशिमान के बराबर ही होता है इति ॥३—५॥

इदानीं विशेषमाह

छेदवधस्य द्वियुगं छेदवधो युगगतं द्वयोरग्रम्।
कुट्टाकारेणैवं ग्याद्विग्रहयुगगतानयनम् ॥ ६ ॥

सु. भा.—छेदवधस्य पूर्वश्लोकेन सम्बन्धः पूर्वं प्रतिपादितः। द्वियुगं द्वयोर्ग्रहयोर्योगश्छेदयोर्वधो भवति तथा युगगतमन्तिमयोगाद्यद्गतं तद्द्वयोश्छेदयोरग्रं शेषं भवति। एवं कुट्टाकारेण ग्याद्विग्रहयुगगतानयनं कार्यम्। अत्रैतदुक्तं भवति। यथैको ग्रहो दिन चतुस्त्रिंशता ऽन्यश्च त्रयोदशदिनैरेकं भगणं भुंक्ते। तयोरन्तिमयुतेर्दशदिनानि व्यतीतानि तदा कल्पात् कियन्ति दिनानि व्यतीतानीति प्रश्ने को राशिश्चतुस्त्रिंशद्धृतो दशशेषस्त्रयोदशहृतश्च दशशेष इति प्रश्नोत्तरेणैवोत्तरसिद्धिः। अत्राग्रयोः समत्वादधिकाग्रहरश्चतुस्त्रिंशदेव कल्पितस्ततः पूर्वप्रकारेणाग्रयोरन्तरं शून्यं गृहीत्वा गुणाकारं शून्यं प्रकल्प्याग्रान्तः शून्यसमो वा द्वितीयहारसमस्तदा राशिः = ह, ह, + शे, अयमग्रश्छेदवधश्च छेद इत्येकस्य प्रकल्प्यान्यस्यैक भगणकालस्तद्धरस्तदग्रश्च पूर्वशेषसमः = शे, इति प्रकल्प्य पुनः कुट्टाकारेणैव विधिना

'ग्रहत्रयान्तिमयुतेर्दशदिनानि व्यतीतानि तदा कल्पगतं कि' मिति प्रश्नोत्तरमानेयम् । एवं त्र्यादिग्रहयुगगतानयनं कार्यम् ॥ ६ ॥

वि. भा.—छेदवधस्यैतस्य पूर्वश्लोकेन सम्बन्धः । द्वियुगं (द्वयोर्ग्रहयोर्योगः) छेदवधो भवति । युगगतं (अन्तिमयोगाद्यद्गतं) तत् द्वयोश्छेदयोरग्रं (शेषं) भवति, एवं कुट्टाकारेण त्र्यादिग्रहयुगगतानयनं कार्यम् । यथैको ग्रहो दिनचतुस्त्रिंशता ऽन्यश्च त्रयोदशदिनैरेकं भगणं भुङ्क्ते तयोरन्तिमयुतेर्दशदिनानि व्यतीतानि तदा कल्पात् कियन्ति दिनानि व्यतीतानीति प्रश्ने को राशिश्चतुस्त्रिंशद् भक्तो दशशेषस्त्रयोदशभक्तश्च दशशेष इति प्रश्नोत्तरेणैव तदुत्तरसिद्धिः । अत्र शेषयोः समत्वादधिकशेषसम्बन्धिहरश्चतुस्त्रिंशदेव कल्पितः । ततः पूर्वप्रकारेण शेषयोरन्तरं शून्यं गृहीत्वा गुणकारं शून्यं प्रकल्प्याग्रान्तः शून्यसमो वा द्वितीयहारसमस्तदा राशिः=ह. ह+शे अयं शेषो हरघातश्च हर इत्येकस्य प्रकल्प्यान्यस्यैकभगणकालस्तद्धरस्तच्छेषश्च पूर्वशेषसमः=शे इति प्रकल्प्य पुनः कुट्टाकारेणैव ग्रहान्तिमयुतेर्दशदिनानि व्यतीतानि तदा कल्पगतं किमिति प्रश्नोत्तरमानेयम् । एवं त्र्यादिग्रह युगगतानयनं कर्त्तव्यमिति ॥ ६ ॥

अब विशेष कहते हैं ।

हि. भा.—दो ग्रहों का योग छेदवध (हर घात) होता है अन्तिम योग से जो गत हैं वह दोनों हर का शेष होता है । एवं कुट्टाकार से त्र्यादि ग्रहयुगगतानयन करना चाहिये । जैसे एक ग्रह चौंतीस दिन में अन्य ग्रह तेरह दिन में एक भगण को भोग करता है । दोनों का अन्तिम योग से दश दिन का समय व्यतीत हुआ तब कल्प से कितने दिन व्यतीत हुए इस प्रश्नमें कौन राशि है—जिस को चौंतीस से भाग देने से दस शेष रहता है । तेरह से भाग देने से दस शेष रहता है इस प्रश्न के उत्तर ही से उसकी उत्तर सिद्धि होती है । यहां शेषद्वय के समत्व से अधिक शेष सम्बन्धी हर चौंतीस ही कल्पना किया गया । तब पूर्व प्रकार से दोनों शेषों के अन्तर को शून्य मानकर गुणकार को शून्य कल्पना कर एक भगण काल—उसका हर और शेष पूर्वशेष शे के बराबर कल्पनाकर पुनः कुट्टक से ग्रह के अन्तिम योग से दश दिन व्यतीत हुए तब कल्पगत क्या है इस प्रश्न का उत्तर लाना चाहिये । इस तरह तीन आदि ग्रहों का युग गतानयन करना चाहिये ॥ ६ ॥

इदानीं भगणादिशेषतो ऽहर्गणानयनमाह ।

भगणादिशेषमग्रं छेदहृतं खं च दिनजशेषहृतम् ।
अनयोरग्रं भगणादि दिनजशेषोद्धृतं द्युगणः ॥ ७ ॥

सु. भा.—भगणादिशेषं छेदहृतमग्रं भवति । खं शून्यं दिनजशेषहृतमेकदिन-

संबन्धि यद्भगणादिशेषं तद्दिनजशेषं तेन हृतं द्वितीयमग्रं कल्प्यम्। भगणादिशेष-मेकमग्रं तच्छेदो दृढ़कुदिनादि। शून्यमपरमग्रं तच्छेदो दिनजशेषमिति प्रकल्प्यानयोश्छेदयोर्वधसमे छेदे पूर्वोक्तकुट्टाकारेणाग्रं साध्यं तद्भगणादि दिनजशेषोद्धृतं द्युगणोऽहर्गणः स्यादिति।

अत्रोपपत्तिः। अहर्गणप्रमाणं या। इदं कल्पभगणगुणं कुदिनहृतं लब्धं गतभगणाः का। शेषं कल्प्यते भशे। ततो जातं समीकरणम्। कभ. या= ककु. का+भशे।

$$\therefore \text{या} = \frac{\text{ककु. का+भशे}}{\text{कभ}}$$

अत्र ककु, कभ भाज्यहाराभ्यां यौ राशी तत्राधरः कभ तष्टः शेषं कालकमानम्। परन्तु यद्यधिकाग्रम्=-भशे, तच्छेदः=ककु। ऊनाग्रम्=० तच्छेदश्च दिनजभगणशेषम्=कभ। तदाऽऽचार्योक्त कुट्टाकारेण छेदवधच्छेदेऽग्रमानम्=का. ककु +भशे। अत इदमग्रं दिनजशेषहृतं लब्धं यावत्तावन्मानमहर्गणः स्यादिति एवं राश्यादिशेषेऽपि तत्तच्छेदाभ्यां छेदवधच्छेदेऽग्रमानीय तदग्रं तद्दिनजशेषहृतं लब्धमहर्गणो भवतीत्युपपन्नमिति।

अत्र कोलब्रूकानुवादानुसारेण प्रश्नरूपार्यायास्त्रुटिः सा च
(इष्टभगणशेषाद्वा राश्यंशकलाविलिप्तिकाशेषात्।
आनयति द्युगणं यः कुट्टाकारं स जानाति ॥ ९ ॥)
एवं भवितुमर्हति। इयमार्या च स्पष्टार्था ॥ ९ ॥

वि. भा. - भगणादिशेषं (भगणशेषम्। राशिशेषम्। कलाशेषम्। विकलाशेषम्। तत् षष्ट्यंशादि शेषं छेदहृतं (छेदेन कुदिनात्मकेन भक्तं) अग्रं (शेषं) भवति। दिनजशेषेण (एकदिनसम्बन्धिभगणादिशेषेण) खं (शून्यं) भक्तं द्वितीय शेषं कल्प्यम्। अत्रायमर्थः—भगणादिशेषमेकमग्रं (शेषं) तच्छेदो (हरः) दृढ़-कुदिनानि। शून्यं द्वितीयमग्रं तच्छेदो दिनजशेषमिति प्रकल्प्य अनयोश्छेदाहृतितुल्ये छेदे पूर्वोक्तकुट्टकरीत्याऽग्रं (शेषं) साध्यं तद्भगणशेषेण भक्तं लब्धमहर्गणो भवेदिति ॥

अत्रोपपत्तिः।

अत्र कल्प्यते ऽहर्गणमानम्=य। तदा ऽनुपातो यदि कल्पकुदिनैः कल्पभगणा लभ्यन्ते तदाऽहर्गणेन किमित्यनुपातेन समागच्छन्ति गतभगणाः, भगणशेषं च, तदाऽनुपातस्वरूपम्$=\frac{\text{कल्पभ} \times \text{य}}{\text{ककु}}=\text{गभगण}+\frac{\text{भशे}}{\text{ककु}}$ छेदगमेन कल्पभ × य

$= \text{ककु} \times \text{गभगण} + \text{भशे}$ पक्षौ (कल्पभ) भक्तौ तदा य$= \frac{\text{ककु} \times \text{गभगण} + \text{भशे}}{\text{कल्पभ}}$

अत्र ककु, कल्पभ भाज्यहाराभ्यां यौ राशी तत्राधरः कल्पभभक्तः शेषं गतभगण-मानम् । परन्तु यद्यधिक शे=भशे, तद्धरः=ककु, अल्पशेषं =०, तद्धरः=कभगण तदा कुट्टकविधिना छेदवध (हरघात) समे हरे शेष मानम्=गतभगण. ककु+भशे अत इदं शेषमानं कल्पभगणभक्तं लब्धं य मानं भवेद्राश्यादिशेषेऽपि तत्तच्छेदाभ्यां छेदघातसमे छेदेऽग्र (शेष) मानीय तत्कल्पभगणभक्तमहर्गणो भवतीति ॥ सिद्धान्त शेखरे "चक्रर्क्षभागकलिका विकलादिशेषमग्रं स्वहारविहृतं भगणादि-भक्तम् । न्यूनाग्रमत्र हि फलं भगणादिनाप्तं लब्धं भवेद्दिनगणस्त्वपवर्त्तिते स्यात् ॥" श्रीपत्युक्तोऽयं प्रकार आचार्योक्तिप्रकार सम एवेति ॥७॥ अत्र कोलब्रू-कानुवादानुसारेण प्रश्नरूपार्यायास्त्रुटिर्वर्त्तते सा च 'इष्ट भगणशेषाद्वा राश्यंश-कलाविलिप्तिकाशेषात् । आनयति द्युगणं यः कुट्टाकारं स जानाति एवं भवि-तुमर्हतीति ॥९॥

अब भगणादि शेष से अहर्गणानयन कहते हैं ।

हि. भा.—भगणादि शेष (भगण शेष,राशिशेष, कलाशेष, विकलाशेष, उसके षष्टच (६०) शादि शेष) को छेद (दृढ़कुदिन) से भाग देने से अग्र (शेष) होता है । एक दिन सम्बन्धी भगणादिशेष (दिनज शेष) से शून्य को भाग देने से द्वितीयशेष होता है । अर्थात् भगणादि शेष एक अग्र (शेष) उसका छेद (हर) दृढ़ कुदिन । और शून्य द्वितीय अग्र उसका छेद दिनज शेष कल्पना कर दोनों छेदों के घात तुल्य छेद में कुट्टक रीति से अग्र(शेष)साधन करना उसको भगणशेष से भाग देने से लब्ध अहर्गण होता है । यहां कोलब्रूक साहब के अनुवादानुसार प्रश्नरूप आर्या की त्रुटि है वह संस्कृतोपपत्ति में लिखित श्लोक के सदृश होना चाहिये ॥६॥

उपपत्ति ।

कल्पना करते हैं अहर्गण प्रमाण=य तब अनुपात करते हैं यदि कल्प कुदिन में कल्प भगण पाते हैं तो अहर्गण में क्या इस अनुपात से आते हैं गतभगण और भगणशेष । तब अनुपात स्वरूप$= \frac{\text{कल्पभ. य}}{\text{ककु}} = \text{गतभ} + \frac{\text{भशे}}{\text{ककु}}$, छेदगम से कल्पभ. य=ककु. गतभ+भशे, दोनों पक्षों को कल्पभ भाग देने से य$= \frac{\text{ककु. गतभ} + \text{भशे}}{\text{कभ}}$ यहां ककु, कल्पभ भाज्य और हार से जो दो राशिप्रमाण होता है उसमें अधर (नीचे की) राशि को 'कल्पभ' से भाग देन से शेष गतभगण का मान होता है । परन्तु यदि अधिकाग्र=भशे, उसका हर=ककु, अल्पाग्र=०, उसका हर=कभगण । तब कुट्टक विधि से छेदवध तुल्य छेद में शेषमान=गत-

भगण. कक्|+भशे इसलिये इस शेषमान को कल्पभगण से भाग देने से लब्ध य मान होता है। राश्यादिशेष में भी तत् तत् शेष के छेदद्वय से छेदद्वय घात तुल्य छेद में अग्र (शेष) को लाना चाहिये, उसको कल्पभगण से भाग देने से अहर्गण होता है ।। सिद्धान्तशेखर में "चक्रर्क्षभाग कलिका विकलादिशेषं" इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से, श्रीपति ने आचार्योक्त प्रकार के सदृश ही कहा है इति ।। ६ ।।

इदानीं विशेषमाह ।

दिनजभगणादि शेषं येन गुणं मण्डलादिशेषकयोः ।
सदृशच्छेदोद्धृतयोस्तद्घातमहर्गणाद्यमतः ।।८।।

सु. भा.—उद्दिष्टं मण्डलादिभगणादिशेषं यदि येन केनापीष्टेन गुणं भवेत् तदा द्वे शेषे सदृशच्छेदे च कृत्वा ततस्तयोः शेषकयोः सदृशच्छेदोद्धृतयोश्च कृत्वा 'भगणादिशेषमग्रं छेदहृत' मित्यादिविधिना तद्घातसम्बन्ध्यग्रं साध्यं तदा तदग्रं तज्जातीयं कल्पगतं भवेदतोऽहर्गणाद्यं भवति। यथा कस्मिन् घटिकात्मके कल्पगते चन्द्रस्य भगणशेषं ४१०५ भवेत्। यदि १३७ दिनैश्चन्द्रभगणाः पञ्च ५ भवन्ति। अत्र यदि दिनानि १३७ षष्टिगुणानि कृत्वा १३७—६०=८२२० अयं हरः कल्प्यते तदा सच्छेदमुद्दिष्टभगणशेषम् $=\frac{४१०५}{८२२०}$ । दिनजभगणशेषं पूर्ववत् ५। ततः 'खं च दिनजशेषहृत' मित्यादिनोनाग्रं सच्छेदम्$=\frac{०}{५}$। अथ सच्छेदे शेषे $\frac{४१०५}{८२३०}$ । $\frac{०}{५}$। अत्र शेषयोः सच्छेदयोः पञ्चभिरपवर्त्य जाते नूतने सच्छेदे शेषे $\frac{८२१}{१६४४}$ । $\frac{०}{१}$ । अधिकाग्रभागहारा दूनाग्रछेदभाजिताच्छेषमित्यादिना प्रथमशेषम् = ०। तच्छेदः=१। शून्येनेष्टेन गुणकारेण गुणितं प्रथमशेषं लब्धमग्रान्तरेण युतं ८२१ तच्छेदेन १ हृतं लब्धं निरग्रम्=८२१। अत्र पूर्वलब्ध्यभावाद्वल्ली $\frac{०}{८२१}$ } अग्रान्तः =०। ऊनाग्रच्छेदभाजितः शेषम्=०। अधिकाग्रच्छेदहतमिदमधिकाग्रयुतं जातो राशिः ८२१। इदं घट्यात्मकं कल्पगतं तत् षष्टिहृतं जातं कल्पगतं दिनादि १३। ४१ ।।

अत्रोपपत्तिः। 'भगणादिशेष' मित्यादि पूर्वसूत्रान्तर्गतैव ।। ८ ।।

वि. भा.—मण्डलादि (भगणादि) शेषं येन केनापीष्टेन यदि गुणं भवेत्तदा द्वेशेषे सदृशच्छेदे च कृत्वा तयोः शेषयोः सदृशच्छेदभक्तयोः कृत्वा 'भगणादिशेषमग्रं छेदहृत' मित्यादिना तद्घातसम्बन्ध्यग्रं साध्यं तदा तदग्रं तज्जातीयं कल्पगतं भवेत्ततो ऽहर्गणाद्यं भवतीति।

यथा कस्मिंन् घटिकात्मके कल्पगते चद्रस्य भगणशेषं ४१०५ भवेत्। यदि १३७ दिनैश्चन्द्रभगणा: पञ्च ५ भवन्ति। अत्र यदि दिनानि × ६० = १३७ × ६० = ८२२० कृत्वा हरः कल्प्यते तदा सच्छेदमुद्दिष्टभगणशेषम् = $\frac{४१०५}{८२२०}$, पूर्ववत् दिनज भगणशेषम् = ५। ततः 'खेच दिनज शेषहृत' मित्यादिना ऽल्पाग्रं सच्छेदम् = $\frac{०}{५}$। अथ सच्छेदे शेषे $\frac{४१०५}{८२२०}$, $\frac{०}{५}$ अत्र शेषयोः सच्छेदयोः पञ्चभिरपवर्त्य जाते नवीने सच्छेदेशेषे $\frac{८२१}{१६४४}$, $\frac{०}{१}$, अधिकाग्रभागहारादूनाग्रच्छेद भाजितादित्यादना प्रथमशेषम् = ०। तच्छेदः = १, शून्येनेष्टेन गुणकारेण गुणितं प्रथमशेषं लब्धं शेषान्तरेणयुतं ८२१ तच्छेदेन १ हृतं लब्धं निरग्रम् = ८२१ अत्र पूर्वलब्ध्यभावात् वल्ली $\frac{०}{८२१}$

इदं घटयात्मकंकल्पगतं तत् षष्टिभक्तं कल्पगतं दिनादि ॥१३।४१॥

अत्रोपपत्तिः।

'भगणादिशेषमग्रं छेदहृतं खं च दिनजशेषहृत' मित्यादेरुपपत्तिदर्शनस्फुटेति ॥८॥

अब विशेष कहते हैं।

हि. भा.—भगणादि शेष को यदि जिस किसी इष्ट से गुणा करते हैं तो दो शेष और (सदृशच्छेदों) को करके सदृशच्छेद से भक्त उन दोनों शेषों को करके 'भगणादि शेषमग्रं छेदहृतं' इत्यादि से उसका घात सम्बन्धी अग्र (शेष) साधन करना चाहिये तब वह अग्र तज्जातीय कल्पगत होता है उससे अहर्गणादि होता है जैसे किसी घटिकात्मक कल्पगत में चन्द्र का भगण शेष ४१०५ होता है। यदि १३७ दिनों में चन्द्र भगण ५ होता है। यहां यदि इनको दिन १३७ × ६० = ८२२० करके हरकल्पना की जाय तब सच्छेद (छेदसहित) उद्दिष्ट भगण शेष = $\frac{४१०५}{८२२०}$, पूर्ववत् दिनज भगण शेष = ५ तब 'खं च दिनजशेषहृतं' इत्यादि से सच्छेद अल्पाग्र = $\frac{०}{५}$, सच्छेद शेषद्वय $\frac{४१०५}{८२२०}$, $\frac{०}{५}$ यहां छेद सहित शेषद्वय को पांच से अपवर्त्तन देने से नवीन छेद सहित शेषद्वय $\frac{८२१}{१६४४}$, $\frac{०}{१}$ 'अधिकाग्रभागहारा दूनाग्रच्छेद भाजितात्' इन्यादि से प्रथम शेष = १०। उसका छेद = १, शून्य इष्ट गुणकार से गुणित प्रथम शेष में शेषान्तर ८२१ को जोड़ देने से जो होता है उसको छेद से भाग देने से लब्ध निरग्र = ८२१, यहां पूर्वलब्धि के अभाव के कारण वल्ली $\frac{०}{८२१}$, यह घटयात्मक कल्प गत है इसको साठ से भाग देने से कल्पगत दिनादि ॥ १३।४१ इति ॥

उपपत्ति ।

'भगणादि शेषमग्रं छेदहृतं खं च दिनजशेषहृतम्' इत्यादि की उपपत्ति देखने से स्फुट है ॥८॥

इदानीं स्थिरकुट्टकमाह ।

हृतयोः परस्परं यच्छेषं गुणकारभागहारकयोः ।
तेन हृतौ निश्छेदौ तावेव परस्परं हृतयोः ॥९॥

लब्धमधोऽधः स्थाप्यं तथेष्टगुणकारसङ्गुणं शेषम् ।
शुध्यति यथैकहीनं गुणकः स्थाप्यः फलं चान्त्यात् ॥१०॥

अग्रान्तमुपान्त्येन स्वोर्ध्वो गुणितोऽन्त्यसंयुतोभक्तम् ।
निःशेषभागहारेणैवं स्थिरकुट्टके शेषम् ॥११॥

सु. भा.—यो राशिः केनचिदुद्दिष्टेन गुणकेन गुणित एकहीन उद्दिष्टभागहारेण भक्तः शुध्यति स क इति प्रश्नोत्तरार्थं प्रथमं गुणभागहारयोर्महत्तमापवर्तनमानीयते । परस्परं हृतयोर्गुणाकारभागहारकयोरन्ते यच्छेषं तेन हृतौ तौ गुणभागहारौ निश्छेदौ दृढौ भवत इति । ततस्तयोर्दृढयोर्गुणभागहारयोः परस्परं हृतयोर्लब्धमधोऽधः स्थाप्यं पूर्वप्रतिपादितकुट्टाकारविधिना । एवमिदं कर्म यथेच्छशेषपर्यन्तं कर्तव्यम् । ततस्तच्छेषं तथा केनापीष्टगुणाकारेण गुणितं रूपेण हीनं तच्छेषसम्बन्धिच्छेदेन हृतं यथा शुध्यति । एवं सतीष्टगुणाकारः पूर्वाधोऽधः स्थापितफलानामधः स्थाप्यस्तदन्त्याच्च फलं स्थाप्यम् । एवं सम्पन्नायां वल्ल्यामुपान्त्येन स्वोर्ध्वो गुणितोऽन्त्येन संयुत एवं कुट्टाकारविधिनैवाग्रान्तं कर्म कर्त्तव्यम् । तत् निःशेषभागहारेण दृढभागहारेण भक्तं शेषमेवं स्थिरकुट्टको भवतीति । अत्र प्रथमं गुणकारेण भागहारो विभाज्यः ।

अत्रोपपत्तिः । 'परस्परं भाजितयोर्ययोर्यः शेषस्तयोः स्यादपवर्तनं सः' इत्यादि भास्करविधिना स्फुटा इहाचार्येण रूपविशुद्धौ गुण एव साधितोऽतोऽत्राधरराशिरेवाग्रान्तो दृढभागहारेण तष्ट इति सर्वं भास्करकुट्टकप्रकरणेन स्फुटम् ॥ ९-११ ॥

अत्रकोलब्रूकानुवादानुसारेण प्रश्नरूपार्यायास्त्रुटिः सा च ।
(भगणादिशेषतोऽर्कस्यान्येषां वा दिवागणार्थं त्वम् ।
स्थिरकुट्टकं प्रचक्ष्व कुट्टार्णव पारगोऽसि यदि ॥ १४ ॥)
एवं भवितुमर्हति ।

वि. भा.—यो राशिः केनचिदुद्दिष्टेन गुणकेन गुणितः, एकहीनः, उद्दिष्ट-

हरेण भक्तः शुध्यति स राशिः कः। प्रथमं गुणहरयोर्महत्तमापवर्त्तनमानीयते। परस्परं भक्तयोर्गुणहरयोरन्ते यच्छेषं तेन भक्तौ तौ (गुणहरौ भवतः) दृढौ गुणहरौ भवतः। ततो दृढयोर्गुणहरयोः परस्परं भक्तयोर्लब्धान्यधोऽधः स्थाप्यानि, पूर्वप्रदर्शितकुट्टकनियमेन। इदं कर्म तावत्पर्यन्तं कर्त्तव्यं यावदन्ते रूपं शेषं तिष्ठेत्। तच्छेषं तथा केनापि गुणकेन गुणितं रूपेण हीनं तच्छेषसम्बन्धिहरेण भक्तं शुध्यति। सत्येवं गुणकः पूर्वाधोऽधः स्थापितकलानामधः स्थाप्यः, तदन्तात्फलं स्थाप्यम्। एवं जातायां वल्यां उपान्तिमेन स्वाध्वो गुणितोऽन्त्येन युत इति कुट्टकविधिना शेषान्तं यावत्कर्म कर्त्तव्यम्। तत् दृढभागहारेण (दृढहरेण) भक्तं शेषमेव स्थिरकुट्टको भवतीति ॥

अत्रोपपत्तिः।

अथ महत्तमापवर्त्तनार्थं कल्प्यते। भाज्यः=य। भाजकः=क, भाजकेन भक्ते भाज्ये लब्धं=न शेषम्=प। पुनः प अनेन स्वहारे क भक्ते लब्धं=ल, शेषम्=ह, पुनरनेन शेषेण स्वहारे प भक्ते लब्धं=र, शेषम्=० तदाऽवश्यमेव य, क माने ह अनेन निः शेषौ भवेताम्। हरलब्ध्योर्घातः शेषयुतो भाज्यसमो भवतीति तेन. य=क. न+प। क=प. ल+ह। प=ह. र एतत् समीकरणत्रयावलोकनेन स्फुटमवसीयते यत् प अयं ह अनेन निः शेषः स्यात्। ततः क अयमपि तेनैव निः शेषो भवेत्। एवं क, प अनयोर्निःशेषत्वात् य अयमपि ह अनेन निःशेषो भवेदेवेति। एतावता 'हृतयोः परस्परं यच्छेषं गुणकार भागहारकयो' रित्याचार्योक्तमुपपन्नम्। सिद्धान्तशेखरे "परस्परं भाजितयोस्तु शेषकं तयोर्द्वयोरप्यपवर्त्तनं भवेत्। तदुद्धृतच्छेदविभाजकौ क्रमादभीष्टनिघ्नौ तु गुणाप्तयोः क्षिपेत्" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवास्ति, तथा लीलावत्यां "परस्परं भाजितयोर्ययोर्यः शेषस्तयोः स्यादपवर्त्तनं सः तेनापवर्त्तेन विभाजितौ यौ तौ भाज्यहारौ दृढसंज्ञकौ स्तः॥" इति भास्करोक्तमपि-आचार्योक्तानुरूपमेवास्ति। आचार्येणात्र रूपशुद्धौ गुणक एव साधितोऽतोऽत्राधरराशिरेवाग्रान्तो दृढभागहारेण भक्त इति ॥९-११॥

कोलब्रूकानुवादानुसारेण प्रश्नरूपार्यायास्त्रुटिरस्ति सा च 'भगणादिशेषतोऽर्कस्यान्येषां वा दिवा गणार्थं त्वम्। स्थिरकुट्टकं प्रचक्ष्व कुट्टार्णवपारगोऽसि यदि' ॥१४॥ एवं भवितुमर्हति।

अथ स्थिर कुट्टक को कहते हैं।

हि. भा.—जिस राशि को किसी उद्दिष्ट गुणक से गुणाकर एक घटा कर उद्दिष्ट हर से भाग देने से शुद्ध होता है वह राशि क्या है। पहले गुणक और हर का महत्तमापवर्त्तन लाते हैं। परस्पर गुणक और हर को भाग देने से अन्त में जो शेष रहता है उससे

गुणक और हर को भाग देने से दृढ़ संज्ञक गुणक और हर होता है तब दृढ़ गुणक और हर को परस्पर भाग देने से जो लब्धियाँ हो उन्हें अधोऽधः स्थापन करना चाहिये। पूर्व प्रदर्शित कुट्टक नियम से इस कर्म को तब तक करना चाहिये जब तक अन्त में रूप शेष रह जाय। उस को किसी गुणक से गुणाकर रूप को घटा कर उस शेष सम्बन्धी हर से भाग देने से शुद्ध हो जाय। इस तरह पूर्वाधोऽधः स्थापित फलों के नीचे गुणक को स्थापन करना चाहिये। अन्त में फल स्थापन करना चाहिये। इस तरह वल्ली सम्पन्न होने पर उपान्त्य से ऊर्ध्वाङ्क को गुणाकर अन्त्य को जोड़ना। इस कुट्टक विधि से अग्रान्तपर्यन्त कर्म करना चाहिये। उसको दृढ़ भाग हार से भाग देने से शेष ही स्थिर कुट्टक होता है ॥

उपपत्ति।

महत्तमापवर्त्तन के लिये कल्पना करते हैं भाज्य=य। भाजक=क, भाज्य में भाजक से भाग देने से लब्ध=न, शेष=प। पुनः प इससे अपने हर क को भाग देने से लब्ध=ल, शेष=ह। पुनः इस शेष से अपने हर प में भाग देने से लब्ध=र, शेष=० तब अवश्य ही य, क, का मान ह इससे निः शेष होगा, हर और लब्धि के घात में शेष को जोड़ देने से भाज्य के के बराबर होता है इसलिये य=क. न+प। क=प. ल+ह। प=ह. र इन तीनों समीकरणों को देखने से स्फुट समझ में आता है कि प यह ह इससे निः शेष होगा, तब क यह भी उसी से निः शेष होगा इस तरह क, और प के निःशेषत्व से य यह भी ह इससे निः शेष होगा ही। इससे 'हृतयोः परस्परं यच्छेषं भाग-भागहारकयोः' इत्यादि आचार्योक्त उपपन्न हुआ। आचार्य ने रूप शुद्धि में गुणक ही साधन किया है इसलिये यहां अधर राशि ही को दृढ़ भाग हार से भाग दिया गया है। सिद्धान्तशेखर में 'परस्परं भाजितयोस्तु शेषकं तयोर्द्वयोरप्यपवर्त्तनं भवेत्' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है। तथा लीलावती में 'परस्परं भाजितयोर्ययोर्यः शेषः' इत्यादि संस्कृतोपपत्ति में लिखित पद्य से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है ॥९-११॥ कोलब्रूक साहिब के अनुवाद के अनुसार प्रश्नरूप आर्या की त्रुटि है वह संस्कृतोपपत्ति में लिखित पद्य के अनुसार होना चाहिये ॥१४॥

इदानीं स्थिरकुट्टकादहर्गणमाह।

इष्टभगणादिशेषात् स्वकुट्टकगुणात् स्वभागहारहृतात्।
शेषं द्युगणो गतनिरपवर्त्तगुणभागहारयुतः ॥१२॥

सु. भा.—यदि भगणशेषमिष्टं तदा कल्पभगणा गुणकारः। यदा राशिशेषमिष्टं तदा द्वादशगुणाः कल्पभगणा गुणकारः। भागहारस्तु सर्वदैव कल्पकुदिनानि ज्ञेयानि। एक गुणकारभागहाराभ्यां स्थिरं स्वकुट्टकं विधाय तत इष्टभगणादिशेषात् किं विशिष्टात् स्वकुट्टकगुणात् पुनः किं विशिष्टात् स्वभागहार-

हृताद्यच्छेषं स द्युगणोऽहर्गणो भवति स गत निरपवर्त्तगुणभागहारयुतोऽनेकधा भवति। गतः प्राप्तो निरपवर्त्तेन येनापवर्त्तेन गुणसम्बन्धी यो भागहारस्तेनार्थाद् दृढभागहारेण युतोऽनेकधा भवतीति।

अत्रोपपत्तिः। 'क्षेपं विशुद्धि परिकल्प्य रूपं पृथक् तयोर्ये गुणकारलब्धी'—इति भास्करविधिना स्फुटा ॥ १२ ॥

वि. भा.--यदि भगणशेषमिष्टं तदा कल्प भगणा गुणकारः। यदि च राशि शेषमिष्टं तदा द्वादशगुणाः कल्पभगणा गुणकारः। भागहरस्तु सदैव कल्पकुदिनानि ज्ञातव्यानि। एवं गुणकहाराभ्यां स्थिरं स्वकुट्टकं विधाय स्वकुट्टकगुणात्–स्वभागहारभक्तादिष्टभगणादिशेषाद्यच्छेषं सोऽहर्गणो भवति। निरपवर्त्तन गुणसम्बन्धी गतः (प्राप्तः) यो भागहारस्तेनार्थाद् दृढ़भागहारेण युतोऽनेकधा भवतीति ॥

अत्रोपपत्तिः।

$\frac{\text{भाज्य. गु} - १}{\text{हा}}$ = ल अत्र कुट्टकयुक्तचा ये गुणलब्धी ते ऋणात्मकक्षेपे। ततः ऋणात्मकरूपक्षेपे यदि समागतगुणलब्धी तदेष्ट ऋणात्मकक्षेपे किं ये गुणलब्धी ते स्वहारभक्ते तदा वास्तवगुणलब्धी भवेताम्। लीलावत्यां 'क्षेपं विशुद्धि परिकल्प्य रूपं पृथक् तयोर्ये गुणाकारलब्धी' इत्यादि भास्करोक्तमप्येतादृशमेव। सर्वत्रैव भास्करोक्तौ यादृशी विषयप्रतिपादने स्पष्टता न तादृशी-आचार्योक्ताविति ॥१२॥

अब स्थिर कुट्टक के लिये अहर्गण को कहते हैं।

हि. भा.—यदि भगण शेष इष्ट है तो कल्प भगण गुणकार होता है। यदि राशि शेष इष्ट है तो बारह गुणित कल्प भगण गुणकार होता है। भाग हार सदा कल्प कुदिन होता है। इस तरह गुणकार और भाग हार से स्थिर स्वकुट्टक करके स्वकुट्टक गुणित और स्वभाग हार से भक्त इष्ट भगणादि शेष से जो शेष हो वह अहर्गण होता है दृढ़ भाग हार को जोड़ने से अनेकधा होता है इति ॥

उपपत्ति।

$\frac{\text{भाज्य. गु} - १}{\text{हा}}$ = ल। यहां कुट्टक नियम से जो गुणक और लब्धी आती है वे ऋणात्मक रूपक्षेप में। तब अनुपात करते हैं यदि ऋणात्मक रूपक्षेप में ये गुणक और लब्धि तो इष्ट ऋणात्मक क्षेप में क्या इससे जो गुणक और लब्धी हो उन्हें अपने हर से भाग देने से वास्तव गुणक और लब्धि होती हैं। लीलावती में 'क्षेपं विशुद्धि परिकल्प्य रूपं' इत्यादि भास्करोक्त भी इसी तरह है इति ॥१२॥

स्थिरकुट्टकेन विकलादिशेषाद् ग्रहाहर्गणयोरानयनं ब्रह्मगुप्तेन भास्कराचार्येण चोक्तं, प्राचीनैः प्राधान्येन विकलादिशेषादहर्गणानयनार्थमेव कुट्टकविधिरुक्तः। भास्कराचार्येण च लीलावत्यां 'अस्य गणितस्य ग्रहगणिते महानुपयोगस्तदर्थं किञ्चिदुच्यते' इत्युक्त्वा तद्विधिश्च "कल्प्याथ शुद्धिर्विकलावशेषं षष्टिश्च भाज्यः कुदिनानि हारः। तज्जं फलं स्युर्विकला गुणस्तु लिप्ताग्रमस्माच्च कलालवाग्रम्। एवं तदूर्ध्वं च तथाधिमासावमाग्रकाभ्यां दिवसा रवीन्द्वोः॥" विधिरुक्तः। ग्रहस्य विकलाशेषाद्ग्रहाहर्गणयोरानयनम्। तद्यथा। तत्र षष्टिर्भाज्यः। कुदिनानि हारः। विकलावशेषं शुद्धिरिति प्रकल्प्य गुणलब्धी साध्ये तत्र लब्धिर्विकलाः स्युः। गुणः कलाशेषम्। एवं कलावशेषं शुद्धिः। षष्टिर्भाज्यः। कुदिनानि हारः। लब्धिः कलाः, गुणो भाग (अंश) शेषम्। भागशेषं शुद्धिः। त्रिंशद्भाज्यः। कुदिनानि हारः फलं भागाः। गुणो राशिशेषम्। एवं राशिशेषं शुद्धिः। द्वादशभाज्यः। कुदिनानि हारः। फलं गतराशयः। गुणो भगणशेषम्। कल्पभगणा भाज्यः। कुदिनानि हारः। भगणशेषं शुद्धिः। फलं गतभगणाः। गुणोऽहर्गणः स्यात्। अहर्गणज्ञानेन ग्रहज्ञानं सुगममेव। यद्यपि श्रीपतिना कुट्टकाध्यायेऽयं विषयो (विकलादि शेषाद्ग्रहाहर्गणयोरानयनं) नोक्तस्तथापि प्रश्नाध्याये-एतद्विषयक प्रश्नो विलिखितो यथा "यो राशिशेषादथ भागशेषाल्लिप्ताविलिप्तोद्भवशेषतो वा। अहोगतं तत्परशेषतोऽपि जानाति खेटं च स कुट्टकज्ञः॥" अर्थात् भगणादि ग्रहानयने यो राशिशेषस्तस्मात्। भागशेषात् भगणादि ग्रहानयन एव योंऽशशेषस्तस्मात्। भगणादिग्रहानयने कलाशेषाद्विकलाशेषाद्वा। खेटं (ग्रहं) तत्परशेषतोऽपि कला विकलादीनां षष्ट्यंशेषु मुहुर्वर्धितेषु तत्परतोऽपि यः शेषस्तस्मादपि च यो गणको गतमहर्गणं जानाति स कुट्टकज्ञोस्तीति॥

अस्योपपत्तिः। कल्पकुदिनैः कल्पभगणा लभ्यन्ते तदाऽहर्गणेन किमिति त्रैराशिकेनाऽभीष्टदिने भगणादिग्रहानयनं क्रियते। तत्र पूर्वोक्तानुपातेन लब्धा भगणाऽवशिष्टं भगणशेषम्। तच्च भगणशेषं द्वादशगुणं कल्पकुदिनैर्भक्तं लब्धा राशयः। शेषं राशिशेषं भवति। पुना राशिशेषं त्रिंशद्गुणितं कल्पकुदिनैर्भक्तं लब्धा अंशाः शेषं चांशशेषं भवति। तदंशशेषं षष्ट्या गुणितं कल्पकुदिनैर्भक्तं लब्धाः कलाः शेषं च कलाशेषम्। कलाशेषमपि षष्ट्या गुणितं कल्पकुदिनैर्भक्तं लब्धा विकला भवन्ति शेषं विकलाशेषमिति भगणादिशेषाणां परिभाषा। अतोऽत्र राश्यादिशेषात् ग्रहानयने कुट्टकगणितानुसारेण सम्भवे सति भाज्यहारक्षेपाः केनाप्यङ्केनापवर्त्तनीयाः। ततः पूर्वकथितरीत्या कलाशेषस्य गुणकः षष्टिः हारो दृढ़कुदिनानि। अथ येन गुणकेन गुणितश्छेदो विकलाशेषयुतः स्वगुणकेन षष्ट्या भक्तो निःशेषो भवति स गुणको ग्रहविकला भवन्ति फलं च कलाशेषम्। एवं कलाशेषात् कला अंशशेषं च भवति। एवमन्ते भगणशेषज्ञानं भवेत् तस्मादहर्गणज्ञानं च भवति।

यथा कलाशेषं षष्टिगुणं दृढकुदिनभक्तं लब्धं गृहविकला: शेषं च विकलाशेष-मिति। हरलब्ध्योर्घातः क्षेपयुतो भाज्यराशिसमः ६० × कशे = गृवि × दृकु + विशे

$\therefore$ कशे = $\frac{\text{गृवि} \times \text{दृकु} + \text{विशे}}{६०}$ अतो दृढकुदिनमानं येन गुणं विकलाशेषयुतं षष्टि-भक्तं निरग्रं भवति। स गुणको गृहविकला:। फलं च कलाशेषमिति। एवं स्वस्वशेषगुणच्छेदाभ्यां तत्तच्छेषमाने भवत इति। भगणादिशेषादहर्गणानयन-विधिरार्यभटीये महासिद्धान्ते—

भगणाद्यग्राणि स्युः क्षेपा ऋण संज्ञकाः क्वहाश्छेदः।
भगणादीनां भाज्याभगणार्यंखा[1] गना तना तेना॥
विकलाशेषोत्पन्नं फलं विलिप्ता गुणः कलाशेषम्।
लिप्ताग्रोत्पन्न फलं लिप्तागुणकोंऽशशेषं स्यात्॥
लवशेषजफलमंशा गुणको राश्यग्रकं भवति।
राश्यग्रोत्पन्नफलं गृहाणि गुणको भवेद् भगणशेषम्॥
मण्डलशेषप्रभवं फलं च चक्राण्यहर्गणो गुणकः॥" इति॥

स्थिर कुट्टक से ग्रहानयन और विकलादिशेष से अहर्गणानयन ब्रह्मगुप्त और भास्कराचार्यने किया है। विकलादिशेष से अहर्गणानयन को ही प्राचीनाचार्य प्रधानरूप से कुट्टक विधि कहते हैं। भास्कराचार्य ने लीलावती में 'अस्य गणितस्य ग्रहगणिते महानुपयोग-स्तदर्थं किञ्चिदुच्यते' यह कहकर उसकी विधि "कल्प्याथ शुद्धिर्विकलावशेषं षष्टिश्च भाज्यः कुदिनानि हारः" तज्जं फलं स्युर्विकला गुणस्तु लिप्ताग्रमस्माच्च कलालवाग्रम्। एवं तदूर्ध्वं च तथा इत्यादि से भास्कराचार्य ने विधि कही है। ग्रह के विकलाशेष से ग्रहानयन अहर्गणानयन करते हैं। जैसे—साठ भाज्य। कुदिन हर, विकलावशेष शुद्धि ये कल्पना कर गुणक और लब्धि साधन करना चाहिये, यहां लब्धि विकला होती है। और गुणक कलाशेष। एवं कलाशेष शुद्धि। साठ भाज्य। कुदिन हर इससे लब्धि कला होती है और गुणक भाग (अंश) शेष होता है। भागशेष शुद्धि, तीस भाज्य, कुदिनहर इससे लब्धि गतराशि प्रमाण होता है। गुणक भगणशेष होता है। कल्पभगण भाज्य। कुदिन हर, भगणशेष शुद्धि इससे लब्धि गतभगण होता है। गुणक अहर्गण होता है। अहर्गण ज्ञान से ग्रहानयन सुगम ही है। यद्यपि श्रीपति ने कुट्टकाध्याय में इस विषय को (विकलादिशेष से ग्रहानयन और अहर्गणा-नयन) नहीं कहा है। तथापि प्रश्नाध्याय में एतद्विषयक प्रश्न लिखे हैं जैसे—

'यो राशिशेषादथ भागशेषा'दित्यादि संस्कृतोपपत्ति में लिखित श्लोक से स्पष्ट किया है। अर्थात् भगणादि ग्रहानयन में जो राशि शेष है उससे, भगणादिग्रहानयन में ही जो अंश शेष है उससे भगणादि ग्रहानयन में कलाशेष से या विकलाशेष से ग्रह को और अहर्गण को जो गणक जानते हैं वे कुट्टकज्ञ हैं।

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(१) यंखा = १२। गना = ३०। तना = ६०। तेना = ६० द्वितीयार्यभटकृते महा-सिद्धान्ते एवमेव केरलमतानुसारी सवत्रैव संख्यापाठोऽस्तीति।

इसकी उपपत्ति ।

यदि कल्प कुदिन में कल्पभगण पाते हैं तो अहर्गण में क्या इस त्रैराशिक से अभीष्ट दिन में भगणादि ग्रहानयन करते हैं । उपर्युक्तानुपात से लब्ध भगण होता है और शेष भगण शेष है । इस भगण शेष को बारह से गुणा कर कल्प कुदिन से भाग देने से लब्ध राशिप्रमाण होता है । शेष राशि शेष है । राशि शेष को तीस से गुणाकर कल्प कुदिन से भाग देने से लब्ध अंश होता है । शेष अंश शेष होता है । इस अंश शेष को साठ से गुणा कर कल्पकुदिन से भाग देने से लब्धि कला होती है । और शेष कला शेष होता है । कला-शेष को साठ से गुणाकर कल्पकुदिन से भाग देने से लब्धि विकला होती है । शेष विकला शेष होता है । यही भगणादिशेषों की परिभाषा है । अतः यहां राश्यादि शेष से ग्रहानयन में कुट्टक गणितानुसार सम्भव रहने पर किसी अङ्क से भाज्य हार-क्षेपों को अपवर्त्तन देना चाहिये । तब पूर्वकथित रीति से कलाशेष के गुणक साठ, हार दृढ़कुदिन, जिस गुणक से गुणित छेद में विकलाशेष जोड़कर अपने गुणक साठ से भाग देने से निःशेष हो वह गुणक ग्रहविकला होती है । लब्धिकला शेष होता है । कलाशेष से कला अंश शेष होता है । इस तरह अन्त में भगणशेष ज्ञान होता है । उससे अहर्गणानयन भी होता है । जैसे कलाशेष को साठ से गुणाकर दृढ़ कुदिन से भाग देने से लब्धि ग्रहविकला होती है और शेष विकला शेष होता है । हर और लब्धि के घात में क्षेप को जोड़ने से भाज्य के बराबर होता है

$\therefore$ ६० $\times$ कशे $=$ ग्रवि. दृकु $+$ विशे $\therefore$ $\frac{\text{ग्रवि. दृकु} + \text{विशे}}{६०}$ $=$ कशे अतः दृढ़कुदिन मानं जिस गुणक से गुणाकर विकला शेष को जोड़कर साठ से भाग देने से निरग्र (निःशेष) हो वह गुणक ग्रहविकला होती है । और लब्धि कलाशेष होता है । भगणादि शेष से अहर्गणा-नयन की विधि आर्यभटीय महासिद्धान्त में है जैसे—

'भगणाद्यग्राणि स्युः क्षेपा ऋण संज्ञकाः कुद्दाश्छेदः ।
भगणादीनां भाज्या भगणा यंखा[1] गना तना तेना ॥'

इत्यादि संस्कृतोपपत्ति में लिखित श्लोकों से स्फुट है इति ॥

भास्कराचार्येण 'कल्प्याथ शुद्धिर्विकलावशेषमित्यादौ' कथ्यते यदस्य गणितस्य ग्रहगणिते महानुपयोगस्तदुपयोगित्वसम्बन्धे विचार्यते । यथा भगणादिशेषतो ऽहर्गणानयनार्थं दृढभगणशेषं चक्रविकलाभिर्गुणितं दृढकुदिनैर्भक्तं लब्धं विकलात्मकग्रहः शेषं विकलाशेषं तत्स्वरूपम् $= \frac{\text{दृभशे} \times \text{चवि}}{\text{दृकुदि}} =$ विग्र $+$ $\frac{\text{विशे}}{\text{दृकुदि}}$ छेदगमेन दृभशे $\times$ चवि $=$ दृकुदि. विग्र $+$ विशे अतः दृभशे

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१. यंखा $=$ १२ । गना $=$ ३० । तना $=$ ६० । तेना $=$ ६० द्वितीयार्यभटकृत महासिद्धान्त में इसी तरह केरलमतानुसारी सब जगह संख्याओं के पाठ हैं ।

$= \frac{\text{दृकुदि. विग्र} + \text{विशे}}{\text{चवि}}$, विग्र = विकलात्मकग्रह । विशे = विकलाशेष । चवि = चक्रविकला। अत्र यदि चक्रविकलातो विकलाशेषमल्पं तदा ऽस्मिन् $\frac{\text{दृकुदि. विग्र}}{\text{चवि}}$ स्वरूपेऽपि शेषेणावश्यं भवितव्यम् यतो दृढभगणस्वरूपे दृढकुट्टकावसरः । कुट्टकस्य सार्वदिक दृढत्वमस्त्येवातो विकलाशेषस्य शेषस्य च योगश्चक्रविकलासमः । अन्यथा दृढत्वाभावापत्तिः । अथ यदि लब्धिः = ल तदा भशे = $\frac{\text{ल. चवि} + \text{शे} + \text{विशे}}{\text{चवि}}$

अर्थात् ल + $\frac{\text{विशे} + \text{शे}}{\text{चवि}}$ परन्त्वत्र शे < चवि, विशे < चवि परञ्च दृढभगणशेषं निरवयवमतः शे + विशे = चवि अतः $\frac{\text{शे} + \text{विशे}}{\text{चवि}} = १$ । तेन ल + १ = दृभशे अन्यथा दृढत्वाभावात्कुट्टकस्याव्याप्तिः । अतः चवि — शे = विशे, यदि शे = ० तदा विशे = चवि । यदि चवि-शे > दृकु स्यात्तदा 'येनच्छिन्नौ भाज्यहारावित्यादि' युक्त्या खिलोद्दिष्टत्वात् दृढभगणशेषमपि खिलम् । अखिलोदाहरणसत्वे 'कल्प्याथ शुद्धिर्विकलावशेष' मित्यादिना ऽहर्गणः साध्यः । अथ पूर्वानीतभगणशेषस्वरूपे छेदगमादिना $\frac{\text{दृभशे. चवि-विशे}}{\text{दृकु}}$ = विग्र अत्र कुट्टकयुक्त्या ऽहर्गणज्ञानं सुलभम् । परञ्चोक्तस्वरूप एव भशे. चवि-विग्र. दृकु = विशे., अस्मिन् इ. चवि योजनेन तुल्य-गुणक पृथक् करणेन च (दृभशे. इ) चवि-विग्र = विशे + इ. चवि अत्र यदि विशे + इ. चवि-दृकु तदा दृभगशे. + इ. = भगशे-विशे + इ. चवि = विशे अस्मादपि कल्प्याथ शुद्धिर्विकलावशेषमित्यादिना ऽहर्गणः साध्य इति ॥

भास्कराचार्य लीलावती में 'कल्प्याथ शुद्धि विकलावशेषं' इत्यादि कहते हैं कि 'अस्य गणितस्य ग्रहगणिते महानुपयोगः' अर्थात् इस गणित के ग्रहगणित में बहुत उपयोगिता है । उसकी उपयोगिता के सम्बन्ध में विचार करते हैं। यथा भगणादिशेष से अहर्गणानयन के लिये दृढभगणशेष को चक्र विकला से गुणाकर दृढकुदिन से भाग देने से लब्ध विकलात्मक ग्रह होता है शेषविकला शेष रहता है उसका स्वरूप = $\frac{\text{दृभशे. चवि}}{\text{दृकुदि}}$ = विग्र + $\frac{\text{विशे}}{\text{दृकुदि}}$

छेदगम से दृभशे. चवि = दृकुदि.विग्र + विशे । अतः $\frac{\text{दृकुदि. विग्र} + \text{विशे}}{\text{चवि}}$ = दृभशे । विग्र = विकलात्मकग्र, विशे = विकलाशेष, चवि = चक्रविकला, यहां यदि चक्रविकला से विकला-शेष अल्प है तब $\frac{\text{दृकुदि.विग्र}}{\text{चवि}}$ इस स्वरूप में भी शेष अवश्य होना चाहिये, क्योंकि दृढभग-णस्वरूप में दृढ़ कुट्टक का अवसर है, कुट्टक का सार्वदिक दृढ़त्व है ही इसलिये विकलाशेष

और शेष का योग चक्र विकला के समान है। अन्यथा दृढ़त्वाभाव रूप आपत्ति होगी। यदि लब्धि = ल तब भशे = $\frac{\text{ल. चवि} + \text{शे} + \text{विशे}}{\text{चवि}}$ अर्थात् ल + $\frac{\text{शे} + \text{विशे}}{\text{चवि}}$ परन्तु यहां शे < चवि, विशे < चवि लेकिन दृढ़ भगण शेष निरवयव है इसलिये शे + विशे = चवि $\therefore$ $\frac{\text{शे} + \text{विशे}}{\text{चवि}}$ = १, इसलिये ल + १ = दृभशे अन्यथा दृढ़त्व के अभाव से कुट्टक की अव्याप्ति होगी, अतः चवि--शे = विशे, यदि शे = ० तब विशे = चवि, यदि चवि-शे > दृकुदि तब 'येनच्छिन्नौ भाज्यहारौ' इत्यादि युक्ति से उदाहरण के खिलत्व से दृढ़भगणशेष भी खिल होगा। अखिल उदाहरण के रहने से 'कल्प्याथशुद्धिर्विकलावशेषं' इत्यादि भास्करोक्त से अहर्गण साधन करना, पूर्वानीत भगणशेषस्वरूप में छेदगमादि से $\frac{\text{दृभशे. चवि} - \text{विशे}}{\text{दृकु}}$ = विग्र। यहां कुट्टक की युक्ति से अहर्गणज्ञान सुलभ है। परञ्च उक्त स्वरूप ही में भशे. चवि-विग्र. दृकु = विशे इसमें इ. चवि जोड़ने से और तुल्य गुणक पृथक् करने से (दृभशे.इ) चवि-विग्र = विशे + इ. चवि। यहां यदि विशे + इ. चवि-दृकुदि तब दृभशे + इ = भगशे × विशे + इ. चवि = विशे, इससे भी 'कल्प्याथ शुद्धि विकलावशेषं' इत्यादि से अहर्गण साधन करना चाहिए इति ॥ १२ ॥

इदानीं स्थिरकुट्टके विशेषमाह।

एवं समेषु विषमेष्वृणं धनं धनमृणं यदुक्तं तत्।
ऋणधनयोर्व्यस्तत्वं गुण्यप्रक्षेपयोः कार्यम् ॥१३॥

सु. भा.—एवं पूर्वागतवल्लीस्थफलेषु समेषु कर्म भवति। विषमेषु फलेषु च यदिष्टगुणाकारतो लब्धं भवेत् तत्तत्र यद्धनं वा ऋणमुक्तं स्यात् तत् क्रमेण ऋणं धनं कार्यम्। एवमृणधनयोर्गुण्यप्रक्षेपयोश्च व्यस्तत्वं कार्यम्। अत्रैतदुक्तं भवति। यदि गुणो धनः क्षेपश्च क्षयस्तत्र धनगुणक्षेपाभ्यां कर्म कर्तव्यम्। यत्र च गुणोऽधनः क्षेपश्च धनस्तत्र धनेन गुणेन ऋणक्षेपे कुट्टकः कर्त्तव्य इति।

अत्रोपपत्ति। 'एवं तदैवात्र यदा समास्ताः' इत्यादिभास्करविधिना स्फुटा। इहाचार्येण प्रथमं गुणकारेण भागहारो विभाजितोऽतोऽत्र द्वितीय लब्धितो वल्ली सम्पन्ना तेन समायां वल्ल्यामृणक्षेपेऽन्यथा धनक्षेपे भवतीति। 'ऋणभाज्ये धनक्षेपे' इत्यादिविधिना शेषोपपत्तिः स्फुटेति ॥ १३ ॥

वि. भा.—विषमेषु फलेषु यदिष्टगुणाकारतो लब्धं भवेत्तत्तत्र यद्धनं वा ऋणमुक्तं तत् क्रमेण ऋणं धनं कार्यम्। एवमृणधनयोर्गुण्यप्रक्षेपयोश्च व्यस्तत्वं कार्यम्। यदि गुणो धनः क्षेपश्चर्णं तत्र धनगुणक्षेपाभ्यां कर्म कार्यम्। यत्र च गुणो

ऋणात्मकः क्षेपश्च धनात्मकस्तत्र धनात्मकगुणेन ऋणक्षेपे कुट्टकः कर्त्तव्य इति ॥

अत्रोपपत्तिः ।

$$\frac{\text{भा. गु}+\text{क्षे}}{\text{हा}}=\text{ल} \therefore \text{भा. गु}+\text{क्षे}=\text{हा. ल}\cdots\cdots\cdots(\text{क})$$

$$\text{इ. भा. हा}=\text{इ. भा. हा}\cdots\cdots\cdots(\text{ख})$$

(ख) अत्र समीकरणे (क) समीकरणं विशोध्यते तदा इ. भा. हा—(भा. गु+क्षे)=इ. भा. हा—हा. ल =इ. भा. हा—भा. गु—क्षे=भा (इ. हा—गु)—क्षे=हा (इ. भा—ल)। अत्र यदि इ=१ तदा भा (हा—गु)—क्षे=हा (भा—ल) अतः $\frac{\text{भा (हा}-\text{गु})-\text{क्षे}}{\text{हा}}=\text{भा}-\text{ल}$ अत्र यदि हा—गु=गु′। भा—ल =ल′ तदा $\frac{\text{भा. गु}'-\text{क्षे}}{\text{हा}}=\text{ल}'$, लीलावत्यां 'यदा गतौ लब्धिगुणौ विशोध्यौ स्वतक्षणाच्छेमितौ तु तौ स्त' इति भास्करोक्तमप्याचार्योक्त सदृशमेव। अथ भा. गु+क्षे =हा. ल, उभयत्रापि इ. भा. हा योजनेन भा. गु+क्षे+इ. भा. हा=हा. ल+इ. भा. हा=भा (गु+इ. हा)+क्षे=हा (ल+इ. भा) अत्र यदि गु+इ. हा=गु′, ल+इ. भा=ल′ तदा भा. गु′+क्षे=हा. ल′ एतावताऽऽचार्योक्तमुपपन्नम्। सिद्धान्त शेखरे "तदुद्धृतच्छेदविभाज्यकौ क्रमादभीष्टनिघ्नौ तु गुणाप्तयोः क्षिपेत्" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति ॥१३॥

अब स्थिर कुट्टक में विशेष कहते हैं ।

हि. भा.—इस तरह पूर्वागत वल्लीस्थ फल में कर्म होता है। विषम फल में इष्ट गुणकार से जो लब्ध हो वह वहां जो धन वा ऋण कथित है वह क्रम से ऋण और धन करना चाहिये। एवं ऋण गुण्य और धन क्षेप को विलोमत्व करना चाहिये। यदि गुणक धन हो और क्षेप ऋण हो वहां धनात्मक गुणक और क्षेप से कर्म करना चाहिये। जहां गुणक ऋण हो और क्षेप धन हो वहां धनात्मक गुणक से ऋण क्षेप में कुट्टक करना चाहिये इति ॥

उपपत्ति ।

$$\frac{\text{भा. गु}+\text{क्षे}}{\text{हा}}=\text{ल. अतः भा. गु}+\text{क्षे}=\text{हा. ल}\cdots\cdots\cdots(\text{क})$$

$$\text{इ. भा. हा}=\text{इ. भा. हा}\cdots\cdots\cdots(\text{ख})$$

(ख) समीकरण में से (क) समीकरण को घटाने से इ. भा. हा—(भा. गु+क्षे) =इ. भा. हा—हा. ल=इ. भा. हा—भा. गु—क्षे=भा (इ. हा—गु)—क्षे=हा

(इ. भा—ल)। यहां यदि इ=१ तब भा (हा—गु)—क्षे=हा (भा—ल) अतः [भा (हा—गु)—क्षे] / हा = भा—ल, यहां यदि हा—गु=गु'। भा—ल=ल' तब [भा. गु'—क्षे] / हा = ल', लीलावती में 'यदा गतौ लब्धिगुणौ विशोध्यौ' इत्यादि भास्करोक्त इससे उपपन्न होता है जो कि आचार्योक्त के सदृश ही है। भा. गु+क्षे=हा. ल दोनों में इ. भा. हा जोड़ने से भा. गु+क्षे+इ. भा. हा=हा. ल+इ. भा. हा=भा (गु+इ. हा)+क्षे=हा (ल+इ. भा) यहां यदि गु+इ. हा=गु'। ल+इ. भा=ल' तब भा. गु'+क्षे=हा. ल' इससे आचार्योक्त उपपन्न होता है। सिद्धान्तशेखर में 'तदुद्धृतच्छेदविभाजकौ क्रमादभीष्टनिघ्नौ' इत्यादि श्रीपत्युक्त भी उपपन्न हुआ जो कि आचार्योक्त के अनुरूप है इति ॥१३॥

इदानीं विलोमगणितमाह।

गुणकश्छेदो छेदो गुणको धनमृणमृणं धनं कार्यम्।
वर्गः पदं पदं कृतिरन्त्याद्विपरीतमाद्यं तत् ॥१४॥

सु. भा.—अन्त्याद् दृश्याद्विपरीतं कार्यं तदाऽऽद्यमाद्यराशिमानं भवेत्। शेषं स्पष्टार्थम्। 'छेदं गुणं गुणं छेदं वर्गं मूलं पदं कृतिम्'—इत्यादि भास्करोक्त मेतदनुरूपमेव ॥ १४ ॥

वि. भा.—अन्त्यात् (दृश्यात्) गुणको हरः। छेदोहरः गुणकः। धनं ऋणं, ऋणं धनं, वर्गो मूलं, मूलं वर्गः, इति सर्वं दृश्ये कार्यं तदाऽऽद्यराशिमानं भवेत्। सिद्धान्तशेखरे "गुणो हरो हरो गुणः पदे कृतिः कृतिः पदम्। क्षयो धनं धनं क्षयः प्रतीपकेन दृश्यके॥" श्रीपत्युक्तमिदं "गुणकारा भागहरा भागहरा ये भवन्ति गुणकाराः। यः क्षेपः सोऽपचयोऽपचयः क्षेपश्च विपरीते॥"इत्यार्यभटोक्तस्यानुरूपमेव आचार्यो (ब्रह्मगुप्त) क्तमप्यार्यभटोक्तानुरूपमेव। गुणकारा भागहरा इत्यादेर्गणितार्थमार्यभटीयटीकाकारस्य परमेश्वरस्योदाहरणम्। कस्त्रिघ्नः पञ्चभिर्भक्तः षड्भिर्युक्तः पदीकृतः। एकोनो वर्गितो वेदसंख्यः स गणक उच्यताम् ॥ छेदं गुणं गुणं छेदं वर्गं मूलं पदं कृतिम्। ऋणं स्वमित्यादि भास्करोक्तमाचार्योक्तानुरूपमेवास्ति। गणेशदैवज्ञोक्तमुदाहरणम्। राशेर्यस्य कराहतस्य च पदं स्वाष्टांश युग्वर्गितं रामाप्तं च निजैस्त्रिभिर्नवलवैरूनं स नूनः पुनः। शिष्टं वेदमितं विलोम विधिना तं ब्रूहि राशिं सखे चेत्पाटीगणिताटवीप्रकटितं शार्दूलविक्रीडितम् ॥"

अब विलोम गणित को कहते हैं।

हि. भा.—अन्त्य (दृश्य) से गुणक को हर, हर को गुणक, धन को ऋण, ऋण

को धन, वर्ग को मूल, मूल को वर्ग यह सब कर्म दृश्य में करना चाहिये तब आद्यराशि मान होता है ॥१४॥

उपपत्ति ।

राशि में जिन कर्मों को करने से दृश्य के बराबर हो, दृश्य में उन्हीं कर्मों की विलोम क्रिया से इष्ट राशि मान होता है ॥ सिद्धान्तशेखर में 'गुणो हरो हरो गुणः पदं कृतिः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्य के अनुरूप ही कहा है । 'गुणकारा भागहरा भागहरा ये भवन्ति गुणकारा' इत्यादि संस्कृतोपपत्ति में लिखित आर्यभटोक्त प्रकार के अनुरूप ही आचार्यो (ब्रह्मगुप्त) क्तप्रकार भी है । लीलावती में 'छेदं गुणं गुणं छेदं वर्गं मूलं पदं कृतिम्' – इत्यादि भास्करोक्त भी आचार्योक्त के अनुरूप ही है इति ॥१४॥

इदानीं प्रश्नमाह ।

यो जानाति युगादिग्रहयुगयातैः पृथक् पृथक् कथितैः ।
द्वित्रिचतुःप्रभृतीनां कुट्टाकारं स जानाति ॥१५॥

सु. भा.—द्विचतुःप्रभृतीनां पृथक्-पृथक् कथितैर्ग्रहयुगयातैर्यो युगादि जानाति स कुट्टाकारं जानातीत्यहं मन्ये । अस्योत्तरं 'छेदवधस्य द्वियुग' मिति षष्ठसूत्रेण स्फुटम् । कोलब्रूकसाहबेन यत्पुस्तकादस्याङ्गलभाषायामनुवादः कृतस्तस्मिन्नयं सप्तमः श्लोकः ॥ १५ ॥

अत्रोदाहरणं चतुर्वेदाचार्येण कल्पे रविभगणाः ३० । चन्द्रभगणाः ४०० । कुजभ. १६ । बुभ. १३० । गुभ. ३ । शुभ. ५० । शभ. १ । च. उ. भ. ४ । च. पा. भ. २ । भदिनानि १०९६० । सौरमासाः ३६० । चान्द्रमासाः ३७० । अधिमासाः १० । सौरदिनानि १०८०० । चान्द्रदिनानि १११०० । क्षयाहाः १४० । सावनदिनानि १०९६० ।

एकस्मिन् दिने भगणात्मिका गतिश्च ।

र.	चं.	भौ.	बु. उ.	गु.	शु. उ.	श.	च. उ.	च. पा.
३/१०९६	५/१३७	१/६८५	१३/१०९६	३/१०९६०	५/१०९६	१/१०९६०	१/२७४०	१/५४८०

कल्पिता । इति सर्वं कोलब्रूकानुवादतो ज्ञायते ।
चतुर्वेदटीकाऽस्याध्यायस्य नोपलब्धाऽस्माभिः ॥ १५ ॥

वि. भा.—द्वित्रिचतुः प्रभृतीनां (द्वित्र्यादीनां) पृथक् पृथक् कथितैर्ग्रहयुगयातैर्यो युगादि जानाति स कुट्टाकारं (कुट्टकगणितं) जानातीति ॥

अत्रोपपत्तिः।

पूर्वोक्ते 'अधिकाग्रभागहारादूनाग्रच्छेद भाजिताच्छेषम्। यत् तत् परस्पर-हृतं लब्धमधोऽधः पृथक् स्थाप्यम्, इत्यादिश्लोकेषु श्रीमतां म. म. सुधाकरद्विवेदिमहोदयानामुदाहरणम्। चतुस्त्रिंशद्धृतोद्व्यग्रः पंक्तयग्रोविश्वभाजितः। तं राशिं शीघ्रमाचक्ष्व यदि जानासि कुट्टकम्॥ एतदनुसारेण "यद्येको ग्रहो दिनचतुस्त्रिंशताऽन्यश्च त्रयोदशदिनैरेकं भगणं भुंक्ते तयोरन्तिमयुतेर्दश दिनानि व्यतीतानि तदा कल्पात् कियन्ति दिनानि व्यतीतानीति" प्रश्ने को राशिश्चतुर्स्त्रिंशद्धृतोदशशेषस्त्रयोदशहृतश्च दशशेष इति प्रश्नोत्तरेणैवोत्तरसिद्धिः। एवं त्र्यादिग्रहाणामपि युगगतानयनं भवति॥ अत्रोदाहरणार्थं चतुर्वेदाचार्येणं कल्पे रविभगणाः=३०, चन्द्रभगणाः=४००, कुजभगणाः=१६, बुधभगणाः=१३०, गुरुभगणाः=३, शुक्रभगणाः=५०। शनि भगणाः=१, चन्द्रोच्च भगणाः=४, चन्द्रपातभगणौ=२, भदिनानि=१०९९०, सौरमासाः=३६०, चान्द्रमासाः=३७०, अधिमासाः=१०, सौरदिनानि=१०८००, चान्द्रदिनानि=१११००, क्षयाहाः=१४०, सावन दिनानि =१०९६०, एकस्मिन् दिने भगणात्मिका गतिश्च। राशौ येन कर्मणा द्वश्यतुल्यो भवेत्तद्विलोमेनैव तेनैव कर्मणा दृश्ये क्रियाकरणेनेष्टराशिर्भवेत्।

(क)

र	चं	मं	वुउ	गु	शुउ	श	चंउ	चंपा
३	५	१	१३	३	५	१	१	१
१०९६	१३७	६८५	१०९६	१०९६०	१०९६	१०९६०	२७४०	५४८०

कल्पिता, इतिसर्वं कोलब्रूकानुवादतो ज्ञायत इति॥१५॥

अब प्रश्न को कहते हैं।

हि. भा—दो तीन आदि ग्रहों के अलग-अलग कथित ग्रह गतयुग से जो युगादि को जानते हैं वे कुट्टक को जानते हैं॥ इसके उत्तर के लिये—

उपपत्ति।

पूर्वोक्त 'अधिकाग्रभागहारादूनाग्रच्छेद भाजिताच्छेषम्' इत्यादि श्लोकों में म.म. श्रीमान् सुधाकर द्विवेदी जी के उदाहरण हैं, जैसे किसी राशि को चौंतीस से भाग देने से दो शेष रहता है, तथा तेरह से भाग देने से दस शेष रहता है उस राशि को कहो। इसके अनुसार यदि एक ग्रह चौंतीस दिनों में और अन्य ग्रह तेरह दिनों में एक भगण को भोग

करते हैं दोनों की अन्तिम युति (योग) से दश दिन व्यतीत हुए तब कल्प से कितने दिन व्यतीत हुए ? इस प्रश्न में 'कौन राशि है जिसको चौंतीस से भाग देने से दस शेष रहता है, तथा उसी राशि को तेरह से भाग देने से भी दस शेष रहता है इस प्रश्न के उत्तर ही से उत्तर सिद्धि होती है । इस तरह तीन आदि ग्रहों का भी युगगतानयन होता है । यहां उदाहरण के लिये चतुर्वेदाचार्य ने, कल्प में रवि भगण = ३०, चन्द्रभगण = ४००, कुजभगण = १६, बुधभगण = १३०, गुरुभगण = ३, शुक्रभगण = ५०, शनिभगण = १, चन्द्रोच्चभगण = ४, चन्द्रपातभगण = २, भदिन = १०९९०, सौरमास = ३६०, चान्द्रमास ३७०, अधिमास = १०, सौरदिन = १०८००, चान्द्रदिन = १११००, क्षयाह = १४०, सावनदिन = १०९६०, तथा एक दिन में भगणात्मक गति की संस्कृतोपपत्ति में लिखित (क) के अनुसार कल्पना की । यह सब कोलब्रूक साहेब के अनुवाद से विदित होता हैं इति ।।१५।।

इदानीमन्यं प्रश्नमाह ।

भगणाद्यमिष्टशेषं कदेन्दुदिवसे रवेर्गुरुदिने वा ।
ज्ञदिने राशीन् कथयति कुट्टाकारं स जानाति ।।१६।।

सु. भा.—रवेर्भगणाद्यमिष्टशेषं भगणादिशेषमिष्टं कदा चन्द्रदिने वा गुरुदिने ज्ञदिने भवतीति विज्ञाय यश्च रवे राशीन् राश्यादिरविं कथयति स कुट्टाकारं जानातीत्यहं मन्ये । अर्थाद्भगणशेषादहर्गणमानयेति प्रश्नः ।

अस्योत्तरं १२ सूत्रेण स्फुटम् । अत्रकुट्टके तावद्धरएकादिगुणः क्षेप्यो यावदभीष्टो वारो भवेदिति ।। १६ ।।

वि. भा.—रवेरिष्टं भगणादिशेषं कदा चन्द्रदिने वा गुरुदिने वा बुधदिने भवतीति ज्ञात्वा राश्यादिरविं यः कथयति स कुट्टाकारं जानातीति, अर्थाद् भगण शेषादहर्गणमानयेति प्रश्नः ।

अत्रोपपत्तिः ।

उपपत्तिः पूर्वं प्रदर्शिताऽपि सौकर्यार्थं विलिख्यते । कल्प्यतेऽहर्गणमानम् = य, तदा कल्पकुदिनैः कल्पभगणा लभ्यन्ते तदा ऽहर्गणेन किं लब्धं गतभगणाः शेषं कल्प्यते भगणशेषम् तदा तत्स्वरूपम् $= \frac{\text{कल्पभ. य}}{\text{ककु}} = \text{गभ} + \frac{\text{भशे}}{\text{ककु}}$ छेदगमेन कल्पभ . य =

ककु. गभ + भशे। ततः $\frac{\text{ककु. गभ + भशे}}{\text{कल्पभ}} = \text{य}$ । अत्र ककु, कल्पभ भाज्यहाराभ्यां यौ राशी तत्राधरः कभ भक्तः शेषं गभमानम् । परन्तु यद्यधिकाग्रम् = भशे । तच्छेदः ककु । ऊनाग्रम् = ०, तच्छेदः = कभ तदाऽऽचार्योक्तकुट्टकप्रकारेण[1] छेदवधच्छेदेऽ-

(१) अधिकाग्रभागहाराद्नाग्रच्छेदभाजिताच्छेषमित्यादिना.

ग्रमानम् = गभ. ककु + भशे, अत इदमग्रं कल्पभगणभक्तं लब्धं य मानं स्यादर्थादहर्गणो भवेत् । ततो रविज्ञानं सुगममेव ॥१६॥

अब अन्य प्रश्न को कहते हैं ।

हि. भा.—रवि के इष्ट भगणादिशेष कब चन्द्रदिन में वा गुरुदिन में वा बुधदिन में होता है इसको जानकर जो राश्यादिरवि को कहते हैं वे कुट्टक को जानते हैं । अर्थात् भगणशेष से अहर्गणानयन के लिये प्रश्न है ।

उपपत्ति ।

कल्पना करते हैं अहर्गणमान = य । तब अनुपात करते हैं कल्पकुदिन में कल्पभगण पाते हैं तो अहर्गण में क्या इससे लब्ध गतभगण, शेष भगणशेष होता है इसका स्वरूप = $\frac{\text{कभ.य}}{\text{ककु}}$

= गभ + $\frac{\text{भशे}}{\text{ककु}}$ छेदगम से कभ . य = ककु . गभ + भशे ∴ $\frac{\text{ककु. गभ + भशे}}{\text{कभ}}$

= य । यहां ककु, कभ भाज्य, हारों से जो राशिद्वय होता है उसमें अधरराशि को कल्पभगण से भाग देने से शेष गत भगणमान होता है । लेकिन यदि अधिकाग्र = भशे उसका छेद = ककु । ऊनाग्र = ० । उसका छेद = कभ तब आचार्योक्त कुट्टक प्रकार से छेदघात तुल्य छेद में अग्र (शेष) मान = ककु . गभ + भशे । इस अग्र को कल्पभगण से भाग देने से लब्ध य मान होता है वही अहर्गण है । अहर्गण ज्ञान से रवि का ज्ञान सुलभ ही है इति ॥ १६ ॥

इदानीमन्यं प्रश्नमाह ।

ज्ञदिने यदंशशेषं विकलाशेषं कदा तदिन्दुदिने ।
भानोरथवा शशिनो यः कथयति कुट्टकज्ञः सः ॥ १७ ॥

सु. भा.—भानोरथवा शशिनश्चन्द्रस्य यदंशशेषं वा विकलाशेषं बुधदिने दृष्टं तदेव कदा चन्द्रदिने भवतीत्यस्योत्तरं यः कथयति स एव कुट्टकज्ञ इत्यहं मन्ये ।

अस्योत्तरं १२ सूत्रेण स्फुटम् ॥ १७ ॥

वि. भा.—भानोः (सूर्यस्य) शशिनः (चन्द्रस्य) यदंशशेषं विकलाशेषं वा बुधदिने दृष्टं तच्चन्द्र दिने कदा भवतीत्यस्योत्तरं यः कथयति सः कुट्टक पण्डित इति ॥

अत्रोपपत्तिः ।

इष्टभगणादिशेषात् स्वकुट्टकगुणात् स्वभागहारहृतादित्यादिना स्फुटैवास्तीति ॥ १७ ॥

अब अन्य प्रश्न को कहते हैं ।

हि. भा.—सूर्य और चन्द्र का जो अंशशेष वा विकलाशेष बुधदिन में देखा गया वही चन्द्रदिन में कब होता है इसका उत्तर जो जानते हैं वे कुट्टक के पण्डित है । इति ॥

उपपत्ति ।

'इष्ट भगणादिशेषात् स्वकुट्टकगुणात्' इत्यादि १२ सूत्र से स्फुट है इति ॥१७॥

इदानीमन्यं प्रश्नमाह ।

तिथिमान दिनेष्विष्टा ये ऽर्काद्यास्ते पुनः कदा तेषु ।
इष्टगृहवारेषु यः कथयति कुट्टकज्ञः सः ॥ १८ ॥

सु. भा.—तिथिमानदिनेषु चान्द्रसौरसावनदिनेष्वर्थादुद्दिष्टाहर्गणे येऽभीष्टा अर्काद्यास्त एव पुनः कदेष्टग्रहवारेषु तेषु चान्द्रसौरसावनदिनेषु भवन्ति । इति यः कथयति स एव कुट्टकज्ञ इत्यहं मन्ये । यस्मिन्नहर्गणे येऽभीष्टा गृहा आगतास्तत्समा एव कदेष्टवारेऽन्यस्मिन्नहर्गणे ते भवन्तीति प्रश्नः ।

अस्योत्तरं च १२ सूत्रेण स्फुटम् ॥ १८ ॥

वि. भा.—तिथिमानदिनेषु (चान्द्रसौरसावनदिनेष्वर्थादुद्दिष्टाहर्गणे) ये इष्टा रव्यादयस्त एव पुनःकदेष्टग्रहवारेषु चान्द्रसौरसावनदिनेषु भवन्तीत्यर्थाद्यस्मिन्नहर्गणे ये ऽभीष्टा गृहा समागतास्तत्तुल्या एव कदेष्टवारे ऽन्यस्मिन्नहर्गणे ते भवन्तीति यः कथयति सः कुट्टकपण्डितोऽस्तीति । 'इष्टभगणादिशेषादि'-त्यादि १२ सूत्रेणाऽस्योपपत्तिः स्फुटैवास्तीति ॥ १८ ॥

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—चान्द्र सौर सावन दिनों में अर्थात् उद्दिष्टाहर्गण में जो इष्ट रवि आदि ग्रह हैं वही पुनः कब इष्टग्रह वारों में उन चान्द्र सौर सावन दिनों में होते हैं अर्थात् जिस अहर्गण में जो अभीष्टग्रह आये हैं उनके बराबर ही कब इष्टवार में अन्य अहर्गण में वे होते हैं यह प्रश्न है इसको जो कहते हैं वे कुट्टक के पण्डित है ॥ इसकी उपपत्ति 'इष्ट भगणादिशेषात्' इत्यादि १२ सूत्र से स्पष्ट ही है इति ॥ १८ ॥

इदानीं बालावबोधार्थं पूर्वप्रश्नोत्तरं कथयति ।

इष्टभगणादिशेषाद् द्युगणस्तत् कुट्टकेन संयुक्तः ।
तच्छेददिनैस्तावद्दिनवारो यावदिष्टः स्यात् ॥ १९ ॥

सु. भा.—इष्टभगणादिशेषात् तत्कुट्टकेन १२ सूत्रविधिना प्रथमं द्युगणोऽहर्गणः साध्यः स तावत् तच्छेददिनैः संयुक्तो यावदिष्टो वारः स्यादिति स्पष्टम् ॥१९॥

वि. भा.—इष्टभगणादिशेषात् पूर्ववत् (इष्टभगणादिशेषादित्यादि १२ सूत्रानुसारेण) अहर्गणः साध्यः स तावत्तच्छेददिनैः संयुक्तः कार्यो यावदिष्टो दिनवारः स्यादिति ॥ १९ ॥

अब बालकों के बोध के लिये पूर्व प्रश्न के उत्तर को कहते हैं।

हि. भा.—इष्टभगणादिशेष से पूर्ववत् ('इष्टभगणादि शेषात्' इत्यादि १२ सूत्र के अनुसार) अहर्गण साधन करना चाहिये उसमें तब तक उन छेददिनों को जोड़ना चाहिये जब तक इष्ट दिनवार हो इति ॥ १९ ॥

इदानीमन्यान् प्रश्नानाह।

यो राश्यादीन् दृष्ट्वा मध्यस्येष्टस्य कथयति द्युगणम्।
द्व्यादिगृहसंयोगात् गृहान्तराद्वा स कुट्टज्ञः ॥ २० ॥

सु. भा.—य इष्टगृहस्य मध्यस्य राश्यादीन् दृष्ट्वा द्युगणं कथयति। वा द्व्यादिग्रहसंयोगाद् द्युगणं कथयति वा द्वयोर्ग्रहयोरन्तराद्द्युगणं कथयति स कुट्टज्ञ कुट्टकज्ञ इत्यहं मन्ये ॥ २० ॥

वि. भा.—इष्टगृहस्य मध्यस्य राश्यादीन् दृष्ट्वा योऽहर्गणं कथयति। वा द्व्यादिगृहसंयोगादहर्गणं कथयति। वा ग्रहान्तरात् (द्वयोर्ग्रहयोरन्तरात्) अहर्गणं कथयति स कुट्टकपण्डितो ऽस्तीति ॥ २० ॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—मध्यम इष्ट ग्रह के राश्यादि को देखकर जो अहर्गण को कहते हैं। वा दो आदि ग्रहों के संयोग से अहर्गण को कहते हैं। वा दो ग्रहों के अन्तर से अहर्गण को कहते हैं वे कुट्टक के पण्डित हैं इति ॥ २० ॥

इदानीं पूर्वप्रश्नस्योत्तरमाह।

निश्छेदभागहाराद्राश्यादिकलादिना हताद् भक्तात्।
भमणकलाभिर्लब्धं मण्डलशेषं दिनगणोऽस्मात् ॥ २१ ॥

सु. भा.—निश्छेदभागहाराद् दृढकुदिनमानात् किं विशिष्टाद् राश्यादिकलादिना ग्रहकलात्मकप्रमाणेन हताच्चक्रकलाभिर्भक्ताद्यल्लब्धं तद्भगणशेषं स्यादस्मात् पूर्वोक्तविधिना दिनगणो भवतीति।

अत्रोपपत्तिः। दृढभगणशेषं चक्रकलागुणं दृढकुदिनभक्तं कलात्मकग्रहो भवत्यतस्तद्विपरीतेन कलात्मकग्रहो दृढकुदिनगुणश्चक्रकलाभक्तो दृढभगणशेषं स्यात्। ततो दृढभगणा भाज्यं दृढभगणशेषं ऋणक्षेपं दृढकुदिनमानं हारं च प्रकल्प्य कुट्टाकारेण गुणमानमहर्गणः स्यात्। ग्रहयोगकलातो वाऽन्तरकलातो यद्दृढभगणशेषं स्यात् तत्र दृढभगणयोगं वा दृढभगणान्तरं भाज्यं प्रकल्प्य पूर्ववत् कुट्टकेनाहर्गणः साध्यः॥

वि. भा.—निश्छेदभागहारात् (दृढ़कुदिनात्) राश्यादिकलादिना (ग्रहकलात्मकमानेन) गुणितात्, भगणकला (चक्रकला) भिर्भक्तात् लब्धं मण्डलशेषं (भगणशेषं) भवति, अस्मात्पूर्ववदहर्गणो भवतीति॥

अत्रोपपत्ति :

$\frac{\text{दृढ़भगणशे} \times \text{चक्रकला}}{\text{दृढ़कुदिन}}$ = कलात्मकग्रह छेदगमेन दृढ़भगण शे $\times$ चक्रकला = दृढ़कुदिन $\times$ कलात्मकग्र, अतः $\frac{\text{दृढ़कुदिन} \times \text{कलात्मकग्रह}}{\text{चक्रक}}$ = दृढ़भगणशेष ततः $\frac{\text{भाज्य} = \text{दृढ़भगण} - \text{दृढ़भगणशे} = \text{क्षेप}}{\text{दृढ़कुदिन}}$ अत्र कुट्टकेन यो गुणः स एवाहर्गणो भवति। ग्रहयोगकलातोऽन्तरकलातो वा यद् दृढ़भगणशेषं भवेत्तत्र दृढभगणयोगं दृढ़भगणान्तरं वा भाज्यं प्रकल्प्य पूर्ववत् कुट्टकेनाहर्गणः साध्य इति ॥२१॥

अब पूर्वप्रश्न के उत्तर को कहते हैं।

हि. भा.—निश्छेदभागहार (दृढ़कुदिन) को ग्रहकलात्मक मान से गुणाकर भगणकला (चक्रकला) से भाग देने से लब्ध मण्डल (भगण) शेष होता है इससे पूर्ववत् अहर्गण होता है इति।

उपपत्ति।

$\frac{\text{दृढ़भगणशे} \times \text{चक्रकला}}{\text{दृढ़कुदिन}}$ = कलात्मकग्रह। छेदगम से दृढ़भगणशे $\times$ चक्रकला = कलात्मकग्र $\times$ दृढ़कुदिन, अतः $\frac{\text{कलात्मकग्रह} \times \text{दृढ़कुदिन}}{\text{चक्रकला}}$ = दृढ़भगणशेष। ततः $\frac{\text{भाज्य} = \text{दृढ़भगण} - \text{दृढ़भगणशे} = \text{क्षेप}}{\text{दृढ़कुदिन}}$ यहां कुट्टक से जो गुणक होता है वही अहर्गण होता है। ग्रह योगकला से वा अन्तर कला से जो दृढ़भगण शेष होता है वहां दृढ़-

भगण योग को वा दृढ़भगणान्तर को भाज्य कल्पनाकर पूर्ववत् कुट्टक से अहर्गण साधन करना चाहिये इति ॥ २१ ॥

इदानीं विशेषमाह।

एवं राश्यंकला विकला शेषादहर्गणः प्राग्वत् ।
नष्टस्थेष्विष्टान् तान् कृत्वा भक्त्वोक्तवच्छेषम् ॥ २२ ॥

सु. भा.—एवं राशिशेषात् अंशशेषात् कलाशेषात् विकलाशेषाच्च प्राग्वदहर्गणः स्यात् । किं कृत्वा नष्टस्थेषु विकलाकलादिमानेषु भक्त्वा विभज्येष्टान् तान् विकलादीन् कृत्वा शेषं भगणशेषमहर्गणं चोक्तवत्कार्यम् । अत्रैतदुक्तं भवति । षष्टिर्भाज्यो विकलाशेषमृणक्षेपो दृढकुदिनानि हार इति प्रकल्प्य यः कुट्टकः सकलाशेषस्तेन षष्टिर्हता विकलाशेषोना दृढकुदिनहृता फलं विकला अभीष्टा स्युस्ततः कलाशेषमृणक्षेपं षष्टिं भाज्यं दृढकुदिनानि हारं प्रकल्प्य यः कुट्टकः स चांशशेषस्तेन षष्टिर्गुणा कलाशेषोना दृढकुदिनभक्ता फलं कला अभीष्टाः स्युः । एवं राशिशेषानयने त्रिंशद्भाज्यो भगणशेषानयने च द्वादशभाज्यकल्प्यः । भगणशेषतः पूर्वविधानेनाहर्गणो गतभगणाश्च साध्याः । 'कल्प्याथ शुद्धिर्विकलावशेषम्'—इत्यादि भास्करोक्तमेतदनुरूपमेव ॥ २२ ॥

वि. भा.—एवं राशिशेषात्-अंशशेषात् कलाशेषात् विकलाशेषात् पूर्ववदहर्गणः स्यात् कथं तदुच्यते । नष्टस्थेषु विकला कलादिमानेषु भक्त्वा (विभज्य) इष्टान् तान् विकलादीन् कृत्वा शेषं (भगणशेषं) अहर्गणंच पूर्ववत्कार्यम् । यथा षष्टिभाज्यः । दृढ़ कुदिनानि हारः । विकलाशेषं शुद्धिरिति प्रकल्प्य कुट्टकविधिना गुणाप्ती साध्ये तत्र लब्धिर्विकलाःस्युः । गुणस्तु कलावशेषम् । ततः कलावशेषं शुद्धिः । षष्टिर्भाज्यः । दृढ़कुदिनानि हार इति प्रकल्प्य कुट्टकेन गुणाप्ती साध्ये तत्र लब्धिः कलाः । गुणोंऽशशेषम् । अंशशेषं शुद्धिः । त्रिंशद् भाज्यः । दृढ़कुदिनानिहारः । अत्र कुट्टकेन लब्धिरंशाः । गुणो राशिशेषम् । एवं राशिशेषं शुद्धिः । द्वादश भाज्यः । कुदिनानि हारः । अत्र कुट्टकेन लब्धिर्गतराशयः । गुणोभगणशेषम् । कल्पभगणा भाज्यः । कुदिनानि हारः । भगणशेषं शुद्धिः । अत्र लब्धिर्गतभगणाः । गुणोऽहर्गणः स्यादिति । लीलावत्यां 'कल्प्याथ शुद्धिर्विकलावशेषं षष्टिश्च भाज्यः कुदिनानि हार' इत्यादि भास्करोक्तमेतदनुरूपमेवेति ॥ २२ ॥

अब विशेष कहते हैं।

हि. भा.—एवं राशिशेष से, अंश शेष से, कलाशेष से, विकलाशेष से अहर्गण होता है। कैसे होता है सो कहते हैं। विकला-कलादि मानों में भाग देकर इष्टविकलादि करके भगणशेष और अहर्गण पूर्ववत् करना चाहिये। जैसे-साठ को भाज्य, दृढ़कुदिन को-

हार, विकलाशेष को ऋणक्षेप कल्पना कर कुट्टक विधि से गुणक और लब्धि साधन करना, उनमें लब्धि विकला होती है, और गुणक कलाशेष होता है। इसके बाद साठ को भाज्य, दृढकुदिन को हार, कलावशेष को ऋणक्षेप कल्पना कर कुट्टक से गुणक और लब्धि साधन करना चाहिए, उनमें लब्धिकला होती है। गुणक अंश शेष होता है। एवं तीस को भाज्य, दृढ़कुदिन को हार, अंशशेष को ऋणक्षेप कल्पना कर कुट्टक से जो गुणक और लब्धि होती है उनमें लब्धि अंश होता है। गुणक राशिशेष होता है। एवं द्वादश को भाज्य, दृढ़कुदिन को हार, राशिशेष को ऋण क्षेप मान कर कुट्टक से लब्धिगत्त राशिमान होता है, गुणक भगणशेष होता है। एवं कल्प भगण को भाज्य, कुदिन को हार, भगणशेष को ऋणात्मक क्षेप क्षेपकल्पना कर कुट्टक से लब्धि गतभगण होता है, गुणक अहर्गण होता है, लीलावती में 'कल्प्याथ शुद्धिर्विकलावशेषं' इत्यादि भास्करोक्त इसके अनुरूप ही है इति ॥ २२

इदानीमन्यं प्रश्नमाह।

राश्यंशकला विकलाशेषात् कथितादभीष्टतो नष्टान्।
यः साधयत्युपरितनान् समध्यमान् कुट्टकज्ञः सः॥ २३॥

सु. भा.—अभीष्टतः कथितान्निर्दिष्टात् राशिशेषत् वांऽशशेषात् वा कलाशेषादथवा विकलाशेषाच्च यो नष्टान् विकलादीन् तथोपरितनानुपरिशेषान् विकलाशेषतः कलाशेषं कलाशेषादंशशेषमित्यादीन् समध्यमान् मध्यमग्रहसहितान् साधयति स एव कुट्टकज्ञः। निर्दिष्टादेकशेषात् मध्यमग्रहं य आनयति स एव कुट्टकज्ञ इत्यर्थः। अस्योत्तरं पूर्वसूत्रेण स्फुटमपि बालावबोधार्थमग्रे वक्ष्यति ॥ २३ ॥

वि. भा.—अभीष्टतः कथितान्निर्दिष्टात् राशिशेषादंश शेषाद्वा कलाशेषाद्विकलाशेषाद्वा नष्टान् (विकलादीन्) उपरितनान् (उपर्युक्तशेषान्) मध्यमग्रहसहितान् यः साधयति सः कुट्टकज्ञः। निर्दिष्टादेकशेषान्मध्यग्रहानयनं यः करोति सः कुट्टकज्ञ इति। अस्योत्तरं यद्यपि पूर्वसूत्रेण स्पष्टमप्यस्ति तथाप्याचार्येणाऽग्रे कथ्यते॥ २३॥

अब अन्य प्रश्न को कहते हैं।

हि. भा.– अभीष्ट से कथित राशिशेष से अथवा अंशशेष से, कलाशेष से अथवा विकलाशेष से विकलादि को तथा उपयुक्त शेष मध्य ग्रह सहित को जो व्यक्ति साधन करता है अर्थात् निर्दिष्ट एकशेष से मध्यम ग्रहानयन करता है वह कुट्टकज्ञ है, यद्यपि इसका उत्तर २२ सूत्र से स्पष्ट है तथापि आचार्य आगे कहते हैं इति ॥ २३ ॥

इदानीमुत्तरमाह।

येन गुणः शेषयुतश्छेदः शुध्यति हृतः स्वगुणकेन।
तद्भुक्तं शेषं फलमेवं शेषात् ग्रहद्युगणौ ॥ २४ ॥

सु. भा.—छेदो दृढकुदिनमानं येन गुणः शेषयुतः स्वगुणकेन हृतः शुध्यति स गुणश्च तद्भुक्तं तस्य ग्रहस्य भुक्तं भवति स्वगुणकेन हृतं यत् फलं प्राप्तं तच्छेषमुपरिशेषं भवति। एवं शेषात् ग्रहाहर्गणौ द्वावेव भवतः। अत्रैतदुक्तं भवति। यथा कलाशेषस्य गुणकः षष्टिश्छेदो दृढकुदिनानि। तत्र येन गुणेन गुणितश्छेदो विकलाशेषयुतः स्वगुणकेन षष्टिमितेन हृतः शुध्यति स गुणो ग्रहविकला भवन्ति फलं च कलाशेषं ज्ञेयमेवं कलाशेषात् कला अंशशेषं च सिध्यति। एवमन्ते भगण-शेषज्ञानं तस्मादहर्गणज्ञानं च भवति।

अत्रोपपत्तिः। यथा कलाशेषं षष्टिगुणं दृढकुदिनहृतं लब्धं ग्रहविकलाः शेषं च विकलाशेषम्। अतो हरो लब्धिगुणः शेषयुतो भाज्यराशिसमः।

$$६० \times \text{कशे} = \text{ग्रवि} \times \text{दृकु} + \text{विशे}$$

$$\therefore \text{कशे} \frac{\text{ग्रवि} \times \text{दृकु} + \text{विशे}}{६०}$$

अतो दृढकुदिनमानं येन गुणं विकलाशेषयुतं षष्टिभक्तं शुध्यति स गुणो ग्रहविकलाः फलं च कलाशेषम्। एवं स्व स्वशेषगुणकच्छेदाभ्यां तत्तच्छेषमाने भवत इत्युपपद्यते ॥ २४ ॥

वि. भा.—छेदो (दृढ़कुदिनमानं) येन गुणः शेषयुतः स्वगुणकेन भक्तः शुध्यति स गुणस्तस्य ग्रहस्य भुक्तं भवति स्वगुणकेन भक्तं सद्यत्फलं लब्धं तदुपरि शेषं भवति। एवं शेषात् ग्रहाहर्गणौ भविष्यतः। यथा कलाशेषस्य गुणकः षष्टिर्दृढ़-कुदिनानि हरः। तत्र येन गुणकेन गुणितो हरो विकलाशेषयुतः स्वगुणकेन षष्टि-तुल्येन भक्तः शुध्यति स गुणो ग्रहविकलाः स्युः फलं कलाशेषमेवं कलाशेषात् कला अंशशेषं सिध्यति। एवमन्ते भगण-शेषज्ञानं भवेत्तस्मादहर्गणो भवेदिति ॥

अत्रोपपत्तिः।

कलाशेषं षष्टिगुणं दृढ़कुदिनभक्तं लब्धं ग्रहविकलाः शेषं विकलाशेषम् तत्स्वरूपम् $= \frac{६० \times \text{कलाशे}}{\text{दृढ़कु}} = \text{ग्रहविकला} + \frac{\text{विकलाशे}}{\text{दृढ़कु}}$ छेदगमेन $६० \times \text{कलाशे} =$ $\text{दृढ़कु} \times \text{ग्रहविकला} + \text{विकलाशे}$, पक्षौ षष्टिभक्तौ तदा $\frac{\text{दृढ़कु} \times \text{ग्रहविकला} + \text{विकलाशे}}{६०}$

=कलाशे, अतो दृढ़कुदिनं येन गुणं विकलाशेषयुतं षष्टिभक्तं शुध्यति स गुणो गृहविकलाः। फलं कलाशेषम् एवं स्वस्वशेषगुणकहराभ्यां तत्तच्छेषमाने भवत इत्युपपन्नं भवतीति ॥२४॥

अब उत्तर कहते हैं।

हि. भा.— दृढ़कुदिन (हर) को जिस से गुणा कर शेष जोड़कर अपने गुणक से भाग देने से शुद्ध हो तब वह गुणक उस ग्रहका भुक्त होता है। अपने गुणक से भाग देने से जो फल होता है वह उपरिशेष होता है इस तरह शेष से ग्रह और अहर्गण होता है, जैसे कलाशेष का गुणक साठ है, दृढ़कुदिन हर है वहां जिस गुणक से गुणित हर में विकला शेष को जोड़ कर साठतुल्य अपने गुणक से भाग देने से शुद्ध होता है तब वह गुणकग्रह विकला होती है और फल कलाशेष होता है, एवं कलाशेष से कला और अंशशेष सिद्ध होता है। इस तरह अन्त में भगण शेष ज्ञान होता है उससे अहर्गणज्ञान होता है इति ॥

उपपत्ति।

कला शेष को साठ से गुणा कर दृढ़कुदिन से भाग देने से लब्ध ग्रह विकला और शेष विकला शेष। उसका स्वरूप $=\frac{६० \times \text{कलाशे}}{\text{दृढ़कु}}=$ ग्रह विकला $+\frac{\text{विकलाशे}}{\text{दृढ़कु}}$ छेदगम से $६० \times$ कलाशे $=$ दृढ़कु $\times$ ग्रह विकला $+$ विकलाशे। दोनों पक्षों को साठ से भाग देने से, कलाशे $=$ $=\frac{\text{दृढ़कु} \times \text{ग्रह विकला} + \text{विकलाशे}}{६०}$ अतः दृढ़कुदिन को जिससे गुणाकर विकला शेष को जोड़कर साठ से भाग देने से शुद्ध होता है वह गुणक ग्रह विकला है और फल कला शेष है एवं अपने अपने शेष गुणक हरों से अपने अपने शेष मान होते हैं, इससे उपपन्न हुआ ॥२४॥

इदानीमन्यान् प्रश्नानाह।

जानाति यो युगगतं कथितादधिमासशेषकादिष्टात्।
अवमावशेषतो वा तद्योगाद्वा स कुट्टज्ञः ॥२५॥

सु. भा.—इष्टादधिमासशेषाद्वा कथितादधिमासशेषाद्यो युगगतं जानाति। वा कथितादवमावशेषात् क्षयशेषाधो युगगतं जानाति। वा तयोरधिशेषक्षयशेषयोर्योगाद्यो युगगतं जानाति स एव कुट्टकज्ञ इत्यहं मन्ये।

अत्र 'तथाऽधिमासावमाग्रकाभ्यां दिवसा रवीन्द्वो'–इत्यादिभास्करविधिनाऽऽद्य प्रश्नद्वयोत्तरं स्फुटम्। तृतीये चान्द्रेभ्यो येऽधिमासा यच्च तच्छेषं सौरेभ्योऽपि त एवाधिमासास्तच्च शेषम्। अतो गतेन्दुदिनप्रमाणं या १ गताधिमासप्रमाणं च का १। तदाऽधिशेषप्रमाणं च=कअधिमा × या—कचादि × का=अधिशे।

एवं यदि गतक्षयाहमानं नी १ तदा कक्ष × या — कचादि × नी = क्षशे ।

द्वयोर्योगेन या (कअधिमा + कक्ष) — कचादि (का + नी) = अधिशे +

$$\text{क्षशे} = \text{यो} \therefore \text{का} + \text{नी} = \frac{\text{या (कअधिमा — कक्ष) — यो}}{\text{कचादि}}$$

अतः कल्पाधिमासक्षयाहयोगं भाज्यमधिमासक्षयशेषयोगमृणाक्षेपं कल्पचान्द्रदिनं हारं प्रकल्प्य यः कुट्टकः स एव गतेंदुदिनानि तेभ्यः सौरसावनदिनानि च स्फुटानि भवन्ति । इत्यनेन तृतीय प्रश्नोत्तरं स्फुटम् ॥ २५ ॥

वि. भा.—इष्टादधिमासशेषात् वा कथितादधिमासशेषाद्यो युगगतं जानाति । वा कथितादवमावशेषतो युगगतं जानाति । वा तद्योगात् (अधिशेषावमशेषयोर्योगात्) युगगतं जानाति स कुट्टकज्ञ इति ।

अत्रोपपत्तिः ।

कल्पाधिमासा भाज्यः । रविदिनानि हारः । अधिमासशेषं शुद्धिः । अत्र कुट्टकविधिना गुणाप्ती साध्ये तत्र लब्धिर्गताधिमासाः । गुणो गतरविदिवसाः । एवं युगावमानि भाज्यः । चान्द्रदिवसा हारः । अवमशेषं शुद्धिः । अत्रापि कुट्टकविधिना गुणलब्धी साध्ये तत्र लब्धिर्गतावमानि गुणो गतचान्द्रदिवसा इति, लीलावत्यां 'तथाधिमासावमाग्रकाभ्यां दिवसा रवीन्द्वो' रिति भास्करेण स्पष्टमेवोक्तम् एतावता प्रथमप्रश्नद्वयोत्तरं जातम् ।

अथ तृतीयप्रश्नोत्तरम् ।

अत्रेष्टचान्द्रप्रमाणम् = य । अस्मादधिमासावमयोस्तच्छेषयोश्च माने ज्ञात्वा स्वस्वशेषोने कृते तयोः स्वरूपे $\frac{\text{क अमा. य — अधिशे}}{\text{कचां}}$ = गताधिमासाः ।
$\frac{\text{क अवम. य — अवशे}}{\text{कचां}}$ = गअवम, अत्र को हरश्चेद् गुणकौ विभिन्नौ तदा गुणैक्यमित्यादि संश्लिष्टकुट्टक युक्त्या कल्पाधिमासावमयोगतुल्ये भाज्ये तयोरेव शेषयोगतुल्ये ऋणाक्षेपे यो गुणः स एवेष्टचान्द्रसमस्तस्मात्सौरसावनदिनानि स्फुटानि भवन्तीति । एतेन तृतीयप्रश्नोत्तरं स्फुटं जातम् ॥ २५ ॥

अब तृतीय प्रश्न के उत्तर को कहते हैं ।

हि. भा.—यहां कल्पना करते हैं इष्ट चान्द्र प्रमाण = य । इस से अधिमास और अवम तथा उन दोनों का शेष जानकर अपना अपना शेष घटाने से उन दोनों के स्वरूप

$\frac{\text{क अमा. य—अधिशे}}{\text{कचां}}$ = गताधिमा, $\frac{\text{क अवम. य—अवमशे}}{\text{कचां}}$ = ग अवम, यहां 'एको हरश्चेद्गुण-कौ विभिन्नौ' इत्यादि भास्करोक्त संश्लिष्ट कुट्टक युक्ति से कल्पाधिमास कल्पावम योगतुल्य भाज्य में उन्हीं दोनों के शेष योगतुल्य ऋण क्षेप में जो गुणक होगा वही इष्ट चान्द्र (य) के बराबर होगा उस से सौर सावन दिन स्फुट होते हैं। इस से तृतीय प्रश्न का उत्तर स्फुट हो गया, इति ॥ २५ ॥

इदानीमन्यान् प्रश्नानाह।

इष्टेषु मानदिवसेष्वधिमासन्यूनरात्रशेषे वा।
भूयस्ते यः कथयति पृथक् पृथग्वा स कुट्टज्ञः ॥ २६ ॥

सु. भा.—इष्टेषुमानदिवसेषु सौरचान्द्रसावनदिनेषु ये अधिमासन्यूनरात्रशेषे स्तस्ते एव भूयः कदा भविष्यत इति यः पृथक्-पृथक् कथयति स एव कुट्टज्ञः कुट्टकज्ञ इत्यहं मन्ये। इष्टदिने यदधिशेषं तदेव पुनः कदावेष्टदिने यदवमशेषं तदेव पुनः कदा वेष्टदिने योऽधिमासक्षयशेषयोगः स एव पुनः कदा भविष्यतीति प्रश्नत्रयम्। पूर्वमधिशेषात् क्षयशेषाद्वा तयोर्योगाद्यथा कुट्टकविधिना गतेन्दुदिनराशिरानीतः स 'इष्टाहतस्वस्वहरेण युक्तो'ऽनेकधा भवति यत्रापि तदेवाधिमासशेषादिकं भवतीत्युत्तरं स्फुटम् ॥ २६ ॥

(इयमार्या कोलब्रूकानुवादे नास्ति)

वि. भा.—इष्टेषु मानदिवसेषु (सौरचान्द्रसावनदिनेषु) ये अधिमासावमशेषे भवतस्त एव भूयः कदा भविष्यत इति पृथक् पृथक् यः कथयति स कुट्टकज्ञोऽस्तीति॥ इष्टदिने यदधिशेषं तदेव पुनः कदा वेष्टदिने यदवमशेषं तदेव पुनः कदा वेष्टदिने योऽधिमासावम शेषयोगः स एव पुनः कदा भविष्यतीति प्रश्नत्रयमस्ति। पूर्वमधिशेषादवमशषात्तयोर्योगाच्च कुट्टकविधिनायथागत चान्द्रदिनप्रमाणमानीतं तदेव 'इष्टाहतस्वस्वहरेण युक्ते' इत्यादिनाऽनेकधा भवति, अत्रापि तदेवाधिमासशेषादिकं भवतीति ॥ २६ ॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—सौर चान्द्र सावन दिनों में जो अधिशेष और अवम शेष है वही बार बार कब होगें इसको पृथक् पृथक् जो कहते है वे कुट्टक के पण्डित है। इष्ट दिन में जो अधिशेष है वही फिर कब होगा वा इष्ट दिन में जो अवमशेष योग है वही फिर कब होगा वा इष्ट दिन में अधिमासावमशेषयोग है वही फिर कब होगा ये तीन प्रश्न हैं। पूर्व में अधिशेष से अवम शेष से और उन दोनों के योग से जैसे कुट्टक विधि से गत चान्द्र

दिन प्रमाण लाये गये । वही 'इष्टाहत स्वस्वहरेण युक्ते' इत्यादि से अनेक प्रकार होते हैं यहां भी वही अधिमास शेषादिक होते हैं इति ।। २६ ।।

इदानीमन्यं प्रश्नमाह ।

अंशकशेषात् त्र्यूनात् सप्तहृतान्मूलमूनमष्टाभिः ।
नवभिर्गुणं सरूपं कदा शतं बुधदिने सवितुः ।। २७ ।।

सु. भा.—सवितुः सूर्यस्यांशकशेषात् त्र्यूनात् सप्तहृद्यन्मूलं तदष्टाभिर्न्यूनं नवभिर्गुणमेकेनाढ्यं बुधदिने कदा शतं भवति ।

	ऋ	भा	मू	ऋ	गु	ध	दृ
न्यासः । अंशे ।	३	७	०	८	९	१	१००
	ध	गु	व	ध	भा	ऋ	दृ
विलोमगणितेन ।	३	७	०	८	९	१	१००

लब्धमंशशेषम्=५७० । अस्मादहर्गणो बुधदिने पूर्ववत् सिध्यति ।। २७ ।।

वि. भा.—सवितुः (सूर्यस्य) अंशकशेषात् त्रिभिर्हीनात् सप्तभक्तान्मूलं यत्तदष्टाभिर्हीनं नवभिर्गुणमेकेन युतं बुधदिने कदाशतं भवतीति ।

न्यासः

ऋ—३	ऋ—३ ध	छेदं गुणं गुणं छेदं वर्गं मूलमित्यादिना विलोमगणितेनांशशेषम् = ५७० अस्मादहर्गणो बुधदिने सिध्यतीति ।। २७ ।।
ह—७	ह—७ गु	
मू—०	मू—० व	
ऋ—८	ऋ—८ ध	
गु—९	गु—९ ह	
ध—१	ध—१ ऋ	
दृश्यम्=१००	दृश्यम्=१००	

अब अन्य प्रश्न को कहते हैं ।

हि. भा.—सूर्य के अंश शेष में तीन घटाते हैं । सात से भाग देते हैं । उसकी मूल जो होता है उसमें से आठ घटाते हैं, फिर उसको नौ से गुणा करते हैं, एक जोड़ते हैं बुधदिन में कब सौ होता है इति ।

न्यास

ऋ—३	—३ – ध
ह —७	ह—७—गु
मू—०	मू—०—व
ऋ—८	ऋ—८—ध
गु—६	गु—६—ह
ध—१	ध – १—ऋ
दृश्य—१००	दृश्य—१००

छेदंगुणं गुणं छेदं वर्गं मूलं इत्यादि भास्करोक्त विधि से इस विलोम गणित से अंश शेष=५७० इससे बुधदिन में अहर्गण सिद्ध होता है इति ॥ २७ ॥

इदानीमन्य प्रश्नमाह ।

त्र्यूनाधिमासशेषान्मूलं द्व्यधिकं विभाजितं षड्भिः ।
द्व्यूनं वर्गितमधिकं नवभिर्नवतिः कदा नवतिः ॥ २८ ॥

सु. भा.—अधिमासशेषात् त्र्यूनाद्यन्मूलं तद् द्वाभ्यां युतं षड्भिर्विभाजितं फलं द्व्यूनं वर्गितं नवभिरधिकं कदा नवतिर्भवति ।

	ऋ	मू	ध	भा	ऋ	व	ध	ह
न्यासः । अधिशे ।	३	०	२	६	२	०	९	९०
	ध	व	ऋ	गु	ध	मू	ऋ	ह
विलोमगणितेन ।	३	०	२	६	२	०	९	९०

अधिमासशेषम्=४०९६ कोलब्रूकानुवादे 'षड्भिः' स्थाने 'द्वाभ्यां' इति पाठः। अधिशेषात् पूर्वप्रकारेणाहर्गणानयनं सुगममिति ॥ २८ ॥

वि. भा.—अधिमास शेषात् त्रिभिर्हीनात् मूलं यत्तद् द्वाभ्यां युतं षड्भिर्भक्तं लब्धं द्वाभ्यां हीनं वर्गितं नवभिर्युतं कदा नवतिर्भवतीति ॥

न्यासः

ऋ--३	ऋ—३—ध
मू—०	मू—०—व
ध—२	ध—२—ऋ
ह—६	ह—६—गु
ऋ—२	ऋ—२—ध
व—०	व--०—मू
—९	ध—९—ऋ
दृश्य=९०	दृश्य=९०

'छेदंगुणं गुणं छेद मि'त्यादि भास्करोक्त्या इति विलोमगणितेनाधिमास शेषम्=४०९६ अधिशेषात् पूर्वोक्त प्रकारेणाहर्गण ज्ञानं सुखेन भवतीति।

कोलब्रूकानुवादे षड्भिः स्थाने द्वाभ्याम् पाठोऽस्तीति ॥ २८ ॥

अब अन्य प्रश्न को कहते हैं

हि. भा.—अधिमास शेष में तीन घटाकर मूल जो होता है उसमें दो जोड्ते हैं छः से भाग देते हैं लब्ध जो होता है उसमें दो घटाते हैं उसके वर्ग में नौ जोड़ते हैं तो कब नव्वे होता है, इति ।

न्यास

ऋ—३	ऋ—३—ध
मू—०	मू—०—व
घ—२	घ—२—ऋ
ह—६	ह—६—गु
ऋ—२	ऋ—२—ध
व—०	व—०—मू
ध—६	ध—६—ऋ
दृश्य—६०	दृश्य—६०

छेदं गुणं गुणं छेदं इत्यादि भास्करोक्ति से इस विलोम गणित से अधिमास शेष=४०६६ अधिशेष से पूर्वोक्त प्रकार से अहर्गण ज्ञान सुगमता से होता है इति ।।२८।।

इदानीमन्यं प्रश्नमाह ।

अवमावशेषवर्गो व्येको विंशतिविभाजितो द्व्यधिकः ।।
अष्टगुणो दशभक्तो द्वियुतोऽष्टादश कदा भवति ।। २६ ।।

सु. भा.—स्पष्टार्थम् ।

	घ	ऋ	भा	घ	गु	भा	ध	दृ
न्यासः । क्षशे	०	१	२०	२	८	१०	३	१८
	मू	घ	गु	ऋ	भा	गु	ऋ	दृ
विलोमगणितेन ।	०	१	२०	२	८	१०	२	१८

क्षयशेषम्=१९ । अस्मात् पूर्वप्रकारेणाहर्गणानयनं सुगमम् ।। २९ ।।

इति कुट्टाकारः ।

वि. भा.—अवमशेषवर्गं एकहीनो विंशत्या भाज्यते, तल्लब्धिः अङ्कद्वयेन संकलय्य अष्टाभिर्गुण्यते, तदा दशभिः पुनः विभज्य द्व्यधिकः क्रियते, एवं प्रकारेण अष्टादशसंख्या कदा भवतीति ।

न्यासः
(अवशे)
व—०
ऋ—१
ह—२०
ध—२
गु—८
ह—१०
ध—२

दृश्यं=१८

व—०—मू
ऋ—१—ध
ह—२०—गु
ध—२—ऋ
गु—८—ह
ह—१०—गु
ध—२—ऋ

दृश्यं=१८

'छेदं गुणं गुणं छेद' मित्यादिना इति विलोम गणितेनावमशेषम्=१९ अस्मात्पूर्वप्रकारेणाहर्गणानयनं स्फुटमेवेति ॥ २९ ॥

इति कुट्टकाध्यायः ।

अब अन्य प्रश्न को कहते हैं ।

हि. भा.—अवम शेष वर्ग में एक घटाकर बीस से भाग देते हैं जो लब्धि होती हैं उसमें दो जोड़ते हैं आठ से गुणा करते हैं दश से भाग देते हैं दो जोड़ते हैं तो कब अठारह होता है ॥ २९ ॥ (३०)

न्यास
(अवशे)
व—०
ऋ—१
ह—२०
ध—२
गु—८
ह—१०
ध—२

दृश्य=१८

व—०—मू
ऋ—१—ध
ह—२०—गु
ध—२—ऋ
गु—८—ह
ह—१०—गु
ध—२—ऋ

दृश्य=१८

'छेदं गुणं गुणं छेदं' इत्यादि से इस विलोम गणित से अवम शेष=१९ इससे पूर्व प्रकारानुसार अहर्गणानयन स्पष्ट है इति ॥ २९ ॥

इति कुट्टकाध्याय ।

अथ धनर्णादीनां सङ्कलितव्यवकलितादि

इदानीं धनर्णशून्यानां सङ्कलनमाह ।

धनयोर्धनमृणमृणयोर्धनर्णयोरन्तरं समैक्यं खम् ।
ऋणमैक्यं च धनमृणधनशून्ययोः शून्ययोः शून्यम् ।। ३० ।।

सु. भा.—धनयोरैक्यं धनमृणयोरैक्यमृणं भवति । धनर्णयोरन्तरमेवैक्यं भवति । समयोर्धनर्णयोरैक्यं खं शून्यं भवति । ऋणशून्ययोरैक्यमृणं धनशून्ययोरैक्यं च शून्यं भवति ।

अत्रोपपत्त्यर्थं मन्मुद्रिता भास्करबीजटिप्पणी द्रष्टव्या ।। ३० ।।

वि. भा—धनात्मकयोरङ्कयोर्योगो धनं भवति । ऋणात्मकयोर्योगश्च ऋणं भवति । धनर्णयोरन्तरमेव योगो भवति । तुल्ययोर्धनर्णयोर्योगः शून्यं भवति । ऋणशून्ययोर्योगो ऋणं धनशून्ययोर्योगश्च धनं भवति, शून्ययोर्योगः शून्यं भवतीति ।

अत्रोपपत्तिः ।

यद्येकस्य पुरुषस्य प्रथमं रूप्यकपञ्चकं धनमासीत्, कालान्तरेण तेन रूप्यकचतुष्टयमर्जितं तयोर्योगे तस्य नवरूप्यकाणि धनानि भविष्यन्ति । एवं तस्यैव यदि रूप्यकपञ्चकमृणं पुना रूप्यकचतुष्टयमृणं कृतं तदा तयोर्योगे तस्य नव रूप्यकाणि ऋणं भविष्यति । यदि च रूप्यकचतुष्टयं धनमस्ति तेन रूप्यकपञ्चकमृणं कृतं तदा रूप्यकचतुष्टयदानेन तस्य निकटे रूप्यकमेकमृणमेव स्थास्यति । यदि रूप्यकपञ्चकं धनमस्ति, तेन पुना रूप्यकपञ्चकमृणं कृतं तदा रूप्यकपञ्चकदानेन तन्निकटे शून्यमेव स्थास्यति । सिद्धान्त शेखरे । ऐक्यां युतौ स्यात् क्षययोः स्वयोश्च धनर्णयोरन्तरमेव योगः, श्रीपत्युक्तमिदं, बीजगणिते 'योगे युतिः स्यात् क्षययोः स्वयोर्वा धनर्णयोरन्तरमेव योगः' भास्करोक्तमिदंचाऽऽचार्योक्तानुरूपमेवेति ।। ३० ।।

अब धनाङ्क ऋणाङ्क और शून्य के सङ्कलन को कहते हैं ।

हि. भा—धनात्मक अङ्कों का योग धन होता है । ऋणात्मक अङ्कों का योग ऋण होता है । धनाङ्क और ऋणाङ्क का अन्तर ही योग होता है । तुल्य धन और ऋण अङ्कों का योग शून्य होता है । ऋणात्मक दो शून्यों का योग ऋण होता है । धनात्मक दो शून्यों का योग धन होता है । दो शून्यों का योग शून्य होता है इति ।

उपपत्ति ।

यदि किसी एक पुरुष के पास पहले पांच रुपये धन था, कालान्तर में उसने चार रुपये उपार्जन किया। तब दोनों का योग नौ रुपये उसके निकट धन होगा। यदि उसी को पहले पांच रुपये ऋण था फिर उसने चार रुपये ऋण लिया तब दोनों मिलकर उसके पास नौ रुपये ऋण होंगे । यदि उसके निकट चार रुपये धन है और पांच रुपया लिया तब चार रुपये सधाने से उसके निकट एक रुपया ऋण रहा। यदि उसके पास पांच रुपये धन है और पांच रुपये ऋण लिया तो पांच रुपये सधाने से उसके पास शून्य (कुछ नहीं) रहा। इससे आचार्योक्त उपपन्न हुआ ॥ सिद्धान्तशेखर में 'ऐक्यं युतौ स्यात् क्षययोः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति तथा बीजगणित में 'योगे युतिः स्यात् क्षययोः स्वयोर्वा' इत्यादि से भास्कराचार्य ने आचार्योक्त के अनुरूप ही कहा है इति ॥ ३० ॥

अथ व्यवकलनमाह ।

ऊनमधिकाद्विशोध्यं धनं धनादृणमृणादधिकमूनम्
व्यस्तं तदन्तरं स्यादृणं धनं धनमृणं भवति ॥ ३१ ॥
शून्यविहीनमृणमृणं धनं धनं भवति शून्यमाकाशम् ।
शोध्यं यदा धनमृणादृणं धनाद्वा तदा क्षेप्यम् ॥ ३२ ॥

सु. भा.—अधिकाद्धनादूनं धनं विशोध्यं शेषं धनं भवति । अधिकादृणादूनमृणं विशोध्यं शेषमृणं भवति । ऊनाद्धनादधिकं धनं वोनादृणादधिकमृणं विशोध्यं तदा तदन्तरं व्यस्तं विपरीतं स्यात् । अर्थादधिकं धनं विशोध्यं तदा शेषमृणं भवति । अधिकमृणं विशोध्यं तदा शेषं धनं भवति । कथं विपरीतं भवतीत्याह । ऋणं धनं भवति धनं चर्णं भवतीति । चेदृणं शून्यविहीनं शून्येन विहीनं तदा ऋणं धनं च शून्यविहीनं धनं शून्यं च शून्यविहीनमाकाशं शून्यं भवति । यदि ऋणाद्धनं शोध्यं वा धनादृणं शोध्यं तदा क्षेप्यमर्थात् तदा तयोर्योग एवान्तरं भवतीति ।

अत्रोपपत्त्यर्थं मन्मुद्रिता भास्करबीज टिप्पणी विलोक्या ॥ ३१-३२ ॥

वि. भा.—अधिकाद्धनादूनं (अल्पं) धनं विशोध्यं तदा शेषं धनं भवति । अधिकादृणादूनमृणं विशोध्यं तदा शेषमृणं भवति । ऊना (अल्पात्) द्धनादधिकं धनं वा ऊनादृणादधिकमृणं विशोध्यं तदा तदन्तरं विपरीतं स्यादर्थादधिकधनस्य शोधनेन शेषमृणं भवति । तथाधिक-ऋणशोधनेन शेषं धनं भवतीति । कथं व्यस्तं (विपरीतं) भवतीति कथ्यते । ऋण धनं भवति, धनं चर्णं भवति, चेदृणं शून्येन विहीनं तदा ऋणम् । धनंच शून्यविहीनं तदा धनं, शून्यं च शून्य विहीनं तदा शेषं शून्यं भवति । यदि ऋणात् धनं शोध्यं वा धनादृणं शोध्यं तदा तयोर्योग एवान्तरं भवतीति ॥

अत्रोपपत्तिः ।

यदि धनरूप्यकपञ्चकाद्रूप्यकत्रयं धनं विशोध्यते अर्थादल्पं क्रियते तदा रूप्यक द्वयं धनमवशिष्यते । यदि ऋणरूप्यकपञ्चकादृणरूप्यकत्रयमल्पं क्रियते तदा रूप्यकद्वयमृणं स्थास्यति । अथ यस्य रूप्यकपञ्चकं धनमस्ति रूप्यकत्रय-मृणमस्ति तदा तदृणस्याधुना विशोधनं जातमर्थाद्येन तदृणं दत्तं तेन न गृह्यते कथ्यते च यदहं तद्रूप्यकत्रयं भवते दत्तवान् तदा तस्य अष्टौ रूप्यकाणि धनं भविष्यति । यदि च रूप्यकपञ्चकमृणं रूप्यकत्रयं च धनं स्यात्तदा तद्रूप्यकत्रयस्य विशोधनेऽर्थादल्पीकरणे तद्रूप्यकत्रयं ऋणात्मकं भविष्यति । तदानीं तस्याष्टौ रूप्य-काणि ऋणात्मकानि भविष्यंतीति । शेषं स्पष्ट मेवास्ति । सिद्धान्तशेखरे 'संशोध्य-मानं स्वमृणं धनर्णं धनं भवेदुक्तवदत्र योगः' श्रीपत्युक्तमिदं, बीजगणिते 'संशोध्य-मानं स्वमृणत्वमेति स्वत्वं क्षयस्तद्युतिरुक्तवच्च' भास्करोक्तमिदंचाऽऽचार्योक्ता-नुरूपमेवास्तीति ।। ३१-३२ ।।

अब व्यवकलन को कहते हैं ।

हि. भा.—अधिक धन में से अल्प धन को घटाने से शेष धन होता है अधिक ऋण में से अल्प ऋण को घटाने से शेष ऋण होता है । अल्प धन में अधिक धन को वा अल्पऋण-में से अधिक ऋण को घटाने से वह अन्तर विपरीत होता है अर्थात् अधिक धन के घटाने से शेष ऋण होता है । तथा अधिक ऋण के घटाने से शेष धन होता है । क्यों विपरीत होता है सो कहते हैं । ऋण धन होता है, धन ऋण होता है यदि ऋण में से शून्य को घटाते हैं तो ऋण ही रहता है अर्थात् उस ऋणाङ्क में किसी तरह का विकार नहीं होता है । धन में से शून्यको घटाने से शेष धन होता है । शून्य में से शून्य को घटाने से शेष शून्य होता है । यदि ऋणाङ्क में से धनाङ्क को घटाया जाय वा धनाङ्क में से ऋणाङ्क को घटाया जाय तब उन दोनों का योग ही अन्तर होता है इति ।।

उपपत्ति ।

यदि धनात्मक पांच रुपये में से धनात्मक तीन रुपयों को घटाते हैं अर्थात् अल्प करते हैं तो दो रुपये धन शेष रहता है यदि ऋणात्मक पांच रूपयों में से ऋणात्मक तीन रुपयों को अल्प करते हैं तो दो रुपये ऋण रहता है । जिसके पास पांच रुपये धन है और तीन रुपये ऋण है उसके उन तीन रुपयों को घटजाना है लेकिन जिसने तीन रुपये दिये थे वह नहीं लिये कहा कि वह तीनों रुपये आप ही को दे दिये तब उस व्यक्ति के पास आठ रुपये धन हो गया । यदि पांच रुपये ऋण है और तीन रुपये धन है तब उन तीनों रुपयों को विशोधन करने से वे तीनों रुपये ऋण होंगें तब उसको कुल आठ रुपये ऋण होग । शेष विषय स्पष्ट ही है । सिद्धान्त शेखर में 'संशोध्यमानं स्वमृणं धनर्णमित्यादि' श्रीपत्युक्त तथा बीजगणित में 'संशोध्यमानं स्वमृणत्वमेति' इत्यादि भास्करोक्त आचार्योक्त के अनुरूप ही है ।। ३१-३२ ।।

इदानीं गुणने करणसूत्रमाह ।

ऋणमृणधनयोर्घातो धनमृणयोर्धनवधो धनं भवति ।
शून्यर्णयोः खधनयोः खशून्ययोर्वा वधः शून्यम् ।। ३३ ।।

सु. भा.—ऋणधनयोर्घात ऋणं भवति। ऋणयोर्वधो धनवधो धनयोर्वधश्च धनं भवति । शून्यर्णयोः खधनयोः शून्यधनयोर्वा खशून्ययोश्च वधः शून्यं भवति ।। ३३ ।।

वि. भा.—ऋणधनयोर्घातऋणं भवति । ऋणयोर्वधो धनं भवति; धनयोर्वधश्च धनं भवति । शून्यर्णयोः, शून्यधनयोः, शून्यशून्ययोर्वावधः शून्यं भवतीति ।।

अत्रोपपत्तिः ।

कल्प्यते गुण्यः=न—प गुणकः=य—क तदा "इष्टोनयुक्तेन गुणेन निघ्नोऽभीष्टघ्न गुण्यान्वित वर्जितो वे" तिभास्करोक्तरीत्या गुणनाय क सममिष्टं युक्तं तदा गुणकः=य अनेन गुण्ये गुणिते तदा जातम् य. न—य. प अस्मात् क गुणितगुण्योऽयं क. न—क .प विशोध्यस्तदा विशोधनप्रकारेण विशोधनेन जातं गुणनफलम्=य. न—य . प—क. न+क. प अत्रान्तिमखण्डे क, प ऋण योर्घातो धनात्मको जातस्था धनयोर्घातो धनमृण धनयोश्च घात ऋणमित्यपि सुगममुपद्यते ।।

गुण्यो यदि रूपाल्पगुणकेन गुण्यते तदा गुणनफलं गुण्यादल्पं भवतीति पाटीगणितरीत्या प्रसिद्धम् । एवं यथा यथा गुणको रूपाल्पस्तथा तथा गुणन फलमल्पंभवति, तदिह गुणकपरमे ह्रासेऽर्थात् शून्यसमत्वे गुणनफलमपि परमाल्पं शून्यसमं भवतीति, एतावताऽऽचार्योक्तमुपपन्नम् । सिद्धान्तशेखरे 'वधे धनं स्याहणयोः स्वयोश्च धनर्णयोः संगुणने क्षयश्चेति श्रीपत्युक्तं बीजगणिते 'स्वयोरस्वयोर्वा वधः स्वर्णघाते' इत्यादि भास्करोक्तंचाऽऽचार्योक्तानुरूपमेवेति ।। ३३ ।।

अब गुणन के लिये विधि कहते हैं ।

हि. भा.—ऋणात्मक अङ्क और धनात्मक अङ्क का घात करने से गुणनफल ऋण होता है, दो ऋणात्मक अङ्कों का घात धन होता है, दो धनात्मक अङ्कों का घात भी धन होता है । शून्य और ऋण का घात शून्य होता है । शून्य और धन का घात तथा शून्य-शून्य का घात शून्य होता है इति ।।

उपपत्ति ।

कल्पना करते हैं गुण्य = न — प, गुणक = य — क तब 'इष्टोनयुक्तेन गुणेन

निघ्नोऽभीष्टघ्न गुण्यान्वितवर्जितो वा' इस भास्करोक्त रीति से क समान इष्ट को जोड़ने से गुणक=य इससे गुण्य को गुणने से य. न—य. प इसमें क गुणित गुण्य 'क. न—क. प' को घटाने से गुणन फल=य. न—य. प—क. न+क. प इसके अन्तिम खण्ड में क, प दोनों ऋणों का घात धनात्मक हुआ । तथा दो धनों का घात धन, धन और ऋण का घात ऋण ये भी सुगमता ही से उपपन्न होता है । गुण्य को यदि रूपाल्प गुणक से गुणा करते हैं तो गुणन फल गुण्य से अल्प होता है यह पाटी गणित से प्रसिद्ध है । एवं जैसे जैसे गुणक रूपाल्प है वैसे वैसे गुणनफल अल्प होता है । गुणक के परम ह्रास में अर्थात् शून्यसमत्व में गुणन-फल भी परमाल्प शून्य के समान होता है । इससे आचार्योक्त उपपन्न हुआ । सिद्धान्तशेखर में 'वधे धनं स्यादृणयोः स्वयोश्च' इत्यादि श्रीपत्युक्त तथा बीज गणित में 'स्वयोरस्वयोर्वा वधः स्वर्ण घाते' इत्यादि भास्करोक्त भी आचार्योक्तानुरूप ही है इति ॥३३॥

इदानीं भागहारे करणसूत्रद्वयमाह ।

धनभक्तं धनमृणहृतमृणं धनं भवति खं खभक्तं खम् ।
भक्तमृणेन धनमृणं धनेन हृतमृणमृणं भवति ॥३४॥
खोद्धृतमृणं धनं वा तच्छेदं खमृणधनविभक्तं वा ।
ऋणधनयोर्वर्गः स्वं खं खस्य पदं कृतिर्यत् तत् ॥३५॥

सु. भा.—धनं धनभक्तं वा ऋणं ऋणभक्तं फलं धनं भवति । खभक्तं खं फलं खं भवति । ऋणेन धनं भक्तं फलमृणं स्यात् । धनेन ऋणं हृतं फलमृणं भवति । ऋणं वा धनं खेनोद्धृतं तच्छेदं तस्य शून्यस्य छेदो यस्मिन्नृणे वा धने तच्छेदं भवति । एवं खं शून्यमृणधन विभक्तं (शून्यं) वा तच्छेदं भवति । फलं शून्यं भवति वा शून्यं तद्धरं स्यादित्यर्थः । ऋणधनयोर्वर्गः स्वं भवति । खस्य वर्गः खं भवति । तदेव वर्गस्य पदं भवति । यत्कृतिः स एव वर्गो भवेदिति । भास्करबीजेप्येतदेव सर्वम् । अत्र खभक्तं खमर्थात् $\frac{0}{0}$ इदं सर्वदा शून्यसमं नेत्येतदर्थं चलनकलनं विलोक्यम् ॥ ३४-३५ ॥

वि. भा.—धनं धनभक्तं ऋणं ऋणभक्तं फलं धनं भवति, खं (शून्यं) खभक्तं (शून्येन भक्तं) फलं शून्यं भवति । ऋणेन भक्तं धनं फलमृणं भवति, धनेन भक्तमृणं फलमृणं भवति, ऋणं धनं वा शून्येन भक्तं तच्छेदं तस्य शून्यस्य छेदो यस्मिन्नृणे धने वा तच्छेदं भवति । तथा शून्यमृणधनभक्तं फलं शून्यं वा तच्छेदं भवति । ऋणधनयोर्वर्गः धनं भवति । शून्यस्य वर्गः शून्यं भवति । तदेव वर्गस्य पदं भवति । यत्कृतिः स एव वर्गो भवतीति ॥

अत्रोपपत्तिः

गुणनोपपत्तिवैपरीत्येन भागहारोपपत्तिरपि सुगमैव । शून्यं शून्येन भक्तं

फलं शून्यं न भवतीति प्रदर्श्यंते। यथा $\frac{३-३}{६-६}=\frac{०}{०}=\frac{३\,(१-१)}{६\,(१-१)}=\frac{३}{६}$ एतावता शून्ये न्यूनाधिकत्वं स्पष्टमेव दृग्गोचरीभूतं भवत्यर्थात्सर्वाणि शून्यानि न समानानि भवन्ति तस्मात् शून्येन शून्यं भक्तं फलं शून्यं न भवितुमर्हति, आचार्येण यदस्य $\frac{०}{०}$ मानं शून्यं कथ्यते तत्समीचीनं नास्ति। समयोर्द्वयोर्घातस्य वर्ग इत्यभिधानात् धनयोर्घातस्य ऋणयोर्घातस्य च धनत्वात् वर्गस्य सर्वथैव धनत्वमेव। ऋणं धनं वा शून्येन विभक्तं तच्छेदं भवतीत्याचार्योक्तौ विचार्यंते। यथा $\frac{य}{र}$ अत्र र मानं यथा यथाऽल्पं भवेत्तथा तथा लब्धिरधिका स्यात्, र मानस्य परमाल्पत्वेऽर्थाच्छून्यसमत्वे लब्धिः परमाधिकाऽनन्तसमा भवेदत एव बीजगणिते $\frac{य}{०}$ खहरराशिसम्बन्धे 'अस्मिन् विकारः खहरे न राशावपि प्रविष्टेष्वपि निःसृतेषु। बहुष्वपि स्याल्लय-सृष्टिकालेऽनन्तेऽच्युते भूतगणेषु यद्वत्, भास्करेण कथितम्। अनेन खहरराशे-रविकारिता दृष्टान्तप्रसङ्गेन भगवतोऽनन्तस्याच्युतस्य साम्यं प्रतिपादयति।

अथ ऋणात्मक राशिसम्बन्धे किञ्चिद्विचार्यंते। $० > -य$, $\frac{य^२}{०}$ = अनन्त, तथा $\frac{य^२}{-य} = -य$ परन्तु $-य < ०$ $\therefore \frac{य^२}{-य} = -य >$ अनन्ताधिक। इति ऋणा-ऽत्मकराशेर्वैचित्र्यमाश्चर्यकारकमस्ति, यतः शून्यादल्पो भूत्वाऽनन्ततोऽपि महान् भवतीति ॥३४-३५॥

अब भाग हार के लिये कहते हैं।

हि. भा.—धन को धन से वा ऋण को ऋण से भाग देने से फल धन होता है। शून्य को शून्य से भाग देने से फल शून्य होता है। धन को ऋण से भाग देने से फल ऋण होता है। धन से ऋण को भाग देने से फल ऋण होता है। ऋण वा धन को शून्य से भाग देने से उस ऋण वा धन में शून्य छेद (हर) होता है। शून्य को ऋण वा धन से भाग देने से फल शून्य होता है। ऋण और धन का वर्ग धन होता है। शून्य का वर्ग शून्य होता है। शून्य का पद (मूल) भी शून्य होता है इति ॥

उपपत्ति।

गुणनोपपत्ति वैपरीत्य से भागहारोपपत्ति भी सुगम ही है। शून्य को शून्य से भाग देने से फल शून्य नहीं होता है। जैसे $\frac{३-३}{६-६}=\frac{०}{०}=\frac{३\,(१-१)}{६\,(१-१)}=\frac{३}{६}$ इससे शून्यों में न्यूनाधिक्य स्पष्ट ही देखने में आता है। अर्थात् सब शून्य बराबर नहीं होते हैं अतः शून्य से

शून्य को भाग देने से फल शून्य नहीं हो सकता है। आचार्य $\frac{0}{0}$ इसका मान शून्य कहते हैं सो ठीक नहीं है। $\frac{य}{र}$ यहां र का मान ज्यों ज्यों अल्प होगा त्यों त्यों लब्धि अधिक होगी। र मान के परमाल्प में अर्थात् शून्य समत्व में लब्धि परमाधिक अर्थात् अनन्त के बराबर होती है। भास्कराचार्य ने बीजगणित में खहर $\frac{य}{0}$ राशि के सम्बन्ध में 'अस्मिन् विकारः खहरे न राशावपि प्रविष्टेष्वपि निःसृतेषु। बहुष्वपि स्याल्लयसृष्टिकालेऽनन्तेऽच्युते भूतगणेषु यद्वत्' कहा है।

अब ऋणात्मक राशि के वैचित्र्य को दिखलाते हैं। $0 > -य$, $\frac{य^2}{0}$ = अनन्त तथा $\frac{य^2}{-य} = -य$ परन्तु $0 > -य$ $\therefore$ $\frac{य^2}{-य} = -य >$ अनन्त यह ऋणात्मक राशि की विचित्रता आश्चर्य कारक है। क्योंकि शून्य से भी अल्प होकर अनन्त से भी अधिक होता है इति ॥३४–३५॥

इदानीं संक्रमणविषमकर्माह।

योगोऽन्तर युतहीनो द्विहृतः संक्रमणमन्तरविभक्तं वा।
वर्गान्तरमन्तरयुतहीनं द्विहृतं विषमकर्म ॥३६॥

सु. भा.—योगो राश्योर्योगोऽन्तरेण राश्यन्तरेण युतो हीनश्च द्विहृतो दलितो राशी स्तः। इदं संङ्क्रमणं नाम गणितम्। वा राश्योर्वर्गान्तरं राश्यन्तरेण विभक्तं फलमन्तरेण युतं हीनं द्विहृतं च राशी स्तः। इदं विषमकर्म नाम गणितम्। 'योगोऽन्तरेणोनयुतः'—इत्यादि तथा 'वर्गान्तरं राशिवियोगभक्तं'—इत्यादि च भास्करोक्तं चैतदनुरूपमेव ॥ ३६ ॥

वि. भा.—द्वयो राश्योर्योगस्तयोरन्तरेण युतो हीनश्च कार्यः। अर्धितस्तदा राशी भवेताम्, इदं सक्रमणं नाम गणितम्। वा राश्योर्वर्गान्तरं राश्यन्तरेण विभक्तं लब्धमन्तरेण युतं हीनं द्वाभ्यां भक्तं तदा राशी भवेताम्। इदं विषमकर्म नाम गणितम् ॥

अत्रोपपत्तिः।

कल्प्येते राशी य, र अनयोर्योगः $= य + र$, अन्तरम् $= य - र$, योगोऽन्तरेण युतः $य + र + य - र = २ य$ अर्धितः $= \frac{योग + अन्तर}{२} = य$। योगोऽन्तरेण हीनः

य+र—(य—र)=य+र—य+र=२ र अर्धित:= $\frac{\text{योग—अन्तर}}{२}$ =र इदं संक्रमणसंज्ञकं गणितम् । तथा राश्योर्वर्गान्तरम्=$य^२—र^२$ राश्यन्तरेण य—र भक्त $\frac{य^२—र^२}{य—र}$=य+र तत: पूर्ववत् । $\frac{\text{योग+अन्तर}}{२}$=य । $\frac{\text{योग+अन्तर}}{२}$=र । इदं विषमकर्म नाम गणितम् । एतावताऽऽचार्योक्तमुपपन्नम् । लीलावत्यां 'योगोऽन्तरेणोनयुतोऽर्धितस्तौ राशी स्मृतं संक्रमणाख्य' मिति तथा वर्गान्तरं राशिवियोगभक्तं योगस्तत: प्रोक्तवदेव राशी' इति च भास्करोक्तमाचार्योक्तानुरूपमेवास्ति ।।३६।।

अब संक्रमण और विषम कर्म को कहते हैं ।

हि. भा.— दो राशियों के योग में दोनों राशियों के अन्तर को युत और हीन कर दो से भाग देने से दोनों राशियों का प्रमाण होता है इसका नाम संक्रमण है । वा दोनों राशियों के वर्गान्तर को राश्यन्तर से भाग देकर जो लब्धि हो उसमें राश्यन्तर को युत और हीनकर दो से भाग देने से राशिद्वय का मान होता है इसका नाम विषम कर्म है ।।

उपपत्ति ।

प्रथम राशि=य । द्वितीय रशि=र, प्ररा+द्विरा=य+र=योग । प्ररा—द्विरा =य—र=अन्तर, योग+अन्तर=य+र+य—र=२य ∴ $\frac{\text{योग+अन्तर}}{२}$ = य ।

योग—अन्तर=य+र—(य—र)=य+र—य+र=२ र । अत: $\frac{\text{योग—अन्तर}}{२}$=र । यह संक्रमण गणित है । वा राशिद्वय का वर्गान्तर=$य^२—र^२$, राश्यन्तर (य—र) से भाग देने से $\frac{य^२—र^२}{य—र}$=य+र=योग तब पूर्ववत् $\frac{\text{योग+अन्तर}}{२}$=य । $\frac{\text{योग—अन्तर}}{२}$ = र, इसका नाम विषमकर्म गणित है । इससे आचार्योक्त उपपन्न हुआ । लीलावती में 'योगोऽन्तरेणोनयुत' इत्यादि से तथा 'वर्गान्तरं राशिवियोगभक्त' इत्यादि से भास्कराचार्य ने आचार्योक्त के अनुरूप ही कहा है इति ।।३६।।

इदानीं समद्विबाहुत्रिभुजे लम्बज्ञानादकरणीगतौ भुजावाह ।

करणी लम्बस्तत्कृतिरिष्टहृतेष्टोनसंयुताऽल्पा भूः ।
अधिको द्विहृतो बाहुः संक्षेप्यो यद्वधो वर्गः ।।३७।।

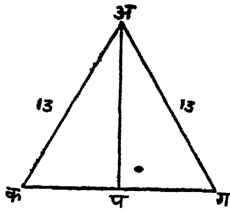
सु. भा.—यो लम्बस्तस्य करणी संज्ञा ज्ञेया । तस्याः करण्याः कृतिरिष्टेन हृता । इष्टोनसंयुता कार्या अनयोर्याऽल्पा सा समद्विबाहोर्भूः कल्प्या । यश्चाधिकः स द्विहृतः समद्विबाहोर्बाहुर्ज्ञेयः । 'संक्षेप्यो यद्वधो वर्गः' इत्यस्याग्रे सम्बन्धः ।

अत्रोपपत्तिः । समद्विबाहौ यः शिरः कोणादाधारोपरि लम्बस्तद्वशाज्जात्यद्वयं समानमुत्पद्यते । तत्र लम्बः कोटिः । आधारार्धं भुजः । समद्विबाह्वोर्बाहुः कर्णः । भुजकर्णान्तरमिष्टं प्रकल्प्य तद्वर्गान्तरात् कोटिवर्गाद्विषमकर्मणाऽनन्तरप्रतिपादितेन द्विगुणभुजो भूः । कर्णो बाहुश्चाकरणीगत आनीत इति ॥ ३७ ॥

वि. भा.—समद्विबाहौ शिरः कोणादाधारोपरि यो लम्बः सा करणी संज्ञका ज्ञेया, तस्या वर्गं इष्टेन भक्तः, इष्टोनयुक्तौ कार्यौ अनयोर्याऽल्पा सा समद्विबाहुत्रिभुजस्य भूः कल्पनीया । योऽधिकः स द्वाभ्यां भक्तः समद्विबाहुत्रिभुजस्य भुजो ज्ञेयः । 'संक्षेप्यो यद्वधोवर्गं' इत्यस्याग्रे सम्बन्धः ॥

अत्रोपपत्तिः ।

अ क ग समद्विबाहु त्रिभुजम् । अ शिरः कोण बिन्दुतः क ग आधारोपरि लम्बः=अ र एतल्लम्बवशेन अकर, अगर जात्यत्रिभुजद्वयं तुल्यं समुत्पद्यते, अर लम्बः कोटिः, कर आधरार्धं भुजः । अक=कर्णः । अत्र भुजकर्णयोर्वर्गान्तरं कोटिवर्गमिष्टं प्रकल्प्य वर्गान्तरं राशिवियोगभक्तमित्यादिना $\frac{\text{कर्ण}^2-\text{भुज}^2}{\text{कर्ण}-\text{भुज}}=\frac{\text{कोटि}^2}{\text{कर्ण}-\text{भुज}}=\frac{\text{इ}^2}{\text{कर्ण}-\text{भु}}$ =कर्ण+भुज ततः कर्णभुजयोर्योगान्तराभ्यां संक्रमणगणितेन भुजकर्णौ भवेत् । भुजो द्विगुणितस्तदा भूर्भवेत् । कर्णो भुजश्चाकरणीगतः समागत इति ॥३७॥



अब समद्विबाहु त्रिभुज में लम्बज्ञान से अकरणीगत भुजद्वय को कहते हैं ।

हि. भा.—सम द्विबाहु में शिरःकोण से आधार के ऊपर जो लम्ब होता है वह करणी संज्ञक है । उस के वर्ग को इष्ट से भाग देकर जो लब्धि हो उस में इष्ट को हीन और युत करना चाहिये । इन दोनों में जो अल्प है उसको समद्विबाहु त्रिभुज की भू कल्पना करना । अधिक जो है उस को दो से भाग देने से जो हो वह समद्विबाहु का भुज होता है इति ॥

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित (१) क्षेत्र को देखिये । अकग समद्विबाहुक त्रिभुज है । अ शिरः कोणबिन्दु से कग आधार के ऊपर लम्ब=अर इस लम्ब के वश से अकर, अगर दो तुल्य जात्य त्रिभुज उत्पन्न होता है । अर लम्ब=कोटि, कर आधारार्धं=भुज, अक=कर्ण यहां भुज और कर्ण के वर्गान्तर कोटि (लम्ब) वर्ग को इष्ट कल्पना कर 'वर्गान्तरं राशि वियोग भक्त' इत्यादि से $\frac{\text{कर्ण}^2-\text{भुज}^2}{\text{कर्ण}-\text{भु}}=\frac{\text{कोटि}^2}{\text{कर्ण}-\text{भु}}=\frac{\text{इ}^2}{\text{कर्ण}-\text{भु}}$ =क+भु तब कर्ण

और भुज के योगान्तर से संक्रमण गणित से भुज और कर्ण का प्रमाण आजायगा, द्विगुणित भुज समद्विबाहुक की भू है। इस तरह अकरणीगत भुज और कर्ण लाया गया है इति ।।३७।।

इदानीं करणीयोगान्तरे गुणनं चाह।

इष्टोद्धृतकरणी पदयुतिकृतिरिष्टगुणिताऽन्तरकृतिर्वा ।
गुण्यस्तिर्यगधोऽधो गुणकसमस्तद्गुणः सहितः ।। ३८ ।।

सु. भा.—यद्वधो ययोः करेण्योर्वधो वर्गो भवति तयोरेव संक्षेप्यो योगोऽन्तरं च भवतीति ज्ञेयम् । इष्टोद्धृतयोः करण्योः पदे ग्राह्ये तद्युतिकृतिर्वा तदन्तरकृतिरिष्टगुणिता तदा तयोः करण्योर्योगान्तरे स्तः। गुणकसमो गुण्यस्तिर्यक् पङ्क्तावधोऽधः स्थाप्यस्ततस्तद्गुणस्तैः खण्डकैर्गुणः सहितो गुणनफलं स्यात् ।

अत्रोपपत्तिः । मत्कृतभास्करबीजटिप्पणीतः स्फुटा ।

यदा $इ_1\sqrt{क}$, $इ_2\sqrt{क}$ एतादृश्यौ करण्यौ तदैव गणितयुक्त्या योगः$=(इ_1+इ_2)\sqrt{क}=\sqrt{(इ_1+इ_2)^2 क}$ ।

अन्तरम्$=(इ_1-इ_2)\sqrt{क}=\sqrt{(इ_1-इ_2)^2 क}$ ।

अथ तदा द्वयोर्वधः$=इ_1\sqrt{क}\times इ_2\sqrt{क}$

$=\sqrt{इ_1^2 क}\times\sqrt{इ_2^2 क}=\sqrt{इ_1^2 इ_2^2 क^2}$

अस्य मूलचिह्नान्तर्गतस्य मूलं निरग्रम्$=इ_1 इ_2 क$। अतो यदा द्वयोर्वधो वर्गोभवति तदैव तयोर्योगान्तरे उत्पद्येते ।। ३८ ।।

वि. भा.—ययोः करण्योर्वधो वर्गो भवति तयोरेव संक्षेप्योऽर्थात् योगोऽन्तरं च भवतीति । इष्टोद्धृतयोः करण्योः पदे (मूले) ग्राह्ये तद्युतिः कृतिर्वा तदन्तरवर्ग-इष्टगुणितस्तदा तयोः करण्योर्योगान्तरे भवतः। गुणकसमो गुण्यस्तिर्यक् पंक्तावधोऽधः स्थाप्यः, ततस्तैः खण्डकैर्गुणः सहितो गुणन फलं भवेदिति ।।

अत्रोपपत्तिः ।

अधुना नवीनैर्मूलचिन्हेन यत् प्रकाश्यते प्राचीनैस्तदेव करणी पदेन व्यवह्रियते । यथा $\sqrt{३}=$क ३ $\sqrt{५}=$क ५ इत्यादि, अथ $\sqrt{य}\pm\sqrt{र}$ इदं स्ववर्गमूलसममतस्तद्वर्गः $य+र\pm२\sqrt{य.र}$ अस्य यन्मूलं वा करणी स एव योगो वियोगो वा भवति $\sqrt{य}$, $\sqrt{र}$ चानयोरिति । अथ $\sqrt{य}\pm\sqrt{र}$ दं $\sqrt{र}$ अनेन गुणनेन भजनेन च $\sqrt{र}\times\left(\sqrt{\frac{य}{र}}\pm\sqrt{\frac{र}{\sqrt{र}}}\right)$ पूर्वागतरूपस्य यो वर्गस्तस्य

मूलमेव $\sqrt{\text{य}}$, $\sqrt{\text{र}}$ अनयोर्युत्यन्तरं भवेदतो $\sqrt{\text{र}} \times \left(\sqrt{\frac{\text{य}}{\text{र}}} \pm \frac{\sqrt{\text{र}}}{\sqrt{\text{र}}}\right)$ ऽस्य-वर्गः $\text{र}\left(\sqrt{\frac{\text{य}}{\text{र}}} \pm \frac{\sqrt{\text{र}}}{\sqrt{\text{र}}}\right)^{2}$ अस्यमूलं वा करणी $\sqrt{\text{य}}$, $\sqrt{\text{र}}$ अनयोर्योगोऽन्तरं भवतीति। सिद्धान्तशेखरे 'ग्राह्यं न मूलं खलु यस्य राशेस्तस्य प्रदिष्टं करणीति नाम। विभाजको वा गुणकोऽथवाऽस्याः कृतिर्नियुक्ता कृतिभिः करण्याः, अनेन करणीपरिभाषां तथा गुणनभजनयोर्विशेषं कथयति। करणीयोगवियोग-सम्बन्धे च, 'योगे वियोगे करणीं स्वबुध्या सन्ताड़येत्तेन यथा कृतेः स्यात्। तन्मूल-संयोगवियोगवर्गौ विभाजयेदिष्ट गुणेन तेन।' उदाहरणार्थं 'द्विकाष्टमित्योस्त्रिभ-संख्ययो' रित्यादि भास्करोक्तः प्रश्नः।

श्रीपत्युक्तौ 'संताड़येत्तेन यथा कृतिः स्यादिति तथा विभाजयेदिष्टगुणेन तेनेति पदद्वयं परिवर्त्यते चेत्तथैव ते एव योगान्तरे भवतः। तथा च तत्सूत्रमेतादृशं भवितुमर्हति।

'योगे वियोगे करणीं स्वबुध्या विभाजयेत्तेन यथा कृतिः स्यात्। तन्मूलसं-योगवियोगवर्गौ संताड़येदिष्टगुणेन तेन' एतादृशं सूत्रमेव परम्परया प्रसिद्ध-मस्ति ज्योतिर्वित्समाजेषु।

'आदौ करण्यावपवर्त्तनीये तन्मूलयोरन्तरयोगवर्गौ। इष्टापवर्त्ताङ्कहतौ भवेतां क्रमेण विश्लेषयुती करण्योः' इदमेव सूत्रं श्री जीवनाथदैवज्ञेन स्वकृत भास्करबीज-गणितटीकायाम्।

'आदौ करण्यावपवर्त्तनीये तन्मूलयोरन्तरयोगवर्गौ' इष्टापवर्त्ताङ्कहतौ मते ते क्रमेण विश्लेषयुती करण्योः'। एवं कथितम्। भास्कराचार्येण लघुकरणी तुल्य-मपवर्त्तनाङ्कं प्रकल्प्य "लघ्व्या हृतायास्तु पदं महत्याः सैकं निरेकं स्वहतं लघु-घ्नम्। योगान्तरे स्तः क्रमशस्तयोर्वा पृथक् स्थितिः स्याद्यदि नास्ति मूलम्" इति सूत्रमुपनिबद्धम्॥ यदि $\text{इ}\sqrt{\text{य}}$, $\text{इ}'\sqrt{\text{य}}$ एतादृश्यौ करण्यौ तदैव गणितयुक्त्या योगः $= (\text{इ}+\text{इ}')\sqrt{\text{य}} = \sqrt{(\text{इ}+\text{इ}')^{2}\text{य}}$, अन्तरम् $= (\text{इ}-\text{इ}')\sqrt{\text{य}} = \sqrt{(\text{इ}+\text{इ}')^{2}.\text{य}}$ तदा द्वयोर्घातः $= \text{इ}\sqrt{\text{य}} \times \text{इ}'\sqrt{\text{य}} = \sqrt{\text{इ}^{2}.\text{य}} \times \sqrt{\text{इ}'^{2}.\text{य}} = \sqrt{\text{इ}^{2}.\text{इ}'^{2}.\text{य}}$ अस्य मूल-चिह्नान्तर्गतस्य मूलं निरग्रम् $= \text{इ}.\text{इ}'.\text{य}$ अतो यदा द्वयोर्वधो वर्गो भवति तदैव तयोर्योगान्तरे भवितुमर्हत इति॥ ३८॥

हि. भा.—जिन दो करणियों का वध वर्ग होता है, उन दोनों का ही योगान्तर होता है। इष्टाङ्क से भाग देकर दोनों करणियों का मूल लेना चाहिए।

दोनों का योग या वर्ग तथा अन्तर वर्ग इष्टगुणित हो तब दोनों करणियों का योगान्तर होता है। गुणक के तुल्य गुण्यखंड को अधोऽधः पंक्ति में तिर्यक् स्थापना करें, उसके बाद उन खण्डों से गुणक को गुणाकर सबों का योग गुणनफल होता है।

उपपत्ति।

इस समय मूलचिह्न से जो प्रकट होता है उसी को पुरातन समय में करणी नाम से प्रकट किया जाता था। 'विभाजको वा गुणकोऽथवाऽस्याः कृतिर्भिनियुक्ता कृतिभिः करण्याः' इस पद से करणी की परिभाषा एवं गुणन, भजन के लिए विशेष बात कही गई है।

करणीयोगान्तर के सम्बन्ध में 'योगे वियोगे करणीं स्वबुद्धया सन्ताडयेत्तेन यथा कृतिः स्यात् तन्मूलम्' इत्यादि संस्कृतोपपत्ति में कहा गया है। उदाहरण के लिए 'द्विकाष्टमित्योस्त्रिभसंख्ययोः' इत्यादि भास्करोक्त है। श्रीपति की उक्ति में 'सन्ताडयेत्तेन यथाकृतिः स्यात्' इत्यादि और 'विभाजयेदिष्टगुणेन तेन' इत्यादि दोनों पदों के परिवर्त्तन से उसी प्रकार योगान्तर होता है। तब यह सूत्र इस प्रकार होना चाहिए "योगे वियोगे करणीं स्व बुद्धया विभाजयेत्तेन यथाकृतिः स्यात्" इत्यादि संस्कृतोपपत्ति में लिखित परम्परा ज्योतिषियों में प्रचलित है।

इसी प्रकार जीवनाथ दैवज्ञ ने भी अपनी भास्करबीजगणित की टीका में लिखा है 'आदौ करण्यापवर्त्तनीये तन्मूलयोरन्तरयोगवर्गौ' इत्यादि भास्कराचार्य ने लघुकरणी के बराबर अपवर्त्तनाङ्क मानकर 'लघ्व्या हृतायास्तु पदम्' इत्यादि सूत्र लिखा है। उदाहरण के लिए यदि $इ\sqrt{य}$, $इ'\sqrt{य}$ यह दोनों करणी हैं। गणित की भांति

$$योग = (इ + इ')\sqrt{य} = \sqrt{(इ+इ')^{२}.य},$$

$$अन्तर = (इ - इ')\sqrt{य} = \sqrt{(इ+इ')^{२}.य},$$ तब दोनों का घात

$$= इ\sqrt{य} \times इ'\sqrt{य} = \sqrt{इ^{२}.य} \times \sqrt{इ'^{२}.य} = \sqrt{इ^{२}.इ'^{२}.य}$$

इस स्वरूप में मूलचिह्नान्तर्गत का मूल निरग्र = इ. इ'. य है। इसलिए जिन दो का वध वर्ग होता है वहीं पर उन दोनों का योग तथा अन्तर होता है ॥ ३८ ॥

इदानीं करणीभागहारे वर्गे च करणसूत्रमाह।

स्वेष्टर्णच्छेदगुणौ भाज्यच्छेदौ पृथक् युजावसकृत्।
छेदैकगतहृतो वा भाज्यो वर्गः समद्विवधः॥ ३९॥

सु. भा.—भाज्यच्छेदौ स्वेष्टर्णच्छेदगुणौ छेदे या काचिदिष्टा करणी तामृणं प्रकल्प्य तादृक्छेदेन भाज्यहरौ द्वावेव गुणौ पृथक् सम्भवे सति गुणितभाज्ये गुणितच्छेदे च द्वयोर्द्वयोः करण्योर्युजौ योगौ साध्यौ। पुनः स्वेष्टर्णच्छेदगुणौ भाज्यच्छेदौ कार्यविवमसकृद्यावच्छेदगतैकैव करणी स्यात्। ततो भाज्यो हरैकगतकरण्या हृतो वा फलं स्यात्। अत्र वा पदेन साधारणभागहारविधिश्च यद्गुणश्छेदो भाज्याच्छुध्यति स गुण एव लब्धिरित्यप्याचार्येण सूचितः। समद्विवधो वर्गो भवतीति स्फुटम्।

अत्रोपपत्त्यर्थं मत्कृतभास्करबीजटिप्पण्यां 'धनर्णताव्यत्ययमीप्सितायाश्छेदे' इत्यादि सूत्रोपपत्तिर्विलोक्या॥ ३९॥

वि. भा.—भाज्यहरौ हरे या काचिदिष्टा करणी तां ऋणं मत्वा तादृशेन हरेण गुणनीयौ, सम्भवे सति गुणितभाज्ये गुणितहरे च द्वयोर्द्वयोः करण्योर्योगौ साध्यौ। पुनः स्वेष्टर्णभाज्यहरौ कार्यविवमसकृद्यावद्धरगतैकैव करणी स्यात्। ततो भाज्यो हरैकगतकरण्या भक्तो वा फलं स्यात्। यो गुणो हरो भाज्याच्छुध्यति स गुण एव लब्धिरिति साधारणभागहाररीतिरपि वा पदेनाचार्येण सूचितः, समद्विघातो वर्गो वतीति॥

अत्रोपपत्तिः।

भाज्यभाजकयोः समेनाङ्केन संगुण्य यदि भजेत्तदा लब्धिरविकृतैवातो भाजकगतकरणीनामेकां व्यस्तधनर्णरूपां प्रकल्प्य तादृशा भाजकेन भाज्यभाजकावुभौ यदि गुण्येते तदा नूतनभाजके योगान्तरघातस्य वर्गान्तरसमत्वे नैका करणी न्यूना भविष्यति पुनस्तथैव कृते प्रायो नूतनभाजकेऽप्येका करणी न्यूना भविष्यति, एवमसकृत्कृतेऽन्त्ये सम्भवे भाजके भविष्यति ह्येकैव करणीत्युपपन्नमाचार्योक्तम्। सिद्धान्तशेखरे "छेदे करण्याः समभीप्सितायाः कृत्वा विपर्यासमृणास्वयोश्च। गुण्यौ पृथक् भाज्यहरौ युतौ तौ छेदेऽसकृत् स्यात् करणीयथैका॥ तया भजेदूर्ध्वग-भाज्यराशिमेवं करण्याः खलु भागहारः। समानराश्योरुभयोश्च घाते कृते करण्याः कृतिमप्युशन्ति" श्रीपत्युक्तमिदं, बीजगणिते 'धनर्णता व्यत्ययमीप्सितायाश्छेदे करण्या असकृद्विधाय। तादृक् छिदा भाज्यहरौ निहन्यादेकैव यावत्करणी हरे-स्यात्॥ भाज्यास्तया भाज्यगता करण्यः' भास्करोक्तमिदं चाऽऽचार्योक्तानुरूपमे-

वास्ति। परन्तु यदि हरे धनकरणी भवेत्तदाऽऽचार्योक्तश्रीपत्युक्तभास्करोक्ता 'हरे यावदेकैव करणी स्यात्' नां व्यभिचारो भवेदिति ॥ ३९ ॥

अब करणी भागहार और वर्ग को कहते हैं।

हि. भा.—हर में जो कोई इष्ट करणी हो उसको ऋण मानकर भाज्य और हर को गुण देना चाहिये। सम्भव रहने से गुणित भाज्य में और गुणित हर में, दो दो करणी के योग साधन करना पुनः उपर्युक्त क्रिया के अनुसार क्रिया करनी चाहिये। इस तरह बार बार तब तक क्रिया करनी चाहिए जब तक हर में एक ही करणी हो। तब भाज्य को भाजकगत एक करणी से भाग देने से फल होता है। वर्ग की परिभाषा कहते हैं समान दो अङ्कों का घात उसका वर्ग कहलाता है॥

उपपत्ति।

भाज्य और भाजक को समान अङ्क से गुणा कर यदि भाग दिया जाय तो लब्धि ज्यों की त्यों रहती है। अर्थात् लब्धि में किसी तरह का विकार नहीं होता है। इसलिये भाजक गत करणियों में एक को व्यस्त (उल्टा) धन, ऋण कल्पना कर उस भाजक से यदि भाज्य और भाजक को गुणा करते हैं तब नवीन भाजक में योगान्तर घात के वर्गान्तर के समान होने के कारण एक करणी न्यून होगी। पुनः उसी तरह क्रिया करने से फिर भी नवीन भाजक में एक करणी न्यून होगी। एवं असकृत् (बार-बार) करने से हर में एक ही करणी होगी, इस से आचार्योक्त उपपन्न हुआ। सिद्धान्तशेखर में 'छेदे करण्याः सममीप्सिताया' इत्यादि संस्कृतोपपत्ति में लिखित श्लोकों से श्रीपति ने तथा बीजगणित में 'धनर्णता व्यत्ययमीप्सिताया' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है। परन्तु भाजक धनकरणी रहेगी तब 'यावद्धरे एकैव करणी भवेत्' इसका व्यभिचार होगा इति॥ ३९॥

इदानीं करणीमूलानयनार्थमाह।

इष्टकरण्यूनाया रूपकृतेः पदयुतोनरूपार्धे।
प्रथमं रूपाण्यन्यत्ततो ततो द्वितीयं करण्यसकृत् ॥ ४० ॥

सु. भा.—रूपकृतेः किं विशिष्टाया इष्टकरण्यूनायाः। इष्टा यैका तया वेष्टयो-र्द्वयोर्यो रूपवद्योगस्तेन वेष्टानामनेकासां यो रूपवद्योगस्तेनोनाया यत्पदं तेन रूपाणि पृथक् युतोनितानि तदर्धे च कार्ये। तत्र प्रथममर्धाद्योगार्धं रूपाणि कल्प्यानि। ततोऽन्यदन्तरार्धं द्वितीयं मूलस्यैका करणी भवति। एवमसकृन्मूलानयनं कार्यम्।

अत्रोपपत्तिः। 'वर्गे करण्या यदि वा करण्योः' इत्यादि भास्करसूत्रस्य या मट्टिप्पण्यामुपपत्तिस्तया स्फुटा। तत्रान्ये बहवो विशेषाश्च निरीक्षणीयाः ॥४०॥

वि. भा.—रूपकृतेः इष्टकरण्यूनायाः इष्टायैका तया, इष्ट योर्द्वयोर्वा रूपवद्यो योगस्तेन, इष्टानामनेकासां यो रूपवद्योगस्तेनोनाया यत्पदं तेन रूपाणि पृथक्-युतोनितानि तदर्धे च कार्ये। तत्र प्रथमं योगार्धरूपाणि कल्प्यानि, ततोऽन्यदन्तरार्धं द्वितीयं मूलस्यैका करणी भवति। एवमसकृन्मूलानयनं कार्यमिति।

अत्रोपपत्तिः।

अथ $अ \pm \sqrt{न} = व \pm \sqrt{म}$ इत्येकं समीकरणं यत्र अ, व संख्या-द्वयं संभवं न, म इति संख्याद्वयं चावर्गाङ्करूपं तदाऽत्र $अ = व$, $न = म$ भविष्यति। यद्येवं न तर्हि कल्प्यते $अ = व + इ$ अतः $व + इ \pm \sqrt{न} = व \pm \sqrt{म}$ समशोधनेन $इ \pm \sqrt{न} = \pm \sqrt{म}$ वर्गीकरणेन $इ^२ \pm २ इ \sqrt{न} + न = म$ समशोधनादिना $\frac{इ^२ \backsim (म - न)}{२ इ} = \sqrt{न}$ अनेन न मूलं भिन्नं वाऽभिन्नं संभवसंख्यासमं जातं परन्तु क मानमवर्गाङ्करूपं पूर्वं प्रकल्पितमवर्गस्य मूलं न सावयवं न निरवयवं च भिन्नवर्गे भिन्नत्वान्निरवयवाङ्कवर्गे वर्गाङ्कत्वादतः पूर्वकल्पना न समीचीना। ततोऽवश्यं $अ = व$, $न = म$ इति सिध्यति।

अथ कल्प्यते $अ + \sqrt{न}$ अस्य मूलं $\sqrt{य} + \sqrt{र}$ वर्गकरणेन $य + र + \sqrt{४ य . र} = अ + \sqrt{न}$ पूर्वसमीकरणयुक्त्या $य + र = अ$। $४ य . र = न$, वर्गकरणेन $य^२ + २ य . र + र^२ = अ^२$, $४ य . र = न$ समशोधनेन $य^२ - २ य . र + र^२ = अ^२ - न$ मूलेन $य - र = \sqrt{अ^२ - न}$ ततः संक्रमणेन य, र अनयोर्मानं भवेदिति। सिद्धान्तशेखरे 'रूपकृतेः करणी रहिताया मूलयुतोनितरूपगुणार्धे। रूपगुणः प्रथमं हि तदन्यत् स्यात् करणीपदमित्यसकृच्च, श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवास्ति। भास्कराचार्येण श्रीपत्युक्तमिदं करणीमलानयनं "वर्गेकरण्या यदि वा करण्योस्तुल्यानि रूपाण्यथवा बहूनाम्। विशोधयेद्रूपकृतेः पदेन शेषस्य रूपाणि युतोनितानि॥ पृथक् तदर्धे करणीद्वयं स्यान्मूलेऽथ बह्वी करणी तयोर्या। रूपाणि तान्येव कृतानि भूयः शेषाः करण्यो यदि सन्ति वर्गे॥" इत्यनेन स्पष्टीकरणपूर्वकं सम्यक् कथितमिति, करणीमूलानयनेऽन्येऽपि बहवो नियमाः स्वबीजगणिते प्रतिपादिताः॥ ४०॥

अब करणी मूलानयन को कहते हैं।

हि. भा.—इष्ट एक करणी, वा इष्ट दो करणियों का रूपवत् जो योग हो उससे वा अनेक करणियों के रूपवत् योग से रहित रूपवर्ग का जो मूल हो उससे रूप को पृथक् युत और हीन करना, दोनों का आधा करना, उसमें प्रथम योगार्ध की रूप कल्पना करना, और अन्य अन्तरार्ध के द्वितीय मूल्य की एक करणी होती है। एवं असकृत् मूलानयन करना चाहिये॥

उपपत्ति ।

$अ \pm \sqrt{न} = व \pm \sqrt{म}$ यह एक समीकरण है जिस में अ, ब ये दोनों संख्याएं संभव हैं, न, म, ये दोनों संख्याएँ अवर्गाङ्क रूप हैं तब अ=व, न=म होगा । यदि ऐसा नहीं होगा तो कल्पना करते हैं $अ = व + इ$ अतः $व + इ \pm \sqrt{न} = व \pm \sqrt{म}$ समशोधन से $इ \pm \sqrt{न} = \pm \sqrt{म}$ वर्ग करने से $इ^2 \pm २ इ \sqrt{न} + न = म$ समशोधनादि से $\frac{इ^2 \sim (म - न)}{२ इ} = \sqrt{न}$ इससे सिद्ध होता है कि न का मूल भिन्न हो कर अभिन्न संभव संख्या के बराबर हुआ, लेकिन क का मान पहले अवर्गाङ्क रूप प्रकल्पित है, अवर्गाङ्क का मूल भिन्न वर्ग में भिन्नत्व के कारण और निरवयवाङ्क के वर्ग में वर्गाङ्कत्व के कारण, नसावयव होता है, न निरयव, इसलिये पूर्व कल्पना समीचीन नहीं हैं । अतः अ=व, न=म सिद्ध होता है । कल्पना करते हैं $अ + \sqrt{न}$ इसका मूल $= \sqrt{य} + \sqrt{र}$ वर्ग करने से $य + र + \sqrt{४ य. र} = अ + \sqrt{न}$ पूर्व समीकरणयुक्ति से $य + र = अ$ । $४ य. र = न$ वर्ग करने से $य^2 + २ य. र + र^2 = अ^2$ । $४ य. र = न$ समशोधन से $य^2 - २ य. र + र^2 = अ^2 - न$ मूल लेने से $य - र = \sqrt{अ^2 - न}$, अन्तर ज्ञान से संक्रमण गणित से य, र इन दोनों का मान विदित हो जायगा । इस से आचार्योक्त उपपन्न हुआ । सिद्धान्त शेखर में 'रूपकृतेः करणी रहिता वा' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्ति के अनुरूप ही कहा है, भास्कराचार्य ने बीज गणित में 'वर्गे करण्या यदि वा करण्योः' इत्यादि संस्कृतोपपत्ति में लिखित पद्यों से श्रीपत्युक्त करणीमूलानयन को स्पष्टी करण पूर्वक कहा है ।। ४० ।।

इदानीमव्यक्तसङ्कलितव्यवकलितयोः करणसूत्रमाह ।

अव्यक्त वर्ग घनवर्ग वर्ग पञ्चगत षड्गतादीनाम् ।
तुल्यानां संकलितव्यवकलिते पृथगतुल्यानाम् ।। ४१ ।।

सु. भा.—अव्यक्तानां तद्वर्गाणां घनानां वर्गवर्गाणां पञ्चगतानां पञ्चघातानां षड्गतादीनां षड्घातादीनां तुल्यानां समानजातीनां सङ्कलितव्यवकलिते भवतोऽतुल्यानां भिन्नजातीनां च पृथक् स्थापनमेव तेषां सङ्कलितव्यवकलिते भवत इति । 'योगोऽन्तरं तेषु समानजात्योर्विभिन्नजात्योश्च पृथक् स्थितिश्च'—इति भास्करोक्तमेतदनुरूपमेवातो ऽस्योपपत्तिश्च तद्वत् ।। ४१ ।।

वि. भा.—अव्यक्तानां वर्गाणां घनानां वर्गवर्गाणां पञ्चघातानां षड्घातादीनां तुल्यानां (समानजातीनां) योगोऽन्तरं भवति, अतुल्यानां (भिन्नजातीनां) पृथक् स्थितिरेव "तद्योगोऽन्तरं भवतीति ।। नारायणीये बीजगणितावतंसे 'वर्णेषु च समजात्योर्योगः कार्यस्तथा वियोगश्च । असदृशजात्योर्योगे पृथक् स्थितिः

स्याद्वियोगे च' इति 'योगोऽन्तरं तेषु समानजात्योर्विभिन्नजात्योश्च पृथक् स्थितिश्च' भास्करोक्तमिदं चाऽऽचार्योक्तानुरूपमेव। समद्विघातो वर्गः। त्रिघातो घनः। चतुर्घातो वर्गवर्ग इत्यादियथेष्टघाता भवितुमर्हति। पाश्चात्यगणिते यस्य घातोऽपेक्ष्यते तन्मस्तकोपरि तद्घातज्ञापनाय तदङ्का रक्ष्यन्ते यथा य अस्य द्विघातः=$य^{२}$=$य^{१}$×$य^{१}$=$य^{१+१}$। त्रिघातो घनः =$य^{३}$=$य^{२}$×$य^{१}$=$य^{१}$×$य^{१}$×$य^{१}$ =$य^{१+१+१}$ ऊर्ध्वरूपदर्शनादवगम्यते यद्वारज्ञापका द्वित्र्यादयः। यदि द्विघाते विचारः क्रियते तदा $य^{१}$×$य^{१}$ अत्रैकघात एकघातेन गुण्यतेऽत्रैकैकयोर्योगो द्वयम् $य^{१}$×$य^{१}$=$य^{१+१}$=$य^{२}$, एवं यथेष्टघातेषु $य^{२}$×$य^{२}$=$य^{२+२}$=$य^{४}$=वर्गवर्गः। य× य×य×य×य=$य^{१+१+१+१+१}$=$य^{५}$=पञ्चघातः इति ॥ ४१ ॥

अब अव्यक्तों के सङ्कलित और व्यवकलित को कहते हैं।

हि. भा.—अव्यक्तों के वर्ग, घन, वर्गवर्ग, पञ्चघात, षड्घात आदि समान जातियों का योग और अन्तर होता है। भिन्न जातियों की पृथक् स्थिति ही योग और अन्तर होता है॥ नारायणीय बीजगणितावतंस में 'वर्णेषुच समजात्योर्योगः कार्यं' इत्यादि विज्ञान भाष्य में लिखित श्लोक तथा बीजगणित में 'योगोऽन्तरं तेषु समान जात्योः' इत्यादि विज्ञान भाष्य में लिखित भास्करीय श्लोक विषय आचार्योक्त के अनुरूप ही है। समान दो अङ्कों का घात वर्ग है, त्रिघात घन है चतुर्घात वर्गवर्ग इत्यादि यथेष्टघात होते हैं। पाश्चात्य गणित में जिसका घात अपेक्षित है उसके मस्तक के ऊपर उस घात के ज्ञानार्थ उस अङ्क को रक्खा जाता है। जैसे य इसका द्विघात=$य^{२}$ = $य^{१}$ × $य^{१}$ = $य^{१+१}$=य का वर्ग त्रिघात घन है। $य^{३}$ = य का घन + $य^{२}$ × $य^{१}$ = $य^{१}$ × $य^{१}$ × $य^{१}$ = $य^{१+१+१}$ एवं यथेष्टघात होते हैं। समान जातिक अङ्कों का योग और अन्तर होता है जैसे ३ $य^{२}$+२ $य^{२}$+५ $य^{२}$ =$य^{२}$ (३ + २ + ५) = १० $य^{२}$ एवं १० $य^{२}$ — २ $य^{२}$—५ $य^{२}$=$य^{२}$ (१०—२ — ५) = $य^{२}$ (१० — ७) = ३$य^{२}$।

यदि १२ $य^{२}$, इसमें ५ $य^{३}$ इसको जोड़ते हैं वा घटाते हैं तो पृथक् स्थापन ही होता है यथा १२$य^{२}$ ± ५$य^{३}$ एवं सर्वत्र समझना चाहिये इति ॥ ४१ ॥

इदानीमव्यक्तगुणने सूत्रमाह।

सदृशद्विवधो वर्गस्त्र्यादिवधस्तद् गतोऽन्यजातिवधः।

अन्योऽन्यवर्णघातो भावितकः पूर्ववच्छेषम् ॥ ४२ ॥

सु. भा.—सदृशयोर्द्वयोरव्यक्तयोर्वधो वर्गो भवति। त्र्यादीनां समजातीनां वधस्तद्गतस्त्र्यादिघातोऽर्थाद् घनवर्गवर्गादिको भवति। अन्यजात्योर्विभिन्न-जात्योर्वधोऽन्योऽन्यवर्णघातो भवति स च भावितको भावित इत्युच्यते। शेषं

गुणनभजनादिकं कर्म पूर्ववदिति । 'स्याद्रूपवर्णाभिहतौ तु वर्णो द्वित्र्यादिकानां समजातिकानां' इत्यादिभास्करोक्तमेतदनुरूपमेव ॥ ४२ ॥

इति धनर्णादीनां सङ्कलितव्यवकलितादि ।

वि. भा.—समानयोर्द्वयोरव्यक्तयोर्घातो वर्गो भवति । समानाव्यक्तत्रयाणां घातस्तद् घनोभवति ।

एवं समानानां चतुर्णामव्यक्तानां घातो वर्गवर्गो भवति एवं पञ्च घातादावपि । विभिन्न जात्योर्वधो ऽन्योऽन्यवर्णघातो भवति स च भावित संज्ञकः[१] । शेषं गुणनभजनादिकं पूर्ववच्छोध्यमिति । अत्रत्यविषयाः पूर्वश्लोकस्य विज्ञानभाष्ये प्रदर्शिताः सन्ति । तत्रैव ते द्रष्टव्या इति ॥ ४२ ॥

इति धनर्णादीनां सङ्कलितव्यवकलितादि ।

अब अव्यक्त गुणन को कहते हैं ।

हि. भा.—समान दो अव्यक्तों का घात उसका वर्ग होता है । समान तीन अव्यक्तों का घात घन होता है, समान चार अव्यक्तों का घात वर्गवर्ग (चतुर्घात) होता है । एवं पञ्चघातादि होता है । विभिन्न जातिक अव्यक्तों के घात भावित संज्ञक है । शेष गुणन भजन आदि कर्म पूर्ववत् समझना चाहिये । यहां के विषय पूर्वश्लोक के हि. भा. में दिखलाये गये हैं वे वहीं द्रष्टव्य हैं इति ॥ ४२ ॥

इति धन और ऋण आदि का सङ्कलित और व्यवकलित समाप्त हुआ ।

(१) "स्याद्रूपवर्णाभिहतौ तु वर्णो द्वित्र्यादिकानां समजातिकानाम् ।
वधे तु तद्वर्गघनादयः स्युस्तद्भावितं चासमजातिघाते ॥
भागादिकं रूपवदेव शेषं व्यक्ते यदुक्तं गणिते तदत्र" भास्करोक्तमिदमाचार्योक्तानुरूपमेवेति ॥

अथैकवर्णसमीकरणबीजम्

तत्राव्यक्तमानानयनार्थमाह ।

अव्यक्तान्तरभक्तं व्यस्तं रूपान्तरं समेऽव्यक्तः ।
वर्गाव्यक्ताः शोध्या यस्माद्रूपाणि तदधस्तात् ॥ ४३ ॥

सु. भा.—समे एकवर्णसमीकरणे व्यस्तं रूपान्तरमव्यक्तान्तरभक्तमव्यक्तमानं व्यक्तं भवेत् । यत्पक्षादव्यक्तमानादन्यपक्षाव्यक्तमानं विशोध्याव्यक्तान्तरं साध्यते तत्पक्षस्थरूपाण्यन्यपक्षरूपेभ्यो विशोध्य यच्छेषं तद्व्यस्तं रूपान्तरमित्यर्थः । 'अव्यक्तः । वर्गाव्यक्ता'—इत्यादेरग्रे सम्बन्धः । 'एकाव्यक्तं शोधयेदन्यपक्षात्'—इत्यादि भास्करोक्तमेतदनुरूपमेव ॥ ४३ ॥

वि. भा.—समे (एकवर्णसमीकरणे) व्यस्तं रूपान्तरमव्यक्तान्तरभक्तमव्यक्तमानं व्यक्तं जायते । यत्पक्षादव्यक्तमानादन्यपक्षाव्यक्तमानं विशोध्याव्यक्तान्तरं साध्यते तत्पक्षस्य रूपाण्यन्यपक्षरूपेभ्यो विशोध्य यच्छेषं तद्व्यस्तं रूपान्तरम् । अव्यक्तः । वर्गाव्यक्ता इत्यादेरग्रे सम्बन्धः । सिद्धान्तशेखरे 'अव्यक्त विश्लेषहृते प्रतीपरूपान्तरेऽव्यक्तमिती भवेताम् । स्याद्वा युतोनाहतभक्तमिच्छेत्तदाऽन्यपक्षे विहिते तथैव, श्रीपत्युक्तमिदं बीजगणिते "यावत्तावत् कल्प्यमव्यक्तराशेर्मानं तस्मिन् कुर्वतोद्दिष्टमेव । तुल्यौ पक्षौ साधनीयौ प्रयत्नात्त्यक्त्वा क्षिप्त्वा वाऽपि संगुण्य भक्त्वा ॥ एकाव्यक्तं शोधयेदन्यपक्षाद्रूपाण्यन्यस्येतरस्माच्च पक्षात् शेषाव्यक्तेनोद्धरेद्रूपशेषं व्यक्तं मानं जायतेऽव्यक्तराशेः" भास्करोक्तमिदं चाचार्योक्तानुरूपमेवेति ॥ ४३ ॥

अब एक वर्ण समीकरण बीज प्रारम्भ होता है ।

उस में पहले अव्यक्त मानानयनार्थ कहते हैं ।

हि. भा.—एकवर्ण समीकरण में विपरीत रूपान्तर को अव्यक्तान्तर से भाग देने से अव्यक्तमान व्यक्त होता है । जिस पक्ष के अव्यक्तमान में से अन्यपक्ष के अव्यक्त मान को घटाकर अव्यक्तान्तर साधन करते हैं उस पक्ष के रूप को अन्य पक्ष के रूप में से घटाकर जो शेष रहता है वही विपरीत रूपान्तर है । सिद्धान्त शेखर में 'अव्यक्तविश्लेषहृते प्रतीप रूपान्तरे' इत्यादि विज्ञान भाष्य में लिखित श्रीपतिपद्य तथा बीजगणित में 'यावत्तावत्कल्प्यमव्यक्तराशेः' इत्यादि वि. भा. लिखित भास्करोक्त आचार्योक्त के अनुरूप ही है इति ॥ ४३ ॥

इदानीं वर्गसमीकरणमाह ।

वर्गचतुर्गुणितानां रूपाणां मध्यवर्गसहितानाम् ।
मूलं मध्येनोनं वर्गद्विगुणोद्धृतं मध्यः ॥ ४४ ॥

सु. भा.—यस्मात्पक्षादव्यक्तो वर्गाव्यक्ता अव्यक्तवर्गश्च विशोध्यस्तदधस्तादितरपक्षाद्रूपाणि बिशोध्यानि । एवमेकपक्षेऽव्यक्तवर्गो ऽव्यक्तश्च । अपरपक्षे च व्यक्तानि रूपाणि । तत्राव्यक्तमानं कथं भवेदित्येतदर्थमाह वर्गचतुर्गुणितानामित्यादि । रूपाणां व्यक्ताङ्कानां किंविशिष्टानां वर्गचतुर्गुणितानां चतुर्गुणिताव्यक्तवर्गगुणकगुणितानाम् । पुनः किं विशिष्टानां मध्यवर्गसहितानां । मध्योऽव्यक्तस्तस्य गुणकश्चात्र मध्येन गृहीतस्तस्य गुणकस्य यो वर्गस्तेन सहितानां यन्मूलं तन्मध्येनाव्यक्तगुणकेनोनं वर्गद्विगुणोद्धृतं द्विगुणाव्यक्तवर्गगुणकेनोद्धृतं तदा मध्योऽव्यक्तोऽर्थादव्यक्तमानं स्यादिति ।

अत्रोपपत्त्यर्थं मत्कृतभास्करबीजटिप्पण्यां 'चतुराहतवर्गसमै रूपैः'—इत्यादि सूत्रोपपत्तिर्द्रष्टव्या ॥ ४४ ॥

वि. भा.—यस्मात् पक्षादव्यक्तो वर्गाव्यक्तोऽव्यक्तवर्गश्च विशोध्यस्तदधस्तादितरपक्षाद्रूपाणि विशोध्यानि । एवमेकपक्षेऽव्यक्तवर्गोऽव्यक्तश्च भवति । इतरपक्षे रूपाणि भवन्ति । तत्राव्यक्तमानज्ञानं कथं भवेत्तदर्थं कथ्यते रूपाणां (व्यक्ताङ्कानां) चतुर्गुणिताव्यक्तवर्गगुणकगुणितानां मध्यवर्गसहितानां मध्योऽव्यक्तस्तस्य गुणकश्चात्र मध्येन गृहीतस्तस्य गुणकस्य यो वर्गस्तेन सहितानां यन्मूलं तन्मध्येनाव्यक्तगुणकेन हीनं वर्गद्विगुणभक्तं (द्विगुणाव्यक्तवर्गगुणकेन भक्तं) तदा मध्योऽव्यक्तोऽर्थादव्यक्तमानं भवेदिति ॥

अत्रोपपत्तिः ।

कल्प्यते $\text{य}^2 \cdot \text{गु} + \text{य} \cdot \overset{|}{\text{गु}} = \text{व्य}$ पक्षौ गु भक्तौ तदा $\text{य}^2 + \text{य} \cdot \frac{\overset{|}{\text{गु}}}{\text{गु}} = \frac{\text{व्य}}{\text{गु}}$ पुनः पक्षयोः $\frac{\overset{|}{\text{गु}}}{2\,\text{गु}}$ अस्य वर्गयोगेनावश्यमेवाव्यक्तपक्षो मूलदो भवति "द्वयोर्द्वयोश्चाभिहतिं द्विनिघ्नीम्"—इत्यादिना तेन $\text{य}^2 + \text{य} \cdot \frac{\overset{|}{\text{गु}}}{\text{गु}} + \frac{\overset{|}{\text{गु}}^2}{4\,\text{गु}^2} = \frac{\overset{|}{\text{गु}}^2 + 4\,\text{गु} \cdot \text{व्य}}{4\,\text{गु}^2}$ एतौ वर्गेण गुणितौ वर्गत्वं न त्यजतोऽतो गुणवर्गेणचतुर्गुणेन गुणितौ जातौ $4\,\text{गु}^2 \cdot \text{य}^2 + 4\,\text{गु} \cdot \text{गु} \cdot \text{य} + \overset{|}{\text{गु}}^2 = \overset{|}{\text{गु}}^2 + 4\,\text{गु} \cdot \text{व्य}$

$= \text{४ गु}\,(\text{गु य}^{\text{२}} + \overset{|}{\text{गु}}\,\text{य}) + \overset{|}{\text{गु}}^{\text{२}} = \overset{|}{\text{गु}}^{\text{२}} + \text{४ गु व्य}$ एतेनाचार्योक्तं तथा चतुराहतवर्गं समैं रूपैः पक्षद्वयं गुणयेत् । अव्यक्तवर्गरूपैर्युक्तौ पक्षौ ततो मूलमिति श्रीधराचार्योक्तसूत्रं चोपपद्यत इति ॥ ४४ ॥

अब वर्गसमीकरण को कहते हैं ।

हि० भा०—जिस पक्ष में अव्यक्त और अव्यक्त वर्ग घटाते हैं उससे इतर पक्ष में रूप को घटाना चाहिये । इस तरह एक पक्ष में अव्यक्तवर्ग और अव्यक्त होता है, इतर पक्ष में रूप होते हैं, वहां अव्यक्त मान ज्ञान कैसे होता है उसके लिए कहते हैं । चतुर्गुणित अव्यक्त वर्ग के रूप से दोनों पक्ष को गुणा दें । दोनों पक्षों में अव्यक्त वर्ग रूप को जोड़कर दोनों पक्ष का मूल लें । तब अन्योन्य पक्षानयन भागादि क्रिया करने पर अव्यक्त राशि मान आ जाता है ।

उपपत्ति ।

कल्पना करते हैं $\text{य}^{\text{२}}.\,\text{गु} + \text{य}\,.\,\overset{|}{\text{गु}} = \text{व्य}$ दोनों पक्षों को गु भाग देने से $\text{य}^{\text{२}} + \text{य}\,.\,\frac{\overset{|}{\text{गु}}}{\text{गु}} = \frac{\text{व्य}}{\text{गु}}$ पुनः दोनों पक्षों में $\frac{\overset{|}{\text{गु}}}{\text{२ गु}}$ इसका वर्ग जोड़ने से अवश्य ही अव्यक्त पक्ष मूलद होता है 'द्वयोर्द्वयोश्चाभिहतिं द्विनिघ्नीं' इत्यादि से, अतः $\text{य}^{\text{२}} + \text{य}.\frac{\overset{|}{\text{गु}}}{\text{गु}} + \frac{\overset{|}{\text{गु}}^{\text{२}}}{\text{४ गु}^{\text{२}}} = \frac{\overset{|}{\text{गु}}^{\text{२}} + \text{४ गु . व्य}}{\text{४ गु}^{\text{२}}}$ इन दोनों को वर्गाङ्क से गुणा करने से वर्गत्व नहीं हटता है इसलिए चतुर्गुणित गुणवर्ग से गुणा करने से $\text{४ गु}^{\text{२}}.\,\text{य}^{\text{२}} + \text{४ गु}.\,\overset{|}{\text{गु}}.\text{य} + \overset{|}{\text{गु}}^{\text{२}} = \overset{|}{\text{गु}}^{\text{२}} + \text{४ गु. व्य} = \text{४ गु}\,(\text{गु. य}^{\text{२}}\,\overset{|}{\text{गु}}.\,\text{य}) + \overset{|}{\text{गु}}^{\text{२}} = \overset{|}{\text{गु}}^{\text{२}} + \text{४ गु . व्य}$, इससे आचार्योक्त तथा 'चतुराहतवर्गसमै रूपैः पक्षद्वयं गुणयेत्' इत्यादि श्रीधराचार्य सूत्र भी उपपन्न हुआ इति ॥ ४४ ॥

इदानीं प्रकारान्तरेण वर्गसमीकरणेऽव्यक्तमानमानयति ।

वर्गाहतरूपाणामव्यक्तार्धकृतिसंयुतानां यत् ।
पदमव्यक्तार्धोनं तद्वर्गविभक्तमव्यक्तः ॥४५॥

सु० भा०—वर्गेणाव्यक्तवर्गगुणकेन हतानां रूपाणां किंविशिष्टानामव्यक्तार्धकृतिसंयुतानामव्यक्तगुणकार्धवर्गसहितानां यत् पदं तदव्यक्तगुणकार्धोनं तदव्यक्तवर्गगुणकविभक्तमव्यक्तोऽव्यक्तमानं स्यादिति ।

अत्रोपपत्तिः । चतुर्भिरपवर्त्य पूर्वसूत्रविधिना स्फुटा ॥ ४५ ॥

वि. भा.—वर्गेणाव्यक्तवर्गगुणकेन गुणितानां रूपाणां (व्यक्ताङ्कानां) अव्यक्तगुणकार्धवर्गसंयुतानां यन्मूलं तदव्यक्तगुणकार्धेन हीनं तदव्यक्तवर्गगुणकविभक्तं तदाऽव्यक्तराशिमानं भवेदिति ॥

अत्रोपपत्तिः ।

पूर्वसूत्रोपपत्तौ $४\,\text{गु}\,(\text{गु}.\,\text{य}^2+\overset{|}{\text{गु}}.\,\text{य})+\overset{|}{\text{गु}}^2=\overset{|}{\text{गु}}^2+४\,\text{गु}.\,\text{व्य}$ पक्षौ चतुर्भिरपवर्त्तितौ $\text{गु}.(\text{गु}.\,\text{य}^2+\overset{|}{\text{गु}}.\,\text{य})+\frac{\overset{|}{\text{गु}}}{४}=\frac{\overset{|}{\text{गु}}}{४}+\text{गु}.\,\text{व्य}=\text{गु}^2.\,\text{य}^2+\text{गु}.\,\overset{|}{\text{गु}}.\,\text{य}+\frac{\overset{|}{\text{गु}}}{४}$

$=\frac{\overset{|}{\text{गु}}}{४}+\text{गु}.\,\text{व्य}$ पक्षयोर्मूल ग्रहणेन $\text{गु}.\,\text{य}+\frac{\overset{|}{\text{गु}}}{२}=\sqrt{\frac{\overset{|}{\text{गु}}}{२}+\text{गु}.\,\text{व्य}}$ पक्षयोः $\frac{\overset{|}{\text{गु}}}{२}$ हीनौ तदा $\text{गु}.\,\text{य}=\sqrt{\frac{\overset{|}{\text{गु}}}{२}+\text{गु}\,.\,\text{व्य}}-\frac{\overset{|}{\text{गु}}}{२}$ पक्षौ गु भक्तौ तदा

$$\text{य}=\frac{\sqrt{\frac{\overset{|}{\text{गु}}}{२}+\text{गु}\,.\,\text{व्य}}-\frac{\overset{|}{\text{गु}}}{२}}{\text{गु}}$$ एतेनाचार्योक्तमुपपन्नम् ॥४५॥

अब प्रकारान्तर से वर्ग समीकरण में अव्यक्त मान लाते हैं ।

हि. भा.—अव्यक्त वर्ग गुणक से गुणित रूपमें अव्यक्त गुणकार्ध वर्ग जोड़कर जो मूल हो उसमें से अव्यक्त गुणकार्ध को घटाकर अव्यक्त वर्ग गुणक से भाग देने से राशि मान होता है इति ।

उपपत्ति ।

पूर्व सूत्रोपपत्ति में $४\,\text{गु}\,(\text{गु}\,.\,\text{य}^2+\overset{|}{\text{गु}}\,.\,\text{य})+\overset{|}{\text{गु}}^2=\overset{|}{\text{गु}}^2+४\,\text{गु}\,.\,\text{व्य}$ दोनों पक्षों को चार से अपवर्त्तन देने से $\text{गु}\,(\text{गु}\,.\,\text{य}^2+\overset{|}{\text{गु}}\,.\,\text{य})+\frac{\overset{|}{\text{गु}}^2}{४}=\frac{\overset{|}{\text{गु}}^2}{४}+\text{गु}\,.\,\text{व्य}=\text{गु}^2\,.\,\text{य}^2$ $+\text{गु}\,.\,\overset{|}{\text{गु}}\,.\,\text{य}+\frac{\overset{|}{\text{गु}}}{४}=\frac{\overset{|}{\text{गु}}}{४}+\text{गु}.\,\text{व्य}$ दोनों पक्षों के मूल ग्रहण करतेसे $\text{गु}\,.\,\text{य}+\frac{\overset{|}{\text{गु}}}{२}$ $=\sqrt{\frac{\overset{|}{\text{गु}}}{२}+\text{गु}.\,\text{व्य}}$ दोनों पक्षों में $\frac{\overset{|}{\text{गु}}}{२}$ घटाने से $\text{गु}.\,\text{य}=\sqrt{\frac{\overset{|}{\text{गु}}}{२}+\text{गु}.\,\text{व्य}}-\frac{\overset{|}{\text{गु}}}{२}$ दोनों पक्षों

को $ग_{ु}$ से भाग देने से $य = \frac{\sqrt{\frac{\overset{।}{ग_{ु}}}{२} + ग_{ु}.व्य} - \frac{\overset{।}{ग_{ु}}}{२}}{ग_{ु}}$ इससे आचार्योक्त उपपन्न हुआ ।।४५।।

इदानीं प्रश्नमाह ।

सैकादंशकशेषाद् द्वादशभागश्चतुर्गुणोऽष्टयुतः ।
सैकांशशेषतुल्यो यदा तदाऽहर्गणं कथय ।।४६।।

सु. भा.—अंशकशेषात् सैकाद्यो द्वादशभागः स चतुर्गुणोऽष्टयुतस्तदा सैकेनांशशेषेण यदा तुल्यो भवति तदाहर्गणं कथयेति । अत्रांशशेषप्रमाणं या १ । तदा प्रश्नालापेन

$\frac{४ (या+१)}{१२} + ८ = \frac{या+१}{३} + ८ = \frac{या+२५}{३} = या+१$, अतश्छेदगामिना

$या+२५ = ३ या+३ \therefore या = ११$

अस्मादंशशेषात् रव्यादीनामुद्दिष्टात् पूर्ववदहर्गणः स्यादिति ।। ४६ ।।

वि. भा.—एकेन सहितादंशकशेषाद्यो द्वादशांशः स चतुर्गुणोऽष्टयुतस्तदा सैकेनांशशेषेण यदा तुल्यो भवति तदाऽहर्गणं कथयेति ।।

अत्रोपपत्तिः ।

अत्रांशशेषप्रमाणं कल्प्यते=य तदा सूत्रोक्तालापेन $\frac{४ (य+१)}{१२} + ८ = \frac{य+१}{३} + ८ = \frac{य+२५}{३} = य+१$ छेदगमेन $य+२५ = ३ य+३$ समशोधनेन $२ य = २२$ अतः $य = \frac{२२}{२} = ११$ अस्मादंशशेषाद्रव्यादीनामुद्दिष्टात् पूर्ववदहर्गणो भवेदिति ।।४६।।

अब अन्य प्रश्न को कहते हैं ।

हि. भा.—एक सहित अंश शेष के द्वादशांश को चार से गुणा कर आठ जोड़ने से यदि एक सहित अंश शेष के बराबर होता है तब अहर्गण प्रमाण को कहो इति ।।

उपपत्ति ।

यहां कल्पना करते हैं अंश शेष प्रमाण=य, तब सूत्रोक्त आलाप से $\frac{४ (य+१)}{१२}$

$+८=\frac{य+१}{३}+८=\frac{य+२५}{३}=य+१$ छेदगम से $य+२५=३\,य+३$ समशोधन से $२\,य=२२ \;\therefore\; य=\frac{२२}{२}=११$ इस अंश शेष से पूर्ववत् अहर्गण होता है इति ।।४६।।

इदानीमन्यं प्रश्नमाह ।

द्व्यूनमधिमासशेषं त्रिहृतं सप्ताधिकं द्विसङ्गुणितम् ।
अधिमासशेषतुल्यं यदा तदा युगगतं कथय ।।४७।।

सु. भा.—स्पष्टार्थम् । अत्र प्रश्नालापेन यदि अधिशेषमानं या १ ।

$$२\left\{\frac{या-२}{३}+७\right\}=\frac{२\,या-४}{३}+१४=\frac{२\,या+३८}{३}=या$$

$\therefore$ या$=$३८ । अस्मादधिमासशेषात् कुट्टकेन युगगतानयनं सुगमम् ।। ४७ ।।

वि. भा.—अधिमासशेषं द्वाभ्यां रहितं त्रिभक्तं सप्तयुतं द्विगुणितं तदाऽधिमासशेषतुल्यं भवति तदा युगगतं कथयेति ।।

अत्रोपपत्तिः ।

अत्र कल्प्यते अधिशेषमानम्$=$य, तदा प्रश्नोक्त्या $२\left\{\frac{(य-२}{३}+७\right\}=\frac{२\,य-४}{३}+१४=\frac{२\,य-४+४२}{३}=\frac{२\,य+३८}{३}=$अधिशेष$=$य छेदगमेन $२\,य+३८=३\,य$ अतः य$=$३८ अस्मादधिमासशेषात् कुट्टकयुक्त्या युगगतानयनं स्फुटमिति ।।४७।।

अब अन्य प्रश्न को कहते हैं ।

हि. भा.—अधिमास शेष में से दो घटाकर तीन से भाग देने से जो लब्ध हो उसमें सात जोड़कर द्विगुणित करने से यदि अधिमास शेष के बराबर होता है तब युगगत को कहो इति ।।

उपपत्ति

यहां कल्पना करते हैं अधिशेषमान $=$ य, तब प्रश्नानुसार $२\left\{\frac{(य-२)}{३}+७\right\}=\frac{२य-४}{३}+१४=\frac{२\,य-४+४२}{३}=\frac{२य+३८}{३}$

= अधिशेष = य छेदगम से २ य + ३८ = ३ य अतः य = ३८ इस अधिमास शेष से कुट्टक युक्ति से युगगतानयन स्फुट है इति ॥ ४७ ॥

इदानीमन्यप्रश्नमाह ।

व्येकमवमावशेषं षड्‌द्धृतं त्रियुतमवमशेषस्य ।
पञ्चविभक्तस्य समं यदा तदा युगगतं कथय ॥ ४८ ॥

सु. भा.—स्पष्टार्थम् । अत्र प्रश्नालापेन यद्यवमावशेषं या १ ।
$\frac{\text{या}-१}{६}+३=\frac{\text{या}+१७}{६}=\frac{\text{या}}{५}$ । छेदगमादिना या = ८५ ।
अस्मात् क्षयशेषात् पूर्वप्रकारेण युगगतानयनं सुगममिति ॥ ४८ ॥

वि. भा.—अवमशेषमेकेन हीनं षड्भक्तं त्रियुतं यदा पञ्चभक्तस्यावमशेषस्य तुल्यं भवति तदा युगगतं कथयेति ।

अत्रोपपत्तिः

अत्र कल्प्यते अवमशेषमानम् = य, तदा प्रश्नोक्तया $\frac{\text{य}-१}{६}+३$ $=\frac{\text{य}-१+१८}{६}=\frac{\text{य}+१७}{६}=\frac{\text{अवमशे}}{५}=\frac{\text{य}}{५}$ छेदगमेन ५ य + ८५ = ६ य अतः य = ८५ अस्मादवमशेषात् पूर्ववद्युगगतानयनं स्फुटमिति ॥ ४८ ॥

अब अन्य प्रश्न को कहते हैं ।

हि. भा.—अवशेष में से एक घटाकर छः से भाग देने से जो लब्ध हो उसमें तीन जोड़ने से यदि पांच से विभक्त अवशेष के बराबर हो तब युगगत प्रमाण को कहो इति ।

उपपत्ति ।

यहाँ कल्पना करते हैं अवमशेषमान = य, तब प्रश्नानुसार $\frac{\text{य}-१}{६}$ $+३=\frac{\text{य}-१+१८}{६}=\frac{\text{य}+१७}{६}=\frac{\text{अवमशे}}{२}=\frac{\text{य}}{५}$ छेदगम से ५ य + ८५ = ६ य अतः य = ८५ इस अवमशे से पूर्ववत् युगगतानयन स्फुट है इति ॥ ४८ ॥

इदानीमन्यप्रश्नमाह ।

मण्डलशेषाद् द्व्यूनान्मूलं व्येकं दशाहतं द्वियुतम् ।
मण्डलशेषं व्येकं भानोर्ज्ञदिने कदा भवति ।। ।। ४९ ।।

सु. भा.—भानोर्मण्डलशेषाद् भगणशेषात् । शेषं स्पष्टार्थम् । अत्र प्रश्नालापेन यदि भगणशेषप्रमाणं या^{२}+२ । १० (या—१)+२ = १० या—८=या^{२}+ २—१=या^{२}+१ पक्षान्तरानयनेन या^{२}—१० या=—९

वर्गसमीकरणविधिना या^{२}—१० या+२५=२५—९=१६

अतः या—५= ±४ ∴ या=९ वा १,

एवमत्र बीजयुक्तितो द्विविधं मानमुत्पद्यते यावत्तावतस्तद्वशेनोत्थापनेन भगणशेषमानम्=८३ वा, ३ । अत्र चतुर्वेदाचार्येण प्रथममानमेव गृहीतम् । कस्माद्भगणशेषात् पूर्वकुट्टकविधिना ऽनेकधा ऽहर्गणो भवति स चाभीष्टवारे ग्राह्यः ।। ४९ ।।

वि. भा.—भानोः (सूर्यस्य) मण्डल शेषात् (भगणशेषात्) द्वाभ्यां हीनान्मूलं यत्तद् व्येकं दशगुणितं द्वियुतं व्येकं मण्डलशेषतुल्यं बुधदिने कदा भवतीति ।।

अत्रोपपत्तिः ।

अत्र कल्प्यते भगणशेषप्रमाणम् = य^{२} + २ तदा प्रश्नोक्त्या $(\sqrt{य^{२} + २ - २} - १)\, १० + २ = (य - १)\, १० + २ =$ १० य —१० + २ = १० य — ८ = भगणशे — १ =य^{२} + २ — १ = य^{२}+१ समशोधनादिना य^{२}— १० य = —९ पमयोः २५ योजनेन य^{२} — १० य + २५ = २५ — ९ = १६ मूल ग्रहणेन य — ५ = ± ४ अतः य = ५ ± ४ अर्थात् य = ९, य = १ आभ्यां भगणशेषस्योत्थापनेन ८३, ३ अस्माद् भगणशेषात् कुट्टकयुक्त्याऽनेकधाऽहर्गणो भवति सोऽभीष्टदिने ग्रहीतव्य इति ।। ४९ ।।

अब अन्य प्रश्न को कहते हैं ।

हि. भा.—सूर्य के भगण शेष में से दो घटा कर जो मूल होता है उसमें से एक घटा-कर दस से गुणाकर दो जोड़ कर यदि एक हीन भगणशेष तुल्य होता है तो बुध दिन में कब होगा इति ।

उपपत्ति ।

यहां कल्पना करते हैं भगण शेष प्रमाण = य^{२} + २ तब प्रश्नानुसार

$(\sqrt{\text{य}^2 + २} - २ - १)\,१० + २ = (\text{य} - १)\,१० + २ = १०\,\text{य} - १० + २ = १०\,\text{य} - ८ = $ भगणशे $- १ = \text{य}^2 + २ - १ = \text{य}^2 + १$ सम शोधनादि से $\text{य}^2 - १०\,\text{य} = - ९$ दोनों पक्षों में २५ जोड़ने से $\text{य}^2 - १०\,\text{य} + २५ = २५ - ९ = १६$ मूलग्रहण से $\text{य} - ५ = \pm ४$ अत: $\text{य} = ५ \pm ४$ अर्थात् $\text{य} = ९$, $\text{य} = १$ इन दोनों से भगण शेष को उत्थापन देने से ८३, ३ इस भगणशेष से कुट्टक युक्ति से अनेकधा अहर्गण होता है वह अभीष्ट दिन में ग्रहण करना चाहिये इति ।। ४९ ।।

इदानीमन्यप्रश्नमाह ।

अधिमासशेषपादात् त्र्यूनाद्वर्गो ऽधिमासशेषसमः ।
अवमावशेषतो वाऽवमशेषसमः कदा भवति ।। ५० ।।

सु. भा.—स्पष्टार्थम् । यद्यधिमासशेषस्य क्षयशेषस्य च प्रमाणं या १ तदा प्रश्नालापेन ।

$$\left(\frac{\text{या}}{४} - ३\right)^2 = \left(\frac{\text{या} - १२}{४}\right)^2 = \frac{\text{या}^2 - २४\,\text{या} + १४४}{१६} = \text{या}$$ तत उक्तवत्

$\text{या}^2 - ४०\,\text{या} = - १४४,$

$\text{या}^2 - ४०\,\text{या} + ४०० = ४०० - १४४ = २५६$

$\therefore\ \text{या} - २० = \pm १६$ ततः $\text{या} = ३६$ वा ४

अत्र यदि रूपत्रयतोऽधिशेषस्य क्षयशेषस्य वा पादः शोध्यते शेषश्च धनात्मकोऽपेक्षितस्तदा द्वितीयं मानमेव ग्राह्यम् । ततोऽधिशेषादवमावशेषाच्च कुट्टकविधिना कल्पगतानयनं सुगममिति ।। ५० ।।

वि. भा.—अधिमासशेषचतुर्थांशात् त्रिहीनात् वर्गोऽधिशेष समः । वा अवमावशेषतोऽवमशेषतुल्यः कदा भवतीति ।।

अत्रोपपत्तिः ।

कल्प्यते अधिमासशेषस्य मानम् = य, तदा प्रश्नोक्त्या $\left(\frac{\text{य}}{४} - ३\right)^2 = $ अधिशेष $= \text{य} = \left(\frac{\text{य} - १२}{४}\right)^2 = \frac{\text{य}^2 - २४\,\text{य} + १४४}{१६}$

$= \text{य}$ छेदगमेन $\text{य}^2 - २४\,\text{य} + १४४ = १६\,\text{य}$ समशोधनेन $\text{य}^2 - ४०\,\text{य} = - १४४$ पक्षयोः ४०० योजनेन $\text{य}^2 - ४०\,\text{य} + ४०० = ४०० - १४४ = २५६$ मूलग्रहणेन $\text{य} - २० = \pm १६ \therefore \text{य} = २० \pm १६$ अर्थात् $\text{य} = ३६$, $\text{य} = ४$

एवमेवावमावशेषतः क्रिया कार्या तदा ऽवमशेषज्ञानं भवेत् । अत्र यदि रूपत्रयतो ऽधिशेषस्यावमशेषस्य वा चतुर्थांशः शोध्यते शेषश्च धनात्मकोऽपेक्षितस्तदा द्वितीयमानमेव ग्राह्यम् । ततोऽधिशेषादवमशेषाच्च कुट्टकेन कल्पगतानयनं स्फुट-मेवेति ॥ ५० ॥

इत्येकवर्णसमीकरणम्

अब अन्य प्रश्न को कहते हैं ।

हि. भा.—अधिमास शेष चतुर्थांश में से तीन घटाकर वर्ग करते हैं वह अधिशेष के बराबर होता है वा अवमशेष चतुर्थांश में से तीन घटाकर वर्ग करते हैं वह अवमशेष के बराबर कब होता है इति ।

उपपत्ति ।

कल्पना करते हैं अधिमास शेष प्रमाण = य, तब प्रश्नानुसार $\left(\frac{य}{४}—३\right)^२$ = अधिशे = य = $\left(\frac{य — १२}{४}\right)^२ = \frac{य^२—२४ य+१४४}{१६}$ = य छेदगम से य^२—२४ य+१४४= १६ य समशोधन से य^२—४० य=—१४४ दोनों पक्षों में ४०० जोड़ने से य^२—४० य + ४०० = ४०० — १४४ मूलग्रहण से य — २०= ± १६ अतः य = २० ± १६ अर्थात् य = ३६, य = ४, इसी तरह अवमावशेष ज्ञान होता है। यहां यदि तीन में से अधिशेष के चतुर्थांश वा अवम शेष के चतुर्थांश को घटाते हैं तथा शेष धनात्मक अपेक्षित हो तब द्वितीय मान ही ग्रहण करना चाहिये । तब अधिशेष अवमशेष से कुट्टक युक्ति से कल्पगतानयन स्फुट ही है इति ।। ५० ।।

इति एक-वर्ण-समीकरण समाप्त हुआ ।

अनेकवर्णसमीकरणबीजम्

इदानीमनेकवर्णसमीकरणमाह ।

आद्याद्वर्णादन्यान् वर्णान् प्रोह्याद्यमानमाद्यहृतम् ।
सदृशच्छेदावसकृद् द्वौ व्यस्तौ कुट्टको बहुषु ॥ ५१ ॥

सु. भा:—आद्याद्वर्णाद्येऽन्ये वर्णास्तानितरस्मात् पक्षात् प्रोह्य शेषमाद्येनाऽऽद्यवर्णगुणकेन हृतमाद्यमानमाद्योन्मितिः स्यात् । एकस्य वर्णस्योन्मितीनां बहुत्वे द्वौ द्वौ पक्षौ व्यस्तावन्योन्यहरगुणनोद्भूतौ सदृशच्छेदौ कृत्वाऽसकृत् तदन्यवर्णोन्मितिः साध्या । एकपक्षस्य हरेणापरपक्षीयौ लवहरौ सङ्गुण्य छेदगमं च विधाय 'आद्याद्वर्णादन्यान्' इत्यादिना तदन्यवर्णमानेयम् । एवमसकृत् कर्म कार्यम् । अन्ते बहुषु वर्णेष्वज्ञातेषु कुट्टको भवति । तत्र कुट्टकोन्मितिः साध्येत्यर्थः । भास्करानेकवर्णसमीकरणमेतदनुरूपमेव ॥ ५१ ॥

वि.भा.—आद्याद्वर्णादन्ये ये वर्णास्तानितरस्मात् पक्षात् प्रोह्य शेषमाद्यवर्णगुणकेन भक्तमाद्यमानं भवति एकस्य वर्णस्योन्मितीनां बहुत्वे द्वौ द्वौ पक्षौ व्यस्तौ (परस्परहरगुणनोद्भूतौ) सदृशहरौ कृत्वाऽसकृत् तदन्यवर्णोन्मितिः साध्या । एकपक्षस्य हरेणापरपक्षीयावंशहरौ संगुण्य छेदगमं च कृत्वा 'आद्याद्वर्णादन्यान्' इत्यादिना तदन्यवर्णमानेतव्यम् । एवमसकृत्कर्मकार्यम् । अन्ते बहुषु वर्णेष्वज्ञातेषु कुट्टको भवति । तत्र कुट्टकेन मानं साध्यमिति ॥ सिद्धान्तशेखरे "आद्यं वर्णं प्रोह्य पक्षात्कुतोऽपि त्यक्त्वा शेषानन्यतश्चाद्यभक्ते । प्राहुस्तज्ज्ञास्तामितीराहुरेवं कार्यातुल्यच्छेदनाभिश्च भूयः ॥ एकोन्माने कुट्टकः स्यात् प्रमाणं तान्यन्यानि स्युः प्रतीपात्ततश्च । कुट्टाकारे भाज्यवर्णस्य मानं तस्मिन् लब्धं हारवर्णस्य चाहुः" श्रीपत्युक्तमिदमनेकवर्णसमीकरणमाचार्योक्तानुरूपमेवास्ति, बीजगणिते "आद्यं वर्णं शोधयेदन्यपक्षादन्यान् रूपाण्यन्यतश्चाद्यभक्ते । पक्षेऽन्यस्मिन्नाद्यवर्णोन्मितिः स्याद्वर्णस्यैकस्योन्मितीनां बहुत्वे ॥ समीकृतच्छेदगमे तु ताभ्यस्तदन्यवर्णोन्मितयः प्रसाध्याः । अन्त्योन्मितौ कुट्टविधेर्गुणाप्ती ते भाज्य तद्भाजक वर्णमाने ॥ अन्येऽपि भाज्ये यदि सन्ति वर्णास्तन्मानमिष्टं परिकल्प्य साध्ये । विलोमकोत्थापनतोऽन्यवर्णमानानि भिन्नं यदि मानमेवम् "भूयः कार्यः कुट्टकोऽत्रान्त्यवर्णं तेनोत्थाप्योत्थापयेद् व्यस्तमाद्यान् ॥" अनेन भास्कराचार्येणाचार्योक्तं श्रीपत्युक्तं वा स्पष्टीकृत्योक्तं व्याख्यातं चेति ॥ ५१ ॥

अब अनेक वर्ण समीकरण को कहते हैं ।

हि. भा.—प्रथम वर्ण से अन्य जो वर्ण है उनको इतर (दूसरे) पक्ष में से घटा कर शेष को प्रथम वर्ण गुणक से भाग देने से प्रथम वर्ण का मान होता है । एक वर्ण के अनेक मान रहने से दो दो पक्षों के समान हर कर के असकृत् (बार बार) अन्य वर्ण का मान साधन करना चाहिए । एक पक्ष के हर से दूसरे पक्ष के अंश और हर को गुणा कर और छेदगम कर के 'आद्याद्वर्णादन्यान्' इत्यादि आचार्योक्ति से अन्य वर्ण का मान लाना चाहिये । एवं असकृत् कर्म करना चाहिये । अन्त में बहुत वर्णों के अज्ञात रहने से कुट्टक होता है अर्थात् वहां कुट्टक से मान साधन किया जाता है ।। सिद्धान्त शेखर में "आद्यं वर्णं प्रोह्य पक्षात्कुतोऽपि' इत्यादि विज्ञान भाष्य में लिखित श्रीपतिप्रकार आचार्योक्त प्रकार के अनुरूप ही है । तथा बीजगणित में "आद्यं वर्णं शोधयेदन्यपक्षादन्यान् रूपाण्यन्यतश्चाद्यभक्ते' इत्यादि विज्ञान भाष्य में लिखित पद्यों से भास्कराचार्य ने आचार्योक्त प्रकार को वा श्रीपत्युक्त प्रकार को स्पष्टीकरणपूर्वक कहा हैं और व्याख्या की हैं इति ।। ५१ ।।

इदानीं प्रश्नानाह ।

गतभगणयुताद् द्युगणात् तच्छेषयुतात् तदैक्यसंयुक्तात् ।
तद्योगाद् द्युगणं वा यः कथयति कुट्टकज्ञः सः ।। ५२ ।।

सु. भा.—अहर्गणादिष्टग्रहस्य गतभगणयुताद्योऽहर्गणं कथयति । वाऽहर्गणात् तस्य गतभगणस्य शेषयुताद्योऽहर्गणं कथयति । वाऽहर्गणात् तयोर्गतभगणभगणशेषयोर्यदैक्यं तेन संयुक्ताद्योऽहर्गणं कथयति । वा तयोर्गतभगणभगणशेषयोर्योगाद्योऽहर्गणं कथयति स एव कुट्टकज्ञः ।

प्रथमप्रश्नेऽहर्गणमानं या १ । भगणशेषमानं का १

ततो ऽनुपातेन गतभगणाः $= \frac{\text{ग्रभ. या} - \text{का}}{\text{ककु}}$

$\therefore$ गभ $+$ या $= \frac{\text{या (ग्रभ} + \text{ककु)} - \text{का}}{\text{ककु}} =$ यो ।

ततः का $= \frac{\text{या (ग्रभ} + \text{ककु)} - \text{ककु. यो}}{१}$

कुट्टकेन यावत्तावन्मानं सुगमम् ।

द्वितीय प्रश्नेऽहर्गणः $=$ या १ । गतभगणाः $=$ का ।

भगणशेषम् $=$ ग्रभ $+$ या $-$ ककु. का

$\therefore$ भशे $+$ या $=$ या (ग्रभ $+$ १) $-$ ककु. का $=$ यो

$\therefore$ का $= \frac{\text{या (ग्रभ} + १) - \text{यो}}{\text{ककु}}$ । अतः कुट्टकेन यावत्तावन्मानं सुगमम् ।

तृतीय प्रश्ने ऽहर्गणः=या १ । गतभगणाः=का । ततो गतभगणशेषम्=ग्रभ. या−ककु. का

अतः भशे+या+ग्रभ=या (ग्रभ+१)—का (ककु—१)=यो

$\therefore$ का=$\frac{\text{या (ग्रभ+१)−यो}}{\text{ककु—१}}$ । कुट्टकेन याक्तावन्मानं सुगमम् ।

चतुर्थ प्रश्नेऽहर्गणः=या । गतभगणाः=का ।

भगणशेषम्=ग्रभ. या—ककु. का

$\therefore$ गभ+भशे=ग्रभ. या—ककु. का+का=ग्रभ. या—का (ककु—१) =यो । अतः का=$\frac{\text{ग्रभ. या −यो}}{\text{ककु—१}}$ । कुट्टकेन यावत्तावन्मानं सुगमम् ॥ ५२ ॥

वि. भा.—द्युगणात् (अहर्गणात्) इष्टग्रहस्य गतभगणयुताद्योऽहर्गणं कथयति । वा योऽहर्गणात् गतभगणस्य शेषयुतादहर्गणं कथयति । वा योऽहर्गणात् गतभगण भगणशेषयोर्यदैक्यं तेन संयुक्तादहर्गणं कथयति । वा यो गतभगण भगणशेषयोर्योगाद हर्गणं कथयति स कुट्टकज्ञ इति ॥

अत्रोपपत्तिः ।

प्रथमप्रश्ने कल्प्यते अहर्गणः=य । भगणशेषमानम्=क ततोऽनुपातेन $\frac{\text{ग्रभ}\times\text{य}}{\text{ककु}}$=गभगण+$\frac{\text{भगणशे}}{\text{ककु}}$ अतः $\frac{\text{ग्रभ}\times\text{य}}{\text{ककु}}-\frac{\text{भगणशे}}{\text{ककु}}=\frac{\text{ग्रभ}\times\text{य}-\text{क}}{\text{ककु}}$=गतभगण पक्षयोः य योजनेन गतभ+य=$\frac{\text{ग्रभ}\times\text{य}-\text{क}}{\text{ककु}}$+य=$\frac{\text{ग्रभ}\times\text{य}+\text{ककु}\times\text{य}-\text{क}}{\text{ककु}}$ =$\frac{\text{य (ग्रभ+ककु)—क}}{\text{ककु}}$ = यो, छेदगमेन य (ग्रभ+ककु)−क = यो$\times$ककु समशोधनेन य (ग्रभ+ककु)—यो$\times$ककु=क अत्र कुट्टकेन य मानं सुखेन व्यक्तं भवेदिति ॥

द्वितीयप्रश्ने कल्प्यते अहर्गणः=य । गतभगणः=क तदा $\frac{\text{ग्रभ}\times\text{य}}{\text{ककु}}$ =गतभ+$\frac{\text{भगणशे}}{\text{ककु}}$ $\therefore$ ग्रभ$\times$य = ककु $\times$ गतभ + भगणशे समशोधनेन ग्रभ$\times$य—ककु$\times$गतभ=भगणशे=ग्रभ$\times$य—ककु $\times$ क पक्षयोः य योजनेन भगणशे+य= यो = ग्रभ$\times$य + य—ककु $\times$ क=य (ग्रभ+१) − ककु$\times$क समशोधनादिना $\frac{\text{य (ग्रभ+१)—यो}}{\text{ककु}}$=क अत्र कुट्टकेम य मानं व्यक्तं भवेदिति ॥

तृतीयप्रश्ने कल्प्यते अहर्गणः=य, गतभगणः=क, ततः $\frac{\text{ग्रभ}\times\text{य}}{\text{ककु}}$=गतभ $+\frac{\text{भगणशे}}{\text{ककु}}$ अतः ग्रभ×य=ककु×गतभ+भगणशे समशोधनेन ग्रभ×य—ककु ×गतभ=भगणशे=ग्रभ×य—ककु×क पक्षयोः य योजनेन भगणशे+य=यो =ग्रभ×य+य—ककु×क=य (ग्रभ+१)—ककु×क समयोजनेन य (ग्रभ+१) =यो+ककु×क समशोधनेन य (ग्रभ+१)—यो=ककु×क पक्षौ ककुभक्तौ तदा $\frac{\text{य (ग्रभ+१)—यो}}{\text{ककु}}$=क अत्र कुट्टकेन य मानं व्यक्तं भवेदिति ॥

चतुर्थप्रश्ने कल्प्यते अहर्गणः=य। गत भगणः=क तदा पूर्ववद्भगणशेषम् =ग्रभ×य—ककु×क पक्षयोः गतभगणयोजनेन भगणशे+गतभ=ग्रभ×य —ककु×क+क=ग्रभ×य—क(ककु—१)=यो समयोजनेन ग्रभ×य=यो+क (ककु—१) समशोधनेन ग्रभ×य—यो=क (ककु—१) पक्षौ ककु—१ भक्तौ तदा $\frac{\text{ग्रभ}\times\text{य—यो}}{\text{ककु—१}}$=क अत्र कुट्टकेन य मानं सुखेन व्यक्तं भवेदिति ॥५२॥

अब प्रश्नों को कहते हैं।

हि. भा.—जो व्यक्ति इष्ट ग्रह के गत भगण युत अहर्गण से अहर्गण को कहता है। वा गतभगण के शेष युत अहर्गण से अहर्गण को जो कहता है, वा गतभगण और भगण शेष के ऐक्य से युत अहर्गण से अहर्गण को जो कहता है। वा गत भगण और भगण-शेष के योग से अहर्गण को जो कहता है वह कुट्टक का पण्डित है ॥

उपपत्ति।

प्रथम प्रश्न में कल्पना करते हैं अहर्गणमान=य। भगणशेषमान=क, तब अनुपात से $\frac{\text{ग्रभ. य}}{\text{ककु}}$=गतभ+$\frac{\text{भगणशे}}{\text{ककु}}$ समशोधन से $\frac{\text{ग्रभ. य}}{\text{ककु}}-\frac{\text{भगणशे}}{\text{ककु}}=\frac{\text{ग्रभक. य—क}}{\text{ककु}}$ =गत भगण, दोनों पक्षों में य जोड़ने से गतभ+य=$\frac{\text{ग्रभ. य—क}}{\text{ककु}}$+य =$\frac{\text{ग्रभ.य+ककु. य—क}}{\text{ककु}}=\frac{\text{य (ग्रभ+ककु)—क}}{\text{ककु}}$=यो छेदगम करने से य (ग्रभ+ककु) —क=ककु. यो, समशोधन से य (ग्रभ+ककु)—ककु. यो=क, यहां कुट्टक से य मान सुगमता से विदित हो जायगा।

द्वितीयप्रश्न में कल्पना करते हैं अहर्गण=य, गतभगण=क, तब $\frac{\text{ग्रभ. य}}{\text{ककु}}$=गतभ

$+\frac{\text{भगणशे}}{\text{ककु}}$ अतः ग्रभ. य=ककु. गतभ+भगणशे, समशोधन से ग्रभ. य—ककु. गतभ =भगणशे=ग्रभ. य—ककु. क दोनों पक्षों में य जोड़ने से भगणशे+य=यो=ग्रभ. य +य—ककु. क=य(ग्रभ+१)—ककु. क समशोधनादि से $\frac{\text{य (ग्रभ+१)—यो}}{\text{ककु}}$=क यहां कुट्टक से य मान व्यक्त हो जायगा।

तृतीय प्रश्न में कल्पना करते हैं। अहर्गण=य। गत भगण=क, तब $\frac{\text{ग्रभ . य}}{\text{ककु}}$ =गतभ+$\frac{\text{भशे}}{\text{ककु}}$ अतः ग्रभ . य=ककु . गतभ+भगशे समशोधन से ग्रभ. य—ककु . गतभ =भगणशे दोनों पक्षों में य जोड़ने से ग्रभ. य+य—ककु . गभ=भगणशे+य=यो=य (ग्रभ+१)—ककु. गभ=य (ग्रभ+१)—ककु. क=यो, दोनों पक्षों में ककु. क जोड़ने से य (ग्रभ+१)=यो+ककु. क समशोधन से य (ग्रभ+१)—यो=ककु. क, अतः $\frac{\text{य (ग्रभ+१)—यो}}{\text{ककु}}$=क यहां कुट्टक से य मान व्यक्त हो जायगा इति।

चतुर्थ प्रश्न में कल्पना करते हैं अहर्गण=य, गत भगण=क तब पूर्ववत् भगणशेष=ग्रभ. य—ककु. क दोनों पक्षों में गत भगण जोड़ने से भगणशे+गतभ=ग्रभ. य —ककु. क+क=ग्रभ. य—क (ककु—१)=यो समयोजन से ग्रभ . य=यो+क (ककु—१) समशोधन से ग्रभ . य—यो=क(ककु—१) दोनों पक्षों को ककु—१ भाग देने से $\frac{\text{ग्रभ. य—यो}}{\text{ककु—१}}$ =क यहां कुट्टक से य मान सुगमता से ही आजायगा ॥५२॥

इदानीमन्यान् प्रश्नानाह।

गतभगणोनाद् द्युगणात् तच्छेषोनात् तदैक्यहीनाद्वा।
तद्विवराद् द्युगणं वा यः कथयति कुट्टकज्ञः सः ॥५३॥

सु. भा.—अनन्तरप्रश्नेषु योगस्थाने वियोगः कृत इति स्पष्टार्थम्। उत्तरार्थं च पूर्वप्रश्नोत्तरे योगस्थाने वियोगं कृत्वा कर्म कर्तव्यमिति ॥ ५३ ॥

वि. भा.—अनन्तरप्रश्नेषु योगस्थाने वियोगः कृतः। उत्तरार्धे पूर्वप्रश्नोत्तरे योगस्थाने वियोगं कृत्वा कर्म कर्त्तव्यमिति ॥५३॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—पूर्व प्रश्नोत्तर में योग स्थान में वियोग (अन्तर) करके क्रिया करनी चाहिये ॥५३॥

इदानीमन्यान् प्रश्नानाह ।

राश्याद्यैस्तच्छेषैश्चैवं भुक्ताधिमासदिनहीनैः ।
तच्छेषैश्च युगगतं यः कथयति कुट्टकज्ञः सः ॥५४॥

सु. भा.—एवं राश्याद्यैस्तच्छेषैश्च युताद्धीनाद्वा ऽहर्गणात् । गतराश्यादि-तच्छेषयोगान्तराद्वा । भुक्ताधिमासक्षयाहैश्च युतोनितादहर्गणात् तच्छेषयुतोनितादहर्गणाच्च वा गताधिमासाधिशेषयोगान्तराद्वा गतक्षयाहतच्छेषयोगान्तराद्वा यो युगगतं कथयति स एव कुट्टकज्ञः ।

अत्र यदि गतराशिदिनगणयोग उद्दिष्टस्तदाऽहर्गणः=या । गतभगणाः=का । भगणशेषम्=ग्रभ. या—ककु. का । इदं द्वादशगुणं राशिशेषमानं नीलकमपास्य कल्पकुदिनहृतं गतराशयः $= \frac{१२ \text{ ग्रभ. या} - १२ \text{ ककु. का} - \text{नी}}{\text{ककु}}$

$$\therefore \text{ गरा} + \text{अह} = \frac{\text{या } (१२ \text{ ग्रभ} + \text{ककु}) - १२ \text{ ककु. का} - \text{नी}}{\text{ककु}} = \text{यो}$$

ततः या $= \frac{१२ \text{ ककु. का} + \text{नी} + \text{यो. ककु}}{१२ \text{ ग्रभ} + \text{ककु}}$ । 'अन्येपि भाज्ये यदि सन्ति वर्णास्तन्मानमिष्टं परिकल्प्य साध्ये' इत्यादि भास्करविधिना कुट्टकेन यावत्तावन्मानं सुगमम् । एवमालापानुसारेण समौ पक्षौ विधाय कुट्टकादिना ऽव्यक्तमानमन्येषु प्रश्नेष्वप्यानेयमिति ॥ ५४ ॥

वि. भा.—राश्याद्यैस्तच्छेषैश्च युतोनादहर्गणात् । भुक्ताधिमासावमैश्च युतोनितादहर्गणात् । तच्छेषयुतोनितादहर्गणाच्च, वा गताधिमासाधिशेषयोगान्तराद्वा गतावमतच्छेषयोगान्तराद्वा युगगतं यः कथयति स कुट्टकज्ञोऽस्तीति ॥

अत्र यदि गतराश्यहर्गणयोग उद्दिष्टस्तदा कल्प्यते अहर्गणः=य, गतभगणः=क तदा $\frac{\text{ग्रभ. य}}{\text{ककु}} = \text{गतभ} + \frac{\text{भशे}}{\text{ककु}}$ छेदगमेन ग्रभ. य=ककु. गभ+भशे समशोधनेन ग्रभ . य—ककु . गतभ=भशे=ग्रभ . य—ककु . क । इदं द्वादश गुणितं राशिशेषमानं (न) त्यक्त्वा कल्पकुदिनभक्तं तदा गतराशयः ।

अत्र राशिशे = न, $\frac{१२ \text{ ग्रभ. य} - १२ \text{ ककु. क} - \text{न}}{\text{ककु}}$ पक्षयोः य योजनेन

$$\frac{१२ \text{ ग्रभ . य} - १२ \text{ ककु . क} - \text{न}}{\text{ककु}} + \text{य} = \text{गतरा} + \text{य} =$$

$$= \frac{१२ \text{ ग्रभ. य} + \text{कक. य} - १२ \text{ ककु. क} - \text{न}}{\text{ककु}}$$

$=\frac{\text{य (१२ ग्रभ+ककु)—१२ ककु. क—न}}{\text{ककु}}$=यो छेदगमेन य (१२ ग्रभ+ककु) —१२ ककु. क—न=ककु. यो समयोजनेन य(१२ ग्रभ+ककु)=१२ ककु. क+न +यो. ककु पक्षौ १२ ग्रभ+ककु भक्तौ तदा $\frac{\text{१२ ककु. क+न+यो. ककु}}{\text{१२ ग्रभ+ककु}}$ = य अन्येऽपि भाज्ये यदि सन्ति वर्णास्तन्मानमिष्टमित्यादि भस्करोक्त्या य मानं कुट्टकेन सुखेन विदितं भवेदिति ॥ एवमालापानुसारेण पक्षद्वयं समानं विधाय कुट्टकादिनाऽन्येषु प्रश्नेष्वपि व्यक्तमानमानेतव्यमिति ॥५४॥

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.— राश्यादि से और उसके शेष से, युतहीन अहर्गण से, भुक्ताधिमास और अवम से, युत और हीन अहर्गण से, उसके शेष से, युत और हीन अहर्गण से भी वा गताधिमास और अधिशेष के योग-अन्तर से वा गतावम अवमशेष के योग-अन्तर से युगगत को जो कहता है वह कुट्टक का पण्डित है इति ॥

उपपत्ति ।

यहां यदि गतराशि और अहर्गण का योग उद्दिष्ट है तो कल्पना करते हैं अहर्गण =य गतभगण=क तब $\frac{\text{ग्रभ. य}}{\text{ककु}}$=गतभ+$\frac{\text{भशे}}{\text{ककु}}$ छेदगम से ग्रभ. य=ककु. गभ+भशे समशोधन से ग्रभ. य—ककु. गतभ=भशे=ग्रभ. य—ककु. क इसको बारह से गुणा कर राशि शेषमान को घटाकर कल्पकुदिन से भाग देने से गत राशि प्रमाण होता है। $\frac{\text{१२ ग्रभ. य—१२ ककु. क—न}}{\text{ककु}}$=गत राशि । यहाँ राशि से=न दोनों पक्षों में य जोड़ने से

$\frac{\text{१२ ग्रभ. य—१२ ककु. क—न}}{\text{ककु}}$+य=गत राशि+य=यो

$=\frac{\text{१२ ग्रभ. य+ककु. य—१२ ककु. क – न}}{\text{ककु}}=\frac{\text{य (१२ ग्रभ+ककु)—१२ ककु . क—न}}{\text{ककु}}$

=यो . छेदगम से य (१२ ग्रभ+ककु)—१२ ककु . क—न = ककु . यो समयोजन से य (१२ ग्रभ+ककु)=१२ ककु . क+न+यो . ककु $\therefore \frac{\text{१२ ककु . क+न+यो . ककु}}{\text{१२ ग्रभ+ककु}}$

=य 'अन्येऽपि भाज्ये यदि सन्ति वर्णा' इत्यादि भास्करोक्ति से कुट्टक युक्ति से य मान सुगमता ही से विदित होगा । एवं आलापानुसार दोनों पक्षों को समान कर कुट्टकादि से अन्य प्रश्नों में भी व्यक्तमान लाना चाहिये इति,॥५४॥

इदानीमन्यप्रश्नद्वयमाह।

अंशकशेषेणयुतात् लिप्ताशेषात्तदन्तरादथवा।
भानोर्ज्ञदिने द्युगणं कथयति कुट्टकज्ञः सः ॥५५॥

सु. भा.—भानोर्लिप्ता शेषादंशकशेषयुताद्वा तयोर्लिप्तांशशेषयोरन्तराद्यो-बुधवारे ऽहर्गणं कथयति स एव कुट्टकज्ञः। कल्प्यते ऽहर्गणः=या। रविभगण-भागाः=च भा . रभ=अ। गतभागाः=का। ततोंऽशशेषम्=अ . या—ककु . का। इदं षष्टिगुणं कल्पकुदिनहृतं लब्धं नीलकमानं नी १। तद्गुणितं हरं भाज्यादपास्य जातं कलाशेषम्=६० अ. या—६० ककु . का—ककु . नी।

अतः भाशे+कशे=६० अ.या—६० ककु.का—ककु. नी+अ.या—ककु.का =या (६० अ + अ) — ककु (६१ का+नी) = यो ततः ६१ का + नी $= \frac{\text{या (६१ अ)—यो}}{\text{ककु}}$। कुट्टकेन यावत्तावन्मानं सुगमम्।

यदि योगमानम्=५३६। कल्पकुदिनानि=१०९६। रविभगणाः=३। तदा अ=चक्रभा . रभ=३६०×३=१०८०।

६१ अ=६५८८०। ततः पूर्वसमीकरणरूपम्।

$$\text{६१ का + नी} = \frac{\text{६५८८० या—५३६}}{\text{१०९६}} = \frac{\text{१६४७० या—१३४}}{\text{२७४}} = \frac{\text{८२३५ या—६७}}{\text{१३७}}$$

$$= \text{६० य} + \frac{\text{१५ या—६७}}{\text{१३७}}।$$

अतो ऽय $\frac{\text{१५ या—६७}}{\text{१३७}}$मभिन्नः। अत्र कुट्टकेन रूपविशुद्धौ वल्ली ९ १ ० }

रूपविशुद्धौ गुणः=६४। अभीष्ट ६७ विशुद्धौ गुणः=४१

यावत्तावन्मानं सुखेन भवति। चतुर्वेदाचार्यमतं यच्च कोलब्रूकेनानुवादितं महागौरवमप्रयोजकं च। एवमन्तरतोऽपि कर्म कर्तव्यम् ॥ ५५ ॥

वि. भा.—भानोः (सूर्यस्य) लिप्ता (कला) शेषात् अंशकशेषेण युतात् वा कलांश शेषयोरन्तराद्बुधवारे योऽहर्गणं कथयति सः कुट्टकपण्डितोऽस्तीति ॥

अत्रोपपत्तिः।

कल्प्यते अहर्गणप्रमाणम्=य। रविभगणांशाः=चभा . रविभ=र, गत-भगणाः = क तदा $\frac{\text{रविभगणांश×य}}{\text{ककु}}$ = गतभगण + $\frac{\text{अंशशे}}{\text{ककु}}$ छेदगमेन

रविभगणांश × य = र × य = ककु . गतभगण + अंशशे = ककु . क + अंशशे समशोधनेन अंशशे = र × य — ककु . क इदं षष्टिगुणितं कल्पकुदिनभक्तं तदा $\frac{६० (र. य - ककु. क)}{ककु}$ = न छेदगमेन ६० र. य - ६० ककु. क = ककु. न एत त्प्रथमपक्षे-विशोध्य जातं कलाशेषम् = ६० र.य - ६० ककु.क - ककु. न, अतः अंशशे + कलाशे = ६० र. य — ६० ककु . क — ककु . न + र . य — ककु . क = य (६० र + र) — ककु (६१ क + न) = यो समयोजनेन य × ६१ र = यो + ककु (६१ क + न) समशोधनेन य × ६१ र — यो = ककु (६१ क + न) पक्षौ ककुभक्तौ तदा $\frac{य. ६१ र - यो}{ककु}$ = ६१ क + न अत्र कुट्टक युक्त्या य मानं सुगमतया विदितं भवेत् । एवमन्तरतोऽपि कर्म कर्त्तव्यमिति ॥५५॥

अब अन्य दो प्रश्नों को कहते हैं ।

हि. भा.—सूर्य के कलाशेष में अंश शेष जोड़ने से जो होता है उससे वा कलाशेष और अंशशेष के अन्तर से बुधदिन में जो अहर्गण को कहता है वह कुट्टक का पण्डित है इति ।

उपपत्ति ।

कल्पना करते हैं अहर्गण प्रमाण = य । रविभगणांश = चभा + रविभ = र, गतभगण = क तब $\frac{रविभगणांश. य}{ककु} = \frac{र . य}{ककु}$ = गतभगण + $\frac{अंशशे}{ककु}$ = क + $\frac{अंशशे}{ककु}$ छेदगम से र. य = ककु. क + अंशशे समशोधन करने से र. य — कु. क = अंशशे, इसको साठ से गुणाकर कल्पकुदिन से भाग देने से $\frac{६० (र. य - ककु. क)}{ककु}$ = न, छेदगम से ६० (र. य — ककु. क) = ६० × र . य — ६० ककु . क = ककु . न इसको प्रथम पक्ष में से घटाने से कलाशे = ६० × र. य — ६० ककु . क — ककु . न, अतः अंशशे + कलाशे = यो = ६० × र. य — ६० ककु . क — ककु. न + र. य — ककु. क = य (६० र + र) — ककु (६१ क + न) = यो = य. ६१ र — ककु (६१ क + न) दोनों पक्षों में ककु (६१ क + न) जोड़ने से य. ६१ = यो + ककु (६१ क + न) समशोधन से य. ६१ र — यो = ककु (६१ क + न) दोनों पक्षों को ककु से भाग देने से $\frac{य. ६१ र - यो}{ककु}$ = ६१ क + न, यहां कुट्टक से य मान सुगमता ही से विदित हो जायगा इति ॥५५॥

इदानीमन्यान् प्रश्नानाह ।

अंशकशेषं त्रियुतं लिप्ताशेषं कदा रवेर्ज्ञदिने ।
षट्सप्ताष्टौ नव वा कुर्वन्नावत्सराद् गणकः ॥५६॥

सु० भा०—रवेरंशकशेषं त्रियुतं कदा बुधदिने लिप्ताशेषं भवति । वांशकशेषं षड्भिः सप्तभिरष्टभिर्वा नवभिर्युतं कदा बुधदिने लिप्ताशेषं भवति । अस्योत्तरमावत्सरादेकवर्षाभ्यन्तरे कुर्वन्नपि गणक इत्युच्यते ऽस्माभिरिति ।

अनन्तरप्रश्नोक्त्या—

अंशशेषम्=अ. या—ककु. का

कलाशेषम्=६० अया—६० ककु . का—ककु . नी

ततः प्रश्नालापेन—

अ . या—ककु. का+३=६० अ. या – ६० ककु. का—ककु. नी

समशोधनेन ५९ ककु. का+ककु. नी=५९. अ. या—३

$\therefore$ ५९ का+नी= $\frac{\text{५९ अ. या—३}}{\text{ककु}}$ । अतः कुट्टकेन यावत्तावन्मानं सुगमम् । एवं रूपत्रयस्थाने षट्, सप्ताद्याः स्थाप्याः ।

अत्रापि चतुर्वेदगौरवं न बुद्धिमद्भिरादृतम् ॥ ५६ ॥

वि. भा.—रवेरंशकशेषं त्रियुतं बुधदिने कदा कलाशेषं भवति । वा षड्भिः सप्तभिरष्टभिर्नवभिर्वा— अंशकशेषयुतं कदा बुधदिने कलाशेषं भवति, एतदुत्तरं वर्षाभ्यन्तरे कुर्वन्नपि गणकः कथ्यते इति ॥

अत्रोपपत्तिः ।

कल्प्यते अहर्गणप्रमाणम् =य । रविभगणांशाः =र । गतभगणाः =क तदाऽनुपातेन $\frac{\text{र. य}}{\text{ककु}}$ = गतभ + $\frac{\quad}{\text{ककु}}$ छेदगमेन र . य = गतभ . ककु + अंशशे = क . ककु+अंशे समाशोधन अंशशे = र . य — क . ककु इदं षष्टिगुणितं कल्पकुदिनभक्तं लब्धं न मानम् = $\frac{\text{६० (र. य—क. ककु)}}{\text{ककु}}$ =न

= $\frac{\text{६० र . य—६० क . ककु}}{\text{ककु}}$ छेदगमेन ६० र . य—६० क . ककु=ककु . न एतद्यदि प्रथमपक्षे शोध्यते तदा कलाशेषम् = ६० र . य—६० क. ककु —ककु. न- ततः प्रश्नोक्त्या अंशशे+३ = कलाशे = ६०र. य —६० क . ककु — ककु. न =र. य—क. ककु+३ पक्षयोः क. ककु योजनेन ६०र. य—६०क. ककु+क. ककु — ककु . न=र . य + ३, ६०र . य — (५९ क . ककु + ककु . न) पक्षौ ५९ क . ककु+ककु . न योजनेन ६०र . य=र. य + ३+५९क. ककु+ककु. न पक्षौ र. य + ३ हीनौ तदा ६०र × य — र. य — ३ = ५९र. य — ३ =५९ क. ककु + ककु. न पक्षौ ककुभक्तौ तदा $\frac{\text{५९र. य — ३}}{\text{ककु}}$ =५९क+न

अत्र कुट्टकेन य मानं सुखेन विदितं भवेत् । एवं रूपत्रयस्थाने षट् सप्तादीन् संस्थाप्योपर्युक्तक्रिययाऽभीष्टसिद्धिरिति ।। ५६ ।।

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—रवि के अंश शेष में तीन जोड़ने से बुध दिन में कब कला शेष होता है । वा अंशशेष में छः सात आठ नौ जोड़ने से कब बुध दिन में कला शेष होता है इसके उत्तर को एक वर्षाभ्यन्तर में करते हुए व्यक्ति गणक कहलाते हैं ।।

उपपत्ति ।

कल्पना करते हैं अहर्गण प्रमाण = य । रविभगणांश = र । गतभगण = क तब अनुपात से $\frac{\text{र. य}}{\text{ककु}}$ = गतभ + $\frac{\text{अंशशे}}{\text{ककु}}$ छेदगम से र . य = ककु . गतभ + अंशशे = ककु . क + अंशशे समशोधन से र. य–क. ककु = अंशशे इसको साठ से गुणाकर कल्प कुदिन से भाग देने से लब्धि = न = $\frac{\text{६० (र. य – क. ककु)}}{\text{ककु}}$ = $\frac{\text{६०र. य —६० क . ककु}}{\text{ककु}}$

छेदगम से ६० र. य—६० क. ककु = ककु . न, अतः कलाशे = ६०र. य —६० क . ककु — ककु. न प्रश्नोक्ति से अंशशे + ३ = कलाशे = ६० र. य —६० क. ककु—ककु.न = र. य — क. ककु + ३ दोनों पक्षों में क. ककु जोड़ने से ६०र. य — ६०क. ककु + क . ककु—ककु . न = र . य + ३ = ६० र . य — (५९ क . ककु + ककु . न) दोनों पक्षों में ५९ क . ककु + ककु . न जोड़ने से ६० र . य = र. य + ३ + ५९ क . ककु + ककु . न दोनों पक्षों में र. य + ३ हीन करने से ६० र. य—र . य—३ = ५९ र . य —३ = ५९ ककु. क + ककु. न दोनों पक्षों को ककु से भाग देने से $\frac{\text{५९ र. य — ३}}{\text{ककु}}$ = ५९क + न यहां कुट्टक से सुगमता से य मान विदित हो जायगा । एवं तीन के स्थान में छः सात-आठ नौ को रखकर उपर्युक्त क्रिया से अभीष्ट सिद्धि होती है इति ।। ५६ ।।

इदानीं प्रश्नद्वयमाह ।

अंशसममंशशेषं कलासमं वा कलाशेषम् ।
दिवसकरस्येष्टदिने कुर्वन्नावत्सराद् गणकः ।।५७।।

सु. भा.—कस्मिन्निष्टदिने दिवसकरस्य रवेरंशमानसममंशशेषं वा कलासमं कलाशेषं भवति । अस्योत्तरमावत्सरात् कुर्वन्नपि गणकः ।

अहर्गणः = या १ । गतभगणाः = का १ । तदा

भगणशेषम् = ग्रभ . या—ककु . का । इदं द्वादशगुणं कल्पकदिनैर्विभज्य

लब्धं राशिमानं नी १। तद्गुणहरं भाज्यादपास्य जातं राशिशेषम्=१२ ग्रभ. या—१२ककु. का—ककु. नी। इदं त्रिंशद्गुणं कल्पकुदिनैर्विभज्य लब्धमंशमानम् पी १। तद्गुणहरं भाज्यादपास्य जातमंशशेषम्=३६० ग्रभ. या—३६० ककु. का—३० ककु. नी—ककु. पी=पी

$$\text{ततः}\ \ \text{या} = \frac{\text{३६० ककु. का} + \text{ककु. नी} + \text{पी (ककु} + \text{१)}}{\text{३६०}}$$

अत्र भाज्ये वर्णत्रयमतो वर्णद्वयस्येष्टमाने प्रकल्प्य कुट्टकेन यावत्तावन्मानं ज्ञेयम्। एवमंशशेषं षष्ट्या संगुण्य कल्पकुदिनैर्विभज्य लब्धं कलामानं लोहितकं प्रकल्प्य तद्गुणहरं भाज्यादपास्य कलाशेषतः समीकरणं कृत्वा तत्र भाज्ये वर्णत्रयमानानीष्टानि प्रकल्प्य यावत्तावन्मानं ज्ञेयम् ॥ ५७ ॥

वि. भा.—दिवसकरस्य (सूर्यस्य) अंशसममंशशेषं वा कलासमं कलाशेषं कस्मिन्निष्टदिने भवति, एतदुत्तरमावत्सराद्वर्षाभ्यन्ते कुर्वन्नपि गणक उच्यते इति ॥

अत्रोपपत्तिः।

कल्प्यते अहर्गणमानम्=य। गतभगणाः=क तदा पूर्ववद् भगणशेषम् =ग्रभ. य—ककु. क इदं द्वादशगुणं कल्पकुदिनैर्भक्तं लब्धं=न तद्गुणं हरं भाज्यादपास्य जातं राशिशेषम्=१२ ग्रभ. य—१२ ककु. क—ककु. न इदं त्रिंशद्-गुणितं कल्पकुदिनैर्भक्तं लब्धमंशमानम्=प तद्गुणं हरं भाज्यादपास्यांश शेषम् =३६० ग्रभ. य—३६० ककु. क—३० ककु. न—ककु. प=प ततः समयोजनेन ३६० ककु. क + ३० ककु. न + प (ककु + १) = ३६० ग्रभ. य, अतः

$$\frac{\text{३६० क. ककु} + \text{३० ककु. न} + \text{प (ककु} + \text{१)}}{\text{३६० ग्रभ}} = \text{य},$$

अत्र भाज्ये वर्णत्रयमस्ति वर्ण-द्वयस्येष्टमाने प्रकल्प्य कुट्टकेन य मानं सुखेन विदितं भवेत्। एवमंशशेषं षष्ट्या संगुण्य कल्पकुदिनैर्भक्तं लब्धं कलामानं ल प्रकल्प्य तद्गुणं हरं भाज्याद्विशोध्य कलाशेषात् समीकरणं कृत्वा तत्र भाज्ये वर्णत्रयमानानीष्टानि प्रकल्प्य य मानं ज्ञातव्यमिति ॥५७॥

अब अन्य दो प्रश्नों को कहते हैं।

वि. भा.– किसी इष्ट दिन में रवि का अंशमान अंशशेष के बराबर होता है वा कलातुल्य कलाशेष होता है इसका उत्तर वर्ष पर्यन्त करते हुए व्यक्ति गणक कहलाते हैं इति ॥५७॥

उपपत्ति।

कल्पना करते हैं अहर्गण प्रमाण=य, गत भगण=क, तब पूर्ववत् भगणशे=

अभ. य—कक्. क इसको बारह से गुणा कर कल्पकुदिन से भाग देने से लब्धि=न तद्गुणित हर को भाज्य में से घटाने से राशिशेष=१२ अभ. य—१२ कक्. क—कक्. न इसको तीस से गुणाकर कल्पकुदिन से भाग देने से लब्धि=प, तद्गुणित हर को भाज्य में से घटाने से अंशशेष=३६० अभ. य—३६० कक्. क—३० कक्. न—कक्. प=प समयोजन से ३६० कक्. क+३० कक्. न+प (कक्+१)=३६० अभ. य, अतः

$\frac{३६० \text{ कक्. क} + ३० \text{ कक्. न} + \text{प} (\text{कक्} + १)}{३६० \text{ अभ}}$ =य। यहां भाज्य में तीन वर्ण हैं, दो वर्णों का मान इष्ट कल्पना कर कुट्टक से य मान सुगमता ही से होता है। एवं अंश शेष को साठ से गुणाकर कल्पकुदिन से भाग देने से लब्ध कलामान ल कल्पना कर तद्गुणित हर को भाज्य में से घटाकर कला शेष से समीकरण कर वहां भाज्य में तीनों वर्णों के मान को इष्ट कल्पना कर य मान जानना चाहिये इति ।।५७।।

इदानीमन्यान् प्रश्नानाह ।

अवमावशेषमवमैरधिमासकशेषमधिमासैः ।
इष्टयुतोनं तुल्यं कुर्वन्नावत्सराद् गणकः ।।५८।।

सु. भा.—इष्टाङ्केन युतमूनं वाऽवमावशेषमवमैस्तुल्यं तथेष्टाङ्केन युतमूनं वाऽधिमासशेषमधिमासैस्तुल्यमस्तीत्यस्योत्तरमावत्सरात् कुर्वन्नपि गणकः ।

अत्राहर्गणमानम्=या १। गतावमानि=का १। तदाऽवमावशेषम्=क्षदि. या—कक्. का। ततः प्रश्नालापेन क्षदि. या—कक्. का ± इ=का

$\therefore$ या=$\frac{(\text{कक्}+१)\text{ का} \mp \text{इ}}{\text{क्षदि}}$। अतः कुट्टकेन यावत्तावन्मानं सुगमम् ।

द्वितीयप्रश्ने गतसौरमानम्=या १। गताधिमासाः=का। तदाऽधिमासशेषम्=अधिमा. या—कसौदि. का। ततः प्रश्नालापेन—

अधिमा. या—कसौदि. का ± इ=का

$\therefore$ या=$\frac{(\text{कसौदि}+१)\text{ का} \mp \text{इ}}{\text{अधिमा}}$। अतो यावत्तावन्मानं सुगमम् ।

अस्योत्तरं गतेन्दुदिनमानं यावत्तावत्कल्प्यते तदाऽपि भवतीति ।। ५८।।

वि. भा.—इष्टाङ्केन युतं हीनमवमावशेषमवमैस्तुल्यं तथेष्टाङ्केन युतं हीनमधिमासशेषमधिमासैस्तुल्यमस्तीत्येतदुत्तरमावत्सरात् (वर्ष पर्यन्तं) कुर्वन्नपि गणकोऽस्तीति ।।

अत्रोपपत्तिः ।

कल्प्यते अहर्गणप्रमाणम्=य। गतावमानि=र तदाऽनुपातेन $\frac{\text{अवम . य}}{\text{कक्}}$

$=$ गतावम $+\frac{\text{अवमशे}}{\text{ककु}}=$ र $+\frac{\text{अवशे}}{\text{ककु}}$ छेदगमेन अवम . य $=$ ककु . र $+$ अवमशे समशोधनेन अवम . य $-$ र . ककु $=$ अवमशे, ततः प्रश्नोक्त्या अवम . य $-$ र . ककु $\pm$ इ $=$ र पक्षयोः र . ककु योजनेन अवम . य $\pm$ इ $=$ र $+$ र . ककु $=$ र (१ $+$ ककु) समशोधनेन अवम. य $=$ र (१ $+$ ककु) $\mp$ इ अतः $\frac{\text{र (१+ककु)} \pm \text{इ}}{\text{अवम}}=$ य, अत्र कुट्टकेन य मानं सुखेन विदितं भवेत् ॥

द्वितीय प्रश्ने कल्प्यते गतसौरप्रमाणम् $=$ य । गताधिमासः $=$ र, तदाऽनुपातेन $\frac{\text{अधिमास . य}}{\text{कसौ}}=$ गताधिमास $+\frac{\text{अधिशे}}{\text{कसौ}}=$ र $+$ अधिशे, छेदगमेन अधिमा. य $=$ कसौ. र $+$ अधिशे, समशोधनेन अधिमा. य $-$ कसौ. र $=$ अधिशे प्रश्नोक्त्या अधिमा. य $-$ कसौ. र $\pm$ इ $=$ र पक्षयोः कसौ र योजनेन अधिमा. य $\pm$ इ $=$ र $+$ कसौ. र $=$ र (१ $+$ कसौ) समशोधनेन अधिमा . य $=$ र (१ $+$ कसौ) $\mp$ इ अतः $\frac{\text{र (१+कसौ)} \mp \text{इ}}{\text{अधिमा}}=$ य अत्र कुट्टकेन य मानं सुखेन विदितं भवेदिति ॥५८॥

अब अन्य प्रश्नों को कहते है।

हि. भा.—इष्टाङ्क से युत वा हीन अवम शेष अवम के बराबर है तथा इष्टाङ्क से युत वा हीन अधिमास शेष अधिमास के बराबर है इसका उत्तर वर्ष पर्यन्त करते हुए व्यक्ति गणक है इति ॥

उपपत्ति।

कल्पना करते हैं अहर्गण प्रमाण $=$ य । गतावम $=$ र, तब अनुपात से $\frac{\text{अवम. य}}{\text{ककु}}$ $=$ गतावम $+\frac{\text{अवमशे}}{\text{ककु}}=$ र $+\frac{\text{अवशे}}{\text{ककु}}$ छेदगम से अवम. य $=$ ककु. र $+$ अवशे समशोधन से अवम. य $-$ र. ककु $=$ अवमशे, तब प्रश्नालाप से अवम. य $-$ र . ककु $\pm$ इ $=$ र दोनों पक्षों में र. ककु जोड़ने से अवम. य $\pm$ इ $=$ र $+$ र. ककु $=$ र (१ $+$ ककु) समशोधन से अवम. य $=$ र (१ $+$ ककु) $\mp$ इ अतः $\frac{\text{र (१+ककु)} \mp \text{इ}}{\text{अवम}}=$ य, यहां कुट्टक से सुगमता से य मान विदित हो जायगा।

द्वितीय प्रश्न में कल्पना करते हैं गत सौर प्रमाण $=$ य । गताधिमास $=$ र तब अनुपात से $\frac{\text{अधिमा . य}}{\text{कसौ}}=$ गताधिमा $+\frac{\text{अधिशे}}{\text{कसौ}}=$ र $+\frac{\text{अधिशे}}{\text{कसौ}}$ छेदगम से अधिमा . य $=$ कसौ . र $+$ अधिशे, समशोधन से अधिशे $=$ अधिमा . य $-$ कसौ . र अब प्रश्नालाप से

अधिमा . य—कसौ . र ± इ = र दोनों पक्षों में ककु—र जोड़ने से अधिमा . य ± इ = र + कसौ . र = र (१ + कसौ) समशोधन से अधिमा . य = र (१ + कसौ) ± इ अतः $\frac{\text{र} (१ + \text{कसौ}) \mp \text{इ}}{\text{अधिमा}}$ = य यहां कुट्टक से सुगमता पूर्वक य मान विदित होगा इति ॥५८॥

इदानीमन्यं प्रश्नमाह ।

निश्छेदभागहारो भानोः सप्ततिगुणोंऽशशेषोनः ।
शुध्यत्ययुतविभक्तः कुर्वन्नावत्सराद् गणकः ॥५९॥

सु. भा.—निश्छेदभागहारो दृढ़कुदिनानि । शेषं स्पष्टार्थम् । ५५ आर्या-प्रश्नोत्तरे यदि अ = चक्रभा. इग्रभ, तदा तेनैव विधिनांशशेषम् = अ . या—दृकक़ु. का = नी । ततः प्रश्नालापेन $\frac{७० \text{ दृककु} \quad \text{अ. या} + \text{दृककु. का}}{१००००}$ अयं निरग्रः ।

$= \frac{७० \text{ दृककु}—\text{नी}}{१००००}$ ।

ततः कुट्टकेन ऋणभाज्यविधिना नीलकमानं सुगमम् ॥ ५९ ॥

इत्यनेकवर्णसमीकरणबीजम् ।

वि. भा.—भानोः (सूर्यस्य) निश्छेदभागहारः (दृढ़कुदिनानि) सप्तत्यागुणः, अंशशेषेण हीनः, अयुतविभक्तः शुध्यति, एतदुत्तरं वर्षपर्यन्तं कुर्वन् गणकोऽस्तीति ॥

अत्रोपपत्तिः ।

५५ सूत्रोपपत्तौ रविभगणांशाः = चभा . रविभ = र तेनैव विधिनांऽशशेषम् = र . य — दृककु . क = न ततः प्रश्नोक्त्या $\frac{७० \times \text{दृकक}—\text{अंशशे}}{१००००}$

$= \frac{७० \times \text{दृककु}—\text{र. य} + \text{दृककु. क}}{१००००} = \frac{७० \times \text{दृककु}—\text{न}}{१००००}$ अयं निःशेषः । ततः कुट्टकेन ऋणभाज्यरीत्या न मानज्ञानं सुलभम् ॥५९॥

इत्यनेकवर्णसमीकरणबीजम्

अब अन्य प्रश्न को कहते हैं ।

हि. भा.—सूर्य के दृढ़कुदिन को सत्तर से गुणाकर अंश शेष घटाकर एक अयुत से भाग देने से निःशेष होता है इसका उत्तर वर्ष पर्यन्त करते हुए व्यक्ति गणक है इति ॥

उपपत्ति ।

५५ सूत्र की उपपत्ति में रवि भगणांश = चभा. रविभ = र, उसी विधि से अंशशेष = र . य — हकक़ु . क = न, तब प्रश्नोक्ति से $\frac{\text{७० हकक़ु — अंशशे}}{\text{१००००}}$

$\frac{\text{७० हकक़ु — र. य + हकक़ु . क}}{\text{१००००}} = \frac{\text{७० हकक़ु — न}}{\text{१००००}}$ यह निःशेष है तब कुट्टक से ऋण भाज्य विधि से न मान ज्ञान सुगम ही है इति ।।५६।।

अनेकवर्णसमीकरणबीज समाप्त हुआ ।

भावितबीजम्

अथ भावितमुच्यते तत्र सूत्रम् ।

भावितकरूपगुणना साव्यक्तवधेष्टभाजितेष्टाप्त्योः ।
अल्पेऽधिकोऽधिकेऽल्पः क्षेप्यो भावितहृतौ व्यस्तम् ॥ ६० ॥

सु. भा.—भावितकस्य भावितगुणकस्य रूपाणां च गुणना वधः किंविशिष्टा साव्यक्तवधाऽव्यक्तगुणकयोर्वधेन सहिता तत इष्टेन भाजिता लब्धिर्ग्राह्या। अनयोरिष्टाप्त्योर्मध्ये योऽधिकः सोऽल्पेऽव्यक्तगुणकेऽल्पश्चाधिकेऽव्यक्तगुणके क्षेप्यः। एवं यौ द्वौ राशी भवतस्तौ भावितकहृतौ भावितगुणकेन हृतौ व्यस्तमव्यक्तमानं स्यात्। यावत्तावद्गुणके क्षेप्येण यन्मानं तत्कालकमानं कालकगुणके क्षेप्येण यन्मानं तद्यावत्तावन्मानं ज्ञेयमिति। एकस्मिन् पक्षे भावितमन्यस्मिन्नव्यक्तौ रूपाणि च कृत्वा तदोपरि लिखितं कर्म कर्त्तव्यमिति ।

अत्रोपपत्तिः। पक्षान्तरादिना कल्प्यते समौ पक्षौ

$$\text{अ. या. का} = \text{क. या} + \text{ख . का} + \text{ग}$$

$$\therefore \text{याका} = \frac{\text{क}}{\text{अ}}\text{या} + \frac{\text{ख}}{\text{अ}}\text{का} + \frac{\text{ग}}{\text{अ}}$$

ततो 'भावितं पक्षतोऽभीष्टात् त्यक्त्वा वर्णौ सरूपकौ' इत्यादि भास्करविधिना $\frac{\text{इ}}{\text{अ}}$ इतीष्टं प्रकल्प्य फलं $= \frac{\text{क. ख} + \text{अ. ग}}{\text{अ. इ}}$ । यतः केवलं संयोजनेन

$$\text{या} = \frac{\text{ख}}{\text{अ}} + \frac{\text{क. ख} + \text{अ. ग}}{\text{इ}} = \frac{1}{\text{अ}}\left(\text{ख} + \frac{\text{क. ख} + \text{अ. ग}}{\text{इ}}\right) = \frac{\text{ख} + \text{आप्ति}}{\text{अ}}$$

$$\text{का} = \frac{\text{क}}{\text{अ}} + \frac{\text{इ}}{\text{अ}} = \frac{\text{क} + \text{इ}}{\text{अ}}$$ । अत उपपन्नम् ।

विशेषाश्च भास्करबीजतोऽवगम्याः। तत्र मत्कृतोपपत्तिश्च तट्टिप्पण्यां विलोक्या ॥ ६० ॥

वि. भा.—भावितकस्य (भावित गुणकस्य) रूपाणां च गुणना (वधः) ऽव्यक्तगुणकयोर्वधेन सहिता, इष्टेन भक्ता लब्धिर्ग्राह्या, इष्टलब्ध्योर्मध्ये योऽधिकः सोऽल्पेऽव्यक्तगुणकेऽल्पश्चाधिकेऽव्यक्तगुणके क्षेप्यः, एवं द्वौ राशी भवतः, तौ भावितकभक्तौ (भावितगुणकेन भक्तौ) तदा विपरीतमव्यक्तमानं स्यात् ॥

अत्रोपपत्तिः ।

यदि इ य+इ'. क +रू=य. क, यत्र य, क माने अभिन्ने स्तः । अत्र यदि य=न + इ', क=प+इ तदा य . क=(न+इ') (प+इ)=इ (न+इ') +इ' (प+इ)+रू वा न. प+इ. न+इ'. प+इ . इ'=इ. न+इ. इ'+इ. प+इ.इ'+रू समशोधनेन न . प =इ. इ'+रू अतः $\frac{\text{इ. इ'+रू}}{\text{न}}$=प, अत्रा (न) स्य तथाऽभिन्नं मानं कल्प्यं यथा प मानमभिन्नं स्यात् । ततो न, प मानाभ्यामुत्थापनेन य, क माने भवेताम् । यदि इ. इ'+रू इदं धनात्मकं भवेत्तदा (न) ऽस्य ऋणमानकल्पने (प) ऽस्यापि ऋणमानमागमिष्यति तदा य=इ'—न क=इ-प, एतेनोपपन्नमाचार्योक्तम् । सिद्धान्तशेखरे 'जह्यात् पक्षादेकतो भावितानि वर्णौ रूपाण्यन्यतो वर्णघातः । क्षिप्तोरूपैस्ताड़िते भाविते च भक्त्वेष्टेन प्राप्तिहारौ नियोज्यौ ।। ज्येष्ठाल्पाभ्यां वर्णकाभ्यां यथेच्छं व्यत्यासाद्वा भाविताप्तौ च वर्णौ । स्यातामेवं स्वस्ववर्णौ त्वभीष्टैर्मानैः कर्मैतत्प्रमाणस्य कुर्यात्' श्री पत्युक्तं च समुपपद्यते । श्रीपत्युक्तमेव भास्करेण बीजगणिते "भावितं पक्षतोऽभीष्टात्त्यक्त्वा वर्णौ सरूपकौ । अन्यतोभाविताङ्केन ततः पक्षौ विभज्य च ।। वर्णाङ्काहतिरूपैक्यं भक्त्वेष्टेनेष्टतत्फले । एताभ्यां संयुतावूनौ कर्त्तव्यौ स्वेच्छया च तौ ।। वर्णाङ्कौ वर्णयोर्माने ज्ञातव्ये ते विपर्ययात्" इत्यनेन स्फुटमुक्तमिति ।। ६० ।।

अब भावित बीज को कहते हैं ।

हि. भा.—भावित के गुणक और रूपों के घात में अव्यक्त गुणकद्वयवध को जोड़ कर इष्ट से भाग देकर लब्धिग्रहण करना चाहिए । इष्ट और लब्धि में जो अधिक हो उसको अल्प अव्यक्त गुणक में जोड़ना और अल्प को अधिक अव्यक्तगुणक में जोड़ना और, इस तरह दो राशिमान होता है उन दोनों राशियों को भावित गुणक से भाग देने से विपरीत अव्यक्तमान होता है अर्थात् प्रथम अव्यक्त गुणक में जोड़ने से जो होता हैं वह द्वितीय अव्यक्त का मान होता है , तथा द्वितीय अव्यक्त गुणक में जोड़ने से जो होता है वह प्रथम अव्यक्त का मान होता है इति ।।

उपपत्ति ।

यदि इ. य+इ'. क+रू=य . क जिसमें य, और क का मान अभिन्न है, यदि य=न+इ', क=प+इ तब य. क=(न+इ') (प+इ)=इ (न+इ')+इ' (प+इ)+रू वा न . प+इ . न+इ' . प+इ'. इ=इ . न+इ . इ'+इ . प+इ. इ' रू समशोधन से

न.प = इ.$\overset{।}{इ}$ + रू अत: $\frac{इ.\ \overset{।}{इ} + रू}{न}$ = प, यहां 'न' का ऐसा अभिन्न मान कल्पना करना चाहिए जिससे 'प' मान अभिन्न हो; तब न, प मानों से उत्थापन करने से य, क, के मान होंगे। यदि इ. $\overset{।}{इ}$ + रू यह धनात्मक है तब 'न' की ऋणात्मक मानकल्पना करने से 'प' का भी ऋणात्मक मान आयगा। तब य = इ — न, क = $\overset{।}{इ}$ — प इससे आचार्योक्त उपपन्न हुआ ॥ सिद्धान्तशेखर में 'जह्यात् पक्षादेकतो भावितानि' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपत्युक्त भी उपपन्न होता है। बीज गणित में 'भावितं पक्षतोऽभीष्टात्' इत्यादि संस्कृतोपपत्ति में लिखित पद्यों से भास्कराचार्य ने श्रीपत्युक्त ही को स्फुट कहा है इति ॥ ६० ॥

इदानीं प्रश्नमाह।

भानोराश्यंशवधात् त्रिचतुर्गुणितान् विशोध्य राश्यंशान्।
नवतिं दृष्ट्वा सूर्यं कुर्वन्नावत्सराद् गणकः ॥ ६१ ॥

सु० भा०—भानोः सूर्यस्य यद्राशिमानं यच्चांशमानं तयोर्वधात् त्रिगुणान् राशीन् चतुर्गुणानंशांश्च विशोध्य शेषं नवतिं दृष्ट्वाऽऽवत्सरात् सूर्यं कुर्वन्नपि स गणक इति।

अत्र राशिमानम् = या १। अंशमानम् = का १। ततः प्रश्नालापानुसारेण—
या. का — ३ या — ४ का = ९०
∴ या. का = ३ या + ४ का + ९०
∴ वर्णाङ्काहतिरूपैक्यम् = ३ × ४ + ९० = १०२। इष्टम् = ६।
फलम् = $\frac{१०२}{६}$ = १७। ततो या = १०। का = २०॥ ६१॥

वि. भा.—भानोः (सूर्यस्य) राश्यंशयोर्वधात् त्रिगुणितान् राशीन् चतुर्गुणानंशांश्च विशोध्य शेषं नवतिं दृष्ट्वा सूर्यमावत्सरात् (वर्षपर्यन्तं) कुर्वन्नपि स गणक इति।

अत्र कल्प्यते राशिप्रमाणम् = य, अंश प्रमाणम् = र तदा प्रश्नोक्त्या य. र — ३ य — ४र = ९० समयोजनेन य. र = ९० + ३ य + ४ र, ततो वर्णाङ्काहतिरूपैक्यम् = ३ × ४ + ९० = १०२ इष्टम् = ६

$\frac{१०२}{६}$ = १७ = फलम्। अतो य = १०, र = २० ॥ ६१ ॥

अब प्रश्न को कहते हैं।

हि. भा.—सूर्य की राशि और अंश के घात में से त्रिगुणित राशि चतुर्गुणित अंश

को घटाने से नव्वे होता है तब एक वर्ष पर्यन्त सूर्य का साधन करते हुए भी वह गणक है इति ।। ६१

यहां कल्पना करते हैं राशि प्रमाण=य । अंश प्रमाण=र, तब प्रश्नानुसार य . र —३ य—४ र=९० दोनों पक्षों में ३ य+४ र जोड़ने से य.र=९०+३ य+४ र तब 'वर्णाङ्काहतिरूपैक्य' मित्यादि भास्करोक्त सूत्र से वर्णाङ्काहतिरूपैक्य=३×४+९०=१०२, इष्ट=६ ∴ $\frac{१०२}{६}$=१७=फल । अतः य=१०, र=२० इति ।। ६१ ।।

इदानीं भाविते प्रकारान्तरमाह ।

भावितके यद्घातो विनष्टवर्णेन तत्प्रमाणानि ।
कृत्वेष्टानि तदाहतवर्णैक्यं भवति रूपाणि ।। ६२ ।।

वर्णप्रमाणभावितघातो भवतीष्टवर्णसङ्ख्यैवम् ।
सिध्यति विनाऽपि भावितसमकरणात् किं कृतं तदतः ।। ६३ ।।

सु. भा.—भावितके भावितसमीकरणे येषां वर्णानां घातो (यद्घातः) ऽस्ति । तत्प्रमाणानि विनष्टवर्णेनेष्टानि कृत्वा तदाहतवर्णैक्यं रूपाणि भवति । एकवर्णमपहाय परेषां मानानीष्टानि प्रकल्प्य तदाहतानां वर्णगुणकानामैक्यं यद्भवति तानि रूपाणि व्यक्तानि भवन्ति । इष्टानां वर्णप्रमाणानां भावितस्य भावितगुणकस्य च घात इष्टविमुक्तवर्णसंख्या भवति । एवं भावितसमकरणाद् भावितसमीकरणाद्विनापि वर्णमानं सिध्यति । अतस्तत् पूर्वं कृतं भावितं किं किमर्थं कार्यमिति शेषः । 'मुक्त्वेष्टवर्णं सुधिया परेषां कल्प्यानि मानानि तथेप्सितानि' इत्यादिभास्करोक्तमेतदनुरूपमेव ।

अत्रोपपत्तिश्चेष्टकल्पितमानानामुत्थापनेन स्फुटा ।। ६२-६३ ।।

वि. भा.—भावितके (भावितसमीकरणे) येषां वर्णानां घातोऽस्ति तत्प्रमाणानि विनष्टवर्णेनेष्टानि कृत्वा तद्गुणितवर्णैक्यं रूपाणि भवति । एकवर्णं त्यक्त्वा परेषां मानानीष्टानि प्रकल्प्य वर्णगुणानामैक्यं यद् भवति तानि रूपाणि (व्यक्तानि) भवन्ति । इष्टानां वर्णप्रमाणानां भावितगुणकस्य घात इष्टविमुक्तवर्णसङ्ख्या भवति । एवं भावितसमीकरणाद्विनाऽपि वर्णमानं सिध्यति, अतस्तत् "पूर्वं कृतं भावितं किमर्थं करणीयमिति" बीजगणिते 'मुक्त्वेष्टवर्णं सुधिया परेषां कल्प्यानि मानानि यथेप्सितानि । तथा भवेद्भावितभङ्ग एवं स्यादाद्यबीजक्रिययेष्टसिद्धिः' भास्करोक्तमिदमाचार्योक्तानुरूपमेवास्तीति ।। ६३ ।।

इति भावितबीजम्

अब भावित में प्रकारान्तर कहते हैं ।

हि. भा.—भावित समीकरण में जिन वर्णों का घात है उसके प्रमाणतुल्य विनष्ट-वर्ण से इष्ट कर वर्णैक्य को उससे गुणा करने से रूप होते हैं । एक वर्ण को छोड़ कर अन्यों के मान इष्ट कल्पना कर वर्णगुणकों का ऐक्य जो हो वे रूप होते हैं । इष्टवर्ण प्रमाण और भावित गुणक का घात इष्टविमुक्त वर्णसंख्या होती है । एवं भावित समीकरण विना भी वर्णमान सिद्ध होता है । अतः पूर्व में किया हुआ भावित क्यों किया जाय । बीज गणित में 'मुक्त्वेष्टवर्णं सुधिया परेषां' इत्यादि भास्करोक्त आचार्योक्त के अनुरूप ही है इति ॥६३॥

इति भावित बीज समाप्त हुआ ।

वर्गप्रकृतिः

वज्राभ्यासतोऽनेककनिष्ठज्येष्ठानयनम्

मूलं द्विधेष्टवर्गाद् गुणकगुणादिष्टयुतविहीनाच्च ।
आद्यवधो गुणकगुणःसहान्त्यघातेन कृतमन्त्यम् ।। ६४ ।।
वज्रवधैक्यं प्रथमं प्रक्षेपः क्षेपवधतुल्यः ।।
प्रक्षेपशोधकहृते मूले प्रक्षेपके रूपे ।। ६५ ।।

सु० भा०—इष्टवर्गाद्गुणकगुणादन्येनेष्टेन केनचिद्युताद्धीनाच्च यन्मूलं तदन्त्यसंज्ञमधोऽधो द्विधा स्थाप्यम् । यस्येष्टस्य वर्गः कृतः स चाद्यसंज्ञोऽप्यधोऽधो द्विधा स्थाप्यः । येन युतेनोनेन वा मूलं प्राप्तं स क्षेपसंज्ञः शोधकसंज्ञो वा ऽधो ऽधो द्विधा स्थाप्यः । एवं तिर्यक्पंक्तिद्वये द्विधा कनिष्ठज्येष्ठक्षेपाणां विन्यासो जातः अत्रेष्टवर्गो येन गुणकेन गुणितस्तस्य संज्ञा प्रकृतिः । आद्यस्य कनिष्ठसंज्ञा । अन्त्यस्य च ज्येष्ठसंज्ञेति सर्वं भास्करबीजे प्रसिद्धम् । आद्ययोः कनिष्ठयोर्वधो गुणकेन प्रकृत्या गुणोऽन्त्ययोर्ज्येष्ठयोर्घातेन सह सहितः । एवमन्त्यमन्यज्ज्येष्ठं कृतमाचार्यैरिति शेषः । कनिष्ठज्येष्ठयोर्वज्रवधैक्य चान्यत् प्रथमं कनिष्ठसंज्ञं भवति । तत्र क्षेपयोर्वधेन तुल्यः प्रक्षेपो भवतीति । एवं प्रक्षेपे वा शोधके ऋणक्षेपे तुल्यभावनया ये मूले कनिष्ठज्येष्ठे ते प्रक्षेपकेण वा शोधकेन हृते रूपे प्रक्षेपके रूपक्षेपे कनिष्टज्येष्ठे भवत इति सर्वं भास्करवर्गप्रकृतितः स्फुटम् ।

अत्रोपपत्त्यर्थं मत्कृतभास्करबीजटिप्पण्यां वर्गप्रकृत्युपपत्तिर्विलोक्या ।। ६४-६५ ।।

वि. भा.—इष्टवर्गात् गुणकगुणात् केनचिदन्येनेष्टेन युतात् हीनाच्च यन्मूलं तदन्त्यसंज्ञं (ज्येष्ठं) अधोऽधो द्विधा स्थाप्यम् । यस्येष्टस्य (कनिष्ठस्य) वर्गकृतः स आद्यसंज्ञो (कनिष्ठ)ऽप्यधोऽधो द्विधा स्थाप्यः । येन युतेन हीनेन वा मूलं लब्धं स क्षेपसंज्ञः शोधकसंज्ञो वाऽधोऽधो द्विधा स्थाप्यः । एवं पंक्तिद्वये कनिष्ठज्येष्ठक्षेपाणां द्विधास्थापनं जातम् । अत्रेष्टवर्गो येन गुणकेन गुणितस्तस्य नाम प्रकृतिः । कनिष्ठयोर्वधः प्रकृत्या गुणो ज्येष्ठयोर्घातेन युत एतदन्यज्ज्येष्ठम् । कनिष्ठज्येष्ठयोर्वज्रवधैक्यमन्यत् कनिष्ठम् । तत्र क्षेपयोर्घातः क्षेपो भवति । एवं प्रक्षेपे वा शोधके ऋणक्षेपे तुल्यभावनया ये कनिष्ठज्येष्ठे ते प्रक्षेपकेण शोधकेन वा भक्ते तदा रूपक्षेपे कनिष्ठज्येष्ठे भवत इति ।।

अत्रोपपत्तिः

सूत्रोक्त्या प्र. क^{२}+क्षे=ज्ये^{२} ∴ ज्ये^{२}—प्र. क^{२}=क्षे । एवमेव ज्ये'^{२}— प्र.क'^{२} =क्षे' अनयोर्घातः क्षे. क्षे'=ज्ये^{२}. ज्ये'^{२}—ज्ये^{२} प्र^{२}. क.—ज्ये^{२}. प्र. क'^{२} +प्र. क^{२}. क'^{२} २ प्र· क. क'. ज्ये. ज्ये' इति धनमृणमृण धनं च क्रियते तदा ज्ये. ज्ये'^{२}±२ प्र. क. क'. ज्ये. ज्ये'+प्र^{२}. क^{२}. क'^{२}∓२ प्र. क. क'. ज्ये. ज्ये'–ज्ये'^{२} प्र. क^{२}–ज्ये^{२}. प्र. क'^{२}=(ज्ये. ज्ये'±प्र. क. क')^{२}—प्र{(ज्ये'. क±ज्ये. क')} पक्षान्तरेण प्र{(ज्ये' . क±ज्ये. क')}^{२} +क्षे. क्षे'=(ज्ये. ज्ये'±प्र. क. क')^{२} अतः क्षेपघाते क्षेपे ज्ये'. क ±ज्ये. क' इदं कनिष्ठं, ज्ये. ज्ये'±प्र. क. क' इदं ज्येष्ठं भवितुमर्हतीति । एतावताऽऽचार्योक्तमुपपन्नम् । सिद्धान्तशेखरे "कृतेर्गुणो यः प्रकृतिर्हि प्रोक्ता क्षिप्तिस्तथैवर्णधनात्मिका स्यात् । रूपं कनीयः पदमस्य वर्गे हते प्रकृत्या वियुते युते वा । क्षिप्त्या पदं यच्च बृहत्पदं तत् ताभ्यां पदे भावनया त्वनन्ते" श्री पत्युक्तमिदमाचार्योक्तानुरूपमेव । भावना विधिश्च ।

वज्राभ्यासौ ह्रस्वज्येष्ठकयोस्तद्युतिर्भवेद्ध्रस्वम् ।
लघुघातः प्रकृतिहतो ज्येष्ठवधेनान्वितो ज्येष्ठम् ॥

क्षिप्त्योर्घातः क्षेपः स्याद्वज्राभ्यासयोर्विशेषो वा ।
ह्रस्वं लघ्वोर्घातः प्रकृतिघ्नो ज्येष्ठयोश्च वधः ॥

तद्विवरं ज्यष्ठपदं क्षेपः क्षिप्त्योः प्रजायते घातः ।
ईप्सितवर्गेण हृतःक्षेपः क्षेपः पदे तदेष्टाप्ते ॥

बीजगणिते " इष्टं ह्रस्वं तस्य वर्गः प्रकत्या क्षुण्णो युक्तो वर्गितो वा स येन । मूलं दद्यात् क्षेपकं तं धनर्णं मूलं तत्र ज्येष्ठमूलं वदन्ति ॥ ह्रस्वज्येष्ठक्षेपकान्न्यस्य तेषां तानन्यान् वाऽधो निवेश्य क्रमेण । साध्यान्येभ्यो भावनाभिर्बहूनि मूलान्येषां भावना प्रोच्यतेऽतः ॥ वज्राभ्यासौ ज्येष्ठलघ्वोस्तदैक्यं ह्रस्वं लघ्वोराहतिश्च प्रकृत्या । क्षुण्णा ज्येष्ठाभ्यासयुग् ज्येष्ठमूलं तत्राभ्यासः क्षेपयोः क्षेपकः स्यात्" भास्करोक्तमिदं सर्वमाचार्योक्तानुरूपमेवास्तीति ॥ ६४-६५

अब वर्गप्रकृति आरम्भ किया जाता है ।

हि. भा.—इष्ट वर्ग को गुणक से गुणा कर किसी अन्य इष्ट को युत वा हीन करने से जो होता है वह अन्त्य संज्ञक (ज्येष्ठ) है । उसको अधोऽधः दो स्थानों में रखना। जिस इष्ट (कनिष्ठ) का वर्ग किया गया है आद्य संज्ञक (कनिष्ठ) है उस को भी अधोऽधः दो स्थानों में स्थापन करना । जिसको जोड़ने वा घटाने से मूल लाभ हुआ है वह क्षेपसंज्ञक

वा शोधक संज्ञक है। उसको भी अधोऽधः दो स्थानों में स्थापन करना। इस तरह दो पंक्तियों में कनिष्ठ ज्येष्ठ और क्षेप का स्थापन हुआ। इष्टवर्ग को जिस गुणक से गुणा किया गया है उसका नाम प्रकृति है। कनिष्ठ द्वय के घात को प्रकृति से गुणा कर ज्येष्ठ-द्वय घात को जोड़ने से अन्य ज्येष्ठ होता है कनिष्ठ और ज्येष्ठ के वज्राभ्यास का योग अन्य कनिष्ठ होता है वहां क्षेपद्वय का घात क्षेप होता है। एवं प्रक्षेप (शोधक) के ऋण क्षेप में तुल्य भावना से जो कनिष्ठ और ज्येष्ठ होते हैं उन्हें प्रक्षेप से भाग देने से रूप क्षेप में कनिष्ठ और ज्येष्ठ होते हैं ॥

उपपत्ति।

प्र = प्रकृति, क = कनिष्ठ, ज्ये = ज्येष्ठ, क्षे = क्षेप तब सूत्रानुसार प्र. क^{2} + क्षे = ज्ये^{2} अतः ज्ये^{2} — प्र. क^{2} = क्षे, एवं ज्ये′^{2} — प्र. क′^{2} = क्षे′, इन दोनों के घात करने से क्षे. क्षे′ = ज्ये^{2}. ज्ये′^{2} — ज्ये^{2}. प्र. क′^{2} — ज्ये′^{2}. प्र. क^{2} + प्र. क.^{2} क′.^{2} इसमें २ प्र. क. क′. ज्ये—ज्ये′ इसको धन ऋण और ऋण धन करने से ज्ये^{2}. ज्ये′^{2} ± २ प्र. क. क′. ज्ये. ज्ये′. + प्र^{2}. क^{2}. क′^{2} ∓ २ प्र. क. क′. ज्ये. ज्ये′ — ज्ये′^{2}. प्र. क^{2} — ज्ये^{2}. प्र. क′^{2} = (ज्ये. ज्ये′ ± प्र. क. क′)^{2} — प्र {(ज्ये′. क ± ज्ये. क′)^{2}} पक्षान्तर से प्र {(ज्ये′. क ± ज्ये. क′)^{2}} + क्षे. क्षे′ = (ज्ये. ज्ये′ ± प्र. क. क′)^{2} अतः क्षेपघात तुल्य क्षेप में ज्ये. क ± ज्ये. क′ यह कनिष्ठ होता है और ज्ये. ज्ये ± प्र. क. क′ यह ज्येष्ठ होता है। इससे आचार्योक्त भावना उपपन्न होती है॥ सिद्धान्त शेखर में 'कृतेर्गुणो यः प्रकृतिर्हि प्रोक्ता क्षिप्तिस्तथैवर्णधनात्मिका स्यात्' इत्यादि संस्कृतोपपत्ति में लिखित, श्रीपत्युक्त आचार्योक्त अनुरूप ही है; भावना विधि 'वज्राभ्यासौ ह्रस्वज्येष्ठकयोस्तद्युतिर्भवेद्ध्रस्वम्' इत्यादि संस्कृतोपपत्ति में लिखित, भावना आचार्योक्त भावना के अनुरूप ही है। बीजगणित में 'इष्टं ह्रस्वं तस्य वर्गः प्रकृत्या क्षुण्णो युक्तो वर्गितो वा स येन' इत्यादि संस्कृतोपपत्ति में लिखित पद्यों से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है ॥ ६४-६५ ॥

इदानीं विशेषमाह।

रूपप्रक्षेपपदे पृथगिष्टक्षेप्यशोध्यमूलाभ्याम् ।
कृत्वाऽऽन्त्याद्यपदे ये प्रक्षेपे शोधनेवेष्टे ॥ ६६ ॥

सु. भा.—रूपप्रक्षेपे ये पदे आद्यान्त्यपदे ते पृथक् स्थाप्ये। तत इष्टक्षेपे वेष्टशोधके ये मूले ताभ्यां भावनयाऽन्ये अन्त्याद्यपदे ज्येष्ठकनिष्ठे कृत्वा ते इष्टे प्रक्षेपे वेष्टे शोधने ऽन्ये अन्त्याद्यपदे ज्ञेये इति ॥ ६६ ॥

वि. भा.—रूप प्रक्षेपे ये अन्त्याद्यपदे (ज्येष्ठ कनिष्ठे) ते पृथक् स्थाप्ये, इष्टक्षेपे (इष्टशोधके वा) ये मूले (कनिष्ठ ज्येष्ठे) ताभ्यां भावनया ज्येष्ठकनिष्ठे कृत्वा ते इष्टक्षेपेऽन्ये ज्येष्ठ कनिष्ठे ज्ञातव्ये इति ।

अत्रोपपत्तिः स्पष्टैवास्तीति ॥ ६६ ॥

अब विशेष कहते हैं ।

हि. भा.—रूपक्षेप में जो ज्येष्ठ, कनिष्ठ है उन्हें पृथक् स्थापन करना, इष्टक्षेप में जो कनिष्ठ, ज्येष्ठ है उसके साथ भावना से इष्टक्षेप में अन्य ज्येष्ठ, कनिष्ठ होते हैं इति ।

उपपत्ति स्पष्ट ही है ॥ ६६ ॥

इदानीं चतुःक्षेपकनिष्ठज्येष्ठाभ्यां रूपक्षेपे कनिष्ठज्येष्ठानयनमाह ।

चतुरधिकेऽन्त्यपदकृतिस्त्र्यूना दलिताऽन्त्यपदगुणाऽन्त्यपदम् ।
अन्त्यपदकृतिर्व्येका द्विहृताऽऽद्यपदाहृताऽऽद्य पदम् ॥ ६७ ॥

सु. भा.—चतुरधिके चतुःक्षेपेऽन्त्यपदकृतिस्त्रिभिरूनार्ऽधिताऽन्त्यपदगुणा फलं रूपक्षेपीयमन्त्यपदं ज्येष्ठं भवेत् । अन्त्यपदकृतिरेकेन हीना द्विहृताऽऽद्यपदेन हृता फलं रूपक्षेपीयमाद्यपदं कनिष्ठं भवेत् ।

अत्रोपपत्तिः । यदि चतुःक्षेपे कनिष्ठम् = क, ज्येष्ठम् = ज्ये । तदा 'इष्टवर्गहृतः क्षेपः क्षेपः स्यात्'—इत्यादिभास्करविधिना रूपक्षेपे कनिष्ठम् $= \frac{\text{क}}{२}$ । ज्येष्ठम् $= \frac{\text{ज्ये}}{२}$ । तथा विलोमेन प्रकृतिः $= \frac{\text{ज्ये}^{२} - ४}{\text{क}^{२}}$ समासभावनया $\frac{\text{क}}{२}$, $\frac{\text{ज्ये}}{२}$, आभ्यामन्ये कनिष्ठज्येष्ठे रूपक्षेपे साध्येते तदा कनिष्ठम् $= \frac{\text{क} \times \text{ज्ये}}{२}$, ज्येष्ठम् $= \frac{\text{ज्ये}^{२} - २}{२}$ आभ्यां $\frac{\text{क}}{२}$, $\frac{\text{ज्ये}}{२}$ एताभ्यां च पुना रूपक्षेपे यदि कनिष्ठज्येष्ठे साध्येते तदा कनिष्ठम् $= \frac{\text{क}\,(\text{ज्ये}^{२} - १)}{२}$ । ज्येष्ठम् = ज्ये (ज्ये^{२}—३) अत उपपद्यते ॥ ६७ ॥

वि. भा.—चतुरधिके (चतुः क्षेपे) ऽन्त्यपद (ज्येष्ठ) वर्गस्त्रिभिर्हीनोऽर्धितो ज्येष्ठगुणितस्तदा रूपक्षेपे ज्येष्ठं भवेत्, ज्येष्ठवर्ग एकेन हीनो द्वाभ्यां भक्तः कनिष्ठगुणितस्तदा रूपक्षेपीयं कनिष्ठं भवेदिति ॥

अत्रोपपत्तिः ।

कल्प्यते चतुः क्षेपे कनिष्ठम् = क । ज्येष्ठम् = ज्ये, तदा 'इष्टवर्गहृतः क्षेप' इत्यादिना इष्टं द्वयं प्रकल्प्य रूपक्षेपे कनिष्ठम् = $\frac{क}{२}$, ज्येष्ठम् = $\frac{ज्ये}{२}$ तथा प्र. क^२ + ४ = ज्ये^{२} समशोधनेन प्र. क^२ = ज्ये^{२} — ४ अतः प्र = $\frac{ज्ये^२ — ४}{क^२}$, $\frac{क}{२}$, $\frac{ज्ये}{२}$ आभ्यां तुल्यभावनया रूपक्षेपे कनिष्ठम् = $\frac{क . ज्ये}{२}$, ज्येष्ठम् = $\frac{ज्ये^२ — २}{२}$ आभ्यां $\frac{क}{२}$, $\frac{ज्ये}{२}$ एताभ्यां भावनया रूपक्षेपे कनिष्ठम् = $\frac{क (ज्ये^२ — १)}{२}$ ज्येष्ठम् = $\frac{क (ज्ये^२ — १)}{२}$, ज्येष्ठम् = $\frac{ज्ये (ज्ये^२ — ३)}{२}$ एतेनाचार्योक्तमुपपन्नम् ॥ ६७ ॥

अब चार क्षेप के कनिष्ठ और ज्येष्ठ से रूप क्षेप में कनिष्ठ और ज्येष्ठ के आनयन को कहते हैं ।

हि.भा.—चार क्षेप में से जो ज्येष्ठ है उसके वर्ग में से तीन घटाकर दो से भाग देने से जो फल हो उसको ज्येष्ठ से गुणा करने से रूपक्षेप में ज्येष्ठ होता है । ज्येष्ठ वर्ग में एक घटाकर दो से भाग देने से जो फल होता है उसको कनिष्ठ से गुणा करने से रूपक्षेप में कनिष्ठ होता है इति ॥

उपपत्ति ।

कल्पना करते हैं चार क्षेप में कनिष्ठ = क । ज्येष्ठ = ज्ये, तब 'इष्टवर्गहृतः क्षेप' इत्यादि भास्करोक्त प्रकार से दो इष्ट कल्पना करने से रूपक्षेप में कनिष्ठ = $\frac{क}{२}$, ज्येष्ठ = $\frac{ज्ये}{२}$, वर्ग प्रकृति लक्षण से प्र. क^२ + ४ = ज्ये^{२} समशोधन से प्र. क^२ = ज्ये^{२} — ४ अतः प्र = $\frac{ज्ये^२ — ४}{क^२}$, $\frac{क}{२}$, $\frac{ज्ये}{२}$ इसकी तुल्य भावना से रूपक्षेप में कनिष्ठ = $\frac{क. ज्ये}{२}$, ज्येष्ठ = $\frac{ज्ये^२ — २}{२}$, इसको $\frac{क}{२}$, $\frac{ज्ये}{२}$ इसके साथ भावना से रूपक्षेप में कनिष्ठ = $\frac{क (ज्ये^२ — १)}{२}$ ज्येष्ठ = $\frac{ज्ये (ज्ये^२ — ३)}{२}$ इससे आचार्योक्त उपपन्न हुआ इति ॥६७॥

इदानीमृणात्मकचतुःक्षेपकनिष्ठज्येष्ठाभ्यां रूपक्षेपे कनिष्ठज्येष्ठयोरानयनमाह।

चतुरूनेऽन्त्यपदकृती त्र्येकयुते वधदलं पृथग्व्येकम् ।
व्येकाद्याहतमन्त्यपदवधगुणमाद्यमन्त्यपदम् ।।६८।।

सु. भा.—चतुरूनेऽन्त्यपदस्य कृतिर्द्विधा स्थाप्या एकत्र त्रियुता ऽन्यत्रैकयुता। अनयोर्वधदलं पृथक्स्थाप्यमेकत्र व्येकं कार्यं तद्व्यकाद्याहतम् । अन्त्यपदकृतिस्त्रियुता प्रथमं या साधिता तद्व्येकेना $ज्ये^2+२$ नेन हृतमित्यर्थः। फलं रूपक्षेपेऽन्त्यं ज्येष्ठपदं स्यात् । पृथक् स्थापितं पदयोः कनिष्ठज्येष्ठयोर्वधेन गुणं फलमान्त्यपदं पूर्वागतान्त्यपदसम्बन्धि आद्यं पदं भवेदिति ।

अत्रोपपत्तिः । कल्प्यते चतुरूने कनिष्ठम् = क । ज्येष्ठम् = ज्ये । तदा विलोमेन प्रकृतिः $= \frac{ज्ये^2+४}{क^2}$ । रूपशोधके च कनिष्ठम् $= \frac{क}{२}$ । ज्येष्ठम् $= \frac{ज्ये}{२}$ ।
आभ्यां समासभावनया रूपक्षेपे कनिष्ठम् $= \frac{क \times ज्ये}{२}$ । ज्येष्ठम् $= \frac{ज्ये^2+२}{२}$ ।
आभ्यां पुनः समासभावनया रूपक्षेपे कनिष्ठम् $= \frac{क.\ ज्ये^2\ (ज्ये^2+२)}{२}$ । ज्येष्ठम् $= \frac{ज्ये^4+४\ ज्ये^2+२}{२}$ । आभ्यां पूर्वसाधिताभ्याम् $\frac{क \times ज्ये}{२}$ । $\frac{ज्ये^2+२}{२}$ एताभ्यां च पुनः समासभावनया रूपक्षेपे कनिष्ठम् $= \frac{क.\ ज्ये\ (ज्ये^4+४\ ज्ये^2+३)}{२} =$ क. ज्ये $\frac{(ज्ये^2+१)\ (ज्ये^2+३)}{२}$ । ज्येष्ठम् $= (ज्ये^2+२)\left(\frac{ज्ये^4+४\ ज्ये^2+१}{२}\right) = (ज्ये^2+२)$ $\left(\frac{ज्ये^4+४\ ज्ये^2+३}{२}-१\right) = \left\{ज्ये^2+२\right\}\left\{\frac{(ज्ये^2+३)\ (ज्ये^2+१)}{२}-१\right\}$ अत उपपद्यते ।।

वि.भा.—चतुरूने (ऋणात्मकचतुःक्षेपे) ऽन्त्यपद (ज्येष्ठ) कृतिर्द्विधा स्थाप्या, एकत्र त्रियुताऽन्यत्रैकयुता, तयोर्घाताधं पृथक् स्थाप्यम् । एकत्रैकहीनं कार्यं तदेकहीनकनिष्ठगुणम् । अन्त्यपद (ज्येष्ठ) कृतिस्त्रियुता प्रथमं या साधिता तद्व्येकेना $ज्ये^2+२$ नेन गुणितमित्यर्थः । तदा रूपक्षेपे ज्येष्ठं भवेत् । पृथक् स्थापितं कनिष्ठज्येष्ठयोर्घातेन गुणं फलं पूर्वागतज्येष्ठसम्बन्धिकनिष्ठं भवेदिति ।।

अत्रोपपत्तिः ।

कल्प्यते ऋणात्मकचतुः क्षेपे कनिष्ठम् = क, ज्येष्ठम् = ज्ये, वर्गप्रकृतिलक्षणेन

प्र. $क^2 - ४ = ज्ये^2$ समयोजनेन प्र. $क^2 = ज्ये^2 + ४$ अतः $\frac{ज्ये^2 + ४}{क^2} = प्र$ । 'इष्टवर्ग हृतक्षेप' इत्यादिनेष्टम् = २ प्रकल्प्य ऋणात्मकरूपक्षेपे कनिष्ठम् = $\frac{क}{२}$, ज्येष्ठम् $= \frac{ज्ये}{२}$ आभ्यां तुल्यभावनया रूपक्षेपे कनिष्ठम् $= \frac{क. ज्ये}{२}$, ज्येष्ठम् $= \frac{ज्ये^2 + २}{२}$ आभ्यां पुनः समासभावनया रूपक्षेपे कनिष्ठम् $= \frac{क. ज्ये (ज्ये^2 + २)}{२}$, ज्येष्ठम् $= \frac{ज्ये^4 + ४ ज्ये^2 + २}{२}$ आभ्यां पूर्वसाधिताभ्यां $\frac{क. ज्ये}{२}$, $\frac{ज्ये^2 + २}{२}$ समास भावनया रूपक्षेपे कनिष्ठम् $= \frac{क. ज्ये (ज्ये^4 + ४ ज्ये^2 + ३)}{२} = क. ज्ये. \frac{(ज्ये^2 + १)(ज्ये^2 + ३)}{२}$

ज्येष्ठम् $= (ज्ये^2 + २) \frac{(ज्ये^4 + ४ ज्ये^2 + १)}{२} = (ज्ये^2 + २) \frac{(ज्ये^4 + ४ ज्ये^2 + ३)}{२} - १$

$= \left\{ (ज्ये^2 + २) \right\} \left\{ \frac{(ज्ये^2 + ३)(ज्ये^2 + १)}{२} - १ \right\}$ अत उपपन्नमचार्योक्त-मिति ॥६८॥

अब ऋणात्मक चार क्षेप के कनिष्ठ और ज्येष्ठ से रूपक्षेप में कनिष्ठ और ज्येष्ठ के आनयन को कहते हैं।

हि. भा.—ऋणात्मक चार क्षेप में ज्येष्ठ वर्ग को दो स्थानों में स्थापन करना, एक स्थान में तीन जोड़ना दूसरे स्थान में एक जोड़ना, इन दोनों के घातार्ध को पृथक् स्थापन करना, एक स्थान में एक हीनकर जो हो उसको एक हीन कनिष्ठ से गुणा करना चाहिये तब रूप क्षेप में ज्येष्ठ होता है। पूर्व स्थापित को कनिष्ठ और ज्येष्ठ के घात से गुणा करने से पूर्वागत ज्येष्ठ सम्बन्धी कनिष्ठ होता है इति ॥

उपपत्ति ।

कल्पना करते हैं ऋणात्मक चारक्षेप में कनिष्ठ = क । ज्येष्ठ = ज्ये । वर्ग प्रकृति लक्षण से प्र. $क^2 - ४ = ज्ये^2$ दोनों पक्षों में चार जोड़ने से प्र. $क^2 = ज्ये^2 + ४$ अतः प्र $= \frac{ज्य^2 + ४}{क^2}$ 'इष्ट वर्ग हृतः क्षेप' इत्यादि से इष्ट = २ कल्पना करने से ऋणात्मक रूपक्षेप में कनिष्ठ $= \frac{क}{२}$, ज्येष्ठ $= \frac{ज्ये}{२}$ तुल्य भावना से रूपक्षेप में कनिष्ठ $= \frac{क. ज्ये}{२}$, ज्येष्ठ $= \frac{ज्ये^2 + २}{२}$ इनसे समास भावना से रूपक्षेप में कनिष्ठ $= \frac{क. ज्ये (ज्ये^2 + २)}{२}$, ज्येष्ठ

$=\frac{\text{ज्येष्ठ}^4+4\ \text{ज्ये}^2+2}{2}$ इनके साथ पूर्वसाधित $\frac{\text{क. ज्ये}}{2}$, $\frac{\text{ज्ये}^2+2}{2}$ इनकी समास भावना से रूपक्षेप में कनिष्ठ $=\frac{\text{क. ज्ये}\ (\text{ज्ये}^4+4\text{ज्ये}^2+2)}{2}=\text{क. ज्ये}\ \frac{(\text{ज्ये}^2+1)\ (\text{ज्ये}^2+3)}{2}$,

ज्येष्ठ $=(\text{ज्ये}^2+2).\ \frac{(\text{ज्ये}^4+4\ \text{ज्ये}^2+1)}{2}=(\text{ज्ये}^2+2).\left(\frac{\text{ज्ये}^4+4\ \text{ज्ये}^2+3}{2}-1\right)$

$=\left\{(\text{ज्ये}^2+2)\right\}.\left\{\frac{(\text{ज्ये}^2+3)\ (\text{ज्ये}^2+1)}{2}-1\right\}$ इससे आचार्योक्त उपपन्न हुआ ॥६८॥

इदानीं वर्गात्मकप्रकृतौ कनिष्ठज्येष्ठयोरानयनमाह् ।

वर्गे गुणके क्षेपः केनचिदुद्धृतयुतोनितो दलितः ।
प्रथमोऽन्त्यमूलमन्यो गुणकारपदोद्धृतः प्रथमः ॥६९॥

सु. भा.—गुणके प्रकृतौ वर्गे वर्गात्मके सति क्षेपः केनचिदिष्टेनोद्धृतः फलं तेनैवेष्टेन युतमूनितं दलितं च कार्यम् । एवं राशिद्वयं भवेत् तत्र प्रथमो राशिरन्त्यमूलं ज्येष्ठं भवेत् । अन्यो गुणकारपदोद्धृतो गुणकारः प्रकृतिस्तत्पदेनोद्धृतः फलं प्रथम आद्योऽर्थात् कनिष्ठं पदं भवेदिति । 'इष्टभक्तो द्विधाक्षेप' इत्यादि भास्करोक्तमेतदनुरूपमेव ।

अत्रोपपत्त्यर्थं मत्कृतभास्करबीज टिप्पण्याम्-इष्टभक्तोद्विधाक्षेपः इत्यस्योपपत्तिर्द्रष्टव्या ॥ ६९ ॥

वि. भा.—गुणके (प्रकृतौ) वर्गे (वर्गात्मके) सति क्षेपः केनचिदिष्ठेन भक्तो लब्धं तेनैवेष्टेन युतं हीनं दलितं च कार्यम् एवं राशिद्वयं भवति । तत्र प्रथमो राशिरन्त्यमूलं (ज्येष्ठं) भवति, गुणकारः (प्रकृतिः) तन्मूलेन भक्तो द्वितीयराशि स्तदा लब्धं कनिष्ठं भवेदिति ॥

अत्रोपपत्तिः ।

वर्गप्रकृत्या $\text{प्र}^2\ .\ \text{क}^2+\text{क्षे}=\text{ज्ये}^2$ समशोधनेन $\text{क्षे}=\text{ज्ये}^2-\text{प्र}^2.\ \text{क}^2$ वर्गान्तरस्य योगान्तरघातसमत्वात् $(\text{ज्ये}+\text{प्र. क})\ (\text{ज्ये}-\text{प्र. क})=\text{क्षे}$, अत्र यदि ज्ये $-$प्र. क इष्टं कल्प्यते तदा $\text{क्षे}=(\text{ज्ये}+\text{प्र . क})\ .\ \text{इ}$ पक्षौ इ भक्तौ तदा $\frac{\text{क्षे}}{\text{इ}}=\text{ज्ये}+\text{प्र. क}$ पक्षौ इ हीनौ तदा $\frac{\text{क्षे}}{\text{इ}}-\text{इ}=\text{ज्ये}+\text{प्र . क}-(\text{ज्ये}-\text{प्र.क})=\text{ज्ये}+\text{प्र.क}$

—ज्ये + प्र.क = २ प्र.क पक्षौ २ प्र भक्तौ तदा $\frac{\frac{क्षे}{इ}—इ}{२प्र}$ = क । $\frac{क्षे}{इ}$ अत्रैवेष्टयोजनेन

$\frac{क्षे}{इ}$ + इ = ज्ये + प्र. क + ज्ये — प्र. क = २ ज्ये अतः $\frac{\frac{क्षे}{इ}+इ}{२}$ = ज्ये, एतावताऽऽचार्योक्तमुपपन्नम् ।। बीजगणिते 'इष्टभक्तो द्विधाक्षेप' इत्यादि भास्करोक्तमेतदनुरूपमेवेति ।।६९।।

अब वर्गात्मक प्रकृति में कनिष्ठ और ज्येष्ठ का आनयन करते हैं।

हि. भा.—वर्गात्मक प्रकृति में क्षेप को किसी इष्ट से भाग देकर जो फल हो उसमें उसी इष्ट को युत और हीन कर आधा करना चाहिये इस तरह दो राशियों का मान होता है, उनमें प्रथम राशि ज्येष्ठ होता है, द्वितीय राशि को प्रकृति के मूल से भाग देने से कनिष्ठ होता है इति ।

उपपत्ति ।

वर्ग प्रकृति से $प्र^{२}. क^{२}$ + क्षे = $ज्ये^{२}$ समशोधन से क्षे = $ज्ये^{२}$ — $प्र^{२}. क^{२}$ वर्गान्तर योगान्तर घात के बराबर होता है इसलिये क्षे = (ज्ये + प्र. क) (ज्ये — प्र. क) यहाँ यदि ज्ये — प्र . क = इष्ट माना जाय तब क्षे = (ज्ये + प्र. क) इ ∴ $\frac{क्षे}{इ}$ = ज्ये + प्र. क, अब संक्रमण गणित से $\frac{\frac{क्षे}{इ}+इ}{२}$ = प्रथमराशि = ज्ये । $\frac{\frac{क्षे}{इ}—इ}{२}$ = द्वितीयराशि = प्र . क

∴ $\frac{\frac{क्षे}{इ}—इ}{२ प्र}$ = क इससे आचार्योक्त उपपन्न हुआ ।

बीज गणित में 'इष्ट भक्तोद्विधाक्षेपः' इत्यादि भास्करोक्त इसके अनुरूप ही है इति ।।६९।।

अतोऽग्रे चैकाऽर्या नष्टा सा कोलब्रूकानुवादानुसारेण ।

वर्गच्छिन्ने गुणके प्रथमं तन्मूल भाजितं भवति ।
वर्गच्छिन्ने क्षेपे तत्पदगुणिते तदा मूले ।।७०।।

एवं भवितुमर्हति ।

सु. भा.—यदि गुणकः प्रकृतिः केनचिद्वर्गेण निःशेषो भवति तदा तं तद्वर्गेण संहृत्य लब्धसमे गुणके मूले साध्ये तत्र प्रथममाद्यमर्थात् कनिष्ठं तस्य वर्गस्य मूलेन भाजितं फलमभीष्टे गुणके कनिष्ठं भवेत्। ज्येष्ठं त्वत्रापि तदेव। क्षेपे वर्गच्छिन्ने सति वर्गेण क्षेपं विभज्य लब्धसमे क्षेपे ये मूले ते तद्वर्गपदेन गुणिते अभीष्टगुणके मूले भवत इति। 'वर्गच्छिन्ने गुणे ह्रस्वं तत्पदेन विभाजयेदिति भास्करप्रकारः प्रथमप्रकारानुरूपः। 'क्षुण्णः क्षुण्णे तदा पदे' इति भास्करप्रकारश्च द्वितीयप्रकारानुरूपः।

अत्रोपपत्त्यर्थं मत्कृतभास्करबीजटिप्पणी विलोक्या ॥ ७० ॥

वि. भा.—यदि गुणकः (प्रकृतिः) केनापि वर्गाङ्केन भक्तः सन् निःशेषो भवेत्तदा तदगुणकं तद्वर्गाङ्केन भक्त्वा लब्धतुल्ये गुणके (प्रकृतौ) कनिष्ठज्येष्ठे साध्ये तत्र प्रथमं (कनिष्ठं) तस्य वर्गाङ्कस्य मूलेन भाजितं तदा तद्गुणके (नवीनप्रकृतौ) कनिष्ठं भवेत्। ज्येष्ठं तदेव, क्षेपे वर्गाङ्केन छिन्ने सति वर्गाङ्केन क्षेपं भक्त्वा लब्धतुल्ये क्षेपे ये कनिष्ठज्येष्ठे ते तद्वर्गाङ्कमूलेन गुणिते तदेष्टगुणके कनिष्ठज्येष्ठे भवेतामिति ॥

अत्रोपपत्तिः।

वर्ग प्रकृति लक्षणेन $प्र.क^2+क्षे=ज्ये^2$, वा $गु^2.\ प्र.\ \frac{क^2}{गु^2}+क्षे=ज्ये^2$ $=गु^2.\ प्र.\left(\frac{क}{गु}\right)^2$ अत्र यदि $गु^2.प्र$ इयमन्या प्रकृति$=प्र'$ तदा तत्सम्बन्धि कनिष्ठं $\frac{क}{गु}$ स्यादेतेन पूर्वार्धं[1]मुपपन्नम्। अथ $प्र.\ क^2+क्षे=ज्ये^2$ पक्षौ $इ^2$ गुणितौ तदा $प्र.\ क^2.गु^2+क्षे.गु^2=ज्ये^2.\ गु^2=प्र.(क.गु)^2+क्षे.गु^2=(ज्ये.गु)^2$ यदि $क्षे.गु^2=क्षे'$ तदा तत्सम्बन्धि कनिष्ठम्$=क.गु=क'$, ज्येष्ठम्$=ज्ये\ .\ गु=ज्ये'$ तदा $प्र.क'^2+क्षे'=ज्ये'^2$ एतेनोत्तरा[2]र्धमुपपद्यत इति ॥७०॥

६९ सूत्र से आगे की एक आर्या नष्ट है वह कोलब्रूक साहेब के अनुवादानुसार निम्नलिखित आशय की है।

हि. भा.—यदि प्रकृति किसी वर्गाङ्क से भाग देने से निः शेष हो तब प्रकृति को

(१) वर्गच्छिन्ने गुणे ह्रस्वं तत्पदेन विभाजयेदिति भास्करोक्तमेतत्सदृशमेव।

(२) क्षेपः क्षुण्णः क्षुण्णे तदा पदे भास्करोक्तमिदमेतत्सदृशमेवेति।

वर्गाङ्क से भाग देने से जो लब्धि हो तत्तुल्य नवीन प्रकृति में कनिष्ठ और ज्येष्ठ साधन करना, उस कनिष्ठ को वर्गाङ्क के मूल से भाग देने से नवीन प्रकृति में कनिष्ठ होता है, ज्येष्ठ यहां भी वही रहता है। यदि क्षेप किसी वर्गाङ्क से भाग देने से निःशेष हो तब वर्गाङ्क से क्षेप को भाग देने से जो लब्धि हो तत्तुल्य नवीन क्षेप में जो कनिष्ठ और ज्येष्ठ हो उनको उस वर्गाङ्क के मूल से गुणा करने से नवीन क्षेप में कनिष्ठ और ज्येष्ठ होते हैं इति ॥

उपपत्ति।

वर्गप्रकृति लक्षण से $\text{प्र. क}^2 + \text{क्षे} = \text{ज्ये}^2 = \text{गु}^2 . \text{प्र.} \dfrac{\text{क}^2}{\text{गु}^2} = \text{गु}^2.\text{प्र.} \left(\dfrac{\text{क}}{\text{गु}}\right)^2$

यहां यदि $\text{गु}^2.\text{प्र}$ यह अन्य प्रकृति $= \text{प्र}'$, है तब तत्सम्बन्धी कनिष्ठ $\dfrac{\text{क}}{\text{गु}}$ होगा, ज्येष्ठ वही रहेगा, इससे पूर्वार्ध उपपन्न हुआ। बीज गणित में 'वर्गच्छिन्ने गुणे ह्रस्वं तत्पदेन विभाजयेत्' यह भास्करोक्त कोलब्रूक के अनुवाद के पूर्वार्ध के अनुरूप ही है। $\text{प्र. क}^2 + \text{क्षे} = \text{ज्ये}^2$ दोनों पक्षों को इ^2 से गुणा करने से $\text{प्र.क}^2.\text{इ}^2 + \text{क्षे. इ}^2 = \text{ज्ये}^2.\text{इ}^2 = \text{प्र.}(\text{क.गु})^2 + \text{क्षे.गु}^2 = (\text{ज्ये.इ})^2$ यदि $\text{क्षे.गु}^2 = \text{क्षे}'$ तब तत्सम्बन्धी कनिष्ठ $= \text{क. गु} = \text{क}'$, तथा ज्येष्ठ $= \text{ज्ये. गु}$. इससे कोलब्रूक साहेब के अनुवाद का उत्तरार्ध उपपन्न हुआ। 'क्षेपः क्षुण्णः क्षुण्णे तदा पदे' यह भास्करोक्त उसी के सदृश है ॥७०॥

इदानीं प्रश्नविशेषस्योत्तरमाह।

गुणकयुतिरष्टगुणिता गुणकान्तरभाजिता राशिः।
गुणकौ त्रिगुणौ व्यस्ताधिकौ हृतावन्तरेण पदे ॥७१॥

सु. भा.—(गुणकद्वयेन गुणितः पृथक् पृथग्राशिरेकयुतश्च।
यदि तत्पदे निरग्रे कुर्वन्नावत्सराद् गणकः ॥)

इति प्रश्नस्योत्तरार्थं गुणकयोर्युतिरष्टगुणिता गुणकयोरन्तरवर्गेण भाजिता राशिः स्यात्। गुणकौ द्वौ त्रिगुणौ कार्यौ तौ व्यस्ताधिकौ व्यस्तगुणकाधिकौ गुणकान्तरेण तौ हृतौ तदा ते एव निरग्रे पदे भवतः।

अत्रोपपत्तिः। कल्प्यते गुणकद्वयं क्रमेण गु_1, गु_2। तथा राशिमानं $\dfrac{\text{या}^2 - 1}{\text{गु}_1}$।

अत्रैकालापः स्वयं घटतेऽतोऽमुं द्वितीयगुणकेन सङ्गुण्य रूपं प्रक्षिप्य काल-
कवर्गेण समंकृत्वा पक्षौ $\frac{\text{गु}_2\ \text{या}^2 - \text{गु}_2 + \text{गु}_1}{\text{गु}_1} = \text{का}^2$ ।

$\therefore\ \text{गु}_1\ \text{का}^2 = \text{गु}_2\ \text{या}^2 - \text{गु}_2 + \text{गु}_1$ ।

गु₁ गुणितौ तथा प्रथमपक्षस्य मूलम् $= \text{गु}_1\ \text{का}$ । द्वितीयपक्षस्यास्य $\text{गु}_1\ \text{गु}_2\ \text{या}^2 - \text{गु}_1\ \text{गु}_2 + \text{गु}^2_1$, वर्गप्रकृत्या ।

क	ज्ये	क्षे
1	गु_1	$\text{गु}^2_1 - \text{गु}_1\ \text{गु}_2$
$\frac{2\ \text{इ}}{\text{गु}_1\ \text{गु}_2 \backsim \text{इ}^2}$	$\frac{\text{गु}_1\ \text{गु}_2 + \text{इ}^2}{\text{गु}_1\ \text{गु}_2 \backsim \text{इ}^2}$	1

समासभावनया क $\frac{2\ \text{गु}_1\ \text{इ} + \text{गु}_1\ \text{गु}_2 + \text{इ}^2}{\text{गु}_1\ \text{गु}_2 \backsim \text{इ}^2}$ | ज्ये $\frac{2\ \text{गु}_1\ \text{गु}_2\ \text{इ} + \text{गु}^2_1\ \text{गु}_2 + \text{गु}_1\ \text{इ}^2}{\text{गु}_1\ \text{गु}_2 \backsim \text{इ}^2}$

अथ यदि $\text{इ} = \text{गु}_1$ तदोत्थापनेन राशिः ।

$$= \frac{\text{या}^2 - 1}{\text{गु}_1} = \left[\left\{ \frac{3\ \text{गु}^2_1 + \text{गु}_1\ \text{गु}_2}{\text{गु}_1\ (\text{गु}^2 \backsim \text{गु}_1)} \right\}^2 - 1 \right] \div \text{गु}_1$$

$$\left\{ \left(\frac{3\ \text{गु}_1 + \text{गु}_2}{\text{गु}_2 \backsim \text{गु}_1} \right)^2 - 1 \right\} \div \text{गु}_1 = \left(\frac{9\ \text{गु}^2_1 + 6\ \text{गु}_1\ \text{गु}_2 + \text{गु}^2_2}{\text{गु}^2_1 - 2\ \text{गु}_1\ \text{गु}_2 + \text{गु}^2_2} - 1 \right) \div \text{गु}_1$$

$$= \frac{8\ \text{गु}^2_1 + 8\ \text{गु}_1\ \text{गु}_2}{(\text{गु}_2 \backsim \text{गु}_1)^2} \div \text{गु}_1 = \frac{8\ (\text{गु}_1 + \text{गु}_2)}{(\text{गु}_1 \backsim \text{गु}_2)^2}$$ । तत आलापेन

प्रथमपदम् $= \sqrt{\frac{8\ \text{गु}^2_1 + 8\ \text{गु}_1\ \text{गु}_2}{\text{गु}^2_1 - 2\ \text{गु}_1\ \text{गु}_2 + \text{गु}^2_2} + 1} = \frac{3\ \text{गु}_1 + \text{गु}_2}{\text{गु}_1 \backsim \text{गु}_2}$ ।

एवं द्वितीयपदम् $= \frac{3\ \text{गु}_2 - \text{गु}_1}{\text{गु}_1 \backsim \text{गु}_2}$ । अत उपपन्नं सर्वम् ॥ ७१ ॥

वि. भा.—गुणकयोर्योग अष्टगुणितो गुणकयोरन्तरेण भक्तस्तदा राशि-र्भवेत् । द्वौ गुणकौ त्रिगुणितौ तौ व्यस्तगुणकाधिकौ गुणकान्तरेण भक्तौ तदा ते एव निरग्रे पदे भवेतामिति ॥

अत्रोपपत्तिः ।

कल्प्यते गुणकद्वयं क्रमेण गु, $\text{गु}'$, तथा राशिप्रमाणम्= $\frac{\text{य}^{2}-\text{१}}{\text{गु}}$ एतत् $\text{गु}'$ अनेन सङ्गुण्यैकं क्षिप्त्वा र वर्गेण समं $\frac{\text{य}^{2}.\text{गु}'-\text{गु}'}{\text{गु}}+\text{१}=\frac{\text{य}^{2}.\text{गु}'-\text{गु}'+\text{गु}}{\text{गु}}$ $=\text{र}^{2}$ छेदगमेन $\text{य}^{2}.\text{गु}'-\text{गु}'+\text{गु}=\text{गु}.\text{र}^{2}$ पक्षौ 'गु' गुणितौ तदा $\text{गु}^{2}.\text{र}^{2}=\text{य}^{2}.\text{गु}.\text{गु}'-\text{गु}.\text{गु}'+\text{गु}^{2}$ प्रथम पक्षस्य मूलम्=गु.र द्वितीय पक्षस्यास्य $\text{य}^{2}.\text{गु}.\text{गु}'-\text{गु}.\text{गु}'+\text{गु}^{2}$ वर्गप्रकृत्या प्रकृतिः$=\text{गु}.\text{गु}'$, क्षेपः$=\text{गु}^{2}-\text{गु}.\text{गु}'$ । अत्र कल्प्यते कनिष्ठम् =क=१ तदा ज्येष्ठम्=ज्ये=गु । क्षेपः$=\text{गु}^{2}-\text{गु}.\text{गु}'$ इष्टवर्गप्रकृत्योर्यद्विवरं तेन वा भजेदित्यादिना रूपक्षेपे कनिष्ठम्$=\frac{\text{२ इ}}{\text{गु}.\text{गु}'\sim\text{इ}^{2}}$, ज्येष्ठम्$=\frac{\text{गु}.\text{गु}'+\text{इ}^{2}}{\text{गु}.\text{गु}'\sim\text{इ}^{2}}$,

क्षेपः = १ समासभावनया $\frac{\text{२ गु}.\text{इ}+\text{गु}.\text{गु}'+\text{इ}^{2}}{\text{गु}.\text{गु}'\sim\text{इ}^{2}}=$क ।

$\frac{\text{२ गु}.\text{गु}'.\text{इ}+\text{गु}^{2}\,\text{गु}'+\text{गु}.\text{इ}^{2}}{\text{गु}.\text{गु}'\sim\text{इ}^{2}}=$ज्ये । अत्र कनिष्ठं य मानं, ज्येष्ठं प्रथमपक्षस्या (गु . र) स्य समम् । यदि इ = गु तदोत्थापनेन राशिः$=\frac{\text{य}^{2}-\text{१}}{\text{गु}}$

$$=\left[\left\{\frac{\text{३ गु}^{2}+\text{गु}.\text{गु}'}{\text{गु}\,(\text{गु}'\sim\text{गु})}\right\}^{2}-\text{१}\right]\div\text{गु}=\left\{\left(\frac{\text{३ गु}+\text{गु}'}{\text{गु}'\sim\text{गु}}\right)^{2}-\text{१}\right\}\div\text{गु}=$$

$$=\left(\frac{\text{९गु}^{2}+\text{६ गु}.\text{गु}'+\text{गु}'^{2}}{\text{गु}^{2}-\text{२गु}.\text{गु}'+\text{गु}'^{2}}-\text{१}\right)\div\text{गु}=\frac{\text{८ गु}^{2}+\text{८गु}.\text{गु}'}{(\text{गु}'-\text{गु})^{2}}\div\text{गु}=\frac{\text{८ (गु}+\text{गु}')}{(\text{गु}'\sim\text{गु})^{2}}$$

अत आलापेन प्रथम पदम्$=\sqrt{\frac{\text{८ गु}^{2}+\text{८ गु}.\text{गु}'}{\text{गु}^{2}-\text{२गु}.\text{गु}'+\text{गु}'^{2}}}+\text{१}=\frac{\text{३ गु}+\text{गु}'}{\text{गु}'\sim\text{गु}}$,

द्वितीय पदम्$=\frac{\text{३ गु}'-\text{गु}}{\text{गु}'\sim\text{गु}}$ इति ॥७१॥

अब प्रश्न विशेष का उत्तर कहते हैं ।

हि. भा.—राशि को पृथक् पृथक् गुणकद्वय से गुणाकर एक जोड़ने से यदि उनके

मूल को एक वर्ष पर्यन्त निः शेष करते हुए व्यक्ति गणक है यह प्रश्न है। तो—

इसका उत्तर

गुणकद्वय योग को आठ से गुणाकर गुणकद्वय के अन्तर वर्ग से भाग देने से राशिमान होता हैं। दोनों गुणकों को तीन से गुणा कर दोनों में विपरीत गुणक जोड़ कर गुणकान्तर से भाग देने से वे दोनों निःशेष पद द्वय होते हैं इति।

उपपत्ति।

कल्पना करते हैं दोनों गुणक क्रम से $\text{गु}, \overset{।}{\text{गु}}$ तथा राशिमान $= \frac{\text{य}^{२} - १}{\text{गु}}$ इसको $\overset{।}{\text{गु}}$ से गुणाकर एक जोड़कर र वर्ग के बराबर करने से $\frac{\overset{।}{\text{गु}}\,\text{य}^{२} - \overset{।}{\text{गु}} + \text{गु}}{\text{गु}} = \text{र}^{२}$ छेदगम से $\text{गु}.\text{र}^{२} = \overset{।}{\text{गु}}.\text{य}^{२} - \overset{।}{\text{गु}} + \text{गु}$ दोनों पक्षों को (गु) गुणा करने से $\text{गु}^{२}.\text{र}^{२} = \text{गु}.\overset{।}{\text{गु}}.\text{य}^{२} - \text{गु}.\overset{।}{\text{गु}} + \text{गु}^{२}$ प्रथम पक्ष का मूल $= \text{गु}.\text{र}$, द्वितीय पक्ष $\text{गु}.\overset{।}{\text{गु}}.\text{य}^{२} - \text{गु}.\overset{।}{\text{गु}} + \text{य}^{२}$ इसकी वर्गप्रकृति से प्रकृति $= \text{गु}.\overset{।}{\text{गु}}$, क्षेप $= \text{गु}^{२} - \text{गु}.\overset{।}{\text{गु}}$, यहां कनिष्ठ $= १$, ज्येष्ठ $= \text{गु}$, क्षेप $= \text{गु}^{२} - \text{गु}.\overset{।}{\text{गु}}$

'इष्टवर्गप्रकृत्योर्यद्विवरं' इत्यादि भास्करोक्त सूत्र से क $= \frac{२\,\text{इ}}{\text{गु}.\overset{।}{\text{गु}} \backsim \text{इ}^{२}}$, ज्ये $= \frac{\text{गु}.\overset{।}{\text{गु}} + \text{इ}^{२}}{\text{गु}.\overset{।}{\text{गु}} \backsim \text{इ}^{२}}$, क्षेप $= १$ समास भावना से क $= \frac{२\,\text{गु}.\text{इ} + \text{गु}.\overset{।}{\text{गु}} + \text{इ}^{२}}{\text{गु}.\overset{।}{\text{गु}} \backsim \text{इ}^{२}}$, ज्ये $= \frac{२\,\text{गु}.\overset{।}{\text{गु}}.\text{इ} + \text{गु}^{२}.\overset{।}{\text{गु}} + \text{गु}.\text{इ}^{२}}{\text{गु}.\overset{।}{\text{गु}} \backsim \text{इ}^{२}}$ यहां कनिष्ठ (य) का मान होता है, तथा ज्येष्ठ प्रथम पक्ष (गु . र) के बराबर होता है यदि $\text{इ} = \text{गु}$ तब उत्थापन से राशि $= \frac{\text{य}^{२} - १}{\text{गु}}$

$$= \left[\left\{ \frac{३\,\text{गु}^{२} + \text{गु}.\overset{।}{\text{गु}}}{\text{गु}.(\overset{।}{\text{गु}} \backsim \text{गु})} \right\}^{२} - १ \right] \div \text{गु} = \left\{ \left(\frac{३\,\text{गु} + \overset{।}{\text{गु}}}{\overset{।}{\text{गु}} \backsim \text{गु}} \right)^{२} - १ \right\} \div \text{गु} =$$

$$= \left(\frac{९\,\text{गु}^{२} + ६\,\text{गु}.\overset{।}{\text{गु}} + \overset{।}{\text{गु}}^{२}}{\text{गु}^{२} - २\,\text{गु}.\overset{।}{\text{गु}} + \overset{।}{\text{गु}}^{२}} - १ \right) \div \text{गु} = \frac{८\,\text{गु}^{२} + ८\,\text{गु}.\overset{।}{\text{गु}}}{(\overset{।}{\text{गु}} \backsim \text{गु}^{२})} \div \text{गु} = \frac{८\,(\text{गु} + \overset{।}{\text{गु}})}{\overset{।}{\text{गु}} \backsim \text{गु}}$$

अब आलाप से प्रथम पद $= \sqrt{\frac{८\,\text{गु}^{२} + ८\,\text{गु}.\overset{।}{\text{गु}}}{\text{गु}^{२} - २\,\text{गु}.\overset{।}{\text{गु}} + \overset{।}{\text{गु}}^{२}} + १} = \frac{३\,\text{गु} + \overset{।}{\text{गु}}}{\text{गु} \backsim \overset{।}{\text{गु}}}$।

द्वितीय पद $= \frac{\text{३ गु—गु}}{\text{गु ∽ गु}}$ इससे आचार्योक्त उपपन्न हुआ इति ॥७१॥

इदानीं प्रश्नान्तरविशेषस्योत्तरमाह।

वर्गोऽन्यकृतियुतोनस्तत्संयोगान्तरार्धकृतिभक्तः।
तद्गुणितौ युतिवियुतौ वर्गौ घाते च रूपयुते ॥ ७२ ॥

सु० भा०—ययो राश्योर्युतिवियुतौ वर्गौ भवतस्तथा घाते रूपयुते च वर्ग स्यात् तत्र राश्योरानयनाय कश्चिदिष्टो वर्गः कल्प्यः। स चान्येष्टवर्गेण युत ऊनश्च कार्यः। एवं राशिद्वयं यद्भवेत् तत्संयोगस्तदन्तरार्धवर्गेण भक्तो यत् फलमागच्छेत् तेन पूर्वसाधितौ द्वौ राशी गुणितावभीप्सितौ राशी भवतः।

अत्रोपपत्तिः। कल्प्येते राशी—

२ इ^{२} (या^{२}+का^{२})। २ इ^{२} (या^{२}—का^{२})

अत्र राश्योर्योगवियोगौ भवतोऽत आलापद्वयं घटते। अथानयोर्घातः सैकः =४ इ^{४} या^{४}—४ इ^{४} का^{४}+१ अयं वर्गः। अत आद्यन्तयोः पदयोः —२ इ^{२} या^{२}, —१ अनयोर्द्विघ्नहतिं — ४ इ^{२} या^{२} मध्यपदसमां कृत्वा पक्षौ—४ इ^{२} या^{२} = —४ इ^{४} का^{४}।

$$\therefore \text{२ इ}^{२} = \frac{\text{२ या}^{२}}{\text{का}^{४}} = \frac{(\text{या}^{२} + \text{का}^{२}) + (\text{या}^{२} - \text{का}^{२})}{\left\{\frac{(\text{या}^{२}+\text{का}^{२}) + (\text{या}^{२}-\text{का}^{२})}{२}\right\}^{२}}$$

अत उपपद्यते यथोक्तम् ॥ ७२ ॥

वि. भा.—ययो राश्योर्युतिवियुतौ वर्गौ भवेतां, घाते रूपयुते च वर्गः स्यात् तत्र तयो राश्योर्ज्ञानार्थं कोपीष्टो वर्गः कल्पनीयः। सोऽन्येष्टवर्गेण युतो हीनश्च कार्यः, तदा यद्राशिद्वयं भवेत् तयोर्योगस्तदन्तरार्धवर्गेण भक्तो यल्लब्धं भवेत्तेन पूर्वानीतौ राशी गुणितौ तदाऽभीप्सितौ राशी भवेतामिति ॥

अत्रोपपत्तिः।

कल्प्येते राशी २ इ^{२} (य^{२}+र^{२}), २ इ^{२} (य^{२}—र^{२}) अत्र राश्योर्योगान्तरे वर्गौ भवतस्तेनाऽऽलापद्वयं घटते। अनयोर्घातः ४ इ^{४} (य^{४}—र^{४})=४ इ^{४}. य^{४}—४ इ^{४}. र^{४} रूपयुतः ४ इ^{४}. य^{४}—४ इ^{४}. र^{४}+१ तदा वर्गः स्यात्। तेनाऽऽद्यन्तयोर्मूलयोः —२ इ^{२}. य^{२}—१ द्विघ्नघातं—४ इ^{२}. य^{२} मध्यपदसमं कृत्वा जातौ पक्षौ—४ इ^{२}. य^{२} = —४ इ^{४}. र^{४} पक्षौ र^{४} भक्तौ तदा — $\frac{\text{४ इ}^{२}.\text{ य}^{२}}{\text{र}^{४}}$ = — ४ इ^{४} =

$- \frac{२\,इ^{२}.\,२\,य^{२}}{र^{४}}$ पक्षौ $-\,२\,इ^{२}$ भक्तौ तदा $२\,इ^{२} = \frac{२\,य^{२}}{र^{४}} = \left\{ \frac{(य^{२}+र^{२})+(य^{२}-र^{२})}{\frac{(य^{२}+र^{२})-(य^{२}-र^{२})}{२}} \right\}^{२}$ एतावता सर्वमुपपन्नमाचार्योक्तमिति ॥ ७२ ॥

अब प्रश्नान्तर विशेष का उत्तर कहते हैं।

हि. भा.—जिन दो राशियों का योग और अन्तर करने से वर्ग होता है, तथा घात में एक जोड़ने से वर्ग होता है वहां दोनों राशियों के आनयन के लिए कोई इष्टवर्ग कल्पना करनी चाहिए। उसमें अन्य इष्टवर्ग को युत और हीन करना चाहिए। इस तरह जो राशि-द्वय होता है उनके योग में उन्हीं के अन्तरार्ध वर्ग से भाग देने से जो फल हो उससे पूर्व साधित राशिद्वय को गुणा करने से अभीप्सित राशिद्वय होता है इति ॥

उपपत्ति।

कल्पना करते हैं राशिद्वय $२\,इ^{२}\,(य^{२}+र^{२})$, $२\,इ^{२}\,(य^{२}-र^{२})$ यहां इन दोनों राशियों का योग और अन्तर वर्ग होता है इसलिए दो आलाप घटित होते हैं। दोनों के घात में रूप जोड़ने से $४\,इ^{४}\,(य^{४}-र^{४})+१=४\,इ^{४}.\,य^{४}-४\,इ^{४}-र^{४}+१$ वर्ग होता है इसलिए प्रथम खण्ड और अन्तिम खण्ड के मूल $(-२\,इ^{२}.\,य^{२}-१)$ के द्विगुणित घात $(-४\,इ^{२}.\,य^{२})$ को मध्य पद के समान करने से $-४\,इ^{२}.\,य^{२}=-४\,इ^{४}.\,र^{४}$ दोनों पक्षों को $र^{४}$ से भाग देने से $-\frac{४\,इ^{२}.\,य^{२}}{र^{४}}=-४\,इ^{४}=-\frac{२\,इ^{२}.\,२\,य^{२}}{र^{४}}$ पुनः दोनों पक्षों को $-२\,इ^{२}$ इससे भाग देने से $२\,इ^{२}=\frac{२\,य^{२}}{र^{४}}=\left\{ \frac{(य^{२}+र^{२})+(य^{२}-र^{२})}{\frac{(य^{२}+र^{२})-(य^{२}-र^{२})}{२}} \right\}^{२}$

इससे आचार्योक्त उपपन्न हुआ इति ॥ ७२ ॥

इदानीं पुनः प्रश्नान्तरविशेषस्योत्तरमाह।

यैरूनो यैश्च युतो रूपैर्वर्गस्तदैक्यमिष्टहृतम्।
इष्टोनं तद्दलकृतिरूनाऽभ्यधिका भवति राशिः ॥ ७३ ॥

सु. भा.—को राशिरेतावद्भी रूपैर्युतस्तथैतावद्भी रूपैरूनश्च वर्गो भवतीति प्रश्नोत्तरार्थं यै रूपैरूनो यैर्युतश्च वर्गो भवति तेषामैक्यं केनचिदिष्टेन हृतं

फलमिष्टोनं कार्यम् । तस्य शेषस्य दलस्यार्धीकृतस्य कृतिरूनाऽभ्यधिका । यै रूपैरूनो राशिर्वर्गो भवति तान्यूनरूपाणि तैरूनैरभ्यधिका राशिर्भवतीत्यर्थः ।

अत्रोपपत्तिः । कल्प्यते राशिमानम् $=$ या १ । अत्र अ-रूपैर्युतः क-रूपैरूनश्च वर्गो भवतीति प्रश्नालापेन—$\text{का}^2 = \text{या} + \text{अ}$, $\text{नी}^2 = \text{या} - \text{क}$,

$\therefore \text{का}^2 - \text{नी}^2 = \text{अ} + \text{क}$ । अथ कल्प्यते $\text{का} - \text{नी} = \text{इ}$ ।

$\therefore \text{का} + \text{नी} = \frac{\text{अ}+\text{क}}{\text{इ}}$, ततः सङ्क्रमणेन $\text{नी} = \frac{1}{2}\left\{\left(\frac{\text{अ}+\text{क}}{\text{इ}}\right) - \text{इ}\right\}$

$$\text{अतः नी}^2 = \left[\frac{1}{2}\left\{\left(\frac{\text{अ}+\text{क}}{\text{इ}}\right) - \text{इ}\right\}\right]^2 = \text{या} - \text{क}$$

$$\text{ततः या} = \left[\frac{1}{2}\left\{\left(\frac{\text{अ}+\text{क}}{\text{इ}}\right) - \text{इ}\right\}\right]^2 + \text{क}$$

अत उपपद्यते यथोक्तम् ॥ ७३ ॥

वि. भा.—को राशी रूपैर्युतोऽन्यरूपैर्हीनश्च वर्गो भवति तदैक्यं केनचिदिष्टेन भक्तं लब्धमिष्टेन हीनं शेषस्यास्यार्धीकृतस्य कृतिर्हीनाऽभ्यधिकाऽर्थात् यैरूपैर्हीनो राशिवर्गो भवति तानि हीनरूपाणि तैर्हीनैरभ्यधिका राशिर्भवतीति ॥

अत्रोपपत्तिः ।

कल्प्यते राशिः $=$ य । अत्र ग रूपैर्युतो मरूपैर्हीनश्च वर्गो भवतीति प्रश्नालापेन $\text{क}^2 = \text{य} + \text{ग}$, $\text{न}^2 = \text{य} - \text{म}$ । अतः $\text{क}^2 - \text{न}^2 = \text{ग} + \text{म}$, अत्र यदि $\text{क} - \text{न} = \text{इ}$ तदा वर्गान्तरं राशिवियोगभक्तमित्यादिना $\text{क} + \text{न} = \frac{\text{ग}+\text{म}}{\text{इ}}$ ततः संक्रमणेन $\text{न} =$

$\left\{\frac{\left(\frac{\text{ग}+\text{म}}{\text{इ}}\right) - \text{इ}}{2}\right\}$ ततः $\left\{\frac{\left(\frac{\text{ग}+\text{म}}{\text{इ}}\right) - \text{इ}}{2}\right\}^2 = \text{य} - \text{म}$ पक्षौ मयुतौ तदा

$\left\{\frac{\left(\frac{\text{ग}+\text{म}}{\text{इ}}\right) - \text{इ}}{2}\right\}^2 + \text{म} = \text{य}$ एतेनोपपन्नमाचार्योक्तमिति ॥ ७३ ॥

अब पुनः प्रश्नान्तरविशेष का उत्तर कहते हैं ।

हि. भा.—कौन राशि है जिसमें रूप जोड़ने तथा अन्य रूप को हीन करने से वर्ग होता है उन दोनों वर्गाङ्कों के योग को किसी इष्ट से भाग देने से जो फल होता है उसमें

से इष्ट को घटाने से जो शेष रहता है उसके आधे का वर्ग हीन रूप है उसको जोड़ने से राशि प्रमाण होता है इति।

उपपत्ति।

कल्पना करते हैं राशिप्रमाण=य। इसमें ग रूप को जोड़ने से वर्ग होता है, तथा म रूप को घटाने से वर्ग होता है इस प्रश्नालाप से $क^2=य+ग$। $न^2=य-म$, अतः $क^2-न^2=ग+म$, यदि $क-न=इ$ तब वर्गान्तरं राशिवियोगभक्त' इत्यादि भास्करोक्ति से $क+न=\frac{ग+म}{इ}$ अतः संक्रमण से $\frac{1}{2}\left\{\left(\frac{ग+म}{इ}\right)-इ\right\}=न$ वर्ग करने से

$$\left[\frac{1}{2}\left\{\left(\frac{ग+म}{इ}\right)-इ\right\}\right]^2=य-म$$ दोनों पक्षों में म जोड़ने से

$$\left[\frac{1}{2}\left\{\left(\frac{ग+म}{इ}\right)-इ\right\}\right]^2+म=य$$ इससे आचार्योक्त उपपन्न हुआ ॥ ७३ ॥

इदानीं प्रश्नान्तरस्योत्तरमाह।

याभ्यां कृतिरधिकोनस्तदन्तरं हृतयुतोनमिष्टेन।

तद्दलकृतिरधिकोनाऽधिकयोरधिकोनयो राशिः ॥ ७४ ॥

सु. भा.—को राशिरुद्दिष्टराशिभ्यां युक्तः कृतिर्भवति। वा को राशिरुद्दिष्टराशिभ्यामूनः कृतिर्भवतीति प्रश्ने याभ्यामुद्दिष्टाभ्यामधिको वोनः कृतिर्भवति तदन्तरमिष्टेन हृतं योगप्रश्न इष्टेनैव युतमूनप्रश्न इष्टेनैवोनं कार्यम्। यन्निष्पन्नं तद्दलस्य कृतिरधिकोद्दिष्टराशिना कार्या अधिकयोरुद्दिष्टराश्योः। उद्दिष्टराश्योरूनयोश्चाधिका कार्या। एवं राशिर्भवति।

अत्रोपपत्तिः। कल्प्यते राशिमानम्=या। यश्च अ—क—राशिभ्यां युतो मूलदः। तथा अ>क तदा प्रश्नानुसारेण—

$$\left.\begin{aligned} का^2&=या+अ\\ नी^2&=य+क\\ का^2-नी^2&=अ-क\\ का-नी&=इ\\ \therefore का+नी&=\frac{अ-क}{इ}=ल \end{aligned}\right\}$$

सङ्क्रमणेन

$$का=\frac{ल+इ}{2}$$

ततः $या=का^2-अ$

एवमून प्रश्ने

का^{२}=या—अ

नी^{२}=या—क

नी^{२}—का^{२}=अ—क

नी—का=इ

∴ नी + का = $\frac{\text{अ—क}}{\text{इ}}$ = ल

} सङ्क्रमणेन

का = $\frac{\text{ल—इ}}{२}$

ततः या

अत उपपद्यते ॥ ७४ ॥

वि. भा.—स को राशिर्य उद्दिष्टराशिभ्यां युक्तो हीनो वा कृति (वर्गः) र्भवति, अत्र याभ्यामुद्दिष्टराशिभ्यां युक्तो हीनो वा वर्गो भवति तदन्तरमिष्टेन भक्तं योग-प्रश्ने इष्टेनयुतं, हीनप्रश्ने इष्टेन हीनं विधेयम् तदा यद् भवति तदर्धस्य वर्गोऽधिको-द्दिष्टराशिना हीनः कार्यः,—अधिकयोरुद्दिष्टराश्योः । उद्दिष्टराश्योरल्पयोरधिकः (युक्तः) कार्यः, तदा राशिर्भवति ॥

अत्रोपपत्तिः ।

कल्प्यते राशिः=य, यो हि न, म उद्दिष्टराशिभ्यां युतो वर्गः स्यात् । अत्र न > म तदा प्रश्नानुसारेण य+न=क^{२}, य+म=व^{२} ततः क^{२}—व^{२}=न—म अत्र यदि क—व=इ तदा वर्गान्तरं राशिवियोगभक्तमित्यादिना $\frac{\text{न—म}}{\text{इ}}$ = $\frac{\text{क}^{२}\text{—व}^{२}}{\text{इ}}$ =क+व=र तदा संक्रमणेन $\frac{\text{र+इ}}{२}$ =क, अतः य=क^{२}—न तथा राशिरुद्दिष्टाभ्यां हीनो वर्गो भवतीति प्रश्ने क^{२}=य—न । य—म=व^{२} ततः व^{२}—क^{२}=न—म अत्र यदि व—क=इ तदा $\frac{\text{व}^{२}\text{—क}^{२}}{\text{व—क}}$ =व+क= $\frac{\text{न—म}}{\text{इ}}$ = र ततः संक्रमणेन $\frac{\text{र—इ}}{२}$ =क ∴ य=क^{२}+न अत आचार्योक्तमुपपन्नम् ॥७४॥

अब पुनः प्रश्नान्तर का उत्तर कहते हैं ।

हि. भा.—कौन राशि है जिसमें उद्दिष्ट राशिद्वय को जोड़ने से वा घटाने से वर्ग होता है, यहां जिन उदिष्टराशिद्वय को जोड़ने वा घटाने से वर्ग होता है उन दोनों उद्दिष्ट राशियों के अन्तर को इष्ट से भाग देने से जो लब्धि हो उसमें इष्ट को जोड़ना योग प्रश्न में । हीन प्रश्न में इष्ट को हीन करना तब जो हो उसके आधे के वर्ग में अधिक उद्दिष्टराशि को घटाना चाहिए, अल्प उद्दिष्टराशि को जोड़ना चाहिए तब राशि प्रमाण होता है इति ।

उपपत्ति ।

कल्पना करते हैं राशि=य, इसमें उद्दिष्टराशिद्वय को जोड़ने से वर्ग होता है, न, म उद्दिष्टराशिद्वय है, तथा न > म तब प्रश्न के अनुसार य+न=क^2

य+म=व^2

अतः क^2—व^2=न—म, यदि क—व=इ तब $\frac{\text{क}^2-\text{व}^2}{\text{इ}}=\frac{\text{न}-\text{म}}{\text{इ}}$ =क+व=र, तब संक्रमण से $\frac{\text{र}+\text{इ}}{2}$=क ∴ य=क^2—न, हीन प्रश्न में य—न=क^2, य—म=व^2

∴ व^2—क^2=न—म । यदि व—क=इ तब $\frac{\text{व}^2-\text{क}^2}{\text{इ}}=\frac{\text{न}-\text{म}}{\text{इ}}$ =व+क=र,

∴ संक्रमण से $\frac{\text{र}-\text{इ}}{2}$=क ∴ य=क^2+न इससे आचार्योक्त उपपन्न हुआ इति ॥ ७४ ॥

इति वर्गप्रकृतिः ।

उदाहरणानि

तत्र प्रथमं वर्गप्रकृत्युदाहरणम् ।

राशिकलाशेषकृतिं द्विनवतिगुणितां त्र्यशीतिगुणितां वा ।
सैकां ज्ञदिने वर्गं कुर्वन्नावत्सराद् गणकः ।।७५।।

सु. भा.—राषिशेषकृतिं द्विनवति—९२ गुणितां सैकां वा कलाशेषकृतिं त्र्यशीति–८३ गुणितां सैकां बुधदिने आवत्सराद्वर्गं कुर्वन्नपि स गणकोऽस्तीत्यहं मन्ये ।

प्रथमप्रश्ने प्र ९२ क्षे १ ततो वर्गप्रकृतिसूत्रतः ।

क १ ज्ये १० क्षे ८
क १ ज्ये १० क्षे ८
भावनया, क २० ज्ये १९२ क्षे ६४
क $\frac{५}{२}$ ज्ये २४ क्षे १
क $\frac{५}{२}$ ज्ये २४ क्षे
भावनया, क १२० ज्ये ११५१ क्षे १

अतो राशिशेषम्=१२० । एवं भावनया बहुधा राशिशेषं स्यादतः कुट्टक विधिनाऽभीष्टाहेऽर्हगणः स्यात् ।

द्वितीय प्रश्ने गु ८३ क्षे १
ततः क १ ज्ये ९ क्षे २
क १ ज्ये ९ क्षे २
क १८ ज्ये १६४ क्षे ४
क ९ ज्ये ८२ क्षे १
भावनया कनिष्ठज्येष्ठयोरानन्त्यम् ।

ततः कलाशेषम् = ९ । कलाशेषात् कुट्टकविधिनाऽभीष्टदिनेऽहर्गणः स्यात् ।। ७५ ।।

वि. भा.— राशिशेषवर्गं द्विनवति (९२) गुणितं सैकं वा कलाशेषवर्गं त्र्यशीतिगुणितं सैकं बुधदिने वर्षपर्यन्तं वर्गं कुर्वन् स गणकोऽस्तीति ।।

प्रथमप्रश्ने प्रकृतिः=९२, क्षेपः=१, तदा 'इष्टं ह्रस्वं तस्य वर्गः प्रकृत्या क्षुण्ण' इत्यादि भास्करोक्तसूत्रेण कनिष्ठम्=क=१, ज्येष्ठम्=ज्ये=१०, क्षेपः=क्षे=८

ततो भावनार्थं न्यासः क=१, ज्ये=१०, क्षे=८
क=१, ज्ये=१०, क्षे=८

वज्राभ्यासौ ज्येष्ठलघ्वोस्तदैक्यमित्यादि भास्करोक्त्या कनिष्ठम्=२०, ज्येष्ठम्=१९२, क्षे=६४, तत इष्टवर्गहृतः क्षेप इत्यादिनेष्टं=८ प्रकल्प्य जाताः कनिष्ठज्येष्ठक्षेपाः, कनिष्ठम्=५/२, ज्येष्ठम्=२४, क्षेपः=१, भावनार्थं न्यासः क=५/२, ज्ये=२४, क्षे=१
क=५/२, ज्ये=२४, क्षे=१ ततः समासभावनया क=१२०, ज्ये=११५१, क्षे=१,

अतो राशिशेषमानम्=१२०, भावनया राशिशेषमानमनेकधा भवति। ततः कुट्टकेनेष्टदिनेऽहर्गणः स्यादिति। द्वितीयप्रश्ने प्रकृतिः=८३, क्षेपः=१, 'तदेष्टं ह्रस्वं तस्य वर्गं' इत्यादि भास्करोक्त्या कनिष्ठज्येष्ठक्षेपाः=क=१, ज्ये=९, क्षे=—२, भावनार्थं न्यासः क=१, ज्ये=९, क्षे=—२
क=१, ज्ये=९, क्षे=—२ ततः समासभावनया

कनिष्ठज्येष्ठ क्षेपाः क=१८, ज्ये=१६४, क्षे=४ अत्रेष्टं=२ प्रकल्प्य 'इष्टवर्गहृतः क्षेप' इत्यादिना रूपक्षेपे कनिष्ठज्येष्ठक्षेपाः क=९, ज्ये=८२, क्षे=१ एवं भावनयाऽनेकधा कनिष्ठज्येष्ठे भवतः। अतः कलाशेषमानम्=९, ततः कुट्टकेनेष्टदिनेऽहर्गणो भवेदिति ॥७५॥

अब उदाहरणों को कहते हैं।
पहले वर्ग प्रकृति के उदाहरण कहते हैं।

हि० भा०—राशिशेषवर्ग को ९२ से गुणा कर एक जोड़ने से जो होता है उसको वा कला शेष वर्ग को तिरासी ८३ से गुणाकर एक जोड़ने से जो होता है उसके वर्ग को बुधदिन में वर्ष पर्यन्त करते हुए व्यक्ति गणक हैं इति ॥७५॥

प्रथमप्रश्न में प्रकृति=९२, क्षेप=१, तब 'इष्टं ह्रस्वं तस्य वर्गः प्रकृत्या क्षुण्णः' इत्यादि भास्करोक्त सूत्र से कनिष्ठ क=१, ज्येष्ठ=ज्ये=१०, क्षेप=क्षे=८ अब भावना के लिय न्यास करते हैं क=१, ज्ये=१०, क्षे=८
क=१, ज्ये=१०, क्षे=८

'वज्राभ्यासौ ज्येष्ठलघ्वोस्तदैक्यं' इत्यादि भास्करोक्त सूत्र से क=२०, ज्ये=१९२, क्षे=६४, अब इष्ट=८ कल्पना कर 'इष्टवर्ग हृतः क्षेपः' इत्यादि भास्करोक्त सूत्र से क=५/२, ज्ये=२४, क्षे=१, पुनः भावना के लिये न्यास क=५/२, ज्ये=२४, क्षे=१
क=५/२, ज्ये=२४, क्षे=१

समास भावना से क=१२०, ज्ये=११५१, क्षे=१, अतः राशि शेष मान=१२०, भावना से राशि शेष अनेकधा होता है। तब कुट्टक विधि से अभीष्ट दिन में अहर्गण सुगमता ही से होता है। द्वितीय प्रश्न में प्रकृति=८३, क्षेप=१, तब 'इष्टं ह्रस्वं तस्य वर्गः' इत्यादि

से क=१, ज्ये=९, क्षे=—२। भावना के लिये न्यास क=१, ज्ये=९, क्षे=—२
क=१, ज्ये=९, क्षे=—२ समास

भावना से क=१८, ज्ये=१६४, क्षे=४, अब इष्ट=२ कल्पना कर 'इष्टवर्गहृतः क्षेपः' इत्यादि से क=९, ज्ये=८२, क्षे=१ एवं भावना से कनिष्ठ और ज्येष्ठ का आनन्त्य होता है। अतः कलाशेष=९ तब कुट्टक विधि से अभीष्ट दिन में सुगमता ही से अहर्गण होगा इति ॥७५॥

इदानीमन्यप्रश्नद्वयमाह।

सूर्यविलिप्ताशेषं पञ्चभिरूनाहतं तथा दशभिः।
वर्गं बृहस्पतिदिने कुर्वन्ना वत्सराद् गणकः ॥७६॥

सु. भा.—सूर्यविलिप्ताशेषं पञ्चभिरूनं पञ्चाहतं च बृहस्पतिदिने वर्गो भवति। वा विलिप्ताशेषं तथैव दशभिरूनं दशभिराहतं च वर्गो भवतीति प्रश्नमावत्सरात् कुर्वन्नपि स गणकोऽस्तीति।

प्रथमप्रश्ने विलिप्ताशेषम्=या।

ततः प्रश्नानुसारेण ५ या—२५ अयं वर्ग इष्टवर्गेण समः कृतः।

ततः ५ या—२५=इ^2 ∴ या $=\frac{\text{इ}^2+२५}{५}$।

यदि इ=५ तदा या=१०।

एवं द्वितीयप्रश्ने १० या — १००=इ^2 ∴ या$=\frac{\text{इ}^2+१००}{१०}$।

यदि इ=१० तदा या=२०। विलिप्ताशेषात् कुट्टकेनाहर्गणानयनं सुगमम् ॥ ७६ ॥

वि. भा.—सूर्यविलिप्ताशेषं पञ्चभिर्हीनं पञ्चभिगु'णितं च बृहस्पतिदिने वर्गो भवति, वा विलिप्ताशेषं दशभिर्हीनं दशभिगु'णितं च वर्गो भवतीति प्रश्नोत्तर मावत्सरात कुर्वन् स गणकोऽस्तीति ॥

प्रथमप्रश्ने कल्प्यते विलिप्ताशेषम्=य, तदाऽऽलापानुसारेण ५ (य—५) इष्टवर्गेण समोऽयं वर्गः कृतः ५ (य—५)=इ^2=५ य—२५ समयोजनेन ५ य=इ^2 +२५ पक्षौ पञ्चभिर्भक्तौ तदा य$=\frac{\text{इ}^2+२५}{५}$, अत्र यदि इ=५ तदा $\frac{२५+२५}{५}$ =य$=\frac{५०}{५}$=१०। अस्मादहर्गणज्ञानं सुगमम्। द्वितीयप्रश्ने आलापानुसारेण १० (य—१०) अयं वर्ग इष्टवर्गेण समः कृतः १० (य—१०)=इ^2=१०य · १००

$=इ^2$ समयोजनेन $१० य=इ^2+१००$ अतः $य=\frac{इ^2+१००}{१०}$ अत्र यदि $इ=१०$

तदा $य=\frac{१००+१००}{१०}=\frac{२००}{१०}=२०$, विलिप्ताशेषाऽत्कुट्टकविधिनाऽहर्गणज्ञानं सुखेन भवेदिति ॥७६॥

अब अन्य दो प्रश्नों को कहते हैं ।

हि. भा.—सूर्य के विलिप्ता शेष में से पांच घटा कर पांच से गुणा करने से बृहस्पति दिन में वर्ग होता है । वा उसी तरह विलिप्ता शेष में से दस घटा कर दस से गुणा करने से बृहस्पति दिन में वर्ग होता है इन प्रश्नों के उत्तर एक वर्ष तक करते हुए व्यक्ति गणक हैं इति ।

प्रथम प्रश्न में कल्पना करते हैं विलिप्ता शेष मान$=य$ । तब प्रश्न के आलापानुसार $५ (य-५)$ यह वर्ग है, इसको इष्ट वर्ग के बराबर करने से $५ (य-५)=५ य-२५=इ^2$, दोनों पक्षों में २५ जोड़ने से $५ य=इ^2+२५$ अतः $य=\frac{इ^2+२५}{५}$, यहां यदि $इ=५$ तब $य=\frac{२५+२५}{५}=\frac{५०}{५}=१०$ इससे कुट्टक विधि से अहर्गणानयन सुगम है । इसी तरह द्वितीय प्रश्न में विलिप्ता शेष मान$=य$, तब प्रश्न के आलापानुसार $१० (य-१०)=इ^2$ $=१० य-१००$, दोनों पक्षों में १०० जोड़ने से $१० य=इ^2+१००$ $\therefore$ $य=\frac{इ^2+१००}{२}$

यदि $इ=१०$ तब $य=\frac{१००+१००}{१०}=\frac{२००}{१०}=२०$ इससे कुट्टक विधि से अहर्गण ज्ञान सुगम है इति ॥७६॥

इदानीमन्यान् प्रश्नानाह ।

भगणादिशेषवर्गं त्रिभिर्गुणं संयुतं शतैर्नवभिः ।
कृतिमष्टशतोनं वा कुर्वन्नावत्सराद् गणकः ॥७७॥

सु. भा.—भगणादीनां भगण-राशि-कला-विकलानां शेषवर्गं त्रिभिर्गुणं नवभिः शतैः संयुतं चाऽष्टशतोनं वर्गमावत्सरात् कुर्वन्नपि स गणकोऽस्तीति ।

अत्र भगणादिशेषमानम्$=या$ ।

ततः प्रश्नालापेन प्रथमप्रश्ने $३ या^2+९००$ अयं वर्गः । अतः ७० सूत्रेण—

क १ ज्ये २ क्षे १
क ३० ज्ये ६० क्षे ९००
भावनया कनिष्ठज्येष्ठयोरानन्त्यम् ।
अतो भगणादिशेषमानम्=३० । द्वितीयप्रश्नेऽप्येवम् ।
३ या^{2}—८०० अयं वर्गः ।

अतः क १ ज्ये १ क्षे २
क २० ज्ये २० क्षे ८००
रूपक्षेपपदाभ्यां भावनयाऽत्रापि पदयोरानन्त्यम् ।
अतो भगणादिशेषम्=२० ॥ ७७ ॥

वि. भा.—भगणादि (भगण-राशि-अंश-कला-विकला) शेषवर्गं त्रिभिर्गुणं नवभिः शतैः संयुतं वाऽष्टशतोनं वर्गः स्यादित्यावत्सरात् कुर्वन् स गणकोऽस्तीति ॥

प्रथमप्रश्ने कल्प्यते भगणादिशेषप्रमाणम्=य, तदाऽऽलापेन ३ य^{2}+९०० अयं वर्गः । अत्र प्रकृतिः=३ कल्प्यते कनिष्ठम्=१, तदा ज्येष्ठम्=२, क्षे=१, तदा क्षुण्णः क्षुण्णे तदा पदे इत्यादिनेष्टम्=३० प्रकल्प्य जाताः कनिष्ठज्येष्ठक्षेपाः क=३०, ज्ये=६०, क्षे=९०० अत्र भावनया कनिष्ठज्येष्ठयोरानन्त्यम् । ततो भगणादिशेषमानम्=३० ।

द्वितीयप्रश्ने आलापानुसारेण ३ य^{2}—८०० अयं वर्गः । अत्र प्रकृति=३, क्षेपः=—८०० कल्प्यते कनिष्ठम्=१, तदा ज्येष्ठम्=१, क्षेपः=—२ अत्रापि 'क्षेपः क्षुण्णः क्षुण्णे तदा पदे, इत्यादिना इष्टम्=२० प्रकल्प्य जाताः कनिष्ठज्येष्ठक्षेपाः क=२०, ज्ये=२०, क्षे = — ८०० रूपक्षेपीयकनिष्ठज्येष्ठाभ्यां तयो (कनिष्ठज्येष्ठयोः) रानन्त्यम् । ततो भगणादिशेषमानम्=२० ॥७७॥

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—भगणादि (भगण-राशि-अंश-कला-विकला) शेष वर्ग को तीन से गुणा कर नौ सौ जोड़ने से वर्ग होता है वा आठ सौ को घटाने से वर्ग होता है इसको एक वर्ष पर्यन्त करते हुए व्यक्ति गणक है । यहां भगणादिशेष प्रमाण=य, है । तब प्रथम प्रश्न के आलापानुसार ३ य^{2}+९०० यह वर्ग है । यहां प्रकृति=३, है तब 'इष्टं ह्रस्वं तस्य वर्गः प्रकृत्या क्षुण्णः' इत्यादि से क=१, ज्ये=२, क्षे=१ 'क्षुण्णः क्षुण्णे तदा पदे' इस भास्करोक्ति से इष्ट=३० कल्पना करने से क=३०, ज्ये=६०, क्षे=९०० यहां भावना से कनिष्ठ और ज्येष्ठ अनन्त होता है । अतः भगणादि शेष=३० ।

द्वितीय प्रश्न में प्रश्न के आलापानुसार ३ य^2—८०० यह वर्ग है, अतः क=१, ज्ये=१, क्षे=—२। यहां भी 'क्षुण्णः क्षुण्णे तदा पदे' इस भास्करोक्ति से इष्ट=२० कल्पना करने से क=२०, ज्ये=२०, क्षे=—८००, यहां भी रूप क्षेपीय पदों से भावना द्वारा कनिष्ठ और ज्येष्ठ अनन्त होगा, इसलिये भगणादि शेष=२० इति ॥७७॥

इदानीमन्यं प्रश्नद्वयमाह।

भगणादिशेषवर्गं चतुर्गुणं पञ्चषष्टिसंयुक्तम्।
षष्ट्यूनं वा वर्गं कुर्वन्नावत्सराद् गणकः ॥७८॥

सु. भा.—स्पष्टार्थम्। प्रथमप्रश्ने भगणादिशेषमानम् =या। ततः प्रश्नानुसारेण ४ या^{2}+६५ अयं वर्गः।

अत्र ६९ सूत्रतः। इष्टम्=५। $\frac{६५}{५}$=१३।

१३—५, ८। $\frac{८}{२}$= ४। $\sqrt{\frac{४}{४}}$=२। अतो भगणादिशेषम्=२ रूपक्षेपपदाभ्यां भावनयाऽनन्त्यम्।

द्वितीयप्रश्नेऽप्येवं ४ या^{2}—६० अयं वर्गः।

अत्रेष्टम्=२। $\frac{६०}{२}$=३०। ३०+२=३२। $\frac{३२}{२}$=१६।

$\sqrt{\frac{१६^2}{४}}$=८। अतोऽत्र भगणादिशेषम्=८। एवं बुद्धिमता ऋणक्षेपे गुणके वर्गे चाधिकसंख्यातः कनिष्ठानयनं कार्यमिति ॥ ७८ ॥

वि. भा.—भगणादीनां (भगण-राशि-भाग-कला-विकलानां) शेषवर्गं चतुर्गुणं पञ्चषष्ट्या युतं वर्गो भवति वा षष्ट्या हीनं वर्गो भवतीति-आवत्सरात् कुर्वन् स गणकोऽस्तीति।

प्रथमप्रश्ने कल्प्यते भगणादिशेषप्रमाणम्=य, तदा प्रश्नालापानुसारेण ४य^2+६५ अयं वर्गः स्यात्। अत्र प्रकृतिः=४, क्षेपः=६५, वर्गात्मकप्रकृतौ कनिष्ठज्येष्ठयोरानयनार्थं 'इष्टभक्तो द्विधाक्षेप' इत्यादि भास्करोक्तसूत्रेणेष्टं =५ कल्पनेन जातं कनिष्ठम्=२, रूपक्षेपीयकनिष्ठज्येष्ठाभ्यां भावनया ऽनन्त्यम्, ततो भगणादिशेषमानम्=२। द्वितीयप्रश्ने प्रश्नालापानुसारेण ४य^2 —६० अयं वर्गः स्यात्। अत्रापि 'इष्ट भक्तो द्विधाक्षेप' इत्यादि भास्करोक्त्या कनिष्ठम्=८, अतो भगणादिशेष मानम्=८ एवं वर्गात्मकप्रकृतौऋणक्षेपेऽधिकसंख्यातः कनिष्ठज्ञानं कार्यमिति ॥७८॥

अब अन्य दो प्रश्नों को कहते हैं।

हि. भा.—भगणादि शेष वर्ग को चार से गुणा कर पैंसठ जोड़ने से वर्ग होता है,

वा साठ घटाने से वर्ग होता है इसको करते हुए व्यक्ति गणक हैं। प्रथम प्रश्न में कल्पना करते हैं भगणादि शेषमान=य, तब प्रश्न के आलापानुसार ४य^{२}+६५ यह वर्ग है, यहां वर्गात्मक प्रकृति=४ है, क्षेप=६५ तब 'इष्टभक्तो द्विधाक्षेपः' इस भास्करोक्त सूत्र से इष्ट =५ कल्पना करने से कनिष्ठ=२, रूपक्षेपीय कनिष्ठ और ज्येष्ठ से भावना द्वारा कनिष्ठ और ज्येष्ठ अनन्त होता है, इसलिये भगणादिशेषमान=२ हुआ। द्वितीय प्रश्न में प्रश्न के आलापानुसार ४ य^{२}—६० यह वर्ग है यहां भी 'इष्टभक्तो द्विधाक्षेपः' इत्यादि भास्करोक्त सूत्र से कनिष्ठ=८, अतः भगणादिशेषमान =८ हुआ। एवं वर्गात्मक प्रकृति में और ऋण-क्षेप में अधिक संख्या से कनिष्ठानयन करना चाहिये इति ॥७८॥

इदानीमन्यं प्रश्नमाह।

इष्टभगणादिशेषं द्विनवत्यूनं त्र्यशीतिसङ्गुणितम्।
रूपेण युतं वर्गं कुर्वन्नावत्सराद् गणकः ॥७९॥

सु. भा.—इष्टभगणादिशेषं द्विनवतिभि ९२ रूनं कार्यं शेषं त्र्यशीति ८३ संगुणितं रूपेण युतं च वर्गमावत्सरात् कुर्वन्नपि स गणकोऽस्तीति। इष्टभगणा-दिशेषमानम्=या। ततः प्रश्नालापेन—

८३ (या—९२)+१=८३ या—८३×९२+१

$$=८३ \text{ या}—७६३६+१=८३ \text{ या}—७६३५=इ^{२} \therefore \text{या}=\frac{इ^{२}+७६३५}{८३}$$

अत्र यदि इ=१ तदा या=९२ इदमेव भगणादिशेषमानम् ॥ ७९ ॥

वि. भा.—इष्ट भगणादिशेषं द्विनवत्या ९२ हीनं शेषं त्र्यशीति ८३ गुणित-मेकेन युतं वर्गः स्यादित्यावत्सरात् कुर्वन् स गणकोऽस्तीति। कल्प्यते इष्टभग-णादिशेषप्रमाणम्=य, तदाऽऽलापानुसारेण ८३ (य—९२)+१ = ८३ य—८३×९२+१=८३य—७६३६+१=८३य—७६३५ अयं वर्गः स्यात् कल्प्यते ८३य—७६३५=इ^{२} पक्षौ ७६३५ युतौ तदा ८३य=इ^{२}+७६३५ पक्षौ ८३ भक्तौ तदा $\frac{इ^{२}+७३३५}{८३}$=य, अत्र यदि इष्टम्=१ तदा य= $\frac{७६३६}{८३}$=९२ इत्येव भगणादिशेषप्रमाणम् ॥७९॥

अब अन्य प्रश्न को कहते हैं।

हि. भा.—इष्ट भगणादिशेष में ९२ घटाने से जो शेष रहता है उसको ८३ से गुणाकर एक जोड़ने से वर्ग होता है इसको करते हुए व्यक्ति गणक है। यहां कल्पना करते हैं भगणादिशेषमान=य, तब प्रश्न के आलापानुसार ८३ (य—९२)+१=८३य—७६३६

+१=८३य—७६३५ यह वर्ग है, कल्पना करते हैं ८३य—७६३५=इ^{२}, दोनों पक्षों में ७६३५ जोड़ने से ८३य=इ^{२}+७६३५, दोनों पक्षों को ८३ से भाग देने से $\frac{इ^{२}+७६३५}{८३}$ =य, यहाँ यदि इ=१ तब $\frac{१+७६३५}{८३}=\frac{७६३६}{८३}$=९२=य यही भगणादिशेष-मान हुआ इति ॥७९॥

इदानीं प्रश्नद्वयमाह ।

अधिमासशेषवर्गं त्रयोदशगुणं त्रिभिः शतैर्युक्तम् ।
त्रिघनोनं वा वर्गं कुर्वन्नावत्सराद् गणकः ॥८०॥

सु. *भा.*—त्रिघनेन सप्तविंशत्योनम् । शेषं स्पष्टार्थम् ।
अत्राधिमासशेषमानम्=या । ततः प्रश्नालापेन
प्रथमे प्रश्ने १३ या^{२}+३०० । अयं वर्गः ।
अत्र वर्गप्रकृत्या, क १ ज्ये ४ क्षे ३
क १० ज्ये ४० क्षे ३००
अत्र रूपक्षेपपदाभ्यां भावनयाऽऽनन्त्यं कार्यम् । अत्र कनिष्ठ—१० मधिमास शेषमानम् ।
अत्र यदि क १ ज्ये ३ क्षे ४ । ततः ६८ सूत्रेण ।

$$रूपक्षेपे\ कनिष्ठम् = \frac{क.\ ज्ये\ (ज्ये^{२}+१)\ (ज्ये^{२}+३)}{२} =$$

$$= \frac{१\times३\ (३^{२}+१)\ (३^{२}+३)}{२} = \frac{३\times१०\times१२}{२} = १८०$$

$$ज्येष्ठम् = \left\{ज्ये^{२}+२\right\}\left\{\frac{(ज्ये^{२}+३)(ज्ये^{२}+१)}{२}-१\right\}$$

$$= \left\{३^{२}+२\right\}\left\{\frac{(३^{२}+३)\ (३^{२}+१)}{२}-१\right\}$$

$$=११\times५९=६४९ ।$$

एवं रूपक्षेपे पदे प्रसाध्य भावनयाऽऽनन्त्यं कार्यम् । द्वितीयप्रश्नेप्येवम्
१३ या^{२}—२७ अयं वर्गः ।
अतः क १ ज्ये ४ क्षे ३
क १ ज्ये २ क्षे ९
भावनया, क ६ ज्ये २१ क्षे २७
अत्रापि रूपक्षेप पदाभ्यां भावनयाऽऽनन्त्यं कार्यम् ।
अत्राधिशेषमानं व्यक्तम्=६ ॥ ८० ॥

वि. भा.—स्पष्टार्थम् । त्रिघनेन सप्तविंशत्या हीनम् । कल्प्यतेऽधिमास-शेषप्रमाणम्=य, तदा प्रथम प्रश्नें प्रश्नोत्तचा १३ य^2+३०० अयं वर्गः स्यात् । अत्र प्रकृतिः=१३, क्षेपः=३००, इष्टं ह्रस्वं तस्य वर्गः प्रकृत्येत्यादिना क=१, ज्ये=४, क्षे=३ ततः 'क्षुण्णः क्षुण्णे तदा पदे' इति भास्करोत्तचेष्टम्=१० प्रकल्प्य जाताः कनिष्ठज्येष्ठक्षेपाः क=१०, ज्ये=४०, क्षे=३०० रूपक्षेपीय कनिष्ठ ज्येष्ठाभ्यां भावनया कनिष्ठज्येष्ठयोरानन्त्यम् । अत्र कनिष्ठम्=१०= अधिमासशेषप्रमाणम्=य । अत्र यदि क=१, ज्ये=३, क्षे=—४ तदा 'चतुरूनेऽन्त्य पदकृती त्र्येकयुते वधदल' मित्याचार्योक्त सूत्रेण रूपक्षेपे कनिष्ठम्=

$$\frac{\text{क.ज्ये}\,(\text{ज्ये}^२+१)\,(\text{ज्ये}^२+३)}{३} = \frac{१\times३\,(३^२+१)\,(३^२+३)}{२}$$

$$= \frac{३\times१०\times१२}{२} = १८०, \text{ तथा ज्येष्ठम्} = \left\{\text{ज्ये}^२+२\right\}$$

$$\left\{\frac{(\text{ज्ये}^२+३)(\text{ज्ये}^२+१)}{२}-१\right\} = \left\{३^२+२\right\}$$

$$\left\{\frac{(३^२+३)(३^२+१)}{२}-१\right\} = ११\times५९ = ६४९$$ एवं रूपक्षेपे कनिष्ठ-ज्येष्ठसंसाध्यभावनयाऽऽनन्त्यं कुर्यादिति द्वितीयप्रश्ने प्रश्नालापेन १३ य^2—२७ अयं वर्गः स्यात् । अत्र प्रकृतिः=१३, क्षेपः=—२७ इष्टं ह्रस्वमित्यादिना क=१, ज्ये=४, क्षेपः=३, तथा कनिष्ठम्=१, ज्येष्ठम्=२, क्षेपः=—९ अनयोर्भावनया क=६, ज्ये=२१, क्षेपः=—२७ रूपक्षेपकनिष्ठज्येष्ठाभ्यां भावनयाऽऽनन्त्यं कार्यम् अत्र कनिष्ठमधिशेषमानम्=६=य ॥८०॥

अब अन्य दो प्रश्नों को कहते हैं ।

हि. भा.—अधिमास शेष वर्ग को तेरह से गुणा कर तीन सौ जोड़ने से वर्ग होता है, वा अधिमास शेष वर्ग को तेरह से गुणा कर सताइस घटाने से वर्ग होता है इसको करते हुए व्यक्ति गणक है इति ॥८०॥

यहां कल्पना करते हैं अधिमास शेषमान=य, तब प्रथम प्रश्न में प्रश्नालाप से १३य^2+३०० यह वर्ग है यहां प्रकृति=१३, क्षेप=३००, 'इष्टं ह्रस्वं तस्य वर्गः' इत्यादि से क=१, ज्ये=४, क्षे=३, तब 'क्षुरणः क्षुरणे तदा पदे' इस भास्करोक्ति से इष्ट=१० कल्पना करने से क=१०, ज्ये=४०, क्षे=३०० रूपक्षेपीय कनिष्ठ और ज्येष्ठ से भावना द्वारा कनिष्ठ और ज्येष्ठ की अनन्तता करनी चाहिये । यहां कनिष्ठ=१०=अधिमास शेष प्रमाण=य, हुआ, यहां यदि क=१, ज्ये=३, क्षे=—४ तब 'चतुरूनेऽन्त्य पदकृती त्र्येक-युते' इत्यादि आचार्योक्त ६८ सूत्र से रूपक्षेप में कनिष्ठ= $\frac{\text{क.ज्ये}\,(\text{ज्ये}^२+१)(\text{ज्ये}^२+३)}{२}$

$$= \frac{१\times ३(३^२+१)(३^२+३)}{२} = \frac{३\times १०\times १२}{२} = १८०, \text{ज्ये} = \left\{ \text{ज्ये}^२+२ \right\}$$

$$\left\{ \frac{(\text{ज्ये}^२+१)\ (\text{ज्ये}^२+३)}{२} - १ \right\} = \left\{ ३^२+२ \right\}$$

$\left\{ \frac{(३^२+१)\ (३^२+३)}{२} - १ \right\} = ११\times ५९ = ६४९$, एवं रूपक्षेप में कनिष्ठ और ज्येष्ट साधन कर भावना से कनिष्ठ और ज्येष्ठ की अनन्तता करनी चाहिये। एवं द्वितीय प्रश्न में १३ य^२—२७ यह वर्ग है, 'इष्टं ह्रस्वं तस्य वर्गः' इत्यादि से क=१, ज्ये=४, क्षे=३ तथा क=१, ज्ये=२, क्षे=—९ इन दोनों की समास भावना से क=६, ज्ये=२१, क्षे=—२७ यहां भी रूपक्षेपीय कनिष्ठ और ज्येष्ठ से भावना द्वारा कनिष्ठ और ज्येष्ठ की अनन्तता करनी चाहिये यहां अधिमास शेष प्रमाण=६=य, हुआ ॥८०॥

इदानीमन्यप्रश्नद्वयमाह ।

इन्दुविलिप्ता शेषं सप्तदश गुणं त्रयोदश गुणं चापि ।
पृथगेकयुतं वर्गं कुर्वन्नावत्सराद् गणकः ॥८१॥

सु. भा.—स्पष्टार्थम् ।
अत्र ७१ सूत्रतः । गु$_१$=१७ । गु$_२$=१३,

$$\text{ततो विलिप्ताशेषम्} = \frac{८\ (\text{गु}_१+\text{गु}_२)}{(\text{गु}_१ \backsim \text{गु}_२)^२} = \frac{८\ (१७+१३)}{(१७-१३)^२} = \frac{८\times ३०}{४^२}$$

$$= \frac{८\times ३०}{४\times ४} = १५ ।$$

वि. भा.—चन्द्रस्य विलिप्ताशेषं पृथक् सप्तदशगुणितं, त्रयोदशगुणितं च एकयुतं वर्गं आवत्सरात् कुर्वन् स गणको ऽस्तीति । अत्र गुणक=गु=१७ । गुणकः=$\overset{१}{\text{गु}}$ = १३ तदा 'गुणकयुतिरिष्टगुणिता गुणकान्तरवर्गभाजिते' त्याद्याचार्योक्तसूत्रेण विलिप्ताशेषम् $= \frac{८\ (\text{गु}+\overset{१}{\text{गु}})}{(\text{गु}\backsim\overset{१}{\text{गु}})^२} = \frac{८\ (१७+१३)}{(१७-१३)^२} =$

$$\frac{८\times ३०}{४^२} = \frac{८\times ३०}{१६} = \frac{३०}{२} = १५ \ ॥८१॥$$

अब अन्य प्रश्नद्वय को कहते हैं ।

हि. भा.—चन्द्र के विलिप्ताशेष को पृथक् सतरह से और तेरह से गुणा कर एक जोड़ने से वर्ग होता है, इसको करते हुए व्यक्ति गणक है ॥ ८१ ॥ यहाँ गुणक=गु=१७,

गुणक=गु=१३, तब 'गुणकयुतिरिष्टगुणिता गुणकान्तरभाजिता' इत्यादि आचार्योक्त सूत्र से विलिप्ताशेष= $\frac{८ (गु+गु')}{(गु\sim गु')^{२}}$ = $\frac{८ (१७+१३)}{(१७-१३)^{२}}$ = $\frac{८\times ३०}{४^{२}}$ = $\frac{८\times ३०}{१६}$ = $\frac{३०}{२}$ =१५, इति ॥ ८१ ॥

इदानीमन्यं प्रश्नद्वयमाह ।

अवमावशेषवर्गं द्वादशगुणितं शतेन संयुक्तम् ।
त्रिभिरूनं वा वर्गं कुर्वन्नावत्सराद् गणकः ॥ ८२ ॥

सु. भा.—स्पष्टार्थम् ।
प्रथमप्रश्ने क्षयशेषमानम्=या । ततः प्रश्नानुसारेण
$१२ या^{२}+१००$ अयं वर्गः ।
वर्गप्रकृत्या, क १ ज्ये ४ क्षे ४
क ५ ज्ये २० क्षे १००
अथ चतुः क्षेप पदाभ्यां ६७ सूत्रेण ।
रूपक्षेपे क = $\frac{क (ज्ये^{२}-१)}{२}$ = $\frac{१ (४^{२}-१)}{२}$ = $\frac{१५}{२}$ ।
ज्ये= $\frac{ज्ये (ज्ये^{२}-३)}{२}$ = $\frac{४ (४^{२}-३)}{२}$ =२६ ।
आभ्यां भावनयाऽऽनन्त्यं कार्यम् । अत्र क्षयशेषम्=५ ।
द्वितीय प्रश्नेऽप्येवम् । $१२ या^{२}-३$ वर्गः ।
अतः क १ ज्ये ३ क्षे ३
रूपक्षेप पदाभ्यामत्राप्यानन्त्यं कार्यम् । अत्र क्षयशेषम्=१ ॥ ८२ ॥

वि. भा.—स्पष्टार्थम् । कल्प्यते अवमशेषप्रमाणम्=य, तदा प्रथम प्रश्नालापेन $१२ य^{२}+१००$ अयं वर्गः स्यात् । अत्र प्रकृतिः=१२, क्षेपः=१०० तदाकनिष्ठं १ प्रकल्प्य 'इष्टं ह्रस्वं तस्य वर्गं' इत्यादि भास्करोक्त्या ज्येष्ठम्=ज्ये=४, क्षेपः=४ ततः क्रमेण न्यासः क=१, ज्ये=४, क्षेपः=४. अत्रेष्टं=५ प्रकल्प्य 'क्षुण्णः क्षुण्णौ तदा पदे' इति भास्करोक्त्या जाताः कनिष्ठज्येष्ठक्षेपाः क=५, ज्ये=२०, क्षे=१००, चतुःक्षेपीय कनिष्ठ ज्येष्ठाभ्यां 'चतुरधिकेऽन्त्यपदकृतिरि'त्यादि आचार्योक्तसूत्रेण रूपक्षेपे कनिष्ठम्= $\frac{क (ज्ये^{२}-१)}{२}$ = $\frac{१\times (४^{२}-१)}{२}$ = $\frac{१६-१}{२}$ = $\frac{१५}{२}$

ज्ये $= \frac{\text{ज्ये}(\text{ज्ये}^2-3)}{2} = \frac{4(4^2-3)}{2}$ $= 2(16-3) = 2\times 13 = 26$ । आभ्यां भावनया कनिष्ठ ज्येष्ठयोरनन्तत्वं विधेयम् । अतोऽवमशेषप्रमाणम् $=5=$ य ।

द्वितीय प्रश्ने १२ य^2—३ अयं वर्गः स्यात् । अत्र प्रकृतिः $=12$, क्षेपः $=-3$ तदेष्टं ह्रस्वमित्यादिना क $=1$, ज्ये $=3$, क्षे $=-3$, रूपक्षेपीय कनिष्ठज्येष्ठाभ्यां कनिष्ठज्येष्ठयोरत्राप्यनन्तत्वं विधेयम् । अतोऽवमशेषमानम् $=1$ ॥ ८२ ॥

अब अन्य दो प्रश्नों को कहते हैं।

हि. भा.—अवमशेष वर्ग को बारह से गुणा कर एक सौ जोड़ने से वर्ग होता है, वा अवम शेषवर्ग को बारह से गुणा कर तीन घटाने से वर्ग होता है इनका उत्तर करते हुए व्यक्ति गणक है इति ॥ ८२ ॥ कल्पना करते हैं अबमशेष प्रमाण $=$ य, तब प्रथम प्रश्न के आलापानुसार १२ य$^2+100$ यह वर्ग है। यहाँ प्रकृति $=12$, क्षेप $=100$ तब 'इष्टं ह्रस्वं तस्य वर्गः' इत्यादि भास्करोक्त सूत्र से चारक्षेप में क $=1$, ज्ये $=4$, क्षे $=4$, यहाँ इष्ट $=5$ कल्पना कर 'क्षुण्णः क्षुण्णे तदा पदे' इस भास्करोक्ति से क $=5$, ज्ये $=20$, क्षे $=100$, चारक्षेप सम्बन्धी कनिष्ठ और ज्येष्ठ से 'चतुरधिकेऽन्त्यपदकृतिः' इत्यादि आचार्योक्त ६७ सूत्र से रूपक्षेप में कनिष्ठ $= \frac{\text{क}(\text{ज्ये}^2-1)}{2} = \frac{1\times(4^2-1)}{2} = \frac{16-1}{2} = \frac{15}{2}$ ज्येष्ठ $= \frac{\text{ज्ये}(\text{ज्ये}^2-3)}{2} = \frac{4(4^2-3)}{2}$ $=2(16-3)=2\times 13=26$ । इन कनिष्ठ और ज्येष्ठ से भावना के द्वारा कनिष्ठ और ज्येष्ठ अनन्त होता है, अतः अवमशेषमान $=$ $5=$ य, हुआ ।

द्वितीय प्रश्न में १२ य^2—३ यह वर्ग है । यहां प्रकृति $=12$, क्षेप $=-3$, 'इष्टं ह्रस्वं तस्य वर्गः' इत्यादि से क $=1$, ज्ये $=3$, क्षे $=-3$, रूपक्षेपीय कनिष्ठ और ज्येष्ठ से भावना से यहाँ भी कनिष्ठ और ज्येष्ठ की अनन्तता होती है । अतः अवमशेष $=1$, हुआ इति ॥ ८२ ॥

इदानीमन्यं प्रश्नमाह ।

ज्ञदिनेऽर्ककलाशेषं गुरुदिनविकलावशेषयुक्तोनम् ।
वर्गं वधं च सैकं कुर्वन्नावत्सराद् गणकः ॥८३॥

सु. भा.—बुधदिनेऽर्कस्य यत् कलाशेषं तद्गुरुदिनजेनार्कस्य विकलावशेषेण युक्तमूनं च वर्गं तथा तयोः कलाविकलाशेषयोर्वधं सैकं च वर्गमावत्सरात् कुर्वन्नपि स गणकोऽस्तीति ।

अत्र ७२ सूत्रेण कल्पित एको वर्गः १६ । अन्यश्च ४ ।
ततः १६+४=२० । १६—४=१२ ।

$$\frac{२०+१२}{\left(\frac{२०-१२}{२}\right)^२}=\frac{३२}{१६}=२$$ । अनेन गुणितौ २० । १२ जातौ राशी ४०।२४ ।

अत्र प्रथमं ४० कलाशेषं द्वितीयं लघुं २४ विकलाशेषम् । कलाशेषात् कुट्टकेन बुधदिनेऽहर्गणः साध्यः । विकलाशेषाच्च कुट्टकेन गुरुदिनेऽहर्गणः साध्य इति ॥ ८३ ॥

वि. भा.—बुधदिने रवेः कलाशेषं यत्तद्बृहस्पतिदिनजेन रवेर्विकलाशेषेण युतं हीनं च वर्गं तथा कलाविकलाशेषयोर्वधं सैकं च वर्गमावत्सरात् कुर्वन् स गणकोऽस्तीति ।

'वर्गोऽन्यकृतियुतोनस्तत्संयोगान्तरार्धकृतिभक्त' इत्यादि सूत्रेणैको वर्गः =१६ कल्पितः । द्वितीयश्च=४, तदा १६+४=२० । १६—४=१२

$$\therefore \frac{२०+१२}{\left(\frac{२०-१२}{२}\right)}=\frac{३२}{४^२}=\frac{३२}{१६}=२$$ । अनेन २०, १२ गुणितौ तदा राशी भवेताम् ४० । २४ अत्र प्रथमं=४०=कलाशेषम् । द्वितीयं=२४=विकलाशेषम् । कलाशेषात् बुधदिने कुट्टकेनाऽहर्गणः साध्यः, विकलाशेषात् कुट्टकविधिना बृहस्पतिदिनेंऽहर्गणः साध्य इति ॥८३॥

अब अन्य प्रश्न को कहते हैं ।

हि. भा.—बुध दिन में रवि के कलाशेष में बृहस्पतिदिनोत्पन्न रवि के विकलाशेष को जोड़ने से और हीन करने से जो वर्ग होता है उस वर्ग को तथा कलाशेष और विकलाशेष के घात में एक जोड़ने से जो वर्ग होता है उस वर्ग को करते हुए व्यक्ति गणक हैं । यहां 'वर्गोऽन्यकृतियुतोनः' इत्यादि आचार्योक्त ७२ सूत्र से एक वर्ग=१६ कल्पना किया, और द्वितीय वर्ग=४ तब आचार्योक्त ७२ सूत्र के अनुसार १६+४=२० । १६—४=१२

$$\therefore \frac{२०+१२}{\left(\frac{२०-१२}{२}\right)^२}=\frac{३२}{४^२}=\frac{३२}{१६}=२$$ इससे २० । १२ गुणा करने से दोनों राशिमान होते हैं ४० । २४ इनमें प्रथम राशि=४०=कलाशेष, द्वितीय राशि=२४= विकलाशेष, कलाशेष से बुध दिन में कुट्टक विधि से अहर्गणानयन करना चाहिये, विकला शेष से कुट्टक विधि द्वारा बृहस्पति दिन में अहर्गणानयन करना चाहिये ।

इदानीमन्यप्रश्नमाह ।

विकलाशेषं सहितं त्रिनवत्या सप्तषष्टिहीनं च ।
भानोर्ज्ञदिने वर्गं कुर्वन्नावत्सराद् गणकः ॥८४॥

सु. भा.—भानोर्बुधदिने यद्विकलाशेषं तत् त्रिनवत्या सहितं वर्गं तथा सप्तषष्टिहीनं च वर्गमावत्सरात् कुर्वन्नपि स गणकोऽस्तीति ।

अत्र ७३ सूत्रेण इष्टम् = ४ ।

$\frac{९३+६७}{४} = \frac{१६०}{४} = ४०$ । $४०-४ = ३६$ । $\frac{३६}{२} = १८$ । $१८^{२} = ३२४$ ।

$३२४ + ६७ = ३९१$ इदं विकलाशेषमतः कुट्टकेन बुधदिनेऽहर्गणानयनंसुगमम् ॥८४॥

वि. भा.—रवेर्बुधदिने विकलाशेषं यत्तत् त्रिनवत्या ९३ युतं वर्गो भवति, तथा सप्तषष्टि हीनं च वर्गो भवतीत्येतत् आवत्सरात् कुर्वन् गणकोऽस्तीति ।

यैरूनो यैश्च युतो रूपैर्वर्ग इत्याद्याचार्योक्त ७३ सूत्रेण, कल्पितमिष्टम् $= ४$ तदा $\frac{९३+६७}{४} = \frac{१६०}{४} = ४०$ । $४०-४ = ३६$ । $\frac{३६}{२} = १८$, $१८^{२} = ३२४$ ततः $३२४ + ६७ = ३९१$ = विकलाशेषमतः कुट्टकविधिना बुधदिनेऽहर्गणः साध्य इति ॥८४॥

अब अन्य प्रश्न को कहते हैं ।

हि. भा.—बुधदिन में रवि का जो विकलाशेष है उसमें तिरानवे जोड़ने से वर्ग होता है । तथा ६७ घटाने से वर्ग होता है इसको करते हुए व्यक्ति गणक हैं इति । 'यैरूनो यैश्च युतो रूपवर्गः' इत्यादि आचार्योक्त ७३ सूत्र से ४ = इष्ट कल्पना कर $\frac{९३+६७}{४} = \frac{१६०}{४} = ४०$, $४०-४ = ३६$, $\frac{३६}{२} = १८$, $१८^{२} = ३२४$ अतः $३२४ + ६७ = ३९१$ = विकला शेष, इससे कुट्टक विधि से अहर्गणानयन करना चाहिये इति ॥८४॥

इदानीमन्यप्रश्नद्वयमाह ।

ज्ञदिनेऽर्ककलाशेषं द्वादशभिः संयुतं त्रिषष्टया च ।
षष्टयाऽष्टाभिश्चोनं कुर्वन्नावत्सराद् गणकः ॥८५॥

सु. भा.—बुधदिनेऽर्कस्य कलाशेषं यत् तद् द्वादशभिः संयुतं वर्गं तथा त्रिषष्टया संयुतं च वर्गमावत्सरात् कुर्वन्नपि स गणकोऽस्तीत्येकः प्रश्नः । वा तत् कलाशेषं षष्टयो ६० नं वर्गं तथाऽष्टाभिश्चोनं वर्गमावत्सरात् कुर्वन्नपि स गणको-

स्तीति द्वितीयः प्रश्नः । अत्र ७४ सूत्रेण । प्रथमप्रश्ने इष्टं ३ प्रकल्प्य $\frac{६३-१२}{२}=\frac{५१}{३}=१७$ । $\frac{१७+३}{२}=\frac{२०}{३}=१०$ । $१०^२=१००$ । $१००-६३$ $=३७$ इदमेव कलाशेषम् । द्वितीय प्रश्ने इष्टं २ प्रकल्प्य $\frac{६०-८}{२}=\frac{५२}{२}=$ $=२६$ । $\frac{२६-२}{२}=\frac{२४}{२}=१२$ । $१२^२=१४४$ । $१४४+६०=२०४$ इदमेव कलाशेषम् ॥८५॥

वि. भा.—बुधदिने रवेः कलाशेषं द्वादशभिः संयुतं वर्गं कुर्वन् तथा त्रिषष्ट्या संयुतं च वर्गमावत्सरात्कुर्वन् स गणकोऽस्तीति प्रथमः प्रश्नः । वा तदेव कलाशेषं षष्ट्या हीनं वर्गं कुर्वन् तथाऽष्टाभिश्च हीनं वर्गमावत्सरात् कुर्वन् स गणकोऽस्तीति द्वितीयः प्रश्नः ।

याभ्यां कृतिरधिकोनं तदन्तरं हृतयुतोनमिष्टेनेत्याचार्योक्तसूत्रेण प्रथमप्रश्ने इष्टं ३ प्रकल्प्य $\frac{६३-१२}{३}=\frac{५१}{३}=१७$, $\frac{१७+३}{२}=\frac{२०}{२}=१०$, $(१०)^२=१००$, $१००-६३=३७=$कलाशेषम् । द्वितीयप्रश्ने इष्टम्$=२$ कल्पयित्वा $\frac{६०-८}{२}=\frac{५२}{२}=२६$, $\frac{२६-२}{२}=\frac{२४}{२}=१२$ । $(१२)^२=१४४$, $१४४+६०=२०४=$कलाशेषम् ॥८५॥

अब अन्य दो प्रश्नों को कहते हैं ।

हि. भा.—बुध दिन में कलाशेष में बारह जोड़ने से तथा तिरसठ जोड़ने से वर्ग को करते हुए व्यक्ति गणक हैं यह प्रथम प्रश्न है । वा कलाशेष में साठ घटाने से तथा आठ घटाने से वर्ग को करते हुए व्यक्ति गणक हैं यह द्वितीय प्रश्न है ।

'याभ्यां कृतिरधिकोनं तदन्तरं' इत्यादि आचार्योक्त ७४ सूत्र से प्रथम प्रश्न में इष्ट $=३$ कल्पना कर $\frac{६३-१२}{३}=\frac{५१}{३}=१७$, $\frac{१७+३}{२}=\frac{२०}{२}=१०$, $(१०)^२$ $=१००$, $१००-६३=३७=$कलाशेष, कलाशेष से बुध दिन में कुट्टक विधि से अहर्गणानयन सुगमता ही से हो जायगा । द्वितीय प्रश्न में इष्ट$=२$ कल्पना कर $\frac{६०-८}{२}=\frac{५२}{२}$ $=२६$ । $\frac{२६-२}{२}=\frac{२४}{२}=१२$, $(१२)^२=१४४$, $१४४+६०=२०४=$कलाशेष इससे बुध दिन में कुट्टक विधि से अहर्गणानयन करना चाहिये इति ॥८५॥

इदानीमन्यान् प्रश्नानाह ।

इन्दुविलिप्ताशेषाद्रविलिप्ताशेषमंशशेषं वा ।
अथवा मध्यममिष्टं कुर्वन्नावत्सराद् गणकः ॥८६॥

सु० भा०—इन्दुविलिप्ताशेषात् रविलिप्ताशेषं वांऽशशेषमथवाऽभीष्टं मध्यमं ग्रहमावत्सरात् कुर्वन्नपि स गणकोऽस्तीति प्रश्नत्रयम् । अत्र चन्द्रकलाविकला-शेषात् कुट्टकविधिनाऽहर्गणज्ञानं तस्मादिष्टमध्यानयनं रवेः कलांशशेषानयनं च सुगमम् ॥८६॥

वि. भा.—चन्द्रस्य विकलाशेषात् रवेः कलाशेषमंश शेषं वा, अथवेष्टं मध्यमं ग्रहं, आवत्सरात् कुर्वन् स गणकोऽस्तीति । अत्र प्रश्नत्रयमस्ति । चन्द्रस्य विकला-शेषात् कुट्टकेनाहर्गणानयनं कार्यं तस्मादभीष्टमध्यमग्रहानयनं रवेः कलाशेषानयन-मंश शेषानयनं च विधेयमिति ॥८६॥

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—चन्द्र के विकलाशेष से रवि के कला शेष को वा अंशशेष को अथवा इष्ट मध्यम ग्रह को करते हुए व्यक्ति गणक हैं, यहां तीन प्रश्न हैं । चन्द्र के विकलाशेष से कुट्टक विधि से अहर्गणानयन करना चाहिये । उस से अभीष्ट मध्यमग्रहानयन, तथा रवि का कलाशेषानयन, अंशशेषानयन सुगमता ही से हो जायगा इति ॥८६॥

इदानीमन्यान् प्रश्नानाह ।

जीवविलिप्ताशेषात् कुजमिन्दुं भौमलिप्तिकाशेषात् ।
रविमिन्दुभागशेषात् कुर्वन्नावत्सराद् गणकः ॥८७॥

सु० भा०—गुरुविलिप्ताशेषात् कुजं भौमकलाशेषाच्चन्द्रं चन्द्रभागशेषाच्च रविमावत्सरात् कुर्वन्नपि स गणकोऽस्तीति ।

गुरोर्विकलाशेषाद्वा भौमकलाशेषादथवा चन्द्रभागशेषात् कुट्टकेनाहर्गण-ज्ञानं ततोऽहर्गणादभीष्टग्रहज्ञानं स्फुटमेवेति ॥८७॥

वि. भा.—बृहस्पतिविकलाशेषान्मङ्गलं, मङ्गलकलाशेषाच्चन्द्रं, चन्द्र-स्यांशशेषाद्रविमावत्सरात् कुर्वन् स गणकोऽस्तीति । बृहस्पतेर्विकलाशेषात्, वा मङ्गलस्य कलाशेषात् । वा चन्द्रस्यांशशेषात्कुट्टकविधिनाऽहर्गणानयनं कार्यम् । तस्मादिष्टमध्यमग्रहानयनं सुगममेवेति ॥८७॥

अब अन्य प्रश्नों को कहते है ।

हि. भा.—बृहस्पति के विकला शेष से मङ्गल को, मङ्गल के कलाशेष से चन्द्र को, चन्द्र के अंश शेष से रवि को करते हुए व्यक्ति गणक हैं इति । बृहस्पति के विकलाशेष से, वा मङ्गल के कलाशेष से, अथवा चन्द्र के अंशशेष से कुट्टक विधि से अहर्गणानयन करना चाहिये, अहर्गण ज्ञान से इष्टमध्यम ग्रहानयन स्पष्ट ही है इति ।।८७।।

इदानीं पूर्वप्रश्नोत्तरमाह ।

इष्टग्रहेष्टशेषाद् द्युगणो गतनिरपवर्त्त संगुणितैः ।
छेददिनैरधिकोऽस्मादन्यग्रहशेषमिष्टो वा ।।८८।।

सु. भा.—इष्टग्रहस्येष्टकलाविकलादिशेषात् कुट्टकविधिना द्युगणोऽहर्गणः साध्यः । स च गतनिरपवर्त्तसङ्गुणितैश्छेददिनैरिष्टाहतदृढकुदिनैरधिकोऽनेकधा स्यादस्मादहर्गणादन्यग्रहस्य कलाविकलादिशेषं वा ऽभीष्टो मध्यमग्रह एव साध्य इति स्फुटमेव सिद्धान्तविदाम् ।।८८।।

वि. भा.—इष्टग्रहस्येष्टकलाविकलादिशेषात्कुट्टकरीत्याऽहर्गणः साध्यः स इष्ट गुणितैश्छेददिनैः (दृढकुदिनैः) युक्तोऽनेकधा स्यात् । अस्मादहर्गणादन्यग्रहस्य कलाविकलादिशेषं साध्यं वा ऽभीष्टो मध्यम ग्रहः साध्य इति ।।८८।।

अब पूर्व प्रश्न के उत्तर को कहते हैं ।

हि. भा.—इष्टग्रह के इष्टकलाशेष, विकला शेष आदि से कुट्टक विधि से अहर्गण साधन करना चाहिये, उसमें इष्ट गुणित दृढकुदिन को जोड़ने से अनेक प्रकार होते हैं । इस अहर्गण से अन्यग्रह के कलाशेष विकलादिशेष साधन करना चाहिये वा अभीष्ट मध्यमग्रह ही साधन करना चाहिए ।।८८।।

इदानीमुद्दिष्टाहर्गणे ग्रहयोर्भगणादिशेषे ये ते एव पुनः कस्मिन्नहर्गणे भवेतामित्यस्योत्तरमाह ।

निश्छेदभागहारौ ग्रहयोर्विपरीतौ ग्रहयोर्द्युगणात् ।
यस्मात् तन्निश्छेदेनोद्धृतयोर्लब्धसङ्गुणितौ ।।८९।।

निश्छेदभागहारौ विपरीतौ तद्युतात् पुनस्तस्मात् ।
शेषे द्युगणादेवं त्र्यादीनां प्राग्वदिष्टदिने ।।९०।।

सु. भा.—(निश्छेदभागहारौ ग्रहयोर्भगणादिशेषयोर्द्युगणात् ।
यस्मात् तन्निश्छेदेनोद्धृतयोर्लब्धसंगुणितौ ॥८९॥)

यस्माद् द्युगणादहर्गणाद् ग्रहयोर्ये भगणादिशेषे भवतस्तयोर्यौ निश्छेदभागहारौ स्वस्वदृढकुदिनसंज्ञौ तयोर्निश्छेदेन महत्तमापवर्त्तनोद्धृतयोस्तयोर्दृढकुदिनसंज्ञयोः सतोर्ये लब्धे ताभ्यां विपरीतौ निश्छेदभागहारौ गुणितौ । महत्तमापवर्त्तभक्तात् प्रथमदृढकुदिन संज्ञाद्यल्लब्धं तेन द्वितीयदृढकुदिनमानं गुण्यं द्वितीयलब्धेन च प्रथमदृढकुदिनमानं गुण्यमित्यर्थः । एवं समच्छेदौ भवतः । तद्युतात् तस्मात् पूर्वसाधिताद् द्युगणात् पुनर्ग्रहयोस्ते एव भगणादिशेषे भवतः । उद्दिष्टादहर्गणः पूर्वसाधितसमच्छेदेन युतस्तदा योगसमेऽहर्गणे पुनस्ते एव ग्रहयोर्भगणादिशेषे भवत इत्यर्थः । एवं त्र्यादीनां ग्रहाणामिष्टदिने यानि भगणादिशेषाणि तानि पुनः कदेति प्रश्नोत्तरं प्राग्वत् कार्यम् । द्वयोर्निश्छेदभागहाराभ्यां पूर्ववत् समच्छेदं विधाय नूतनो निश्छेदभागहारः कल्प्यः । पुनरस्य तृतीयदृढकुदिनस्य च लघुतमापवर्त्योऽन्वेषणीयः । एवमग्रेऽपि कर्म कार्यम् । अन्ते सर्वदृढकुदिनानां यो लघुतमापवर्त्यस्तेन युतोऽहर्गणः कार्यः । योगसमेऽहर्गणे च पुनस्तान्येव शेषाणि भवन्ति ।

अत्रोपपत्तिः ।

यदि ग्रहाणां दृढभगणाः भ$_1$, भ$_2$, भ$_3$, दृढकुदिनानि च कु$_1$, कु$_2$, कु$_3$, कल्प्यन्ते तथा दृढकुदिनानां लघुतमापवर्त्यश्च अ । तदा अ+अह अस्मिन्नहर्गणे दृढभगणगुणे दृढकुदिनहृते प्रथमखण्डे निरवयवभगणा लभ्यन्ते ते प्रयोजनाभावाद्यदि त्यज्यन्ते तदोद्दिष्टाहर्गणाद्यद्भगणशेषं तदेव अ+अह अस्मादपि । आचार्येणात्र द्वयोर्द्वयोर्निश्छेदभागहारयोर्महत्तमापवर्त्तनविभक्तयोः सतोर्ये लब्धे ताभ्यामन्योन्यहारौ सङ्गुण्य लघुतमापवर्त्य एवोत्पादित इति गणितविदां प्रसिद्धमेवेति ॥८९-९०॥

वि. भा.—यस्मात् द्युगणात् (अहर्गणात्) ग्रहयोर्ये भगणादिशेषे स्तस्तयोर्निश्छेदभागहारौ (स्वस्वदृढ़कुदिनसंज्ञकौ) यौ तयोर्निश्छेदेन (महत्तमापवर्त्तनेन) भक्तयोर्ये लब्धे ताभ्यां निश्छेदभागहारौ गुणितावर्थात् महत्तमापवर्त्तनभक्तात् प्रथमदृढ़कुदिनसंज्ञकाद्यल्लब्धं तेन द्वितीयदृढ़कुदिनप्रमाणं गुणनीयं, द्वितीयलब्धेन प्रथमदृढ़कुदिमानं गुणनीयमेवं समच्छेदौ भवतः । तद्युतात् (पूर्वसाधितादहर्गणात्) पुनस्ते एव ग्रहयोर्भगणादिशेषे भवतः । पूर्वसाधितसमच्छेदेनोद्दिष्टाहर्गणो युतस्तदा योगसमेऽहर्गणे पुनस्ते एव भगणादिशेषे भवतः । एवमिष्टदिने त्र्यादीनां ग्रहाणां यानि भगणादिशेषाणि तानि पुनः कदेतिप्रश्नोत्तरं पूर्ववत्कार्यम् । द्वयोर्निश्छेदांशहाराभ्यां पूर्ववत् समच्छेदं विधाय नवीनो निश्छेदभागहारः कल्पनीयः ।

पुनरस्य तृतीयदृढ़कुदिनस्य च लघुतमापवर्त्यो गवेषणीयः । अग्रेऽप्येवमेव कर्म कार्यम् । अन्ते सर्वेषां दृढ़कुदिनानां यो लघुतमापवर्त्यस्तेनाहर्गणो युतस्तदा योगतुल्येऽहर्गणे पुनस्तान्येव शेषाणि स्युरिति ॥८९-९०॥

अत्रोपपत्तिः ।

यदि ग्रहाणां दृढ़कुदिनानि क, ख, ग, दृढ़भगणाः य, र, ल, कल्प्यन्ते, तथा दृढ़कुदिनानां लघुतमापवर्त्यश्च=प, तदा 'प+अहर्गण' ऽयमहर्गणो दृढ़भगणगुणो दृढ़कुदिनभक्तः प्रथमखण्डे निःशेषभगणाः समागच्छन्ति, प्रयोजनाभावात्ते यदि न गृह्यन्ते तदोद्दिष्टादहर्गणाद्यद् भगणशेषं तदेवा 'प+अहर्गण' स्मादपि, द्वयोर्द्वयोर्दृढ़ कुदिनसंज्ञकयोर्महत्तमापवर्त्तनेन विभक्तयोर्ये लब्धी ताभ्यां परस्परं हारौ सङ्गुण्य लघुतमापवर्त्य एव सम्पादित आचार्येणेति ॥८९-९०॥

अब उद्दिष्ट अहर्गण में दो ग्रहों के भगणादि शेष जो है वे ही पुनः किस अहर्गण में होंगे इस प्रश्न के उत्तर कोकहते हैं।

हि. भा.-जिस अहर्गण से दो ग्रहों के जो भगणादि शेष हैं उन दोनों के अपने अपने दृढ़ कुदिन को महत्तमापवर्त्तन से भाग देने से जो लब्धिद्वय होता है उन दोनों से विपरीत दोनों दृढ़ कुदिन को गुणा करना चाहिए अर्थात् प्रथम दृढ़कुदिन संज्ञक को महत्तमावर्त्तन से भाग देने से जो लब्धि हो उससे द्वितीय दृढ़कुदिन को गुणना चाहिए और द्वितीय लब्धि से प्रथम दृढ़कुदिन को गुणा करना चाहिए, इस तरह करने से समच्छेद होता है। उस से युत पूर्व साधित अहर्गण से फिर दोनों ग्रहों के वे ही भगणादि शेष होते हैं अर्थात् उद्दिष्टा-हर्गण में पूर्व साधित समच्छेद को जोड़ने से योग तुल्य अहर्गण में पुनः वे ही दोनों ग्रहों के भगणादि शेष होते हैं। इसी तरह तीन आदि ग्रहों के इष्टदिन में जो भगणादि शेष हों वे पुनः कब होंगे इसका उत्तर पूर्ववत् करना चाहिए। दो ग्रहों के दृढ़कुदिन संज्ञकों से पूर्ववत् समच्छेद करके नये दृढ़कुदिन कल्पना करना फिर इसके और तृतीय दृढ़कुदिन के लघुतमापवर्त्य अन्वेषण (खोजना) करना चाहिए, एवं आगे भी क्रिया करनी चाहिए। अन्त में सब दृढ़कुदिनों के जो लघुतमापत्र्य हो उसको अहर्गण में जोड़ देना चाहिए तब योग-तुल्य अहर्गण में पुनः वे ही शेष होंगे इति ॥

उपपत्ति ।

यदि ग्रहों के दृढ़कुदिन क, ख, ग, और दृढ़भगण य, र, ल कल्पना करते हैं तथा दृढ़कुदिन संज्ञकों के लघुतमापवर्त्य=प, तब प+अहर्गण को दृढ़भगण से गुणाकर दृढ़-कुदिन से भाग देने से प्रथम खण्ड में निःशेष भगण लब्ध होता है, प्रयोजना भाव से यदि उसको छोड़ देते हैं तब उद्दिष्ट अहर्गण से जो भगणादि शेष होता है वही प+अहर्गण, इससे भी, आचार्य ने यहां दो ग्रहों के दृढ़कुदिन को महत्तमपवर्त्तन से भाग देने से जो लब्धिद्वय

होते हैं उन दोनों से परस्पर हारों को गुणाकर लघुतमापर्त्य ही उत्पादित किया इति ॥८९–९०॥

इदानीमन्यान् प्रश्नानाह ।

द्युगणमवमावशेषाद्रविचन्द्रौ मध्यमौ स्फुटावथवा ।
एवं तिथिं ग्रहं वा कुर्वन्नावत्सराद् गणकः ॥९१॥

सु. भा.—अवमावशेषात् क्षयशेषाद्द्युगणमहर्गणं वा मध्यमौ रविचन्द्रावथ वा स्फुटौ रविचन्द्रौ वैवं तिथिं वा ग्रहमिष्टग्रहं भौमाद्यन्यतममावत्सरात् कुर्वन्नपि स गणकोऽस्तीति पञ्च प्रश्ना अत्र ॥९१॥

वि. भा.-अवमावशेषादहर्गणं वा मध्यमौ रविचन्द्रौ, अथवा स्फुटौ रविचन्द्रौ, वैवं तिथिं वेष्टग्रहं मङ्गलाद्यन्यतममावत्सरात् कुर्वन् स गणकोऽस्तीति । अत्र पञ्चप्रश्नाः सन्ति ॥९१॥

हि. भा.—जो व्यक्ति अवमशेष से अहर्गण को कहते हैं वा मध्मय रवि और मध्यम चन्द्र को कहते हैं अथवा स्फुट रवि और चन्द्र को कहते हैं । वा तिथि को कहते हैं वा इष्ट ग्रह (कुजादि ग्रहों में किसी ग्रह) को कहते हैं वे गणक हैं । यहां पांच प्रश्न है इति ॥९१॥

इदानीमन्यान् प्रश्नानाह ।

एकदिनमवमशेषं यद्गुणमेकं रविचन्द्रभगणोनम् ।
शुध्यति भूदिनभक्तं व्येकं चान्द्रैस्तदुक्तिरियम् ॥९२॥

सु. भा.—एकदिनसम्बन्ध्यवमशेषं यद्गुणं येन गुणमेकोनं भूदिनभक्तं शुध्यति वाऽवमशेषं यद्गुणं रविभगणोनं भूदिनभक्तं शुध्यति । वाऽवमशेषं यद्गुणं चन्द्रभगणोनं भूदिनभक्तं शुध्यति । वाऽवमशेषं यद्गुणं व्येकं चान्द्रैश्चान्द्रदिनैर्भक्तं शुध्यति । अथेयं वक्ष्यमाणा तेषां प्रश्नानामुक्तिरुत्तरोक्तिरिति ॥९२॥

वि. भा.—एकदिनसम्बन्ध्यवमशेषं येन गुणमेकहीनं कुदिन भक्तं शुध्यति । वाऽवमशेषं येन गुणं रविभगणहीनं कुदिनभक्तं शुध्यति । वाऽवमशेषं येन गुणं चन्द्रभगणेन हीनं कुदिनभक्तं शुध्यति, वाऽवमशेषं येन गुणमेकहीनं चान्द्रदिनैर्भक्तं शुध्यति । इदं वक्ष्यमाणा तेषां प्रश्नानामुत्तरोक्तिः । अत्र चत्वारः प्रश्नाः सन्तीति ॥९२॥

अब अन्य प्रश्नों को कहते हैं ।

हि. भा.—एक दिनसम्बन्धी अवमशेष को जिस गुणक से गुणाकर, एक घटाकर

कुदिन से भाग देने से निःशेष होता है। वा अवमशेष को जिस गुणक से गुणाकर रविभगण को घटाकर कुदिन से भाग देने से निःशेष होता है। अथवा अवमशेष को जिस गुणाकाङ्क से गुणाकर चन्द्रभगण को घटाकर कुदिन से भाग देने से निःशेष होता है। वा अवमशेष को जिस गुणाकाङ्क से गुणाकर एक घटाकर चान्द्र दिन से भाग देने से निःशेष होता है। आगे के विषय उन प्रश्नों की उत्तरोक्ति है इति ॥६२॥

अथ प्रथमप्रश्नस्योत्तरमाह।

इषुशरकृताष्टदिग्भिः १०८४५५ सङ्गुणितादवमशेषकाद् भक्तात्।
रूपाष्टवेदरसशून्यशरगुणै ३५०६४८१ दिनगणः शेषम् ॥६३॥

सु. भा.—अवमशेषादिषु शरकृताष्टदिग्भिः १०८४५५ सङ्गुणितात् रूपाष्टवेदरसशून्यशरगुणै ३५०६४८१ भक्ताच्छेषं दिनगणोऽहर्गणो भवति।

अत्रोपपत्तिः।

कल्पदृढावमानि दिनगणगुणानि दृढावमशेषोनानि कल्पदृढकुदिनहृतानि फलं निरग्रं गतावमानि। अतो दृढकल्पावमानि भाज्यं दृढावमशेषमृणक्षेपं दृढकल्पकुदिनानि हारं प्रकल्प्य यो गुणः सोऽहर्गणः स्यात्। तत्र लाघवार्थमाचार्येण रूपशुद्धौ शरशरवेदाष्टपंक्तिमितः स्थिरकुट्टकः कृतः। रूपाष्टवेदादिसंख्या कल्पदृढकुदिनानि तदानयनं च। $\frac{\text{कक्ष}}{\text{ककुदि}} = \frac{२५०८२५५०००0}{१५७७९१६४५००००} =$

$= \frac{५०००० \times ५०१६५१}{५०००० \times ३१५५८३२९} = \frac{५०००० \times ९ \times ५५७३९}{५०००० \times ९ \times ३५०६४८१} = \frac{५५७३९}{३५०६४८१}$

$= \frac{\text{दृक्षदि}}{\text{दृकुदि}}$ अथ प्रसङ्गाद् दृढरविभगणकुदिनानयनं प्रदर्श्यते। $\frac{\text{करभ}}{\text{ककुदि}}$

$= \frac{४३२००००००००}{१५७७९१६४५००००} = \frac{५००० \times ८६४००}{५०००० \times ३१५५८३२९} = \frac{५०००० \times ९ \times ९६००}{५०००० \times ९ \times ३५०६४८१}$

$= \frac{५०००० \times ९ \times ३ \times ३२००}{५०००० \times ९ \times ३ \times ११६८८२७} = \frac{३२००}{११६८८२७} = \frac{\text{दृरभ}}{\text{दृकुदि}}$। एवं

$\frac{\text{चकभ}}{\text{ककुदि}} = \frac{५७७५३३००००००}{१५७७९१६४५००००} = \frac{५०००० \times ११५५०६६}{५०००० \times ३१५५८३२९}$

$= \frac{५०००० \times ३ \times ३८५०२२}{५०००० \times ३ \times १०५१९४४३} = \frac{३८५०२२}{१०५१९४४३} = \frac{\text{दृचभ}}{\text{दृकुदि}}$।

वि. भा.—अवमशेषात् १०८४५५ एभिर्गुणितात् ३५०६४८१ एभिर्भक्तात्, यच्छेषं सोऽहर्गणः स्यादिति॥

अत्रोपपत्तिः ।

यदि कल्पदृढ़कुदिनैर्दृढ़कल्पावमानि लभ्यन्ते तदाऽहर्गणेन किमित्यनुपातेन समागच्छन्ति स शेष गतावमानि तत्स्वरूपम् $= \frac{\text{दृढ़कल्यावम} \times \text{अहर्गण}}{\text{दृढ़ककुदिन}} = \text{गतावम} + \frac{\text{दृढ़ावमशे}}{\text{दृढ़ककुदिन}}$ पक्षौ $\frac{\text{दृढ़ावमशे}}{\text{दृढ़कल्पकुदिन}}$ एभिर्हीनौ तदा $\frac{\text{दृढ़कल्पावम} \times \text{अहर्गण}}{\text{दृढ़ककुदिन}} - \frac{\text{दृढ़ावमशे}}{\text{दृढ़ककुदिन}} = \frac{\text{दृढ़कल्पावम} \times \text{अहर्गण} - \text{दृढ़ावमशे}}{\text{दृढ़ककुदिन}} = \text{गतावमानि}$ । अत्र यदि दृढ़कल्पावमं भाज्यं दृढ़ावमशेषमृणक्षेपं दृढ़कल्पकुदिनं हारं कल्प्यते तदा कुट्टकेन योगुणः समाग मिष्यति स एवाहर्गणो भवेत् । अत्राचार्येण लाघवार्थं रूपशुद्धौ (ऋणात्मकरूपक्षेपे) १०८४५५ गुणकं प्रकल्प्य स्थिरकुट्टकः कृतः । ३५०६४८१ इति दृढ़कुदिनानि सन्ति तदानयनं क्रियते ।

$$\frac{\text{कल्पावम}}{\text{ककुदि}} = \frac{२५०८२५५००००}{१५७७९१६४५००००} = \frac{५०००० \times ५०१६५१}{५०००० \times ३१५५८३२९}$$

$$= \frac{५०००० \times ९ \times ५५७३३९}{५०००० \times ९ \times ३५०६४८१} = \frac{५५७३९}{३५०६४८१} = \frac{\text{दृढ़ावम}}{\text{दृढ़कुदिन}} \text{ ॥}$$

अथ दृढ़रविभगणदृढ़कुदिनयोरानयनं प्रदर्श्यते ।

$$\frac{\text{करभगण}}{\text{ककुदिन}} = \frac{४३२००००००००}{१५७७९१६४५००००} = \frac{५०००० \times ८६४००}{५०००० \times ३१५५८३२९}$$

$$\frac{५०००० \times ९ \times ९६००}{५०००० \times ९ \times ३५०६४८१} = \frac{५०००० \times ९ \times ३ \times ३२००}{५०००० \times ९ \times ३ \times ११६८८२७} = \frac{३२००}{११६८८२७}$$

$$= \frac{\text{दृढ़रविभगण}}{\text{दृढ़कुदिन}} \text{ । एवमेव } \frac{\text{चं कल्पभगण}}{\text{ककुदिन}} = \frac{५७७५३३०००००}{१५७७९१६४५००००}$$

$$= \frac{५०००० \times ११५५०६६}{५०००० \times ३१५५८३२९} = \frac{५०००० \times ३ \times ३८५०२२}{५०००० \times ३ \times १०५१९४४३} = \frac{३८५०२२}{१०५१९४४३}$$

$$= \frac{\text{दृढ़ चं भगण}}{\text{दृढ़कुदिन}} \text{ ॥}$$

अब प्रथम प्रश्न के उत्तर को कहते हैं।

हि. भा.—अवमशेष को १०८४५५ इससे गुणा कर ३५०६४८१ इससे भाग देने से शेष अहर्गण होता है ॥९३॥

उपपत्ति ।

यदि कल्प दृढ़कुदिन में दृढ़ कल्पावम पाते हैं तो अहर्गण में क्या इस अनुपात से

शेष (शेषसहित) गतावम प्रमाण आता है उसका स्वरूप $= \frac{\text{दृढ़कल्पावम} \times \text{अहर्गण}}{\text{दृढ़कल्पकुदिन}} =$ गतावम $+ \frac{\text{दृढ़ावमशे}}{\text{दृढ़ककुदिन}}$ दोनों पक्षों में $\frac{\text{दृढ़ावमशे}}{\text{दृढ़ककुदिन}}$ घटाने से $\frac{\text{दृढ़कल्पावम} \times \text{अहर्गण}}{\text{दृढ़ककुदिन}} - \frac{\text{दृढ़ावमशे}}{\text{दृढ़ककुदिन}} = \frac{\text{दृढ़कल्पावम} \times \text{अहर्गण} - \text{दृढ़ावमशे}}{\text{दृढ़कल्पकुदिन}} =$ गतावम, यहां यदि दृढ़कल्पावम को भाज्य, दृढ़ावमशेष को ऋणक्षेप और दृढ़कल्पकुदिन को हार माना जाय तब कुट्टक विधि से जो गुणक आयगा वही अहर्गण होगा, यहां आचार्य ने लाघवार्थ ऋणात्मक रूपक्षेप में १०८४५५ कल्पना कर स्थिर कुट्टक किया है, ३५०६४८१ यह दृढ़कुदिन है, इसका आनयन करते हैं। $\frac{\text{कल्पावम}}{\text{कल्पकुदिन}} = \frac{२५०८२५५००००}{१५७७९१६४५००००} = \frac{५०००० \times ५०१६५१}{५०००० \times ३१५५८३२९}$

$= \frac{५०००० \times ९ \times ५५७३९}{५०००० \times ९ \times ३५०६४८१} = \frac{५५७३९}{३५०६४८१} = \frac{\text{दृढ़ावम}}{\text{दृककुदिन}}$ इससे अभीष्ट सिद्धि हो गई इति ॥

अब दृढ़रविभगण और दृढ़कुदिन का आनयन करते हैं।

$$\frac{\text{कल्परविभगण}}{\text{कल्पकुदिन}} = \frac{४३२००००००}{१५७७९१६४५००००} = \frac{५०००० \times ८६४००}{५०००० \times ३१५५८३२९}$$

$$= \frac{५०००० \times ९ \times ९६००}{५०००० \times ९ \times ३५०६४८१} = \frac{५०००० \times ९ \times ३ \times ३२००}{५०००० \times ९ \times ३ \times ११६८८२७} = \frac{३२००}{११६८८२७}$$

$= \frac{\text{दृढ़रवि भगण}}{\text{दृढ़ककुदिन}}$ इसी तरह $\frac{\text{चं कल्पभगण}}{\text{कल्प कुदिन}} = \frac{५७७५३३००००००}{१५७७९१६४५००००}$

$$= \frac{५०००० \times ११५५०६६}{५०००० \times ३१५५८३२९} = \frac{५०००० \times ३ \times ३८५० \times २२}{५०००० \times ३ \times १०५१९४४३} = \frac{३८५०२२}{१०५१९४४३}$$

$= \frac{\text{दृढ़ चं भगण}}{\text{दृढ़ कुदिन}}$ ॥

इदानीमवमशेषाद्रव्यानयनमाह ।

जिनरसगोऽब्धिरद ३२४९६२४ गुणात् शशिवसुकृतरसखभूतराम ३५०६४८१ हृतात् ।
इष्टावमशेषाद्यत् शेषं रविभगणशेषं तत् ॥९४॥

सु. भा.—स्पष्टार्थम् ।

अत्रोपपत्तिः ।

अत्र पूर्वप्रकारेणाहर्गणः=१०८४५५ क्षशे—३५०६४८१ इ। अयं रविदृढ-भगणगुणस्तद् दृढकुदिनगुणो जातो रविभगणात्मकः ।

$= \frac{३२००\times१०८४५५ \text{ क्षशे}—३२००\times३५०६२८१ \text{ इ}}{११६८८२७} = \frac{३४७०५६००० \text{ क्षशे}}{११६८८२७}$

$—३२००\times३ \text{ इ} = \frac{१०८३२०८}{११६८८२७} + ९६ \text{ क्षशे} — ९६०० \text{ इ}$ अतो दृढभगणशेषम्

=१०८३२०८ क्षशे—११६८८२७ इ, । आचार्येण गुणहरौ त्रिभिः सङ्गुण्य दृढक्षयशेषसम्बन्धिदृढकुदिनहरे रवेर्भगणशेषम्=३२४६६२४क्षशे—३५०६४८१ इ, इदं साधितमत इदं सर्वदा त्रिभिरपवर्त्यं तदा वास्तवमर्कदृढभगणशेषं ज्ञेयम् । यद्याचार्यानीतं भगणशेषं त्रिभिर्नापवर्त्यं तदा प्रश्नः खिलो ज्ञेय इति सुगणकैर्भृशं विचिन्त्यम् ॥६४॥

वि. भा.—इष्टावमशेषात् ३२४९६२४ एभिर्गुणात् ३५०६४८१ एभिर्भक्ताच्छेषं रविभगणशेषं भवेदिति ॥

अत्रोपपत्तिः ।

अथ पूर्वसाधिताहर्गण = १०८४५५ × अवमशे — ३५०६४८१ इ, ततः

$\frac{\text{अहर्गण}\times\text{दृढ़रविभगण}}{\text{दृढ़रविकुदिन}}$ = भगणात्मकरविः =

$\frac{३२००\times१०८४५५ \text{ अवमशे}—३२००\times३५०६४८१ \text{ इ}}{११६८८२७} = \frac{३४७०५६००० \text{ अवमशे}}{११६८८२७}$

$—३२००\times३ \text{ इ} = \frac{१०८३२०८ \text{ अवमशे}}{११६८८२७} + ९६ \text{ अवमशे}—९६०० \text{ इ}$, अतो दृढ़-भगण शेषम्=१०८३२०८ अवमशे—११६८८२७ इ, अत्राऽऽचार्येण हरगुणकौ त्रिभिः संगुण्य दृढ़ावमशेष सम्बन्धि हरे रवेर्भगणशेषं साधितम् । तद्रविभगण-शेषम्=३२४९६२४ अवमशे—३५०६४८१ इ । तेनेदं सर्वदा यदि त्रिभिरपवर्त्यं तदैव रविभगणशेषं वास्तवं बोध्यं, यद्याचार्येणानीतं भगणशेषं त्रिभिरपवर्त्यं न भवेत्तदा प्रश्न एव खिलो बोध्य इति ॥९४॥

अब अवमशेष से रवि के आनयन को कहते हैं ।

हि. भा.—इष्टावमशेष को ३२४६६२४ से गुणाकर ३५०६४८१ इससे भाग देने से जो शेष रहता है वह रवि का भगणशेष होता है इति ।

उपपत्ति ।

पूर्व प्रकार से अहर्गण=१०८४५५ अवमशे—३५०६४८१इ, अतः

$\frac{\text{अहर्गण}\times\text{दृढ़रविभगण}}{\text{रविदृढ़कुदिन}}$ = भगणात्मकर

$= \frac{३२०० \times १०८४५५ \text{ अवमशे} - ३२०० \times ३५०६४८१ \text{ इ}}{११६८८२७} = \frac{३४७०५६००० \text{ अवमशे}}{११६८८२७}$

$- ३२०० \times ३ \text{ इ} = \frac{१०८३२०८ \text{ अवमशे}}{११६८८२७} + ९६ \text{ अवमशे} - ९६०० \text{ इ}$, अतः दृढ़भगणशेष

= १०८३२०८ अवमशे — ११६८८२७ इ, यहां आचार्य ने गुणक और हर को तीन से गुणा कर दृढ़अवमशेष सम्बन्धी दृढ़कुदिन हर में रवि का भगणशेष = ३२४९६२४ अवमशे— ३५०६४८१ इ, यह साधन किया हैं इसलिये सर्वदा इसको तीन से अपवर्त्तनीय होना चाहिये तब ही रवि के भगणशेष को वास्तव समझना चाहिये अन्यथा प्रश्न खिल (अशुद्ध) समझना चाहिये ॥९४॥

इदानीमवमशेषात्तिथ्यानयनमाह ।

गोऽगेन्दुखेश ११०१७९ गुणिताद् भक्तान्नख पक्ष यमरसेषु गुणैः ।
शेषमवमावशेषात्तिथयो ऽवमशेषकाद्विकलम् ॥९५॥

सु० भा०—अवमशेषकाद्विकलं वर्त्तमानतिथेर्भुक्त मानं साध्यम् । शेषं स्पष्टम् ।

अत्रोपपत्तिः ।

चान्द्रेभ्यो यान्यवमानि यच्च तच्छेषं तान्यवमानि तदेव शेषं च सावनेभ्य इति 'सावनान्यवमानि स्युश्चान्द्रेभ्यः साधितानि चेत्'—इत्यादि मिताक्षरायां स्वगोलाध्याये भास्करेण स्फुटीकृतम् । अतो गतचन्द्रदिनैः कल्पावमानि गुणानि कल्पचन्द्रदिनैर्भक्तानि फलं गतावमानि शेषं क्षयशेषम् ।

अतः $\frac{\text{इचादि} \times \text{कक्षदि}}{\text{कचादि}}$ । अयमभिन्नः । अतः क्षयदिनादि भाज्यं क्षयशेषमृणक्षेपं चान्द्रदिनानि हारं प्रकल्प्य यः कुट्टकः साध्यते तान्येव चान्द्रदिनानि गततिथयो भवन्ति । तत्राचार्येण लाघवार्थं रूपविशुद्धौ स्थिरकुट्टकः साधितः स एवावमशेषगुणकः पठितः । अथ दृढावमचन्द्रदिनज्ञानार्थं न्यासः ।

$\frac{\text{कक्षदि}}{\text{कचादि}} = \frac{२५०८२५५००००}{१६०२९९९००००००} = \frac{५०००० \times ५०१६५१}{५०००० \times ३२०५९९८०}$

$= \frac{५०००० \times ९ \times ५५७३९}{५०००० \times ९ \times ३५६२२०} = \frac{५५७३९}{३५६२२०} = \frac{\text{दृक्षदि}}{\text{दृचादि}}$ अतो दृढ़चान्द्रदिनान्येव हर इति सर्वं स्फुटम् । गणितागतमवमशेषम् ५००००×९ अनेन विभज्य लब्धमत्र दृढावमशेषं सुधीभिर्ज्ञेयमिति । ९१ आर्यायामन्ये येऽवशिष्टा प्रश्नास्तेषामुत्तराणि क्षयशेषादहर्गणमानीय ततोऽहर्गणात् कार्याणि । ९२ आर्यायां च ये प्रश्नास्ते-

षामुत्तराणि कुट्टकविधिना स्फुटानि । आचार्येणापीह स्फुटत्वात् तेषामुत्तराणि नोक्तानीति ॥९५॥

वि. भा.—अवमशेषात् ११०१७९ एतैर्गुणितात् ३५६२२२० एतैर्भक्ताच्छेषं तिथयो भवन्ति, अवमशेषकाद्वर्त्तमानतिथेर्भुक्तं मानं साध्यमिति ॥

अत्रोपपत्तिः ।

'सावनान्यवमानि स्युश्चान्द्रेभ्यः साधितानि चेत् । सावनेभ्यस्तु चान्द्राणि तच्छेषं तद्वशात्तथेति' सिद्धान्त शिरोमणौ प्रतिपादितम् । तेन चान्द्रेभ्यो यान्यवमानि तच्छेषं च यत्तदेव शेषमवमानि च सावनेभ्यो भवन्ति, ततः कल्पचान्द्रदिनैर्यदि कल्पावमानि लभ्यन्ते तदा गत चान्द्रदिनैः किमित्यनुपातेन लब्धं गतावमानि शेषमवमशेषं तत्स्वरूपम् $= \frac{\text{कल्पावम} \times \text{गत चान्द्रदि}}{\text{कल्पचांदि}} = \text{गतावम} + \frac{\text{अवमशे}}{\text{कल्पचांदि}}$

पक्षौ $\frac{\text{अवशे}}{\text{कल्पचांदि}}$ एभिर्हीनौ तदा $\frac{\text{कल्पावम} \times \text{गतचान्द्रदि} - \text{अवमशे}}{\text{कल्पचांदि}} = \text{गतावम}$,

अत्र कल्पावमानि भाज्यं, अवमशेषमृणक्षेपं कल्पचान्द्रदिनानि हारं प्रकल्प्य कुट्टकेन यो गुणस्तान्येव गतचान्द्रदिनानि गततिथयो भवन्ति । तत्राचार्येण ऋणात्मकरूप क्षेपे स्थिर कुट्टकः साधितः स एवावमशेष गुणकः पठितः । अथ दृढ़ावम दृढ़चान्द्रदिनयोरानयनं क्रियते $\frac{\text{कल्पावमदि}}{\text{कल्पचांदि}} = \frac{२५०८२५५००००}{१६०२९९००००००}$

$$= \frac{५०००० \times ५०१६५१}{५०००० \times ३२०५९९८०} = \frac{५०००० \times ९ \times ५५७३९}{५०००० \times ९ \times ३५६२२०} = \frac{५५७३९}{३५६२२०}$$

$= \frac{\text{दृढ़ावमदि}}{\text{दृढ़चांदि}}$ अतो दृढ़चान्द्रदिनान्येव हरः सिद्धः । गणितागतमवमशेष- ५००००×९ मनेन विभक्तं लब्धमत्र दृढ़ावमशेषं बोध्यमिति । ९१ श्लोके-अवशिष्टा अन्ये ये प्रश्नास्तेषामुत्तराण्यवमशेषादहर्गणं संसाध्य तस्मादहर्गणात्कार्याणि । ९२ श्लोके च ये प्रश्नास्तेषामुत्तराणि कुट्टकयुत्तया कार्याणीति ॥९५॥

अब अवमशेष से तिथि के आनयन को कहते हैं ।

हि. भा.—अवमशेष को ११०१७९ इससे गुणाकर ३५६२२२० इन से भाग देने से जो शेष रहता है वह तिथि होती है । अवमशेष से वर्त्तमान तिथि का भुक्तमान साधन करना चाहिये इति ॥९५॥

उपपत्ति ।

चान्द्रदिन से साधित अवम और जो अवमशेष होता है वही अवम और अवमशेष

सावन से भी होता है 'गोलाध्याय में सावनान्यवमानि स्युश्चान्द्रेभ्यः साधितानि चेत्' इत्यादि श्लोक की मिताक्षरा में भास्कराचार्योक्त से स्पष्ट है, अतः कल्प चान्द्र दिन में यदि कल्पावम पाते हैं तो गतचान्द्र दिन में क्या इस अनुपात से सशेष (शेष सहित) गतावम आता है उसका स्वरूप $= \frac{\text{कल्पावम} \times \text{गतचांदि}}{\text{कल्पचांदि}} = \text{गतावम} + \frac{\text{अवमशे}}{\text{कल्पचांदि}}$ दोनों पक्षों में $\frac{\text{अवमशे}}{\text{कल्पचांदि}}$ इसको घटाने से $\frac{\text{कल्पावम} \times \text{गतचांदि} - \text{अवमशे}}{\text{कल्पचांदि}} = \text{गतावम}$, यहां यदि कल्पावम को भाज्य, अवमशेष को ऋणक्षेप, कल्पचान्द्र दिन को हार कल्पना की जाय तब कुट्टक विधि से जो गणक होता है वही गतचान्द्रदिन गततिथि होती है। वहां आचार्य ने ऋणात्मक रूप क्षेप में स्थिर कुट्टक साधन किया है वही अवमशेषका गुणक पठित हैं। दृढ़ावम और दृढ़चान्द्र दिन का आनयन करते हैं $\frac{\text{कल्पावमदि}}{\text{कल्पचांदि}} = \frac{२५०८२५५००००}{१६०२९९००००००} = \frac{५०००० \times ५०१६५१}{५०००० \times ३२०५९९८०}$ $= \frac{५०००० \times ९ \times ५५७३९}{५०००० \times ९ \times ३५६२२०} = \frac{५५७३९}{३५६२२०} = \frac{\text{दृढ़ावमदि}}{\text{दृढ़चांदि}}$ अतः चान्द्रदिन ही हर सिद्ध हुआ। गणितागत अवमशेष को ५००००×९ इससे भाग देने से जो लब्ध होता है वह यहां अवमशेष समझना चाहिये।

९१ श्लोक में अवशिष्ट जो अन्य प्रश्न हैं उन सबों के उत्तर अवमशेष से अहर्गण साधन कर उस अहर्गण से करना चाहिये। तथा ९२ श्लोक में जो प्रश्न हैं उन सबों के उत्तर कुट्टक विधि से स्पष्ट हैं; आचार्य ने भी इसी कारण से उनके उत्तर नहीं कहे हैं इति ॥९५॥

इदानीं पुनः प्रश्नान्तरं तदुत्तरं चाह।

भागकलाविकलैक्यं दृष्ट्वा विकलान्तरं च के शेषे।
ऐक्यं द्विधाऽन्तराधिकहीनं च द्विभाजितं शेषे ॥९६॥

सु. भा.—भागविकलं भागशेषं। कलाविकलं कलाशेषम्। अनयोरैक्यं तथाऽनयोर्विकलयोः शेषयोरन्तरं न दृष्ट्वा शेषे ते द्वे के स्त इति प्रश्नः। अथ तदुत्तरमाहैक्यमिति।

ऐक्यं द्विधा स्थाप्यमन्तरेणैकत्राधिकमन्यत्र हीनं कार्यं ततो द्विभाजितं दलितं शेषे भवतः।

अत्रोपपत्तिः। सङ्क्रमणगणितेन स्फुटा ॥९६॥

वि. भा.—भागविकलं (अंशशेषं) कलाविकलं (कलाशेषं) एतयोरैक्यं (योगं) तथा विकलान्तरं (शेषयोरन्तरं) दृष्ट्वा ते शेषे के स्त इति प्रश्नः। ऐक्यं

(शेषयोर्योगं) स्थानद्वये स्थाप्यमेकत्रान्तरेण युतमन्यत्र हीनं कार्यं द्वाभ्यां भक्तं तदा शेषे भवेतामित्युत्तरम् ।

अत्रोपपत्तिः ।

कल्प्यते अंशशेषमानम्=य, कलाशेषमानम्=र, अनयोर्योगः=य+र =यो, तयोरेवान्तरम्=य—र=अं तदा यो+अं=(य+र)+(यो—अं)=य+र+य—र=२ य ∴ $\frac{\text{यो—अं}}{२}$=य तथा यो—अं=(य+र)—(य—र)=य+र —य+र=२ र∴ $\frac{\text{यो—अं}}{२}$=र, अत आचार्योक्तमुपपन्नम् ॥९६॥

अब पुनः प्रश्नान्तर और उसके उत्तर को कहते हैं।

हि. भा.—अंशशेष और कलाशेष का योग तथा उन्हीं दोनों शेषों का अन्तर जान कर वे दोनों शेष क्या हैं यह प्रश्न है। दोनों शेषों के योग को दो स्थानों में रख कर एक स्थान में अन्तर को जोड़ कर दूसरे स्थान में अन्तर को घटाकर आधा करने से दोनों शेषों के मान होते हैं, यह उत्तर है।

वृहद्राशिः=य, लघुराशिः=र । य+र=योगः=यो । य—र=अन्तरम्=अं, तब यो+अं=य+र+य—र=२ य अतः $\frac{\text{यो+अं}}{२}$=य, तथा यो—अं=य+र—(य—र)=य+र—य+र=२ र अतः $\frac{\text{यो—अं}}{२}$=र, यहां यदि अंशशेष=य, कला-शेष=र तब $\frac{\text{यो+अं}}{२}$ = आचार्योक्त सूत्र उपपन्न होता है। आचार्य संक्रमण गणित "योगोऽन्तरयुतहीनो द्विहृत" इत्यादि से पहले कह चुके हैं, यहां भी 'ऐक्यं द्विधाऽन्तराधिक-हीनं' इत्यादि से उसी संक्रमण की प्रक्रिया का पिष्टपेषण करते हैं, सिद्धान्तशेखर में 'योगोऽन्तरेणोनयुतो द्विभक्तः कर्मोदितं संक्रमणाख्यमेतत्' इससे श्रीपति तथा लीलावती में 'योगोऽन्तरेणोनयुतोऽर्धितस्तौ राशी स्मृतं संक्रमणाख्यमेतत्' इससे भास्कराचार्य ने भी आचार्योक्त संक्रमण कर्म के सदृश ही संक्रमण कर्म कहा है इति ॥९६॥

इदानीं पुनः प्रश्नान्तरं तदुत्तरं चाह ।

तद्वर्गान्तरमाद्ये तदन्तरं चान्तरोद्धृतयुतोनम् ।
वर्गान्तरं विभक्तं द्वाभ्यां शेषे ततो द्युगणः ॥९७॥

सु. भा.—आद्येऽनन्तरोक्ते प्रश्ने यदि तयोः शेषयोर्वर्गान्तरं तथा तयोरन्तरं

चोद्दिष्टं भवेत् तदा वर्गान्तरमन्तरेणोद्धृतं लब्धं चान्तरेण युतमूनं च कार्यम् । ततो द्वाभ्यां विभक्तं शेषे भवतः । ततो भागकलाशेषाभ्यां प्राग्वत् कुट्टकविधिनाऽहर्गणः साध्यः ।

अत्रोपपत्तिः । विषमकर्मणा स्फुटा ॥९७॥

वि. भा.—आद्ये (अनन्तरोक्ते) प्रश्ने यदि तयोः शेषयोर्वर्गान्तरं तथा तयोरन्तरं चोद्दिष्टं भवेत् तदा वर्गान्तरमन्तरेण भक्तं लब्धं तयोर्योगो भवेत्, लब्धमन्तरेण युतं हीनं च विधेयं द्वाभ्यां भक्तं तदा शेषे भवतः । ततोंऽशकला शेषाभ्यां पूर्ववत् कुट्टकेनाऽहर्गणज्ञानं भवेदिति ।

अत्रोपपत्तिः ।

कल्प्यते अंशशेषमानम्=य, कलाशेषमानम्=र, तदा $\frac{य^2—र^2}{य—र}$ =य+र

= $\frac{वर्गान्तर}{अन्तर}$ =यो । य—र=अन्तर, ततः संक्रमणेन $\frac{यो+अं}{२}$ =य ।

$\frac{यो—अं}{२}$ =र एतावताऽऽचार्योक्तमुपपन्नम् । अत्रापि 'वर्गान्तरमन्तरयुतहीनमित्यादि' विषमकर्म संज्ञकस्य गणितस्य पिष्टपेषणमेव कृतमाचार्येण 'वर्गान्तरं स्वान्तरहृद्युतोनं योगो द्विभक्तं विषमाख्यकर्म' अनेन श्रीपतिनाऽऽचार्योक्तविषमकर्मसदृशमेव विषमकर्मोक्तम्' भास्कराचार्येणैतस्य नाम विषमकर्म न कथ्यते; अंशकलाशेषाभ्यां पूर्ववत् कुट्टकेनाहर्गणज्ञानं भवेदेवेति ॥९७॥

अब पुनः प्रश्नान्तर और उसके उत्तर को भी कहते हैं ।

हि. भा.—यदि अंशशेष और कलाशेष का वर्गान्तर तथा उन्हीं दोनों का अन्तर उद्दिष्ट है तब वर्गान्तर को अन्तर से भाग देने से जो लब्ध हो उस में अन्तर को युत और हीन कर, दो से भाग देने से अंशशेष और कलाशेष होते हैं, इन दोनों शेषों से पूर्ववत् कुट्टक विधि से अहर्गणानयन सुगमता ही से होता है ॥९६॥

उपपत्ति ।

कल्पना करते हैं अंशशेषमान=य, कलाशेषमान=र, तब य^2--र^2=वर्गान्तर,

य—र=अन्तर $\frac{य^2—र^2}{य—र}$ = $\frac{वर्गान्तर}{अन्तर}$ =य+र=योग, अब योग और अन्तर ज्ञान से संक्रमण गणित से य, और र विदित हो जायंगे, तब अंशशेष और कलाशेष ज्ञान से पूर्ववत् कुट्टक विधि से अहर्गण ज्ञान सुगमता से हो जायगा । यहां आचार्य ने पूर्वोक्त विषमकर्मोक्त प्रक्रिया लिख कर विषम कर्म का पिष्ट पेषण किया हैं ॥९७॥

इदानीं शेषयोर्वर्गयोग-योगाभ्यां तयोरानयनमाह ।

कृतिसंयोगाद् द्विगुणाद्युतिवर्गं प्रोह्यमूलं यत् ।
तेन युतोनो योगो दलितः शेषे पृथगभीष्टे ॥९८॥

सु. भा.—एवं भवितुमर्हति ।

यदाऽनन्तरोक्ते प्रश्ने शेषयोर्वर्गयोगः शेषयोगश्चोद्दिष्टो भवेत् तदा द्विगुणात् कृतिसंयोगाच्छेषयोर्युतिवर्गं प्रोह्य शेषस्य यन्मूलं भवेत् तद्भागकलाशेषयोरन्तरं भवेत् तेन योगो युतोनो दलितः पृथगभीष्टे भागकलयोः शेषे भवतः ।

अत्रोपपत्तिः । अत्रप्रश्नानुसारेण ।

$भाशे^2 + कशे^2 = वयु$

$भाशे + कशे = यु$

$\therefore २\ भाशे^2 + २\ कशे^2 = २\ वयु$

$भाशे^2 + २\ भाशे \times कशे + कशे^2 = यु^2$, द्वयोरन्तरेण

$भाशे^2 - २\ भाशे \times कशे + कशे^2$

$= (भाशे + कशे)^2 = वयु - यु^2$

$\therefore भाशे - कशे = \sqrt{२\ वयु - यु^2}$

अवशिष्टोपपत्तिः सङ्क्रमणेन स्फुटा ।९८।।

वि. भा.—यदि पूर्वोक्तशेषयोर्वर्गयोगः शेषयोगश्चोद्दिष्टो भवेत्तदा शेषयोर्द्विगुणाद्वर्गयोगाच्छेषयोर्युतिवर्गं विशोध्य शेषस्य मूलं यत्तदंशकलाशेषयोरन्तरं भवेत् तेन योगो युतोनोऽर्धितस्तदा पृथगभीष्टेंऽशकलयोः शेषे भवेतामिति ॥

अत्रोपपत्तिः

कल्प्यते अंशशेषप्रमाणम्$=$य, कलाशेषमानम्$=$र, $य^2 + र^2 =$ वर्गयोगः । $य + र =$ युतिः$=$यु, तदा $२\ वर्गयो = २\ य^2 + २\ र^2$, $(य + र)^2 = यु^2 = य^2 + २\ य.र + र^2$ अतः $२\ वर्गयोः - यु^2 = २\ य^2 + २\ र^2 - (य^2 + २\ य.र + र^2) = २\ य^2 + २\ र^2 - य^2 - २\ य.र - र^2 = य^2 + र^2 - २\ य.र = (य - र)^2$ मूलग्रहणेन $\sqrt{२\ वयो - यु^2} = य - र =$ अंशशे$-$कलाशे, ततो विदिताभ्यामंशशेषकलाशेषयोर्योगान्तराभ्यां संक्रमणेन ते शेषे (अंशकलयोः शेषे) विदिते भवतः[1] एतेन

(१) एतस्योत्तरमन्यरीताऽपि भवति, यथा 'वर्गयोगस्य यद्राश्योर्युतिवर्गस्य चान्तरमि' त्यादि भास्करोक्त सूत्रेण $योग^2 - वर्गयो = (य + र)^2 - (य^2 + र^2) = य^2 + २\ य.र + र^2 - य^2 - र^2 = २\ य.र$ द्वाभ्यां गुणनेन $२\ (योग^2 - वर्गयो) = ४\ य.र$ ततश्चतुर्गुणस्य घातस्य युतिवर्गस्य चान्तरमि' त्यादि भास्करोक्त सूत्रेण $योग^2 - ४घात = य^2 + २\ य.र + र^2 - ४\ य.र = य^2 - २\ य.र + र^2 = (य - र)^2$ मूल ग्रहणेन $य - र =$ अन्तरम् ततः संक्रमणेन य, र अनयोर्ज्ञानं भवेदिति ॥

सूत्रमुपपन्नम् ॥९८॥

अब शेषद्वय के वर्ग योग और शेषद्वय के आनयन को कहते हैं।

हि. भा.—यदि पूर्वोक्त शेषद्वय का वर्गयोग और शेषयोग उद्दिष्ट हो तब द्विगुणित वर्गयोग में से शेष योग वर्ग को घटा कर जो शेष हो उसका मूल दोनों शेषों का अन्तर होता हैं योग में इस अन्तर को युत और हीन कर आधा करने से दोनो शेषों के प्रमाण होते हैं ॥९८॥

उपपत्ति।

कल्पना करते हैं अंश शेषमान=य, कलाशेषमान=र, $य^2+र^2$=वर्गयो। य+र=योग=यो, तब $२ वर्गयो-यो^2=२ य^2+२ र^2-(य+र)^2=२ य^2+२ र^2-(य^2+२ य.र+र^2)=२ य^2+२ र^2-य^2-२ य.र-र^2=य^2+र^2-२ य.र=(य-र)^2$ मूल लेने से $\sqrt{२ वयो-या^2}$=य—र=अंश शे—कलाशे, तब अंशद्वय के योग और अन्तर ज्ञान से संक्रमण से दोनों शेषों का मान विदित हो जायगा। इस प्रश्न का उत्तर दूसरी रीति से भी हो सकता है। जैसे 'वर्ग योगस्य यद्राश्योरि'त्यादि भास्करोक्त सूत्र से $योग^2-वर्गयो=(य+र)^2-(य^2+र^2)=य^2+२ य.र+र^2-य^2-र^2=$ २ य.र द्विगुणित करने से; $२ \{(य+र)^2-(य^2+र^2)\}=४ य र$, अब 'चतुर्गुणस्य घातस्य युति वर्गस्य चान्तरं' इत्यादि भास्करोक्त सूत्र से $योग^2-४ घात=(य+र)^2-४ य.र=य^2+२ य.र+र^2-४ य.र=य^2-२ य.र+र^2=(य-र)^2$ मूल लेने से अन्तर ज्ञान होगा तब संक्रमण से य, र का ज्ञान हो जायगा इति ॥९८॥

इदानीं पुनः प्रश्नान्तरस्योत्तरमाह।

शेषवधाद् द्विकृतिगुणात् शेषान्तरवर्गसंयुतान्मूलम्।
शेषान्तरोनयुक्तं दलितं शेषे पृथगभीष्टे ॥९९॥

सु. भा.—यदाऽनन्तरोक्ते प्रश्ने भागकलाशेषयोरन्तरं वधश्चेति द्वयमुद्दिष्टं भवेत् तदा द्विकृतिगुणात्। द्वयोर्या कृतिर्वर्गस्तेनार्थाद्वेदै ४ र्गुणाच्छेषवधाच्छेषान्तरवर्गसंयुतान्मूलं ग्राह्यम्। तच्छेषान्तरेणोनं युक्तं दलितं च पृथगभीष्टे भागकलाशेषे भवतः।

अत्रोपपत्तिः। अत्र प्रश्नानुसारेण

भाशे—कशे=अं

भाशे×कशे=व

$\therefore (भाशे-कशे)^2=भाशे^2-२ भाशे\times कशे+कशे^2=अं^2$

$४ भाशे\times कशे \quad =४ व$

द्वयोर्योगेन

भाशे^{२}+२ भाशे × कशे + कशे^{२} = (भाशे + कशे)^{२} = अं^{२} + ४ व

मूलग्रहणेन, भाशे + कशे = $\sqrt{\text{अं}^{२} + ४ \text{ व}}$

शेषवासना सङ्क्रमणेन स्फुटा ॥६६॥

वि. भा.—यदि अंशकलाशेषयोरन्तरं घातश्चेति द्वयमुद्दिष्टं भवेत्तदा द्विकृतिगुणात् (चतुर्गुणात्) शेषयोर्घाताच्छेषान्तरवर्गयुतान्मूलं यत्तच्छेषान्तरेण हीनं युक्तं तदर्धे पृथगभीष्टेंऽशकला शेषे भवेतामिति ।

अत्रोपपत्तिः ।

कल्प्यते अंशशेषमानम् = य, कलाशेषमानम् = र शेषयोरन्तरं = य−र, चतुर्गुणघातः = ४ य.र = घा अन्तर^{२} + ४ घात = (य−र)^{२} + ४ य.र = य^{२}−२ य.र + र^{२} + ४ य.र = य^{२} + २ य.र + र = (य + र)^{२} मूलग्रहणेन य + र = योग । ततः $\frac{\text{योग} + \text{अन्तर}}{२}$ = य, $\frac{\text{योग} - \text{अन्तर}}{२}$ = र, बीजगणिते 'चतुर्गुणस्य घातस्य युतिवर्गस्य चान्तरमि' त्यादिना भास्कराचार्येण राश्योर्योगवधयोर्ज्ञानाद्राश्यन्तरज्ञानार्थं विधिः प्रदर्शितः, अत्राऽऽचार्येण राश्योरन्तरवधयोर्ज्ञानाद्राशियोगज्ञानं कृतं वस्तुतोऽनयोर्न कश्चिद् भेद इति ॥९९॥

अब पुनः प्रश्नान्तर के उत्तर को कहते हैं ।

हि. भा.—यदि पूर्वोक्त प्रश्न में अंश शेष और कलाशेष का अन्तर तथा उन्ही दोनों का चतुर्गुणित घात उद्दिष्ट हो तब शेषान्तर वर्ग में चतुर्गुणित घात को जोड़ कर जो मूल हो उस में से शेषान्तर को हीन और जोड़ कर आधा करने से अभीष्ट शेषद्वय का मान होता है इति ॥६०॥

उपपत्ति ।

कल्पना करते हैं । अंशशेष = य, कलाशेष = र, दोनों शेषों का अन्तर = अं = य −र, चतुर्गुणघात = ४ य.र = ४ घा, अं^{२} + ४ घा = (य − र)^{२} + ४ य.र = य^{२} − २ य.र + र^{२} + ४ य.र = य^{२} + २ य.र + र^{२} = (य + र)^{२} मूल लेने से य + र = यो, तब $\frac{\text{यो} + \text{अं}}{२}$ = य, $\frac{\text{योग} - \text{अं}}{२}$ = र, बीजगणित में 'चतुर्गुणस्य घातस्य युतिवर्गस्य चान्तरम्' इत्यादि से भास्कराचार्य ने योग और घात के ज्ञान से राश्यन्तर ज्ञानार्थ विधि दिखलाई है । यहां आचार्य ने अन्तर और वध के ज्ञान से राशियोग ज्ञात किया है वस्तुतः इन दोनों में कुछ भेद नहीं है इति ॥६६॥

इदानीं छात्रान् स्ववक्तव्यं कथयति ।

हृन्मात्रममी प्रश्नाः प्रश्नानन्यान् सहस्रशः कुर्यात् ।
अन्यैर्दत्तान् प्रश्नानुक्तयैवं साधयेत् करणैः ॥१००॥

सु. भा.—अमी पूर्वोक्ताः प्रश्नाश्छात्राणां हृन्मात्रं हृदये बोधार्थमात्रमेव मया लिखिताः। एतान् बुद्ध्वा बुद्धिमान् सहस्रशोऽन्यान् प्रश्नान् कुर्यात्। एवमुक्तया पूर्वोक्तया करणैः साधनप्रकारैश्चान्यैर्दत्तान् प्रश्नानपि बुद्धिमान् साधयेत् प्रश्नोत्तराणीति शेषः ॥१००॥

वि. भा.—अमी पूर्वकथिताः प्रश्नाः, छात्राणां हृन्मात्रं (हृदये ज्ञानार्थमात्रमेव) मया कथिताः। एतान् ज्ञात्वा प्रतिभावान् सहस्रशोऽन्यान् प्रश्नान् कुर्यात् एवं पूर्वोक्तया करणैः (साधन प्रकारैः) अन्यैर्दत्तान् प्रश्नान् प्रतिभावान् साधयेत् (तदुत्तराणि) इति ॥१००॥

अब छात्रों को अपना वक्तव्य कहते हैं।

हि. भा.—ये पूर्व कथित प्रश्न समूह छात्रों के हृदय में केवल बोध के लिये कहे है। इन प्रश्नों को मेधावी व्यक्ति समझ कर अन्य हजारों प्रश्नों को करे, पूर्वोक्त साधन प्रकारों से अन्य व्यक्ति से दिये हुए प्रश्नों को भी बुद्धिमान् साधन करे अर्थात् उत्तर करे इति ॥१००॥

इदानीं प्रश्नप्रशंसामाह ।

जन संसदि दैवविदां तेजो नाशयति भानुरिव भानाम् ।
कुट्टाकारप्रश्नैः पठितैरपि किं पुनः शतशः ॥१०१॥

सु. भा.—गणकः कुट्टाकारप्रश्नैः पठितैरपि जनसंसदि गणकजनसभायां दैवविदां ज्योतिर्विदां तेजो नाशयति भानां भानुरिव। पुनः सूत्रैः किं वक्तव्यमस्ति। प्रश्नपाठैरेव गणको ज्योतिर्विदां मध्ये भानुरिव भवति तत्सूत्रज्ञानेन पुनः किं भवतीति वर्णनातीतमित्यर्थः ॥१०१॥

वि. भा.—कुट्टाकारप्रश्नैः पठितैरपि गणको जनसंसदि (ज्योतिर्वित्सभायां) ज्योतिर्विदां तेजो नाशयति यथा सूर्यस्याग्रे नक्षत्राणां तेजो नष्टं भवति, अर्थात्प्रश्नपठनमात्रेणैव गणको ज्योतिर्विदां संमुखे सूर्य इव भवति तदा पुनः शतशः सूत्रादिपाठेन किं भवतीति ॥१०१॥

अब प्रश्न प्रशंसा करते हैं ।

हि. भा.—कुट्टाकार प्रश्नों के पठनमात्र से ही गणक ज्यौतिषिकीसभा में ज्यौतिषिकों के तेज को नाशकरते हैं जैसे सूर्य भगवान् नक्षत्रों के तेज (प्रकाश) को नाश करते हैं। अर्थात् प्रश्नों के पठन मात्र ही से गणक ज्यौतिषिकों के मध्य में नक्षत्रों के मध्य में सूर्य की तरह होते हैं तब फिर उन सूत्रों के ज्ञान से क्या होगा अर्थात् उसका वर्णन नहीं हो सकना है इति ।। १०१ ।।

इदानीमध्यायोपसंहारमाह ।

प्रतिसूत्रममीं प्रश्नाः पठिताः सोद्देशकेषु सूत्रेषु ।
आर्यात्र्यधिकशतेन च कुट्टश्चाष्टादशोऽध्यायः ॥१०२॥

सु. भा.—प्रतिसूत्रं मयाऽमी प्रश्नाः पठिताः । एवं सोदाहरणेषु सूत्रेषु आर्यात्र्यधिकशतेनायं कुट्टक नामाऽध्यायोऽष्टादशः ।

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते ।
हृदितं विनिधाय नूतनोऽयं रचितः कुट्टविधौ सुधाकरेण ।।

इति श्री कृपालुदत्तसूनूसुधाकरद्विवेदि विरचिते ब्राह्मस्फुटसिद्धान्त नूतन तिल के कुट्टकाध्यायोऽष्टादशः ॥१८॥

वि. भा.—मया प्रतिसूत्रममी पूर्वोक्ताः प्रश्नाः पठिताः । एवमुदाहरण-सहितसूत्रेषु आर्यात्र्यधिकशतेना (त्र्यधिकशतप्रमिताऽऽर्यया) ऽयं कुट्टकनामाऽध्या-योऽष्टादशोस्तीति ।

इति श्री ब्राह्मस्फुटसिद्धान्ते कुट्टकाध्यायोऽष्टादशः समाप्तः ॥१८॥

अब अध्याय के उपसंहार को कहते हैं।

हि. भा.—हम ने पूर्वोक्त इन प्रश्नों को प्रति सूत्र में पठित किया है। एक सौ तीन आर्याओं से कुट्टक नाम का यह अठारहवां अध्याय है इति ।।१०२।।

इति ब्राह्म स्फुट सिद्धान्त में अठारहवां (कुट्टक) अध्याय समाप्त हुआ ।।१८।।

ब्राह्मस्फुटसिद्धान्तः

शंकुच्छायादिज्ञानाध्यायः

ब्राह्मस्फुटसिद्धान्तः

७

अथ शंकुच्छायादिज्ञानाध्यायः

तत्र प्रथमं प्रश्नानाह ।

दृष्ट्वा दिनार्धघटिका योऽर्कज्ञोऽक्षांशकान् विजानाति ।
उदयान्तरघटिकाभिर्ज्ञाताज्ज्ञेयं स तन्त्रज्ञः ॥१॥

सु. भा.—योऽर्कज्ञो दिनार्धघटिका दृष्ट्वाऽक्षांशकान् विजानाति । एकग्रहस्योदयाद्यावतीभिर्घटिकाभिरन्यो ग्रह उदेति ता उदयान्तरघटिकास्ताभिर्द्वयोर्ग्रहयोर्मध्ये यो ज्ञातो ग्रहोस्ति तस्माज्ज्ञातादपरं ज्ञेयं ग्रहं वा यो विजानाति स एव तन्त्रज्ञः सिद्धान्तविद्याविदित्यहं मन्य इति शेषः ॥१॥

वि. भा.—योऽर्कज्ञो दिनार्धघटिका दृष्ट्वाऽक्षांशकान् विजानाति, उदयान्तरघटिकाभिः (एकग्रहस्योदयादन्यो ग्रहो यावतीभिर्घटिकाभिरुदेति ता उदयान्तर घटिकास्ताभिः) ग्रहयोर्मध्ये यो ज्ञातग्रहो (विदितग्रहः) ऽस्ति तस्मादपरं ज्ञेयं ग्रहं वा यो विजानाति स तन्त्रज्ञो (सिद्धान्त शास्त्रवेत्ता) ऽस्तीति ॥१॥

अब शङ्कुच्छायादि ज्ञानाध्याय प्रारम्भ किया जाता है ।
उसमें पहले प्रश्नों को कहते हैं ।

हि. भा.—जो रवि के ज्ञाता दिनार्ध घटी को देख कर अक्षांश को जानते हैं अर्थात् जो व्यक्ति रवि और दिनार्ध घटी से अक्षांश को जानते हैं । वा उदयान्तर घटी (एक ग्रह के उदय से दूसरे ग्रह जितनी घटी में उदित होते हैं वे उदयान्तर घटी हैं) से दोनों ग्रहों में जो विदित ग्रह है उससे ज्ञेय (ज्ञातव्य) ग्रह को जानते हैं वे सिद्धान्त विद्या के पण्डित हैं इति ॥१॥

इदानीमन्यान् प्रश्नानाह ।

अस्तान्तरघटिकाभिर्यो ज्ञाताज्ज्ञेयमानयति तस्मात् ।
मध्यगतिं युगभगणानानयति ततः स तन्त्रज्ञः ॥२॥

सु. भा.—एकग्रहस्यास्तानन्तरमन्यो ग्रहो यावतीभिर्घटिकाभिरस्तं याति ता अस्तान्तरघटिकास्ताभिर्ज्ञाताच्चैकस्माद्ग्रहादन्यं ज्ञेयं ग्रहं य आनयति। तस्मात् स्पष्टज्ञेयग्रहात् मध्यमगतिं मध्यमज्ञेयं ग्रहं य आनयति। ततस्तस्मान्मध्यमज्ञेया-द्युगभगणान् तस्य य आनयति स एव तन्त्रज्ञ इति ॥२॥

वि. भा.— एकग्रहस्यास्तानन्तरं यावतीभिर्घटिकाभिर्द्वितीयग्रहोऽस्तं याति ता अस्तान्तरघटिकास्ताभिर्ज्ञातादेकस्माद् ग्रहाज्ज्ञेयं (ज्ञातव्यं) द्वितीयग्रहं य आनयति। वा तस्मात् स्पष्टज्ञेयग्रहात् ज्ञेयं मध्यमग्रहं य आनयति, तस्मान्मध्य-मज्ञेयग्रहात्तस्य युगभगणान् य आनयति स तन्त्रज्ञोऽस्तीति ॥२॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा.— जो व्यक्ति अस्तान्तर घटी (एक ग्रह के अस्त के बाद द्वितीय ग्रह जितनी घटी में अस्त होता है वह अस्तान्तर घटी है) से विदित एक ग्रह से ज्ञेय (ज्ञातव्य) द्वितीय ग्रह को लाते हैं अर्थात् जानते हैं। वा उस स्पष्टज्ञेय ग्रह से मध्यम ग्रह को जानते हैं वा उस मध्यम ग्रह से उसके युग भगण को जानते हैं वे सिद्धान्त विद्या के पण्डित हैं इति ॥२॥

इदानीमन्यान् प्रश्नानाह।

आनयति यस्तमोरविशशाङ्कमानानि दीपकशिखौच्च्यात्।
शङ्कुतलान्तरभूमिज्ञाने छायां स तन्त्रज्ञः ॥३॥

सु. भा.—यो राहुरविचन्द्रबिम्बमानान्यानयति। दीपकशिखौच्च्यात् प्रदीपोच्छ्रितेः शङ्कुतलान्तरभूमिज्ञाने प्रदीपतलाच्छङ्कुमूलान्तरं शङ्कुतला-न्तरम्। तदेव भूमिरिति शङ्कुतलान्तरभूमिस्तस्या ज्ञाने यश्छायामानयति स एव तन्त्रज्ञः ॥३॥

वि. भा.—यस्तमोरविशशाङ्कमानानि (राहुरविचन्द्रबिम्बमानानि) आन-यति, प्रदीपोच्छ्रितेः शङ्कुतलान्तरभूमिज्ञाने (प्रदीपतलाच्छङ्कु मूलं यावच्छंकु-तलान्तरं तदेव भूमिस्तस्याज्ञाने) छायामानयति स तन्त्रज्ञोऽस्तीति ॥३॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—जो व्यक्ति राहु–रवि और चन्द्र के बिम्बमान को जानते हैं। दीपशिखौ-च्च्य (दीप की ऊंचाई) से दीपतल और शङ्कु मूल के अन्तर को जानते हैं। शंकुतलान्तर (दीपतल और शङ्कु मूल के अन्तर) से छाया को जानते हैं वे सिद्धान्त विद्या के पण्डित हैं इति ॥३॥

इदानीमन्यं प्रश्नमाह ।

इष्टगृहौच्च्यज्ञो यस्तदन्तरज्ञो निरीक्षते तु जले ।
गृहभित्त्यग्रं दर्शयति दर्पणे वा स तन्त्रज्ञः ।।४।।

सु. भा.—य इष्टग्रहौच्च्यज्ञ आत्मस्थानात् तस्य गृहस्यान्तरज्ञश्च जले गृहभित्त्यग्रं निरीक्षते वा दर्पणे तदग्रं दर्शयति स एव तन्त्रज्ञः ।।४।।

हि. भा.—य इंष्टगृहौच्च्यज्ञाता स्वस्थानात्तस्य गृहस्यान्तरज्ञाता च जले गृहभित्त्यग्रं निरीक्षते वा दर्पणे तदग्रं दर्शयति स तन्त्रज्ञोऽस्तीति ।।४।।

अब अन्य प्रश्न को कहते हैं ।

हि. भा.—जो इष्टगृह की ऊंचाई तथा अपने स्थान से उस गृह के अन्तर का भी ज्ञाता जल में उस गृह की भीति के अग्र को देखता है वा दर्पण में उसके अग्र को दिखलाता है वह तन्त्रज्ञ हैं ।।४।।

इदानीमन्यं प्रश्नमाह ।

छायाद्वितीयभाग्रान्तर विज्ञानेन वेत्ति दीपौच्च्यम् ।
शङ्कुच्छायाज्ञो वा भूमेश्छायां स तन्त्रज्ञः ।।५।।

सु. भा.—यः शङ्कुछायाज्ञः(शङ्कोर्ये द्वे छाये ते जानातीति शङ्कुछायाज्ञः) छायाद्वितीयभाग्रान्तरविज्ञानेन छायायाः प्रथमच्छायाया द्वितीय भाग्रस्य द्वितीयच्छायाया यदन्तरं तस्य विज्ञानेन दीपौच्च्यं वेत्ति वा भूमेर्भूमिमानाच्छायां वेत्ति स एव तन्त्रज्ञः ।।५।।

वि. भा.—यः शङ्कुच्छायाज्ञः (शङ्कोर्ये छाये ते जानातीति शङ्कुच्छायाज्ञः) प्रथम छायाया द्वितीयच्छायायाश्च यदन्तरं तद्विज्ञानेन दीपौच्च्यं जानाति वा भूमिमानात् छायां जानाति स तन्त्रज्ञोऽस्तीति ।।५।।

अब अन्य प्रश्न को कहते हैं ।

हि. भा—जो शङ्कु के दो छायाओं के ज्ञाता हैं । तथा जो प्रथम छाया और द्वितीय छाया के अन्तर को जानकर दीपौच्च्य को जानते हैं वा भूमिमान से छाया को जानते हैं वे सिद्धान्त विद्या के पण्डित हैं ।।५।।

इदानीमन्यं प्रश्नमाह ।

गृहपुरुषान्तरसलिले यो दृष्ट्वाग्रं गृहस्य भूमिज्ञः ।
वेत्ति गृहौच्च्यं दृष्ट्वा तैलस्थं वा स तन्त्रज्ञः ।।६।।

सु. भा.—(गृहपुरुषान्तरसलिले यो दृष्ट्वाऽग्रं गृहस्य भूमिज्ञः ।
वेत्ति गृहौच्च्यं दृष्ट्वा तैलस्थं वा स तन्त्रज्ञः ॥६॥

पुरुषो द्रष्टा ग्रहपुरुषयोरन्तरे मध्ये स्थापितं यत् सलिलं जलं तस्मिन् गृहस्याग्रं दृष्ट्वा यो भूमिज्ञो जले यत्र गृहाग्रस्य प्रतिबिंब तस्माद्गृहान्तरं नरान्तरं च यत् तद्भूमिपदेनोच्यन्ते तज्ज्ञो गृहौच्च्यं वेत्ति वा तैलस्थं गृहाग्रं दृष्ट्वा यो भूमिज्ञो गृहौच्च्यं वेत्ति स एव तन्त्रज्ञ इत्यहं मन्य इति ॥६॥

वि. भा.—गृहपुरुषयोरन्तरे स्थापितं यज्जलं तस्मिन् गृहस्याग्रं दृष्ट्वा यो भूमिज्ञो (जले प्रतिबिम्बितस्य गृहाग्रस्य गृहस्य च यदन्तरं नरांतरं च यत्तद्भूमि-शब्देन कथ्यते तज्ज्ञाता) गृहौच्च्यं जानाति, वा तैलस्थं गृहाग्रं दृष्ट्वा यो भूमिज्ञो गृहौच्च्यं जानाति स तन्त्रज्ञोऽस्तीति अत्र पुरुषशब्देन द्रष्टा ज्ञेयः) ॥६॥

अब अन्य प्रश्नों को कहते हैं।

हि. भा.—गृह और पुरुष (द्रष्टा) के अन्तर में रखे हुए जल में गृह के अग्र को देखकर जो जल में प्रतिबिम्बित गृहाग्र और गृह के अन्तर और नरान्तर को जानने वाले गृहौच्च्य को जानते हैं, वा जो जल में प्रतिबिम्बत गृहाग्र और गृह के अन्तर और नरान्तर को जानने वाले तेलस्थित गृहाग्र को देखकर गृहौच्च्य (गृह की ऊंचाई) को जानते हैं वे सिद्धान्त विद्या के ज्ञाता है इति ॥६॥

इदानीमन्यं प्रश्नमाह।

वीक्ष्य गृहाग्रं सलिले प्रसार्य सलिलं पुनः स्वभूज्ञाने।
आनयति जलाद्भूमिं गृहस्य वौच्च्यं स तन्त्रज्ञः ॥७॥

सु. भा.—सलिले गृहाग्रं वीक्ष्य सलिलं च तस्मिन्नेव मार्गे स्थानान्तरे प्रसार्य पुनस्तस्मिन् सलिले गृहाग्रं वीक्ष्यात्मसलिलान्तरे ये वेधद्वये ते स्वभूसंज्ञे तयोर्ज्ञाने जलाद्गृहस्यान्तरं भूमिं य आनयति वा गृहस्यौच्च्यं य आनयति स एव तन्त्रज्ञ इत्यहं मन्ये ॥७॥

वि. भा.—जले गृहस्याग्रं दृष्ट्वा जलं च तस्मिन्नेव मार्गे स्थानान्तरे प्रसार्य पुनस्तस्मिन् जले गृहस्याग्रं दृष्ट्वा स्वस्य जलस्य चान्तरे ये वेधस्थानद्वये ते स्वभू-संज्ञके तयोर्ज्ञाने गृहजलयोरन्तरभूमिं य आनयति वा गृहस्यौच्च्यं य आनयति स तन्त्रज्ञोऽस्तीति ॥७॥

अब अन्य प्रश्न को कहते हैं।

हि. भा.—जल में गृह के अग्र को देखकर जलको उसी मार्ग में स्थानान्तर (दूसरे

स्थान) में फैलाकर फिर उसी जल में गृह के अग्र को देखकर अपने और जल के अन्तर में जो बेधद्वय है उसके ज्ञान से गृह और जल की अन्तरभूमि को जानते हैं वा गृहौच्च्य (गृह की ऊंचाई) को जानते हैं वे सिद्धान्त विद्या के पण्डित हैं इति ॥७॥

इदानीं प्रश्नान्तरमाह ।

ज्ञातैश्छायापुरुषैर्विज्ञाते तोयकुड्ययोर्विवरे ।
कुड्येऽर्कतेजसो यो वेत्त्यारूढिं स तन्त्रज्ञः ॥८॥

सु. भा.—तोयकुड्ययोर्जलभित्त्योर्विवरेऽन्तरे विज्ञाते छायापुरुषैर्ज्ञातैः पुरुषस्योच्छ्रित्या जले तच्छायामानेन च य आरूढिं भित्त्युच्छ्रितिं वेत्ति वाऽर्कतेजसोऽर्कप्रकाशतश्छायादिज्ञानं विज्ञायारूढिं वेत्ति स एव तन्त्रज्ञ इत्यहं मन्ये ॥८॥

वि. भा.—तोयकुड्ययोः (जलभित्त्योः) विवरे (अन्तरे) विज्ञाते छायापुरुषैर्ज्ञातैः (पुरुषस्योच्छ्रित्या जले तच्छायाप्रमाणेन च य आरूढ़ि (भित्त्युच्छ्रिति) जानाति, वा कुड्ये (भित्तौ) रवेः प्रकाशतछायादिज्ञानं विज्ञाय भित्युच्छ्रितिं जानाति स तन्त्रज्ञोऽस्तीति ॥८॥

अब प्रश्नान्तर को कहते हैं ।

हि. भा.—जल और भित्ति (दिवाल) के अन्तर को जानकर पुरुषी ऊंचाई और जल में उसके छायाप्रमाण से जो व्यक्ति भित्ति की ऊंचाई को जानते हैं वा भित्ति में रवि के प्रकाश से छायादिज्ञान जानकर भित्ति की उंचाई को जानते हैं वे सिद्धान्त विद्या के ज्ञाता हैं इति ॥८॥

अथ प्रश्नानामुत्तराणि ।

प्रथमं प्रथमप्रश्नस्योत्तरमाह ।

इष्टदिवसार्धघटिका पञ्चदशान्तरप्राणाः ।
तद्दिवसचरप्राणास्तैरक्षं साधयेत् प्राग्वत् ॥९॥

सु. भा.—(इष्टदिवसार्धघटिकापञ्चदशान्तरघटीभवाः प्राणाः ।
तद्दिवसचरप्राणास्तैरक्षं साधयेत् प्राग्वद् ॥९॥

पञ्चदशेष्टदिनार्धान्तरघटीनां ये प्राणास्ते गोलयुक्त्या चरप्राणा भवन्ति । तैश्चरासुभिरर्कात् क्रान्तिज्ञानेन च प्राग्वत् त्रिप्रश्नोत्तराध्यायविधिना गणकोऽक्षमक्षांशान् साधयेत् ॥९॥

वि. भा.—इष्टदिनार्धघटी पञ्चदशघट्योरन्तरोत्पन्ना ये प्राणाः (असवः) ते चरासवो भवन्ति, तैः (चरासुभिः) पूर्ववत् (त्रिप्रश्नोत्तराध्याय विधिना) अक्षं (अक्षांशान्) साधयेद् गणक इति ॥९॥

अत्रोपपत्तिः ।

क्षितिजाहोरात्रवृत्तयोः सम्पाताद्याम्योत्तराहोरात्रवृत्तयोः सम्पातं यावद्दिनार्धम् । उन्मण्डलाहोरात्रवृत्तयोः सम्पाताद्याम्योत्तरवृत्ताहोरात्रवृत्तयोः सम्पातं यावत्पञ्चदश घटिकाः । अनयोरन्तरं क्षितिजाहोरात्रवृत्तयोः सम्पातादुन्मण्डलाहोरात्रवृत्तयोः सम्पातं यावच्चरार्धासवः = दिनार्धघटी ∽ पञ्चदशघटी, अत्र चरार्धासुरव्योर्ज्ञानेनाक्षांशज्ञानं क्रियते । रविज्ञानेन $\frac{\text{जिज्या. रविभुजज्या}}{\text{त्रि}}$ = क्रांज्या, अस्याश्चापम् = क्रान्तिः, क्रान्तिज्ञानं जातम्, ततः $\sqrt{\text{त्रि}^2 - \text{क्रांज्या}^2}$ = द्यु. $\frac{\text{चरज्या} \times \text{द्यु}}{\text{त्रि}}$ = कुज्या, ततः $\frac{\text{कुज्या} \times १२}{\text{क्रांज्या}}$ = पलभा, तथा $\sqrt{\text{कुज्या}^2 + \text{क्रांज्या}^2}$ = अग्रा । तदा $\frac{\text{कुज्या. त्रि}}{\text{अग्रा}}$ = अक्षज्या, अस्याश्चापम् = अक्षांशाः, एतेनोत्तरं जातमिति ।

अब प्रश्नों के उत्तरों को कहते हैं ।
पहले प्रथम प्रश्न के उत्तर को कहते हैं ।

हि. भा.—इष्ट दिनार्ध घटी और पञ्चदश (१५) घटी का अन्तर जनित जो असु है वह चरार्धासु है उससे पूर्ववत् (त्रिप्रश्नोत्तराध्यायोक्त विधि से). अक्षांश साधन करना चाहिए इति ॥९॥

उपपत्ति ।

यहां किसी इष्ट दिन में रवि और चरासु विदित है, इनसे अक्षांश ज्ञान करते हैं । क्षितिजाहोरात्रवृत्त के सम्पात से याम्योत्तरवृत्ताहोरात्रवृत्त के सम्पात पर्यन्त दिनार्ध घटीहै, तथा उन्मण्डलाहोरात्रवृत्त के सम्पात से याम्योत्तरवृत्ताहोरात्रवृत्त की सम्पात पर्यन्त पञ्चदश (पन्द्रह) घटी हैं, इन दोनों का अन्तर करने से क्षितिजवृत्त और उन्मण्डल के अन्तर में अहोरात्र वृत्तीय चाप चरघटी है, यह विदित है, रवि के ज्ञान से $\frac{\text{जिज्या. रविभुज्या}}{\text{त्रि}}$ = क्रांज्या, इसका चाप = क्रान्ति, क्रान्ति ज्ञान से $\sqrt{\text{त्रि}^2 - \text{क्रांज्या}^2}$ = द्युज्या = द्यु तब $\frac{\text{चरज्या. द्यु}}{\text{त्रि}}$ = कुज्या, $\frac{\text{कुज्या. १२}}{\text{क्रांज्या}}$ = पलभा, तथा $\sqrt{\text{कुज्या}^2 + \text{क्रांज्या}^2}$ = अग्रा, अतः $\frac{\text{कुज्या. त्रि}}{\text{अग्रा}}$

=अक्षज्या, इसका चाप=अक्षांश, इससे अभीष्ट सिद्धि हो गई इति ॥९॥

इदानीमुदयान्तरघटिकाभिस्तथास्तान्तरघटिकाभिरित्यादि-
प्रश्नद्वयस्योत्तरमाह ।

ज्ञातज्ञेयग्रहयोरुदयान्तरनाड़िकाभिरधिकोनः ।
उदयैर्ज्ञातो ज्ञाताज्ज्ञेयः प्रागपरयोर्ज्ञेयः ॥१०॥

ज्ञातः सभार्धं उदयैरस्तान्तरनाडिकाभिरधिकोनः ।
ज्ञातात्पूर्वापरयोर्ज्ञेयो भार्धोनके ज्ञेयः ॥११॥

सु. भा.—ज्ञातज्ञेयग्रहयोर्या उदयान्तर घटिकास्ताभिरुदयैः स्वदेशोदयैर्ज्ञातात् प्रागपरयोः पूर्वपश्चिमयोर्ज्ञातोऽधिकोनः कार्यः । यदि ज्ञेयो ज्ञातात् पूर्वदिश्यर्थादग्रे तदा ज्ञातमर्कं प्रकल्प्य स्वदेशोदयैरुदयान्तरघटीमितेष्टे क्रमलग्नं ज्ञातात् पश्चिमस्थे च ज्ञेये विपरीतलग्नं यत् स एव स्फुटो ज्ञेयो ग्रहो ज्ञेयः । अस्तान्तरघटीज्ञाने च ज्ञातः सभार्धोऽर्कः कल्प्यः अस्तान्तरघटिका इष्टघटिकाः । अत्रापि ज्ञातात् पूर्वेऽग्रे ज्ञेये क्रमलग्नं पश्चिमस्थे च विपरीतलग्नं यत् तस्मिन् भार्धोनके सति ज्ञेयो ग्रहो भवतीति ।

अत्र वासना लग्नानयनवत् सुगमा ॥१०-११॥

वि. भा.--ज्ञातज्ञेयग्रहयोरुदयान्तरघटिकाभिः स्वदेशीयोदयैर्ज्ञातात् पूर्वदिशि स्थिते ज्ञेये तदा ज्ञातं रविं प्रकल्प्य स्वदेशीयोदयैः, उदयान्तघटीतुल्ये इष्टकाले क्रमलग्नं यद् भवेत् तथा ज्ञातात् पश्चिमदिशि स्थिते ज्ञेये विपरीतलग्नं यद् भवेत् स एव स्फुटो ज्ञेयग्रहो वाध्यः । अस्तान्तरघटिकाज्ञाने ज्ञातः षड्राशियुतः कार्यस्तं रविं प्रकल्प्य, अस्तान्तरघटिकामिष्टकालं प्रकल्प्य ज्ञातात् पूर्वे (अग्रे) ज्ञेये क्रमलग्नं साध्यं ज्ञातात् पश्चिमस्थे ज्ञेये विपरीतलग्नं साध्यं तत्र षड्राशिहीने सति स्फुटो ज्ञेयग्रहो भवतीति ॥

अत्रोपपत्तिर्लग्नानयनवद् बाध्येति ॥१०॥

अब 'उदयान्तर घटिकाभिः' तथा 'अस्तान्तर घटिकाभिः' इत्यादि प्रश्नद्वय के उत्तर को कहते हैं ।

हि. भा.—ज्ञात ग्रह से ज्ञेय ग्रह पूर्व (आगे) में हो तब ज्ञात ग्रह को रवि कल्पना कर तथा ज्ञात ग्रह और ज्ञेय ग्रह का उदयान्तर घटी को इष्ट काल मानकर स्वदेशीय उदय से क्रमलग्न जो हो वही स्फुट ज्ञेय ग्रह होता है, तथा ज्ञात ग्रह से पश्चिम में हो तब विपरीत लग्न जो होता है वही स्फुट ज्ञेय ग्रह होते हैं । अस्तान्तर घटी के विदित रहने से ज्ञात ग्रह में छः राशि जोड़कर जो हो उसको रवि कल्पना कर अस्तान्तर घटी को इष्टकाल मानकर ज्ञात ग्रह से पूर्व (आगे) में ज्ञेय ग्रह के रहने से क्रम लग्न जो हो उसमें छः राशि घटाने से

स्फुट ज्ञेय ग्रह होते हैं। तथा ज्ञात ग्रह से पश्चिम में ज्ञेय ग्रह के रहने से विपरीत लग्न जो हो उसमें छः राशि घटाने से स्फुट ज्ञेय ग्रह होते हैं इति ॥

उपपत्ति लग्नानयनवत् समझनी चाहिये ॥१०-११॥

इदानीं तस्मान्मध्यगतिं ततो युगभगणान् साधयति य इत्यस्योत्तरमाह ।

ज्ञातं कृत्वा मध्यं भूयोऽन्यदिने तदन्तरं भुक्तिः ।
त्रैराशिकेन भुक्त्या कल्पग्रहमण्डलानयनम् ॥ १२ ॥

सु. भा.— एवं स्फुटज्ञेयग्रहात् स्पष्टीकरणविलोमविधिना मध्यं ग्रहं ज्ञातं कृत्वा भूयः पुनरन्यदिने च मध्यं ग्रहं ज्ञातं कृत्वा तदन्तरं तयोरन्तरं कार्यमेवं ग्रहस्य मध्यमा भुक्तिर्भवेत् । ततो भुक्त्या त्रैराशिकेनैकस्मिन् दिने मध्यमा गतिस्तदा कल्पकुदिनैः किमिति त्रैराशिकेन कल्पग्रहभगणानयनं सुगममिति ॥१२॥

वि. भा.—स्पष्टज्ञेयग्रहात् 'स्फुटं ग्रहं मध्यखगं प्रकल्प्ये' त्यादि भास्करोक्त-सूत्रेण स्पष्टीकरणविलोमक्रियया मध्यमं ग्रहं संसाध्य पुनरन्यस्मिन् दिने तेनैव विधिना मध्यमग्रहसाधनं कार्यं तयोरन्तरमेकदिनजा ग्रहस्य मध्यमा गतिर्भवेत् । ततोऽनुपातेना 'यद्येकस्मिन् दिने इयं मध्यमा गतिस्तदा कल्पकुदिनैः किम्' न कल्प-ग्रहभगणमानानयनं स्फुटमेवेति ॥१२॥

अत्रोपपत्तिर्विज्ञानभाष्यलिखितस द्रष्टव्येति ॥१२॥

अब 'तस्मान्मध्यगतिं ततोयुत भगणमानयति यः' इसके उत्तर को कहते हैं ।

हि. भा..—स्पष्ट ज्ञेयग्रह से 'स्फुटं ग्रहं मध्यखगं प्रकल्प्य' इत्यादि भास्करोक्त सूत्र से स्पष्टीकरण की विलोम विधि से मध्यम ग्रह ज्ञान करके पुनः अन्य दिन में उसी विधि से मध्यम ग्रह ज्ञान करना चाहिये, दोनों मध्यम ग्रहों के अन्तर एक दिन सम्बन्धी ग्रह की मध्यम गति हुई, तब इस मध्यम गति से अनुपात 'यदि एक दिन में यह मध्यम गति पाते हैं तो कल्प कुदिन में क्या' से कल्प ग्रह भगणानयन स्फुट ही है इति ॥१२॥

इदानीमानयति यस्तमोरविशशाङ्कमानानीत्यस्योत्तरमाह ।

स्थित्यर्धाद्विपरीतं तमः प्रमाणं स्फुटं ग्रहणे ।
मानोदयाद्रवीन्द्वोर्घटिकावयवेन भोदयतः ॥१३॥

सु. भा.— स्थित्यर्धाद्विपरीतं विपरीतविधिना ग्रहणे स्फुटं तमः प्रमाणं भूभाबिम्बप्रमाणं भवति । अत्रैतदुक्तं भवति । स्थित्यर्धं रविचन्द्रगत्यन्तरकला-गुणं षष्टिहृतं स्थित्यर्धकला भवन्ति । तद्वर्गाच्छरवर्गयुतान्मूलं मानैक्यार्धकला-

स्ताभ्यश्चन्द्रबिम्बार्धं प्रोह्य भूभाबिम्बार्धम्। एवं विपरीतक्रमेण ज्ञेयमिति। मानोदयाद् घटिकावयवेन भोदयतः स्वदेशराश्युदयतो रवीन्द्वोर्बिम्बमाने ज्ञेये। यदा प्राक्क्षितिजे बिम्बोर्ध्वपालिदर्शनं जातं ततोऽनन्तरं यावता घटिकावयवेनाधः पालिदर्शनं जातं स घटिकावयवो वेधेन ज्ञेयः। ततः स्वदेशराश्युदयघटीभिरष्टादशशतकलास्तदा वेधोपलब्धघटिकावयवेन किमेवं बिम्बकला रवेश्चन्द्रस्य च भवन्तीति। रविबिम्बस्योर्ध्वाधरप्रदेशौ यत्र क्रान्तिवृत्ते लग्नौ तयोरुदयदर्शनेनैवैवं बिम्बकला भवन्ति। चन्द्रश्च विमण्डले भ्रमति तेनैवं चन्द्रबिम्बकलाः स्वल्पान्तराद्भवन्ति ॥१२॥

वि. भा.—स्थित्यर्धाद्विपरीतविधिना ग्रहणे स्फुटं तमः प्रमाणं (भूभाबिम्बमानं) भवत्यर्थात् 'षष्ट्या विभाजिता स्थितिविमर्ददलनाड़िके' त्याद्याचार्योक्त सूत्रेण 'स्थित्यर्धनाड़ी गुणिता स्वभुक्तिरि' त्यादि भास्करोक्तसूत्रेण वा स्थित्यर्धकलाप्रमाणं विदितं भवेत्तद्वर्गयुताच्छरवर्गान्मूलं मानैक्यार्धकला भवन्ति, तत्र चन्द्रबिम्बार्धस्य विशोधनेन भूभाबिम्बार्धं भवेदिति, भोदयतः (स्वदेशीयराश्युदयात्)मानोदयाद् घटिकावयवेन रविचन्द्रयोर्विम्बमाने ज्ञेये, अर्थात् पूर्वक्षितिजे यदा बिम्बस्योर्ध्वपालिदर्शनं भवेत्तस्माद्यावता घटिकावयवेन बिम्बस्याधः पालिदर्शनं भवेत्सघटिकावययो वेधेन ज्ञातव्यः। ततो

$\frac{१८०० \times \text{वेधोपलब्ध घटिकावयय}}{\text{स्वदेशीयराश्युदयघ}}$ ऽनुपातेनानेन रविचन्द्रयोर्बिम्बकला भवन्तीति, रविबिम्बस्योर्ध्वाधरप्रदेशौ यत्र क्रान्तिवृत्ते संलग्नौ तयोरुदयदर्शने नैवं बिम्बकला भवन्ति। परन्तु चन्द्रस्तु विमण्डले भ्रमणं करोति तस्मादेवं स्वल्पान्तराच्चन्द्रबिम्बकला भवन्ति ॥१३॥

अब 'आनयति यस्तमो रविशशाङ्कमानानि' इस प्रश्न के उत्तर को कहते हैं।

हि. भा.—स्थित्यर्ध से विपरीत विधि से अर्थात् जिस विधि से स्थित्यर्ध साधन होता है उससे विपरीत विधि से ग्रहण में स्फुट भूभाबिम्ब ज्ञान होता है, अर्थात् 'षष्ट्या विभाजिता स्थितिविमर्ददलनाड़िका' इत्यादि आचादि आचार्योक्त सूत्र से मानैक्यार्ध कला आती है उसमें से चन्द्र बिम्बार्ध को घटाने से भूभा बिम्बार्ध होता है। रवि और चन्द्र के बिम्बोदय घटिकावयव से रवि और चन्द्र का बिम्बमान जानना चाहिए अर्थात् पूर्वक्षितिज में जब बिम्बकी ऊर्ध्वपाली देखने में आवे उसके बाद जितने घटिकावय में बिम्ब के अधः पाली का दर्शन हो उस घटिकावयव को वेध से जानकर अनुपात

$\frac{१८०० \times \text{वेधोपलब्ध घटिका वयव}}{\text{स्वदेशीय राश्युदयघ}}$, से रवि और चन्द्र की बिम्ब कला होती है। रवि बिम्ब का ऊर्ध्व प्रदेश और अधः प्रदेश और क्रान्तिवृत्त में जहां लगे हुए हैं उनके देखने ही

से इस तरह बिम्बकला होती है। परन्तु चन्द्र विमण्डल में रहते हैं इसलिये चन्द्र बिम्बकला इस तरह स्वल्पान्तर से होती है इति ।।१३।।

इदानीं दीपखौच्च्याच्छङ्कुतलान्तरभूमिज्ञाने छायां य आनयतीत्यस्योत्तरमाह ।

दीपतलशङ्कुतलयोरन्तरमिष्टप्रमाणशङ्कुगुणम् ।
दीपशिखौच्च्याच्छङ्कुं विशोध्य शेषोद्धृतं छाया ।।१४।।

सु. भा.—गणिताध्यायस्य ५३ आर्येयमतस्तत्रैव स्फुटा ।।१४।।

वि. भा.—दीपतलशङ्कुतलयोरन्तरं इष्टशङ्कुगुणं दीपशिखौच्च्य शङ्क्वन्तरेण भक्तं तदा छाया भवेदिति ।।

अत्रोपपत्तिः ।

अक=दीपशिखौच्च्यम् । क=दीपतलम् । मन=शङ्कुः । न=शङ्कुतलम् । नप=छाया । नक=दीपतलशङ्कुतलयोरन्तरम्=मश, म बिन्दुतः कपरेखायाः समानान्तरा मशरेखाऽस्ति । अक—कश =अक—मन=अश=दीपशिखौच्च्य—शङ्कु । तदा अशम, मनप त्रिभुजयोः साजात्यादनुपातः

$$\frac{\text{मश} \times \text{मन}}{\text{अश}} = \text{नप} = \frac{\text{दीपशङ्कुतलान्तर} \times \text{शङ्कु}}{\text{दीपशिखौच्च्य} - \text{शङ्कु}}$$

=छाया । सिद्धान्तशेखरे "विशङ्कुना दीपशिखोच्छ्रयेण शङ्कावभीष्टाङ्गुलके विभक्ते । प्रदीपशङ्क्वन्तरमाननिघ्ने प्रभाप्रमाणं प्रवदन्ति सन्तः" श्रीपत्युक्तमिदं लीलावत्यां 'शङ्कुः प्रदीपतलशङ्कुतलान्तरघ्नश्छाया भवेद्विनरदीप शिखौच्च्यभक्तः' भास्करोक्तमिदं च आचार्योक्तानुरूपमेवास्तीति ।।१४।।

अब 'दीपशिखौच्च्याच्छङ्कुतलान्तरभूमिज्ञाने छायां य आनयति' इस प्रश्न के उत्तर को कहते हैं।

हि. भा—दीपतल और शङ्कुतल के अन्तर को इष्टशंकु से गुणा कर शङ्कुहीन दीपशिखौच्च्य से भाग देने से छाया होती है।

उपपत्ति ।

यहाँ संस्कृतोपपति में लिखित (१) चित्र को देखिये। अक=दीपशिखौच्च्य । क =दीपतल, मन=शङ्कु, न=शङ्कुतल, नप=छाया, नक=दीपतल और शङ्कुतल का

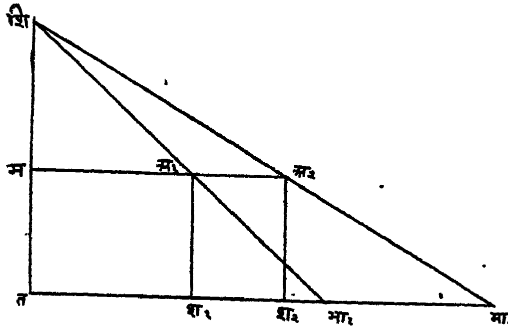
अन्तर=मश, म बिन्दु से कप रेखा की समानान्तर रेखा मश है। अक—कश=अक—मन =दीपशिखौच्च्य — शङ्कु=अश, तब अशम, मनप दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं $\frac{\text{मश} \times \text{मन}}{\text{अश}} = \frac{\text{दीप शङ्कुतलान्तर} \times \text{शङ्कु}}{\text{दीपशिखौच्च्य} - \text{शङ्कु}}$ =नप = छाया, इसमें आचार्योक्त उपपन्न हुआ। सिद्धान्तशेखर में 'विशङ्कुना दीपशिखोच्छ्रयेण' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है लीलावती में 'शंकुः प्रदीपतलशङ्कुतलान्तरघ्नः' इत्यादि संस्कृतोपपत्ति में लिखित पद्य से भास्कराचार्य ने आचार्योक्त के अनुरूप ही कहा है इति ।।१४।।

इदानीं छाया द्वितीयभाग्रान्तरविज्ञानेनेत्यादि प्रश्नोत्तरमाह।

शङ्क्वन्तरेण गुणिता छाया छायान्तरेण भक्ता भूः।
स छाया शङ्कुगुणा दीपौच्च्यं छायया भक्ता ।।१५।।

सु. भा.—छायेष्टस्य कस्यापि शङ्कोश्छाया शङ्कोरन्तरेण शङ्कुमूलान्तरेण गुणिता छाययोरन्तरेण भक्ता भूर्भवति। सा सच्छाया छायया सहिता शङ्कुगुणा छायया भक्ता च दीपौच्च्यं भवति।

अत्रोपपत्तिः।



तशि=दीपौच्च्यम्। $\quad$ अ१ श१=अ२ श२ शङ्कुप्रमाणम्।

श१ भा१=प्रथमशङ्कुच्छाया
श२ भा२=द्वितीयशङ्कुच्छाया } श२ भा२—श१ भा१=छाग्रं।

श२ भा२=शङ्क्वन्तरम्=शग्रं, भा१भा२=छायाग्रान्तरम्=भाग्राग्रं।
=श२ भा२—(श१ भा१—श१ शा२)
=श२ भा२—श१ भा१ +श२ श२ =छाग्रं+शग्रं।
ततो गणिताध्यायस्य ५४ सूत्रेण।

$\frac{(\text{छाग्रं}+\text{शग्रं})}{\text{छाग्रं}}=\text{तभा}_1$ ।

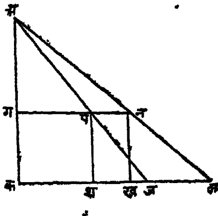
$\text{श}_1\text{त}=\text{तभा}_1-\text{श}_1\text{भा}_1=\frac{(\text{छाग्रं}+\text{शग्र}')\,\text{श}_1\text{भा}_1-\text{छाग्र}'.\,\text{श}_1\text{भा}_1}{\text{छाग्र}}$

$=\frac{\text{शग्र}'.\,\text{श}_1\text{भा}_1}{\text{छाग्र}'}$ ।

अत्राचार्येण तश, मानमेव भूसंज्ञं कल्पितमित्युपपन्नम् । द्वितीवच्छाया ग्रहणेन द्वितीया भूर्भवति । इयं भूः सच्छाया तदा छायाव्यवहारस्य ५४ सूत्रीया भूर्भवति ततो दीपौच्च्यं प्राग्वदिति । अत उपपन्नम् ॥१५॥

वि. भा.—कस्यापीष्टशङ्कोश्छाया शङ्क्वन्तरेण (शङ्कुद्वयमूलान्तरेण) गुणिता छाययोरन्तरेण भक्ता तदा भूर्भवति । सा छायया सहिता—शङ्कु-गुणिता, छायया भक्ता तदा दीपौच्च्यं भवतीति ॥१५॥

अत्रोपपत्तिः ।



पश=नख= शङ्कुद्वयम् । शख= शङ्कु मूलान्तरम् = शङ्क्वन्तरम् । अक= दीपौच्च्यम् । पश = प्रथमशङ्कुः । नख= द्वितीयशङ्कुः । शज = प्रथमच्छाया । खल=द्वितीयच्छाया । जल=छायाग्रान्तरम् । खल—शज=छायान्तरम् ।

खल—(शज—शख)=खल—शज+शख=छायान्तर+शङ्क्वन्तर ततो गणिताध्यायस्य ५४ सूत्रेण ।

$\frac{\text{प्रथमच्छाया (छायान्तर+शङ्क्वन्तर)}}{\text{छायान्तर}}=\text{कज}$, अतः कज—शज=कश ।

$=\frac{\text{प्रथमछाया (छायान्तर+शङ्क्वन्तर)}}{\text{छायान्तर}}-\text{प्रथमच्छाया}$ ।

$=\frac{\text{प्रथमच्छाया}\times\text{छायान्तर}+\text{प्रथमच्छाया}\times\text{शङ्क्वन्तर}-\text{छायान्तर}\times\text{प्रथमछाया}}{\text{छायान्तर}}$

$=\frac{\text{प्रथमच्छाया}\times\text{शङ्क्वन्तर}}{\text{छायान्तर}}=\text{कश}=\text{भूः}$ । एवमेव $\frac{\text{द्वितीयच्छाया. शंक्वन्तर}}{\text{छायान्तर}}$

=कख=भूः । कश+शज =भू+प्रथमच्छाया=कज = (छायाव्यवहारस्य ५४

सूत्रोक्त भू) । कख+खल=भू+द्वितीयच्छाया=कल=छायाव्यवहारस्य ५४ सूत्रोक्त भू, लीलावत्यां 'छायाग्रयोरन्तर सङ्गुणा भा छाया प्रमाणान्तरहृद्भु-वेद्भूरित्यत्र' भास्कराचार्येण कज, कल इत्येव भू द्वयं गृहीतम् । ततः अकज, पशज त्रिभुजयोः साजात्यादनुपातः । $\frac{\text{पश} \times \text{कज}}{\text{शज}} = \frac{(\text{५४ सूत्रोक्त भू}) \times \text{प्रथमशं}}{\text{प्रथमच्छाया}}$

=अक=दीपौच्च्यम् । एवमेव अकल, नखल त्रिभुजयोः साजात्यात् $\frac{\text{नख} \times \text{कल}}{\text{खल}}$

$= \frac{\text{द्वितीयशं (५४ सूत्रोक्त भू)}}{\text{द्वितीयच्छाया}}$ =दीपौच्च्यम् एतेनाऽऽचार्योक्त सूत्रमुपपन्नम् ।।१५।।

अब 'छाया द्वितीय भाग्रान्तर विज्ञानेन इत्यादि' प्रश्न के उत्तर को कहते हैं ।

हि. भा.—किसी इष्ट शङ्कु की छाया को शङ्कुद्वय के अन्तर (शङ्कुद्वय मूलान्तर) से गुणा कर छायान्तर से भाग देने से भू होती है, भू में छाया को जोड़ने से जो हो उसको शङ्कु से गुणा कर छाया से भाग देने से दीपौच्च्य होता है इति ।।१५।।

उपपत्तिः ।

यहां संस्कृतोपपत्ति में लिखित (१) चित्र को देखिये । पश=नख=दोनों शङ्कु । शख=शङ्कुमूलान्तर=शङ्कवन्तर । अक=दीपौच्च्य । पश=प्रथमशङ्कु । नख =द्वितीयशङ्कु । शज=प्रथमच्छाया=प्रछा, खल=द्वितीयच्छाया=द्विछा जल=छाया-ग्रान्तर, खल—शज=छायान्तर, खल—(शज—शख)=खल—शज+शख=छायान्तर +शङ्कवन्तर, तब गणिताध्याय के ५४ सूत्र से $\frac{\text{प्रछा (छायान्तर+शङ्कवन्तर)}}{\text{छायान्तर}}$ =कज

अतः कज—शज=कश= $\frac{\text{प्रछा (छायान्तर+शङ्कवन्तर)}}{\text{छायान्तर}}$ —प्रछा=

$= \frac{\text{प्रछा. छायान्तर+प्रछा शङ्कवन्तर—प्रछा छायान्तर}}{\text{छायान्तर}} = \frac{\text{प्रछा. शङ्कवन्तर}}{\text{छायान्तर}}$

=कश=भू । इसीतरह $\frac{\text{द्विछा. शङ्कवन्तर}}{\text{छायान्तर}}$ =कख=भू । कश+शज = भू+प्रछा =छायाव्यवहार की ५४ सूत्रोक्त भू । कख+खल=भू+द्विछा=कल=छायाव्यवहार की ५४ सूत्रोक्त भू, लीलावती में 'छायाग्रयोरन्तर सङ्गुणाभा 'इत्यादि श्लोक में भास्कराचार्य कज, कल इन्हीं दोनों को प्रथम भू, और द्वितीय भू कहते हैं । अब अकज, पशज दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं । $\frac{\text{पश.कज}}{\text{शज}}$ =अक= $\frac{(\text{५४ सूत्रोक्तभू}) \times \text{प्रथमशं}}{\text{प्रछा}}$

=दीपौच्च्य। इसी तरह अकल, नखल दोनों त्रिभुजों के सजातीयत्व से $\frac{\text{नख} \times \text{कल}}{\text{खल}}$

$= \frac{\text{द्वितीयशं (५४ सूत्रोक्त, भू)}}{\text{द्विछा}}$ =दीपौच्च्य। इससे आचार्योक्त उपपन्न हुआ इति ॥१५॥

इदानीं छायातो गृहादीनामौच्च्यानयनमाह।

ज्ञात्वाशङ्कुच्छायामनुपातात् साधयेत् समुच्छ्रायान्।
गृहचैत्यतरुनगानामौच्च्यं विज्ञाय वा छायाम् ॥१६॥

सु. भा.—शङ्कुच्छायां ज्ञात्वाऽनुपातादृगृहचैत्यतरुपर्वतानां समुच्छ्रायान् गणकैः साधयेत्। वा तेषामौच्च्यं विज्ञाय तेषामिष्टकाले छायां साधयेत्। इष्टकाले गृहादीनां छायाप्रमाणं ज्ञात्वा तदैवेष्टशङ्कोश्च छायाप्रमाणं विज्ञाय शङ्कुच्छायया शङ्कुप्रमाणं तदा गृहादिच्छायया किम्। एवं गृहादीनामौच्च्यं भवति। औच्च्याच्चैवमनुपातेन गृहादीनां छायां साधयेत् ॥१६॥

वि. भा.—शङ्कुच्छायां ज्ञात्वा, अनुपातात् गृहचैत्यवृक्षपर्वतानां समुच्छ्रायान् साधयेज्ज्यौतिषिकः। वा तेषामौच्च्यं विज्ञायेष्टकाले तेषां छायां साधयेदि ॥१६॥

अत्रोपपत्तिः।

यदि शङ्कुच्छायया शङ्कुप्रमाणं लभ्यते तदा गृहचैत्यवृक्षपर्वतानां छायया किमित्यनुपातेन तेषामुच्छ्रितिं प्रमाणमागमिष्यति। एवं तेषामौच्च्यज्ञानेन तेषां छायानयनमनुपातेनैव भवति यथा यदि शङ्कुना छाया लभ्यते तदा गृहादीना मौच्च्येन कि समागच्छन्ति तेषां छाया प्रमाणानीति ॥१६॥

अब छाया से गृहादियों का औच्च्या (ऊंचाई) नयन कहते हैं।

हि. भा.—शङ्कु की छाया जान कर अनुपात से गृह-चैत (माटा) वृक्ष, पर्वत इन सबों प्री उच्छ्रिति (ऊंचाई) को गणक साधन करे, वा उन सबों की उच्छ्रिति जानकर उन सबों की छाया साधन करे इति ॥१६॥

उपपत्ति।

यदि शङ्कुच्छाया में शङ्कु प्रमाण पाते हैं तो गृह-चैत्य-वृक्ष-पर्वतों की छाया में क्या इस अनुपात से उन सबों की ऊंचाई के मान आजायगा। यदि उन गृहादियों की ऊंचाई

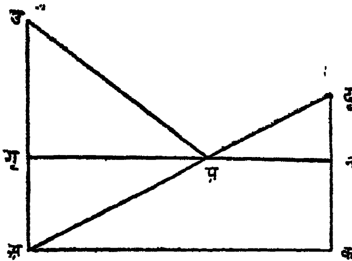
से उन सबों का छायानयन करना हो तो 'यदि शङ्कु में इष्टछाया पाते हैं तो गृहादियों के औच्च्य में क्या' इस अनुपात से गृहादियों के छायाप्रमाण आते हैं इति ॥१६॥

इदानीमिष्टगृहौच्च्यज्ञो य इत्यादि प्रश्नोत्तरमाह।

युतदृष्टिगृहौच्च्यहृता ह्यन्तरभूमिर्दृगौच्च्यसङ्गुणिता।
फलभून्यस्ते तोये प्रतिरूपाग्रं गृहस्य नरात् ॥१७॥

सु. भा.—गृहस्य नरस्य च मध्ये याऽन्तरभूमिः सा दृगौच्च्येन दृष्टच्छ्रित्या सङ्गुणिता युतदृष्टिगृहौच्च्यहृता दृष्टच्छ्रितिसंयुतगृहोच्छ्रित्या हृता। यत् फलं प्राप्तं तन्मिता भूर्नराद्गृहाभिमुखी या तत्र तोये जले न्यस्ते तस्मिन् गृहस्य प्रतिरूपाग्रमग्रस्य प्रतिबिम्बं दृश्यं भवेदिति।

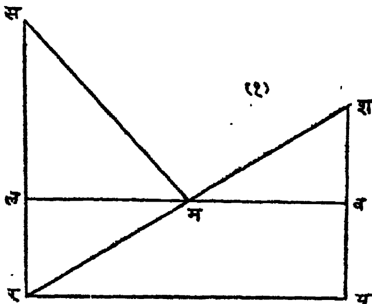
अत्रोपपत्तिः



गृन = गृहनरान्तरभूमिः = अक। गृउ = गृहौच्च्यम्। प्र = जलम्। न दृ = दृगौच्च्यम्। तदा ज्योतिर्विद्यया गृहाग्रप्रतिबिम्बं चेद् दृ — दृष्ट्या दृश्यं तदा < गृ प्र उ = < न प्र दृ। अतः गृ उ = गृ अ = न क। दृ क = न दृ + गृ उ। दृ अ क, दृ प्र न त्रिभुजे च सजातीये। ततः प्र न

$= \frac{\text{अक} \times \text{दृन}}{\text{दृन}}$। अत उपपन्नम् ॥१७॥

वि. भा.—नरात् (द्रष्टुः) गृहस्यान्तरभूमिरर्थाद् गृहनरयोर्मध्ये या भूमिः सा दृष्टच्छ्रित्या गुणिता दृष्टच्छ्रितियुतगृहौच्च्यभक्ता यत्फलं लब्धं भवेत् नराद् गृहाभिमुखं तन्मितभूमौ स्थापिते जले गृहाग्रस्य प्रतिबिम्बं दृश्यं भवेदिति।



लस = गृहौच्च्यम्। वश = दृगौच्च्यम्। म = जलम्। लव = गृहनरान्तरभूमिः = रय, गृहाग्रप्रतिबिम्बं यदि श दृष्टचा दृश्यं भवेत्तदा ज्योतिर्विद्यायाः पतितपरावर्त्तितकोणसाम्यं भवतीति सिद्धान्तात् < लमस = < वमश तथा < रमल = < वमश,

<मलर=<मलस=९० अतः रमल, लमस त्रिभुजद्वये तुल्ये (रे.प्र.अ.२६ क्षे) तेन लस=लर=वय। अतः यश=वश+लस शरय, शमव त्रिभुजयोः साजात्याद-नुपातः $\frac{\text{रय.वश}}{\text{यश}}$=वम अत उपपन्नमाचार्योक्तमिति ॥१७॥

अब 'इष्टगृहौच्च्यज्ञो यः' इत्यादि प्रश्न को उत्तर कहते हैं।

हि. भा.—गृह और नर (द्रष्टा) के मध्य में जो अन्तर भूमि है उसको दृष्टि की उच्छ्रिति (ऊंचाई) से गुणा कर गृह की उच्छ्रितियुत दृष्ट्युच्छ्रिति से भाग देने से जो लब्ध हो तत्तुल्य भूमि नर से गृह की तरफ (गृहाभिमुख) जो हो वहां जल को स्थापन करने से उस जल में गृह के अग्र के प्रति बिम्ब दृश्य होता है इति ॥१७॥

उपपत्ति।

यहां संस्कृतोपपत्ति में लिखित (१) चित्र को देखिये। लस=गृहौच्च्य, वश=दृगौच्च्य, दृष्टि की ऊंचाई, म=जल, लब=गृह और नर की अन्तर भूमि=रय, गृह के अग्र का प्रति बिम्ब यदि श दृष्टि से दृश्य होता है तब ज्योतिर्विद्या के पतित कोण और परावर्त्तित कोण की तुल्यता सिद्धान्त से ∠लमस=∠वमश तथा <रमल=<वमश, <मलर=<मलस=९०। इसलिये रमल, लमस दोनों त्रिभुज सर्वथा तुल्य हुए (रे.प्र.अ. २६ क्षे) अतः लस=लर=वय, तथा यश=वश+लस, शरय, शमव दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं $\frac{\text{रय.वश}}{\text{यश}}$ =वम, अतः आचार्योक्त उपपन्न हुआ इति ॥१७॥

इदानीं गृहपुरुषान्तरसलिले यो दृष्ट्वेत्यादि प्रश्नोत्तरमाह।

गृहपुरुषान्तरसलिले वीक्ष्य गृहाग्रं दृगौच्च्य सङ्गुणितम्।
गृहतोयान्तरमौच्च्यं गृहस्य नृजलान्तरेण हृतम् ॥१८॥

सु. भा.—गृहपुरुषयोर्मध्येयत् सलिलं स्थापितं तस्मिन् गृहाग्रं वीक्ष्य यदि गृहौच्च्यमपेक्षितं तदा गृहतोयान्तरं दृगौच्च्यसङ्गुणितं नृजलान्तरेण हृतं फलं गृहस्यौच्च्यं भवेत्। अत्रोपपत्तिः। पूर्वश्लोक क्षेत्रे गृहतोयान्तरम्=गृप्र। नृजलान्तरम्=प्र न। प्र ग्र उ, दृ न प्र त्रिभुजे च सजातीये ततः=गृ उ =$\frac{\text{गृ प्र}\times\text{न दृ}}{\text{प्र न}}$ अत उपपद्यते ॥१८॥

वि. भा.—गृहपुरुषान्तरे स्थापिते जले गृहाग्रं दृष्ट्वा यदि गृहौच्च्यज्ञानमभीष्टं तदा गृहजलान्तरं दृगौच्च्य (दृष्टयुच्छ्राय) गुणितं पुरुषजलान्तरेण भक्तं तदा लब्धं गृहस्यौच्च्यं भवेदिति।

अत्रोपपत्तिः ।

अत्र पूर्वश्लोको (१७) पपत्तौ लिखितं क्षेत्रं द्रष्टव्यम् । लस=गृहौच्च्यम् । वश=दृगौच्च्यम् । लव=गृहपुरुषान्तर भूमिः, म=जलम् । तदा सलम, शमव त्रिभुजयोः साजात्यादनुपातः $\frac{\text{वश} \times \text{लम}}{\text{वम}}$ =लस= $\frac{\text{दृगौच्च्य} \times \text{गृहजलान्तर}}{\text{पुरुषजलान्तर}}$ =गृहौच्च्यम् । एतेनोपपन्नमाचार्योक्तम् ।।१८।।

अब 'गृहपुरुषान्तर सलिले यो दृष्ट्वाग्रं' इत्यादि प्रश्न के उत्तर को कहते हैं ।

हि. भा.—गृह और पुरुष के मध्य भूमि में स्थापित जल में गृह के अग्र को देख कर यदि गृहौच्च्यज्ञान अपेक्षित हो तब गृह और जल के अन्तर को दृगौच्च्य (दृष्टि की उच्छ्रिति) से गुणा कर पुरुष और जल के अन्तर से भाग देने से लब्ध गृहौच्च्य होता है इति ।

उपपत्ति ।

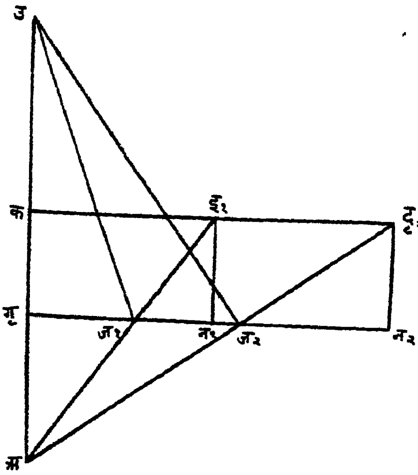
यहां पूर्व श्लोक (१७) की संस्कृतोपपत्ति में लिखित (१) क्षेत्र को देखिये । लस= गृहौच्च्य, वश=दृगौच्च्य । लव=गृह और पुरुष का अन्तर, म=जल, तब सलम और शवम दोनों त्रिभुजों में सजातीयत्व से अनुपात करते हैं $\frac{\text{वश.लम}}{\text{वम}}$ =सल= $\frac{\text{दृगौच्च्य.गृहजलान्तर}}{\text{पुरुषजलान्तर}}$ =गृहौच्च्य, इससे आचार्योक्त सूत्र उपपन्न हुआ ।।१८।।

इदानीं वीक्ष्य गृहाग्रं सलिले प्रसार्येत्यादि प्रश्नोत्तरमाह ।

प्रथमद्वितीय नृजलान्तरान्तरेणोद्धृता जलापसृतिः ।
दृगौच्च्य गुणोच्छ्रायस्तोयान्नृजलान्तरगुणा भूः ।।१९।।

सु. भा.—यत्र प्रथमं जले गृहाग्रप्रतिबिंब नरेण दृष्टं तत्र यन्नृजलान्तरं तत् प्रथमं ज्ञेयम् । एवं द्वितीयं नृजलान्तरं जानीयात् । ततो जलापसृतिर्जलयोरन्तरे भूमिः सा प्रथमद्वितीयनृजलान्तरयोरन्तरेणोद्धृता लब्धिर्द्विधा स्थाप्या । एकत्र दृगौच्च्यगुणा तदा गृहोच्छ्रायः स्यादन्यत्र नृजलान्तरेण गुणा तदा तोयाद्गृहतलपर्यन्तं भूभूमिः स्यात् ।

अत्रोपपत्तिः ।



अ गृ = गृ उ = गृहौच्च्यम् । ज$_1$, ज$_2$ प्रथम द्वितीय जलस्थाने । न$_1$, न$_2$ प्रथमद्वितीयनरस्थाने । गृ क = न$_1$ हृ$_1$ = न$_2$ हृ$_2$ = हृगौच्च्यम् । ज$_1$ ज$_2$ = जलान्तरम् = जलापसृतिः । न$_1$ न$_2$ = हृ$_1$ हृ$_2$ = नरान्तरम् । द्वयोरन्तरम् = न$_1$ न$_2$ — ज$_1$ ज$_2$ = न$_1$ न$_2$ — (ज$_1$ न$_1$ + न$_1$ ज$_2$) = न$_1$ न$_2$ — न$_1$ ज$_2$ — ज$_1$ न$_1$ = ज$_2$ न$_2$ — ज$_1$ न$_1$ ।

अ ज$_1$ ज$_2$, अ हृ$_1$ हृ$_2$ सजातीय त्रिभुजयोः क्रमेण अ गृ, अ क बहिर्लम्बः ।

$$\text{तेन}\ \frac{\text{अ क}}{\text{अ गृ}} = \frac{\text{हृ}_1\ \text{हृ}_2}{\text{ज}_1\ \text{ज}_2}\ \therefore\ \frac{\text{अ क} - \text{अ गृ}}{\text{अ गृ}} = \frac{\text{क गृ}}{\text{अ गृ}} = \frac{\text{हृ}_1\ \text{हृ}_2 - \text{ज}_1\ \text{ज}_2}{\text{ज}_1\ \text{ज}_2}$$

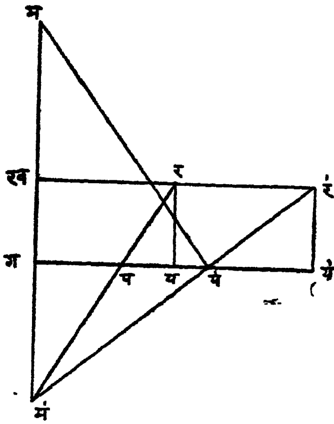
$$= \frac{\text{न}_1\ \text{न}_2 - \text{ज}_1\ \text{ज}_2}{\text{ज}_1\ \text{ज}_2}\ \text{। ततः अ गृ} = \frac{\text{हृ औ} \times \text{ज}_1\ \text{ज}_2}{\text{ज}_2\ \text{न}_2 - \text{ज}_1\ \text{न}_1}\ \text{।}$$

ततः गृ ज$_1$ उ, ज$_1$ न$_1$ हृ$_1$ सजातीयजात्ययोः ।

$$\text{गृ ज}_1 = \frac{\text{ज}_1\ \text{न}_1\ \text{ज}_1\ \text{ज}_2}{\text{ज}_2\ \text{न}_2 - \text{ज}_1\ \text{ज}_1}\ \text{। एवं गृ ज}_2\ \frac{\text{ज}_2\ \text{न}_2 \times \text{ज}_1\ \text{ज}_1}{\text{ज}_2\ \text{न}_2 - \text{ज}_1\ \text{न}_1}$$

अत उपपद्यते ॥१९॥

वि. भा.—नरेण गृहाग्रप्रतिबिम्बं जले प्रथमं यत्र दृष्टं तत्र नरजलान्तरं यत्तत् प्रथमं नरजलान्तरं बोध्यं, एवं नरेण द्वितीयं गृहाग्रप्रतिबिम्बं जले यत्र दृष्टं तत्र द्वितीयं नरजलान्तरं ज्ञेयम् । जलयोरन्तरे जलापसृतिभूमिः प्रथमद्वितीय नरजलान्तरयोरन्तरेण भक्ता लब्धिः स्थानद्वये स्थाप्या, एकत्र दृष्टचुच्छ्रायेण गुणिता गृहोच्छ्रितिर्भवेत् द्वितीयस्थाने नर जलान्तरेण गुणिता तदा जलाद् गृहतलपर्यन्तभूमिमानं भवेदिति ॥



उपपत्तिः ।

प, प' प्रथम द्वितीय जल स्थाने, य, य' प्रथम द्वितीय नरस्थाने, गम = ग'म = गृहोच्छ्रितिः । प प' = जलान्तरम् = जलापसृतिः य य' = र र' = नरान्तरम् । अनयोरन्तरम् = य' — पप' = प'य — पय, सजातीययोः म'पप', म'रर' त्रिभुजयोः क्रमेण मग, म'ख बहिर्लम्ब स्तदा $\frac{\text{म'ख}}{\text{म'ग}} = \frac{\text{र र'}}{\text{प प'}}$

उभयत्रैक शोधनेन $\frac{\text{म'ख}}{\text{म'ग}} - १ = \frac{\text{र र'}}{\text{प प'}} - १ = \frac{\text{म'ख} - \text{मग}}{\text{मग}} = \frac{\text{खग}}{\text{मग}} = \frac{\text{र र'} - \text{प प'}}{\text{प प'}}$

$= \frac{\text{य य'} - \text{प प'}}{\text{प प'}}$ अतः म'ग = मग = $\frac{\text{दृष्टच्छ्रिति} \times \text{जलान्तर}}{\text{नरजलान्तरयोरन्तरं}}$ = गृहोच्छ्रितिः । अथ गमप, परय सजात्य त्रिभुजयोः साजात्यादनुपातः $\frac{\text{पय. प प'}}{\text{प'य'} - \text{पय}}$ = गप = प्रथमजलस्थानाद् गृहतलपर्यन्त = $\frac{\text{प्रथमनरजलान्तर} \times \text{जलान्तर}}{\text{नरजलान्तरयोरन्तरं}}$, एवमेव

$\frac{\text{द्वितीय नरजलान्तर} \times \text{जलान्तर}}{\text{नर जलान्तरयोरन्तरं}}$ = द्वितीय जलस्थानाद् गृहत पर्यन्तं एतावता-ऽऽचार्योक्तमुपपन्नम् ॥१९॥

अब 'बीक्ष्य गृहाग्रं सलिले प्रसार्य' इत्यादि प्रश्न के उत्तर को कहते हैं ।

हि. भा—गृह के अग्र का प्रतिबिम्ब जल में पहले जहां देखा गया वहां जो नर और जल का जो अन्तर है उसको प्रथम नर जलान्तर समझना चाहिये । एवं द्वितीय गृहाग्र प्रतिबिम्ब में जहां देखा गया वहां नर और जल का जो अन्तर है उस को द्वितीय नर जलान्तर समझना चाहिये । दोनों जलस्थानों के अन्तर (जलापसृति) में जो भूमि है उसको प्रथम द्वितीय नर जलान्तर के अन्तर से भाग देने से जो लब्धि हो उसको दो स्थानों में स्थापित करना एक

स्थान में दृष्टि की ऊंचाई (दृगौच्च्य) से गुणा करने से गृहोच्छ्राय होता है। द्वितीय स्थान में नरजलान्तर से गुणा करने से जल से गृहतलपर्यन्त भूमि होती है इति ।

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित (१) क्षेत्र को देखिये । प = प्रथम जलस्थान । प' = द्वितीय जलस्थान । य = प्रथमनर (द्रष्टा) स्थान, य' = द्वितीय नरस्थान, गम = गम' = गृहोच्छ्रिति, पप' = जलान्तर = जलापसृति यय' = रर' = नरान्तर, इन दोनों का अन्तर = यय' — पप' । मपप', मरर' सजातीय त्रिभुजद्वय के क्रम से मग, मख' बहिर्लम्ब है । तब $\frac{\text{मख}'}{\text{मग}}$

$= \frac{\text{रर}'}{\text{पप}'}$ दोनों पक्षों में रूप घटाने से $\frac{\text{मख}'}{\text{मग}} - १ = \frac{\text{रर}'}{\text{पप}'} - १ = \frac{\text{मख}' - \text{मग}}{\text{मग}} = \frac{\text{खग}}{\text{मग}}$

$= \frac{\text{रर}' - \text{पप}'}{\text{पप}'} = \frac{\text{यय}' - \text{पप}'}{\text{पप}'}$ अतः मग = मग' $= \frac{\text{दृष्ट्युच्छ्रिति} \times \text{जलान्तर}}{\text{नरजलान्तर का अन्तर}}$ = गृहोच्छ्रिति । अथ गमप, परय, जात्य त्रिभुजद्वय के सजातीयत्व से $\frac{\text{पय. पप}'}{\text{पय}' - \text{पय}}$ = गप = प्रथमजल स्थान से गृहतलपर्यन्त $= \frac{\text{प्रथम नर जलान्तर} \times \text{जलान्तर}}{\text{नरजलान्तर द्वयान्तर}}$, इसी तरह

$\frac{\text{द्वितीयनरजलान्तर} \times \text{जलान्तर}}{\text{नरजलान्तर द्वयान्तर}}$ = द्वितीय जल स्थान से गृहतल पर्यन्त; इससे आचार्योक्त सूत्र उपपन्न हुआ इति ॥१९॥

इदानीमुच्छ्रितिमाह ।

छायापुरुषच्छिन्नं जलकुड्यान्तरमवाप्तमारूढिः ।
अध्यायो विंशत्यार्याणामेकोन विंशोऽयम् ॥२०॥

सु. *भा.*—छायाया यः पुरुषः शङ्कुभागस्तेन जलभित्योरन्तरं भक्तमत्र यदवाप्तं सा भित्तेरारूढिरुच्छ्रितिर्भवति । जलाद्यावताऽन्तरेण नरो भित्यग्रप्रतिबिंबं जले पश्यति तदन्तरमेवात्र नरस्य छाया कल्प्या । अर्कतेजसो या भित्तेश्छाया ज्ञातव्या । (छायाव्यवहारस्य प्रथमश्लोकश्च छायापुरुषार्थं द्रष्टव्यः) शेषं स्पष्टार्थम् ।

अत्रोपपत्तिः । नरस्य छायया नरप्रमाणसमोच्छ्रितिस्तदा भित्तेश्छायया किमित्यनुपातेन भित्तेरुच्छ्रितिः स्फुटा ।

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते ।
हृदि तं विनिधाय नूतनोऽयं रचितो भादिविधौ सुधाकरेण ॥

इति श्रीकृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्तनूतन-तिलके शङ्कुछायादिज्ञानं नामैकोनविंशोऽध्यायः ॥१९॥

वि. भा.—जलकुड्यान्तरं (जलभित्त्योरन्तरं) छायापुरुषच्छिन्नं (छायायाः पुरुषः शङ्कुभागस्तेन भक्तं) तदा लब्धं भित्तेरुच्छ्रितिर्भवेत्, आरूढ़िशब्देनो-च्छ्रितिर्बोध्या । जले भित्त्यग्रप्रतिबिम्बं नरो यावतान्तरेण पश्यति तदेवान्तरमत्र नरस्य छाया, रविकिरणसम्बन्धेन भित्तेश्च्छायाऽन्यत्र जलकुड्यान्तरं तदा नरस्य रविकिरणसम्बन्धेन या छाया सैव छाया बोध्येति । आर्याणां विंशत्याऽयमे-कोनविंशोध्यायोऽस्तीति ।

अत्रोपपत्तिः ।

नरस्य छायया नरतुल्योच्छ्रितिस्तदा भित्तेश्छायया किमिति समागच्छति भित्तेरुच्छ्रितिरिति ॥२०॥

इति ब्राह्मस्फुट सिद्धान्ते शङ्कुच्छायादिज्ञानं नामक एकोनविंशो-ऽध्यायः ॥१९॥

अब भित्ति की उच्छ्रिति को कहते हैं ।

हि. भा.—जल और भित्ति के अन्तर को छाया के शङ्कुभाग से भाग देने से जो लब्धि हो वह भित्ति की उच्छ्रिति (ऊंचाई) होती है । जल में नर (द्रष्टा) भित्ति के अग्र के प्रतिबिम्ब जल से जितने अन्तर पर देखता है उसी (अन्तर) को यहां नर की छाया कल्पना करनी चाहिये । रवि के तेज से भित्ति की जो छाया होती है अन्य प्रश्न में जल और भित्ति का अन्तर होता है तब रवि के तेज से नर की जो छाया होती है वही छाया समझनी चाहिये । यह बीस आर्यायों के उन्नीसवां अध्याय है इति ।

उपपत्ति ।

नर की छाया में नर प्रमाण तुल्य उच्छ्रिति पाते हैं तो भित्ति की छाया में क्या इस अनुपात से भित्ति की उच्छ्रिति आती है ॥२०॥

इति ब्राह्मस्फुट सिद्धान्त में शङ्कुच्छायादिज्ञान नामक उन्नीसवां अध्याय समाप्त हुआ ।

ब्राह्मस्फुटसिद्धान्तः

छन्दश्चित्युत्तराध्यायः

ब्राह्मस्फुटसिद्धान्तः

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अथ छन्दश्चित्युत्तराध्यायः

ऋग्वर्गः पर्यायः समूहयोगावयुक्षु युग्मेषु ।
सो याः प्राग्वत् प्राप्तादाश्चतुष्ककाः शेषयुक्तचोन्त्यः ॥ १ ॥

एकादियुतविहीनावाद्यन्तौ तद्विपर्ययौ यावत् ।
वर्गादिषु विषमयुजां क्रमोत्क्रमाद्वर्धयेत् पादान् ॥ २ ॥

एकैकेन द्व्या द्व्याः सोप्यधिकेषु तत् प्रतिष्ठेषु ।
वर्गादिरभीष्टान्तः प्रस्तारो भवति यवमध्यः ॥ ३ ॥

सूनोन्त्यो द्विपदाग्रं त्रिपदाद्यानामधः पृथक् संख्या ।
तच्छोध्यो व्येकः पृथगन्ताद्रूपमूर्ध्वयुतम् ॥ ४ ॥

यावत् पादाव्येकागच्छाद्वर्गेष्वथैक वृद्धेषु ।
रूपाद्युतघाते वर्गाद्यानां परा संख्या ॥ ५ ॥

रूपाधिकपादार्धे विषमेषूर्ध्वः समेषु पादार्धे ।
अर्धाद्द्विगुणां व्येकां युलान्यधस्तस्य सर्वेषाम् ॥ ६ ॥

माध्यैस्तथार्धहीनैःक्रमपादैर्व्यस्ततुल्यपादाद्यः ।
विषमे व्येकं मध्ये प्रोह्याद्यान्यतः कुर्यात् ॥ ७ ॥

सैकक्रम तुल्याद्यैर्न्यासोऽभ्यधिको विशोधितश्चाधः ।
संख्यैक्यं तादृक् यादृक् प्रथमस्त्रिरहितो नष्टे ॥ ८ ॥

माध्यैः कृतैश्च दलितैः समसंख्यायां क्रमोत्क्रमात्क्षेप्यम् ।
विषमायां व्येकायां दलं क्रमादुत्क्रमात्सैकम् ॥ ९ ॥

समसंख्यायां सोपानक्रमोत्क्रमाभ्यां तथैव विषमाभ्याम् ।
कल्प्यापचिते दृष्टे प्रथमः शेषाक्षराण्यन्ते ॥ १० ॥

समदल समविषमाणां संख्या पादार्ध सर्वकल्पवधः ।
स्वाद्यवधोऽन्यैः पादैः स्वपरस्य प्राग्वधः सैकैः ॥ ११ ॥

आद्यादनन्तरोऽधः कल्प्योऽन्यतुल्यमाद्यः प्राक् ।
न्यासो वर्गोऽन्योनः प्रस्तारोऽर्धसमविषमाणाम् ।। १२ ।।

नष्टेऽन्त्यात् स्वाधस्थोनकल्पघातोऽर्धतुल्यविषमाणाम् ।
व्येकः पृथक् स्ववर्गोद्धृतः फलं तुल्यकल्पानाम् ।। १३ ।।

उद्दिष्टे कल्पहृतेऽतीतैः प्रथमः फले स्वरूपेऽन्यः ।
असकृद्वर्गांशयुते सैके वार्धसमविषमाणाम् ।। १४ ।।

कल्पेषु पृथक् गुरुलघु संख्यैकादिभाजिता प्राग्वत् ।
विषमेष्वाद्यलघूनो लघुभिर्मेरुः समादीनाम् ।। १५ ।।

एकद्वितयोः परतो द्विसङ्गुणोऽनन्तराद्विरूपोऽधः ।
वर्गधराद्योनोदलसमविषमाणां ध्वजो लघुभिः ।। १६ ।।

लघुसंख्या पददलिता परतोऽधोऽधश्च शुध्यति हृता यैः ।
द्विगुणान्तैः शुद्धैर्वर्गपरैर्मन्दरो लघुभिः ।। १७ ।।

कृत्वाऽधोऽधः कल्प्यान्येकाद्येकोत्तरानधस्तेषाम् ।
स्वात्परतोऽन्यैक्यमधः प्रस्तारादुक्तवदिहाद्यैः ।। १८ ।।

गुरुषष्ट्येकानि घटीद्विगुणान्येकांगुलानि संख्या स्यात् ।
द्वाविंशतिरार्याणां छन्दश्चित्युत्तरोऽध्यायः ।। १९ ।।

इति श्रीब्राह्मस्फुट सिद्धान्ते छन्दश्चित्युत्तरोऽध्यायो विंशतितमः ।। २० ।।

ब्राह्मस्फुटसिद्धान्तः

गोलाध्यायः

ब्राह्मस्फुटसिद्धान्तः

७

अथ गोलाध्यायः

व्याख्यायते। तत्र प्रथमं तदारम्भप्रयोजनमाह।

ग्रहनक्षत्रभ्रमणं न समं सर्वत्र भवति भूस्थानाम्।
तद्विज्ञानं गोलाद्यतस्ततो गोलमभिधास्ये ॥१॥

सु. भा.—भूस्थानां जनानां सर्वत्र ग्रहनक्षत्रभ्रमणं समं न भवति। तद्भ्रमणसंस्थानविज्ञानं च यतो गोलादेव भवति ततोऽहं गोलमभिधास्ये कथयामीति ॥१॥

वि. भा.—भूगोलनिवासिनां जनानां मध्ये ग्रहाणां नक्षत्राणां च भ्रमणं सर्वत्र समं (एकरूपं) न भवति, तेषां ग्रहनक्षत्राणां भ्रमणवैषम्यस्य विज्ञानं यतो गोलात् (गोलाध्यायात्) भवति, ततोऽहं (ब्रह्मगुप्तः) गोलं (गोलाध्यायं) अभिधास्ये (कथयामि)। प्रायः सर्वेऽपि ज्यौतिषसिद्धान्तग्रन्था ग्रहगणितगोलाध्यायाभ्यां विभक्ता भवन्ति, तत्र ग्रहगणिते ग्रहसाधनादयो विधयो गोलाध्याये ग्रहसाधनादिविधीनामुपपत्तयश्च वर्णिता भवन्ति, पूर्वं ग्रहसाधनादिविधीनुक्त्वाऽधुना तदुपपत्तिं कथयतीति। सिद्धान्तशेखरे "उडुग्रहाणां भ्रमणं न तुल्यं सर्वत्र भूगोलनिवासिनां हि। तत्तत्त्वबोधावगतिस्तु गोलादतः स्फुटं गोलमिहाभिधास्ये" श्रीपतिनाप्याचार्योक्तानुरूपमेव कथ्यत इति ॥१॥

अब गोलाध्याय प्रारम्भ किया जाता है, उसमें पहले आरम्भ करने का प्रयोजन कहते हैं।

हि. भा.—भूगोल निवासी लोगों के मध्य में ग्रहों का भ्रमण और नक्षत्रों का भ्रमण सब जगह समान (एकरूप) नहीं होता है उनके भ्रमणवैषम्य का ज्ञान गोलाध्याय से होता है इसलिये मैं (ब्रह्मगुप्त) गोलाध्याय को कहता हूं। प्रायः ज्यौतिष के सब सिद्धान्त ग्रन्थ ग्रहगणित और गोलाध्याय से विभक्त होते हैं। ग्रहगणित में ग्रहसाधनादि विधियों का वर्णन रहता है और गोलाध्याय में उनकी उपपत्तियों का वर्णन रहता है। पूर्व में ग्रहसाधनादि विधियों को कह कर अब उनकी उपपत्ति कहते हैं इति ॥१॥

इदानीं भूगोलसंस्थानमाह ।

शशिबुधसितार्क कुजगुरुशनिकक्षावेष्टितो भ कक्षान्तः ।
भूगोलः सत्त्वानां शुभाशुभैः कर्मभिरुपात्तः ॥२॥

सु. भा.—अयं भूगोलः सत्त्वानां प्राणिनां शुभाशुभैः कर्मभिरुपात्तः प्राप्तो भवति । 'भूमेः पिण्डः शशाङ्कज्ञकविरवि–इत्यादि भास्करोक्तमेतदनुरूपमेव । शेषं स्पष्टम् ॥२॥

वि. भा.—चन्द्रबुधशुक्ररविकुजगुरुशनीनां कक्षावृत्तैर्वेष्टितः (आवृतः) नक्षत्रकक्षाया मध्येऽयं भूगोलोऽस्ति यश्च प्राणिनां 'शुभाशुभैः कर्मभिः प्राप्तो भवति । चन्द्रबुधशुक्रादिग्रहकक्षावृत्तानां कथमीदृशी उपर्युपरि स्थितिरस्ति तद्युक्तिज्ञानार्थं मध्यमाध्यायो द्रष्टव्यो वा मट्टीकाविभूषितो वटेश्वरसिद्धान्तस्य मध्यमाधिकारो द्रष्टव्यः भूमेः स्वरूपे मतान्तराणि सन्ति यथा "आदर्शोदरसन्निभा भगवती विश्वम्भरा कीर्त्तिता, कैश्चित् कैश्चन कूर्मपृष्ठसदृशी कैश्चित् सरोजाकृतिः । अस्माकं तु कदम्बपुष्पनिचयग्रन्थेः समा सम्मता सर्वत्रासुमतां चयेन निचिता तोयस्थलस्थायिनाम्" कैश्चित् पौराणिकैः देवतास्वरूपा भगवती पृथ्वी मुकुरतलतुल्या कथिता, कैश्चन कूर्मपृष्ठसदृशी उन्नतमध्या, कैश्चित् कमलाकारा कथिता, अस्माकं ज्यौतिषिकाणां तु कदम्बपुष्पनिचयग्रन्थेः समा, सर्वत्र जीवानां चयेन निचिताऽनुमतेति सिद्धान्तशेखरे श्रीपत्युक्तिरस्ति, सिद्धान्तशिरोमणौ 'सर्वतः पर्वतारामग्रामचैत्यचयैश्चितः । कदम्बकुसुमग्रन्थिः केसर प्रसरैरिव' भास्करोक्तिरियं श्रीपत्युक्तिसदृश्येवास्ति, परन्तु नवीनाः पृथिव्या आकृतिं दीर्घं पिण्डाकृतिसदृशीं स्वीकुर्वन्ति । ग्रहनक्षत्रकक्षावृत्तसंस्थानसम्बन्धे सिद्धान्तशेखरे 'विधुबुधसित सूर्योरेज्यपातङ्गिकक्षावलयपरिवृत्तोऽसावृक्षकक्षोदरस्थ' इत्यादि श्रीपत्युक्तिरियं सिद्धान्तशिरोमणौ 'भूमेः पिण्डः शशाङ्कज्ञकविरविकुजेज्यार्किनक्षत्रकक्षावृत्तैर्वृतो वृत्तः सन् मृदनिलसलिलव्योमतेजोमयोऽयम्' भास्करोक्तिरियं चाऽऽचार्योक्तिसदृश्येवास्तीति सम्प्रति वेधेन चन्द्रो भुवः समन्ताद् भ्रमणं करोति तथा सूर्यात् परितः क्रमेण बुधशुक्रभूमिभौमगुरुशनि नक्षत्राणि भ्रमन्तीति सिध्यति । अत एव प्राचीनानां भूस्थिरवादिनां भूपरितो ग्रहा भ्रमन्तीति वदतां मते बुधशुक्रकर्णयोर्महदन्तरमिति प्रसिद्धम् । पूर्वपश्चिमयोस्तयोर्दृश्यादृश्यत्वं च तन्मते न घटते । ग्रहाणामूर्ध्वाधरत्वं च तेषां कर्णानां ज्ञानेन स्फुटं विज्ञायते । बिम्बीयकर्णानामानयनं पूर्वमेव मध्यमाध्याये मया लिखितं तत्तत एव ज्ञातव्यम् । एवं रविग्रहबिम्बान्तरवेधेन सर्वे ग्रहा रविपरितो भ्रमन्तीति स्फुटं सम्प्रति नव्यमतेन विज्ञायत इति ॥२॥

अब भूगोल संस्थान को कहते हैं ।

हि. भा.—चन्द्र–बुध-शुक्र-रवि-मङ्गल-गुरु (बृहस्पति) शनि इन सबों के कक्षावृत्तों

से वेष्टित (घिराहुआ) नक्षत्र कक्षा के मध्य में यह भूगोल है, जो प्राणियों के शुभ-अशुभ कर्मों से प्राप्त होता है। चन्द्र बुध शुक्रादिग्रह कक्षावृत्तों की क्यों इस तरह उपर्युपरिस्थिति है इस की युक्ति के लिये मध्यगति अध्याय में लिखित उपपत्ति अथवा बटेश्वर सिद्धान्त के मध्यमाधिकार में हमारी लिखी हुई टीका देखनी चाहिये। भूगोल के स्वरूप में बहुत मतान्तर है जैसे पौराणिक लोग देवता स्वरूप भगवती पृथ्वी को अयनक के तल सदृश कहते हैं, कोई कोई कछुए की पृष्ठ के सदृश पृथ्वी के स्वरूप कहते हैं, कोई कोई कमल के आकार के सदृश कहते हैं, हमारे ज्यौतिषिकों के मत से कदम्ब फल के सदृश है और जिस तरह कदम्ब फल में सर्वत्र केसर रहता है उसी तरह इस गोलाकार पृथ्वी के ऊपर सर्वत्र प्राणियों की स्थिति है यह विषय सिद्धान्तशेखर में 'आदर्शोदरसन्निभा भगवती विश्वम्भरा' इत्यादि विज्ञान भाष्य में लिखित श्लोक से श्रीपति ने कहा है, सिद्धान्तशिरोमणि में 'सर्वतः पर्वतारामग्रामचैत्य चयैश्चितः' इत्यादि श्लोक से भास्कराचार्य ने भी श्रीपति के कथनानुसार ही कहा है लेकिन नवीन लोग पृथ्वी का आकार दीर्घपिण्डाकार मानते हैं, इसके सम्बन्ध में वटेश्वर सिद्धान्त के मध्यमाधिकार में हमारी लिखी हुई टीका देखनी चाहिये। ग्रह-नक्षत्र कक्षावृत्तों की स्थिति के सम्बन्ध में सिद्धान्तशेखर में, 'विधुबुधसितसूर्यारेज्यपातङ्गिकक्षा' इत्यादि से श्रीपति तथा सिद्धान्त शिरोमणि में 'भूमेः पिण्डः शशाङ्कज्ञ कविरविकुजेज्यार्कि नक्षत्रकक्षावृत्तैः' इत्यादि से भास्कराचार्य ने भी अचार्योक्त के अनुरूप ही कहा है। सम्प्रति वेध से चन्द्र पृथ्वी के चारों तरफ भ्रमण करती है तथा सूर्य के चारों तरफ क्रम से बुध-शुक्र पृथ्वी-मङ्गल-गुरु-शनि और नक्षत्र परिभ्रमण करते हैं यह सिद्ध होता है, इसलिये प्राचीनों के 'पृथ्वी स्थिर है उसके चारों तरफ ग्रह भ्रमण करते हैं' मत में बुध और शुक्र के कर्ण में बहुत अन्तर होता जो नहीं होना चाहिये। तथा उन (प्राचीनों) के मत में बुध और शुक्र का दृश्वादृश्यत्व नहीं घटता है। ग्रहों का ऊर्ध्वाधरत्व उन (ग्रहों) के बिम्बीय कर्णज्ञान से समझा जाता है। बिम्बीय कर्णों का आनयन प्रकार मैं पहले ही मध्यमाध्याय में लिख चुका हूं। वह वहीं से समझना चाहिये; एवं रवि और ग्रह के बिम्बान्तर वेध से रवि के चारों तरफ सब ग्रह भ्रमण करते हैं यह इस समय नवीनों के मत से समझा जाता है इति ॥२॥

इदानीं देवासुरसंस्थानमाह।

खे भूगोलस्तदुपरि मेरौ देवाः स्थितास्तले दैत्याः।
खे भगणाक्षाग्रस्थावुपर्यधश्च ध्रुवौ तेषाम् ॥३॥

सु. भा.—आकाशे भूगोलस्तदुपरि मेरुस्तत्र मेरावुपरि देवाः स्थिताः। तले मेरुतले कुमेरौ दैत्याः स्थिताः। तेषां देवदैत्यानां ख आकाशे भगणाक्षाग्रस्थौ भगणाक्षो ध्रुवयष्टिस्तदग्रस्थौ ध्रुवावुपर्यधश्च। देवानामुत्तरो ध्रुव उपरि दक्षिणोऽधो दैत्यानां दक्षिण उपरि उत्तरो ध्रुवश्चाध इति। 'सौम्यं ध्रुवं मेरुगताः खमध्ये' इत्यादि भास्करोक्तमेतदनुरूपमेव ॥३॥

वि. भा.—खे (आकाशे) भूगोलोऽस्ति, भूगोलोपरि मेरुरस्ति, मेरावुपरि भागे देवाः) स्थिताः सन्ति, मेरुतले (मेरोरधोभागे) कुमेरौ दैत्याः स्थिताः सन्ति, तेषां (देवानां दैत्यानां च) खे (आकाशे) भगणाक्षाग्रस्थौ (भगणाक्षशब्देन ध्रुवयष्टि-स्तदग्रस्थितौ) ध्रुवौ उपर्यधश्चार्थात् देवानामुत्तरो ध्रुव उपरि, दक्षिणध्रुवश्चाधः, दैत्यानां दक्षिणध्रुव उपरि, उत्तर ध्रुवश्चाध इति ।। सिद्धान्तशेखरे 'स्वमूर्धगं मेरु-गतास्तमुत्तरं तथेतरं वाड़ववा सिनो जनाः, वड़वानलवासिनः —दैत्याः । श्रीपत्यु-क्तमिदं सिद्धान्तशिरोमणौ 'सौम्यं ध्रुवं मेरुगताः खमध्ये याम्यं च दैत्या निजमस्तकोर्ध्वे, भास्करोक्तमिदं चाऽऽचार्योक्तानुरूपमेवास्तीति ।।३।।

अब देव और दैत्य के संस्थान (स्थिति) को कहते हैं।

हि. भा.—आकाश में भूगोल है, भूगोल के ऊपर मेरु है, मेरु के ऊपरी भाग में देवता लोग स्थित हैं और मेरु के अधो भाग (कुमेरु) में दैत्य लोग स्थित हैं। उन देवताओं और दैत्यों के आकाश में ध्रुवयष्टी के अग्रद्वय में स्थित दोनों ध्रुव ऊपर और नीचे है अर्थात् उत्तर ध्रुव देवों के ऊपर है दक्षिण ध्रुव नीचे में है और दैत्यों का दक्षिण ध्रुव ऊपर में है उत्तर ध्रुव नीचे में है ।। सिद्धान्तशेखर में 'स्वमूर्धगं मेरुगतास्तमुत्तरं' इत्यादि विज्ञान भाष्य में लिखित पद्य से श्रीपति तथा सिद्धान्त शिरोमणि में 'सौम्यं ध्रुवं मेरुगताः खमध्ये' इत्यादि वि. भा. लिखित पद्य से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा हैं इति ।।३।।

इदानीं देवानां दैत्यानां च भचक्रभ्रमणव्यवस्थामाह।

ध्रुवयोर्बद्धं सव्यगममराणां क्षितिजसंस्थमुडुचक्रम् ।
अपसव्यगमसुराणां भ्रमति प्रवहानिलाक्षिप्तम् ।।४।।

सु. भा.—स्पष्टम् । 'सव्यापसव्यं भ्रमदृक्षचक्रम्' इत्यादि भास्करोक्तमेत-दनुरूपमेव ।।४।।

वि. भा.—प्रवहवायुना प्रेरितं ध्रुवयष्ट्यधीनं देवानां क्षितिज संसक्तं भचक्रं सव्यगं भ्रमति, दैत्यानामपसव्यगं भ्रमत्यर्थादुत्तरं क्रान्तिमण्डलार्धं देवाः सव्यगं पश्यन्ति, दक्षिणं तदर्धं—अपसव्यगं दैत्याः पश्यन्ति, सव्यगमिति पश्चिमाभिमुखं भ्रमत् अपसव्यगं च पूर्वाभिमुखं भ्रमदित्यर्थः। चलद् भमण्डलं स्वक्षितिजगतं देवा दैत्याश्च पश्यन्ति, तत्क्षितिजमण्डलेन सह क्रान्तिवृत्तस्य स्थानद्वये योग इति नक्षत्रचक्रं क्षितिजवृत्तस्थितमुपचर्यते। दक्षिणं क्रान्तिवृत्तार्धं कदाचिदपि देवैर्नावेक्ष्यते उत्तरं क्रान्तिवृत्तार्धं दैत्यैर्नावेक्ष्यत इति ।। सिद्धान्तशेखरे 'सौम्यं हि मेषाद्यप-मण्डलार्धं पश्यन्त्यमी सव्यगमेव देवाः। तुलादिकं दक्षिणमन्यदर्धं सदैव दैत्यास्त्व-

पसव्यवर्त्ति, श्रीपत्युक्तमिदं सिद्धान्तशिरोमणौ 'सव्यापसव्यं भ्रमदृक्षचक्रं विलोकयन्ति क्षितिजप्रसक्तम्' भास्करोक्तमिदं चाऽऽचार्योक्तानुरूपमेवेति ॥४॥

अब देवों और दैत्यों की भचक्र-भ्रमण-व्यवस्था को कहते हैं ।

हि. भा.—प्रवह वायु द्वारा प्रेरित ध्रुव यष्टी के अधीन (अर्थात् ध्रुव यष्टी के घूमने से घूमने वाला) देवों का क्षितिज वृत्त संसक्त भचक्र सव्य घूमता है, और दैत्यों का अपसव्य घूमता है, अर्थात् क्रान्तिमण्डल के उत्तरार्ध को देव सव्यग देखते हैं, क्रान्ति मण्डल के दक्षिणार्ध को दैत्य अपसव्यग देखते हैं, सव्यग से पश्चिमाभिमुख भ्रमण करते हुए और अपसव्यग से पूर्वाभिमुख भ्रमण करते हुए समझना चाहिए । सिद्धान्तशेखर में 'सौम्यं हि मेषाद्यपमण्डलार्ध' इत्यादि विज्ञान भाष्य में लिखित श्लोक से श्रीपति तथा सिद्धान्त शिरोमणि में 'सव्यापसव्यं भ्रमदृक्षचक्र'' इत्यादि से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है इति ॥४॥

इदानीं चक्रभ्रमणव्यवस्थामाह ।

अन्यत्र सर्वतो दिशमुन्नमति भपञ्जरो ध्रुवो नमति ।
लङ्कायामुडुचक्रं पूर्वापरगं ध्रुवौ क्षितिजे ॥५॥

सु. भा.—अन्यत्र मेरुतोऽन्यत्र सर्वतो दिशं भूगोले भपञ्जरो भचक्रमुन्नमति ध्रुवश्च नमति । लङ्कायामुडुचक्रं भचक्रं पूर्वापरगं सममण्डलाकारं ध्रुवौ च क्षितिजे स्त इति । आचार्येण यथा यथा मेरुतो द्रष्टा सर्वतो दिशं याति तथा तथा ध्रुवो नमतीत्युक्तम् । भास्करेण लङ्कामेव मूलस्थानं प्रकल्प्य स्थितिः प्रतिपादिता 'अतो निरक्षदेशे क्षितिमण्डलोपगौ ध्रुवौ नरः पश्यति दक्षिणोत्तरौ' इत्यादि भास्करोक्तमेतदनुरूपमेव ॥५॥

वि. भा.—मेरुतोऽन्यत्र सर्वतो दिशं पृथिव्यां भपञ्जरः (भचक्रं) उन्नमति, ध्रुवश्च नमति, लङ्कायां भचक्रं पूर्वापरगं सममण्डलाकारं ध्रुवौ च तत्क्षितिजे स्तः । द्रष्टा मेरुतो यथा यथा सर्वतो दिशं याति तथा तथा ध्रुवो नमतीत्याचार्येणोक्तम् । लङ्कामेव मूलस्थानं मत्वा भास्कराचार्येण स्थितिः प्रतिपादिता तेन 'निरक्षदेशे क्षितिमण्डलोपगौ ध्रुवौ नरः पश्यति दक्षिणोत्तरावि'त्यादि भास्करोक्ताऽऽचार्योक्त्योर्न कोऽपि भेदः, अर्थात् मेर्वभिमुखं गच्छतो नरस्योत्तरध्रुवोन्नतिस्तथा भचक्रस्य नतिर्भवति, एवमुत्तरभागतो निरक्षदेशाभिमुखं गच्छतो नरस्य विपरीते नतोन्नते भवतोऽर्थादुत्तरध्रुवस्य नतिर्भचक्रस्योन्नतिर्भवति, 'उदग्दिशं याति यथा यथा नरः' इत्यादि भास्करोक्तेरिदं स्फुटमस्ति, निरक्षाद्बहुत्रोत्तरदेशेऽपि उत्तरध्रुव-दर्शनं न भवत्यतोऽत्र सिद्धान्तप्रतिपादने भूपृष्ठावरोधनमनङ्गीकृत्य भूगर्भतः सर्वं विचार्यम् ध्रुवयोर्बद्धं भचक्रं प्रवहवायुनाऽऽक्षिप्तं सततं पश्चिमाभिमुखं

भ्रमति । चन्द्रादीनां ग्रहाणां कक्षाश्च तस्मिन् भचक्रे बद्धा भ्रमन्तीति ॥ सूर्यसिद्धान्ते "ध्रुवोन्नतिर्भचक्रस्य नतिर्मेरुं प्रयास्यतः । निरक्षाभिमुखं यातुर्विपरीते नतोन्नते ॥ भचक्रं ध्रुवयोर्बद्धमाक्षिप्तं प्रवहानिलैः । पर्येत्यजस्रं तन्नद्धा ग्रहकक्षा यथाक्रमम्" इति सूर्यांशपुरुषोक्तसदृशमथवाऽऽचार्योक्तं चेति ॥५॥

अब चक्रभ्रमण व्यवस्था को कहते हैं ।

हि. भा.—मेरु से अन्यत्र सब दिशाओं में भचक्र की उन्नति होती है और उत्तर ध्रुव की नति होती है । लङ्का में भचक्र सममण्डलाकार है और दोनों ध्रुव लङ्का क्षितिज में हैं । द्रष्टा मेरु से ज्यों ज्यों सब दिशाओं में जाते हैं त्यों त्यों ध्रुव की नति होती है यह आचार्य का कथन है, परन्तु लङ्का ही को मूल स्थान मानकर भास्कराचार्य ने स्थिति का प्रति पादन किया है इसलिये 'निरक्षदेशे क्षितिमण्डलोपगौ' इत्यादि भास्कराचार्योक्ति और आचार्योक्ति में कुछ भी भेद नहीं है । अर्थात् मेरु की ओर जाते हुए मनुष्य को उत्तर ध्रुव की उन्नति और भचक्र की नति देखने में आती है । एवं उत्तर भाग से निरक्ष देशाभिमुख जाते हुए मनुष्य को नति और उन्नति विपरीत देखने में आती हैं अर्थात् उत्तर ध्रुव की नति और भचक्र कीं उन्नति देखने में आती है । 'उदग्दिशं याति यथा यथा नरः' इत्यादि भास्करोक्ति से यह स्फुट है । निरक्षदेश से उत्तर भी बहुत देशों में उत्तर ध्रुव का दर्शन नहीं होता है, इसलिए यहां सिद्धान्त कहने में भूपृष्ठजनित अवरोध को स्वीकार न कर भूगर्भ ही से सब कुछ विचार करना चाहिए ॥ सूर्य सिद्धान्त में भी 'ध्रुवोन्नतिर्भचक्रस्य' इत्यादि विज्ञान भाष्य में लिखित श्लोकों से इन्हीं बातों को कहा गया है इति ॥५॥

इदानीं देवादीनां रविभ्रमणस्थितिं कथयति ।

देवाः[1] सव्यगमसुराः पश्यन्त्यपसव्यगं रविं क्षितिजे ।
विषुवति समपश्चिमगं निरक्षदेशस्थिताः पुरुषाः ॥६॥

सु० भा०—विषुवति मेषतुलादौ देवाः क्षितिजे रविं सव्यगमसुरा अपसव्यगं निरक्षदेशस्थाः पुरुषाश्च समपश्चिमगं पश्यन्तीति प्रसिद्धम् ॥६॥

वि. भा.—देवा दैत्याश्च नाडीमण्डलरूपक्षितिजे विषुवति (सायनमेषतुलादौ) क्रमशः सव्यगमपसव्यगं रविं पश्यन्ति । निरक्ष देशवासिनस्तं रविं (सायनमेषादौ सायनतुलादौ च स्थितं सूर्यं) पूर्वापरवृत्तानुकारे नाड़ीवृत्ते पश्यन्तीति ॥६॥

अब देवादियों की रवि भ्रमण स्थिति को कहते हैं ।

हि. भा.—नाड़ी मण्डल रूपक्षितिज में सायन मेषादि में और सायनतुलादि में

(१) 'देवासुरा विषुवति क्षितिजस्थं दिवाकरम् । पश्यन्ति' इति सूर्य सिद्धान्तेऽप्येवमेवास्ति ।

सव्यगत रवि को देवता लोग देखते हैं और दैत्य लोग अपसव्यगत देखते हैं। निरक्ष देश वासियों के नाड़ीवृत्त पूर्वापर वृत्त हैं इसलिए वे लोग तब (सायन मेषादिस्थित सूर्य को और सायन तुलादि स्थित सूर्य को) पूर्वापर वृत्तगत देखते हैं इति ॥६॥

इदानीं देवदैत्ययोराशिसंस्थानमाह ।

सौम्यमपमण्डलार्धं मेषाद्यं सव्यगं सदा देवाः ।
पश्यन्ति तुलाद्यर्धं दक्षिणमपसव्यगं दैत्याः ॥७॥

सु. भा.—देवाः सदा मेषाद्यं सौम्यमुत्तरं क्रान्तिमण्डलार्धं सव्यगं दैत्याश्च तुलादिक्रान्तिमण्डलार्धं दक्षिणमपसव्यगं पश्यन्ति ।

अत्रोपपत्तिः ।

गोलसंस्थानेन 'लम्बाधिका क्रान्तिरुदक् च यावत्'—इत्यादि भास्करविधिना स्फुटा ॥७॥

वि. भा.—देवाः सर्वदा मेषाद्यमुत्तरं क्रान्तिवृत्तार्धसव्यगं पश्यन्ति । दैत्याः तुलादिक्रान्तिवृत्तार्धं दक्षिणं (अपसव्यगं) पश्यन्तीति ।

अत्रोपपत्तिः ।

मेरौ कुमेरौ चाक्षांशा नवतिः=९०, अतो लम्बांशाः=०, तेनमेषादिषण्णां राशीनां क्रान्तेर्लम्बांशाधिकत्वात्तदहोरात्रवृत्तानां तत्क्षितिजोर्ध्वगतत्वाच्च तत्र स्थितं रविं देवाः सर्वदा पश्यन्ति। एवमेव तुलादिषण्णां राशीनां क्रान्तेरपि लम्बांशाधिकत्वात्तदहोरात्रवृत्तानां तक्षितिजोर्ध्वगतत्वात्तेषु राशिषु स्थितं सूर्यं सर्वदा दैत्याः पश्यन्त्येव। दिनरात्रिसम्बन्धे सिद्धान्तशिरोमणौ 'लम्बाधिका क्रान्तिरुदक् च यावत्तावद्दिनं संततमेव तत्र। यावच्च याम्या सततं तमिस्रा' इत्येवं भास्करेण यत् कथितं तेनैव स्फुटमस्तीति ॥७॥

अब देवों के और दैत्यों के राशि संस्थान को कहते हैं ।

हि. भा.—देवता लोग मेषादि उत्तर क्रान्तिवृत्तार्धं को सर्वदा सव्यगत देखते हैं। तथा दैत्य लोग तुलादि क्रान्तिवृत्तार्धं को अपसव्यगत देखते हैं इति ॥७॥

उपपत्ति ।

मेरु में और कुमेरु में अक्षांश=९०, अतः लम्बांश शून्य=०, है इसलिये मेषादि (उत्तर गोलीय) छः राशियों की क्रांतियों के लम्बांशाधिक होने के कारण उन राशियों के अहोरात्रवृत्तों के क्षितिजवृत्त से ऊपर होने से उन राशियों में स्थित सूर्य को सर्वदा देखते हैं।

एवं तुलादि (दक्षिणगोलीय) छः राशियों की क्रान्तियों के लम्बांशाधिक होने के कारण उन राशियों में स्थित सूर्य को दैत्य लोग सर्वदा देखते हैं, सिद्धान्त शिरोमणि में 'लम्बाधिका क्रान्तिरुदक्' इत्यादि संस्कृतोपपत्ति में लिखित भास्करोक्त श्लोक से यह स्पष्ट है। सूर्य सिद्धान्त में 'देवासुरा विषुवति क्षितिजस्थं दिवाकरम् । पश्यन्ति' इससे सूर्यांश पुरुष आचार्योक्त के सदृश ही कहा है इति ॥ ७ ॥

इदानीं देवदैत्ययोः पितृमानवयोश्च दिनप्रमाणमाह ।

पश्यन्ति देवदैत्या रविवर्षार्धमुदितं सकृत् सूर्यम् ।
शशिगाः शशिमासार्धं पितरो भूस्था नराः स्वदिनम् ॥८॥

सु. भा.—देवदैत्याः सकृदुदितं सूर्यं रविवर्षार्धं सौरवर्षदलपर्यन्तं शशिगाः शशिपृष्ठस्थाः पितरश्च शशिमासार्धं पर्यन्तं भूस्था नराश्च स्वदिनं स्वदिनमानपर्यन्तं पश्यन्ति ।

अत्रोपपत्तिः । भास्करगोलाध्यायतः स्फुटा ॥८॥

वि. भा.—देवा दैत्याश्च सकृदुदितं सूर्यं सौरवर्षार्धं पश्यन्ति । शशिगाः (चन्द्रपृष्ठस्थाः) पितरश्चान्द्रमासार्धं रविं पश्यन्ति । पृथिव्यां स्थिता मनुष्याः स्वदिनमानपर्यन्तं रविं पश्यन्तीति ।

अत्रोपपत्तिः ।

उत्तरध्रुवो देवानां खस्वस्तिकम् । दक्षिणध्रुवश्च दैत्यानां खस्वस्तिकम् । ध्रुवाभ्यां नवत्यंशेन यद्वृत्तं तन्नाडीवृत्तं देवदानवयोः क्षितिजवृत्तम् । नाडीवृत्तक्रान्तिवृत्तयोः सम्पाते सायनमेषादौ सायनतुलादौ च रविदर्शनानन्तरं पुनस्तत्सायनमेषादौ सायनतुलादौ च रविदर्शनं यावता कालेन भवेत् स रवेरेकभगणः (सायनरविभगणः) देवदैत्ययोरहोरात्रप्रमाणं भवति, परन्त्वेकसायनभगणभोगः सौरवर्षमतो देवदैत्ययोः सायनसौरवर्षार्धं (षण्मासप्रमाणं) दिनं सिद्धम् । परन्तु देवदैत्ययोर्दिनरात्री विलोमेन भवतोऽर्थाद्यदा मेषादावुदितं रविं प्रतिदिनं क्षितिजोपरिगतं देवाः पश्यन्ति तदा देवानामधःस्थितत्वाद्दैत्यास्तं रविं न पश्यन्ति, अतो यदा देवानां दिनं तदा दैत्यानां रात्रिः, यदा देवानां रात्रिस्तदा दैत्यानां दिनमिति । सिद्धान्तशेखरे "सकृदुद्गतो दिनकरः सुरासुरैरपि वत्सरार्धमवलोक्यते स्फुटम् । पितृभिश्च मासदलमिन्दुगोलगैर्द्युदलं महीतलगतैश्च मानवैः" श्रीपतिनाऽनेनाक्षरश आचार्योक्तानुरूपमेव कथितम् । अस्योपपत्तिर्दिनरात्रिस्वरूपे च सिद्धान्तशिरोमणौ ।

"विषुवद्वृत्तं द्युसदां क्षितिजत्वमितं तथा च दैत्यानाम् ।
उत्तरयाम्यौ क्रमशो मूर्ध्वोर्ध्वगतौ ध्रुवौ यतस्तेषाम् ॥

उत्तरगोले क्षितिजादूर्ध्वं परितो भ्रमन्तमादित्यम् ।
सव्यं त्रिदशाः सततं पश्यन्त्यसुरा असव्यगं याम्ये ॥

सांहितिका उत्तरायणदक्षिणायने देवानां दिनरात्री भवत इति कथयन्ति एतस्य खण्डनं सिद्धान्तशेखरे ।

दिनप्रवृत्तिर्मरुतामजादौ तुलाधरादौ च निशाप्रवृत्तिः ।
ते कल्पिते यैर्मृगकर्कयोरत्रोपपत्तिं न च ते ब्रुवन्ति ॥
द्वन्द्वान्तयातं कनकाद्रियाताः पश्यन्ति पङ्क्तेरुहिणीपतिं चेत् ।
अपक्रमस्यात्र समानतायां कथं कुलीरे न विलोकयन्ति ॥

देवानां मेषादौ सूर्ये दिनारम्भः, तुलादौ च रात्र्यारम्भः, यैः सांहितिकैस्ते दिनरात्री मकरकर्कयोः कल्पिते तेऽत्र युक्तिं न कथयन्ति । अर्थात् कथमुत्तर-दक्षिणायने देवानां दिनरात्री भवत इत्यत्र ते सांहितिकाः काञ्चिद्युक्तिं न वदन्ति । देवा मिथुनान्तस्थितं सूर्यं यदि पश्यन्ति तदा कर्कराशौ क्रान्तेः समत्वे कथं न पश्यन्तीति प्रश्नः । अस्य किमप्युत्तरं न तेन 'अत्रोपपत्तिं न च ते ब्रुवन्ति' कथनमिदं युक्तम् । श्रीपतिरत्नमालायाम्—

"शिशिरपूर्वमृतुत्रयमुत्तरं ह्ययनमाहुरहश्च तदामरम् ।
भवति दक्षिणमन्य दृतुत्रयं निगदिता रजनी मरुतां च सा ॥
गृहप्रवेशत्रिदशप्रतिष्ठाविवाह चौलव्रत बन्धपूर्वम् ।
सौम्यायने कर्म शुभं विधेयं यद्गर्हितं तत्खलु दक्षिणे च ॥"

इत्यनेन श्रीपतिरपि संहितोक्तफलादेशार्थं—उत्तरदक्षिणायने एव दिनरात्री कथयित्वाऽत्र ज्यौतिष सिद्धान्ते "अत्रोपपत्तिं न च ते ब्रुवन्ती" ति तदुपहासं करोतीति ॥

पितृदिनोपपत्तिः ।

चन्द्रस्योर्ध्वभागे पितरो निवसन्ति । भूगर्भाच्चन्द्रकेन्द्रगता रेखा पितृरणामूर्ध्व-याम्योत्तरवृत्ते यत्र लगति तत्र तेषामूर्ध्वखस्वस्तिकम्, तत्रैव परिणतचन्द्रोऽपि, यदि तत्र रविरपि भवेच्चन्द्रस्य शराभावश्चेत्तदा रविचन्द्रयोरेकत्र स्थित्वाद्दर्शान्तः, ऊर्ध्वखस्वस्तिकगते रवौ दिनार्धं भवति तेन दर्शान्ते पितृणां दिनार्धं भवतीति सिध्यति, सैव भूगर्भतश्चन्द्रकेन्द्रगता रेखाऽधोयाम्योत्तरवृत्ते यत्र लगति, तत्र तेषामधः खस्वस्तिकम् । तत्र रविचन्द्रयोः षड्भान्तरत्वात् पूर्णान्तः पितृणामर्धरा-त्रश्च, पितृणाममावास्यां मध्यान्हत्वात् पूर्णान्ते च रात्र्यर्धत्वात्तारतम्येन कृष्ण-पक्षस्य सार्धसप्तम्यां रविरुदेति शुक्लपक्षस्य सार्धसप्तम्यां चास्तमेतीति सिध्यति ।

सिद्धान्तशेखरे "चान्द्रे गोले शिरसि पितरः सन्ति तेषां च पर्वण्यूर्ध्वे भास्वान् भवति हि ततस्तत्र तद्वासरार्धम् । कृष्णाष्टम्यां सवितुरुदयोऽस्तं च शुक्लाष्टमी चेत् ? प्रोक्तस्तेषामिह मुनिवरैः पौर्णमास्यां निशीथः ॥" श्रीपतिनैवं कथ्यते। दर्शान्ते पितृदिनार्धम्, द्वितीयदर्शान्तेऽपितृदिनार्धं भवति, दर्शान्तद्वययोरन्तरं चान्द्रमासः, परन्तु दिनार्धान्तरकालः सूर्योदयान्तरकालतुल्यः। सूर्योदयद्वयान्तर-कालश्चैकं दिनं तेन सिद्धं यत्पितृणामेकचान्द्रमासतुल्यं दिनं भवति । तेन चन्द्रोर्ध्वभागे वसन्तः पितरः सकृदुदितं रविं चान्द्रमासार्धं (पक्षपर्यन्तं) पश्यन्तीति सिद्धम् । सूर्यसिद्धान्ते 'सकृदुद्गतमब्दार्धं पश्यन्त्यर्कं सुरासुराः । पितरः शशिगाः पक्षं स्वदिनं च नरा भुवि' सूर्यांशपुरुषोक्तस्यास्य सदृशमेवाऽऽचार्योक्तमस्ति, सिद्धान्त शिरोमणौ 'रवीन्द्वोर्युतेः संयुतिर्यावदन्या विधोर्मास एतच्च पैत्रं द्युरात्र' मिति भास्करोक्तमाचार्योक्तानुरूपमेव। तथा च भास्करः ।

"विधूर्ध्वभागे पितरो वसन्तः स्वाधः सुधादीधितिमामनन्ति ।
पश्यन्ति तेऽर्कं निजमस्तकोर्ध्वे दर्शे यतोऽस्माद् द्युदलं तदैषाम् ।
भार्धान्तरत्वान्न विधोरधःस्थं तस्मान्निशीथः खलु पौर्णमास्याम् ।
कृष्णेरविः पक्षदलेऽभ्युदेति शुक्लेऽस्त मेत्यर्थत एव सिद्धम् ।"

यस्मिन् वृत्ते ग्रहबिम्बं भ्रमति तदन्तर्गतो द्रष्टा यदि सर्वदा ग्रहबिम्बस्यैकं भागमेव पश्यति तदा ग्रहबिम्बं स्वाक्षोपरिस्वाङ्गभ्रमं करोति। यथा यदा वयं देव-मन्दिरस्य प्रदक्षिणां कुर्मस्तदा भ्रमणवृत्तान्तर्गतो द्रष्टा सर्वदाऽस्मद्दक्षिणभागमेवा-स्मदङ्गभ्रमणेन पश्यति, भ्रमण वृत्तबहिर्गतो द्रष्टा च स्वाभिमुखमस्मच्छरीरावयवं भिन्नं भिन्नं पश्यतीति प्रत्यक्षप्रतीतिः। यथा बालावात्यावद् भूमौ लघुप्रदेशे भ्रमंतः स्वाङ्गभ्रममुत्पादयन्ति तथा वयं महति प्रदेशे प्रदक्षिणा परिधौ भ्रमन्तः स्वाङ्गभ्र-ममुत्पादयामः भ्रमणवृत्तस्यात्यल्पत्वात्तद्बहिः स्था द्रष्टारो बालानां स्वाङ्गभ्रमेण भिन्नान् भिन्नानवयवान् पश्यन्तीति। अथ यस्मिन् वृत्ते चन्द्रो भ्रमति तदन्तर्गता वयं सदा चन्द्रस्य कलङ्कसहितं तमेव भागं पश्यामोऽतः पूर्वकथितसिद्धान्तेन चन्द्रो भ्रमन् स्वाङ्गभ्रममुत्पादयतीति सिध्यति। अथ यच्च चन्द्रे कलङ्कनाम्ना प्रसिद्धं तत् सूक्ष्मदर्शकयन्त्रबलेन चन्द्रोपरि वनं पर्वतादिकं चास्तीति स्फुटं दृश्यते नव्यैस्तत्पर्वतादीनामुच्छ्रितिज्ञानं च कृतमस्तीति । पितृदिनसम्बन्धे बटेश्वर सिद्धान्ते मद्टीकाऽवलोकनीयेति ॥८॥

अब देव-दैत्यों को और पितर-मनुष्यों के दिनमान कहते हैं ।

हि· भा·—देव और दैत्य एक बार उदित सूर्य को छः महीने तक देखते हैं । चन्द्र पृष्ठ निवासी पितर एकबार उदित सूर्य को चान्द्रमासार्ध (एकपक्ष) देखते हैं । पृथ्वी पर स्थित मनुष्य अहोरात्रार्ध तक रवि को देखते हैं ॥८॥

उपपत्ति ।

उत्तरध्रुव देवों का खस्वस्तिक है । दक्षिण ध्रुव दैत्यों का ख स्वस्तिक है । दोनों ध्रुवों को केन्द्र मान कर नवत्यंश से जो वृत्त (नाड़ीवृत्त) होता है वह देव और दैत्यों का क्षितिज वृत्त है । नाड़ीवृत्त और क्रान्तिवृत्त के सम्पातद्वय सायन मेषादि में और सायन तुलादि में रवि दर्शन के बाद पुनः जितने काल में सायन मेषादि और सायन तुलादि में रवि-दर्शन होता है वह एक सायनरविभगण (एक सायन सौरवर्ष) देव और दैत्य का अहोरात्र मान होता है । अतः देवों और दैत्यों का सायन सौरवर्षार्ध (छः महीने) दिन सिद्ध हुआ । परन्तु देवों और दैत्यों का दिन और रात्रि बिलोम से होती है अर्थात् जब मेषादि में उदित रवि को प्रति दिन क्षितिज से ऊपर देव लोग देखते हैं तब देवों से अधः स्थित होने के कारण दैत्य लोग उस रवि को नहीं देखते हैं इसलिये जब देवों का दिन होता है तब दैत्यों की रात्रि होती है । जब देवों की रात्रि होती है तब दैत्यों का दिन होता है । सिद्धान्तशेखर में 'सकृदुद्गतो दिनकरः सुरासुरैरपि वत्सरार्धमवलोक्यते स्फुटम्' यह श्रीपत्युक्त आचार्योक्त के अनुरूप ही है । सूर्य सिद्धान्त में 'सकृदुद्गतमब्दार्धं पश्यन्त्यर्कं सुरासुराः' इस सूर्यांश पुरुषोक्ति के अनुरूप ही श्रीपत्युक्त और आचार्योक्त है । सिद्धान्तशिरोमणि में 'रवेश्चक्रभोगोऽर्कवर्षं प्रदिष्टं द्युरात्रं च देवासुराणां तदेव' इस से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा हैं । इसकी उपपत्ति और दिन रात्रि का स्वरूप सिद्धान्तशिरोमणि में "विषुवद्वृत्तं द्युसदां क्षितिजत्वमितं तथा च दैत्यानाम् । उत्तरयाम्यौ क्रमशो मूर्ध्वोर्ध्वगतौ" इत्यादि संस्कृतो-पपत्ति में लिखित श्लोक से इस तरह भास्कराचार्य ने कहा है । सांहितिक लोग 'उत्तरायण देवों का दिन और दक्षिणायन उनकी रात्रि होती है' कहते हैं, इसका खण्डन सिद्धान्तशेखर में 'दिनप्रवृत्तिर्मरुतामजादौ तुलाधरादौ च निशा प्रवृत्तिः' इत्यादि से श्रीपति ने किया है । मेषादि में सूर्य के रहने से दिनारम्भ होता है, तुलादि में सूर्य के रहने से रात्र्यारम्भ होता है, जो सांस्कृतिक लोग मकरादि में और कर्कादि में दिन और रात्रि कहते हैं वे लोग इसमें युक्ति कुछ भी नहीं कहते हैं अर्थात् उत्तरायण देवों का दिन होता है और दक्षिणायन रात्रि होती है इसमें कुछ भी युक्ति नहीं कहते हैं । देवता लोग यदि मिथुनान्त स्थित सूर्य को देखते हैं तो कर्कराशि में क्रान्ति के समत्व के कारण क्यों नहीं देखते हैं । इस प्रश्न का उत्तर कुछ नहीं है । इसलिये 'अत्रोपपत्तिं न च ते ब्रुवन्ति' यह श्रीपति का कहना ठीक है । श्रीपति रत्नमाला में 'शिशिरपूर्वमृतुत्रयमुत्तरं' इत्यादि संस्कृतोपपत्ति में लिखित श्लोकों से श्रीपति भी संहितोक्त फलादेश के लिये 'उत्तरायण और दक्षिणायन ही को दिन और रात्रि कह कर इस ज्योतिष सिद्धान्त में 'अत्रोपपत्तिं न च ते ब्रुवन्ति' से उनका उपहास करते हैं ।

पितृ दिनोपपत्ति ।

चन्द्र के ऊर्ध्व भाग में पितर बसते हैं । भूकेन्द्र से चन्द्रकेन्द्र गत रेखा पितरों के ऊर्ध्व याम्योत्तरवृत्त में जहां लगती है वह बिन्दु उनका ऊर्ध्व खस्वस्तिक है । वही बिन्दु परिणत चन्द्र भी पितृ त्रिज्या गोल में है । ऊर्ध्वखस्वस्तिक गत रेखा अधोयाम्योत्तर वृत्त में जहां

लगती है वह पितरों का अधः खस्वस्तिक है। पितरों के ऊर्ध्व खस्वस्तिक (परिणतचन्द्र) में रवि के आने से पितरों का दिनार्ध काल होगा लेकिन वहीं पर चन्द्र भी है इसलिये यदि चन्द्र का शराभाव हो तो रवि और चन्द्र के एक स्थान में रहने से दर्शान्त (अमावास्या) होने के कारण सिद्ध होता है कि दर्शान्त में पितरों का दिनार्ध होता है। एवं द्वितीय दर्शान्त में द्वितीय दर्शान्त होता है, दोनों दर्शान्त का अन्तर एक चान्द्रमास है वही पितरों का दिनार्धान्तर काल भी है परन्तु दिनार्धान्तर काल (एक दिनार्ध से दूसरे दिनार्ध तक) उदयान्तर काल (एक सूर्योदय से दूसरे सूर्योदय तक) के बराबर होता है, सूर्योदयद्वयान्तर काल एक दिन है अतः दिनार्धान्तर काल भी एक दिन के बराबर हुआ। इसलिये सिद्ध हुआ कि पितरों का दिन (अहोरात्र) एकचान्द्रमास के वराबर होता है अर्थात् पितर लोग चान्द्र मास के आधे (एक पक्ष) तक उदित सूर्य को देखते रहते हैं। सूर्य सिद्धान्त में 'सकृदुद्गतमब्दार्धं पश्यन्त्यर्कं सुरासुराः। पितरः शशिगाः पक्षं' इस सूर्यांश पुरुषोक्त के अनुरूप ही आचार्योक्त है। सिद्धान्त शिरोमणि में 'रवीन्द्वोर्युतेः संयुतिर्यावदन्या विधोर्मास एतच्च पैत्रं द्युरात्रम्' यह भास्करोक्त आचार्योक्त के अनुरूप ही है। तथा 'विधूर्ध्वभागे पितरो वसन्तः स्वाधः सुधादीधितिमामनन्ति पश्यन्ति तेऽर्कं' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से गोलाध्याय में भास्कराचार्य ने उसी बात को कहा है इति ॥८॥

इदानीं भूगोले लङ्कावन्त्योः संस्थानमाह।

भूपरिधि चतुर्भागे लङ्काभूमस्तकात् क्षितितलाच्च।
लङ्कोत्तरतोऽवन्ती भूपरिधेः पञ्चदशभागे ॥९॥

सु. भा.—भूमस्तको मेरुः क्षितितलश्च कुमेरुस्तस्माद्भूपरिधिचतुर्थभागेऽन्तरे दक्षिणदिशि लङ्कानाम नगरी। लङ्कोत्तरतश्च भूपरिधिपञ्चदशभागेऽवन्ती वर्त्तते। भास्करश्चाचार्यानुयायी 'निरक्षदेशात् क्षितिषोडशांशे भवेदवन्ती' इति कथितवान्। तेनान्येषां मते 'षोडशे भागे' इत्यत्र पाठान्तरम्। चतुर्वेदाचार्यसम्मतः पाठश्च 'पञ्चदशभागे' अयमेव ॥९॥

वि. भा.—भूमस्तकात् (मेरोः) क्षितितलाच्च (कुमेरोश्च) भूपरिधिचतुर्थांशा (नवत्यंश) न्तरे-दक्षिणस्यां दिशि लङ्का नाम नगरी वर्त्तते। लङ्कात उत्तरदिशि भूपरिधिपञ्चदशांशान्तरेऽवन्ती (उज्जयिनी) वर्त्तते। भास्कराचार्येण गोलाध्याये 'निरक्षदेशात् क्षितिषोड़शांशे भवेदवन्ती गणितेन यस्मात्' एवं कथ्यते। भूपरिधियोजनषोड़शांशान्तरे निरक्षदेशादवन्ती वर्त्तते तदर्थं गणितम्। यदि षष्ट्यधिकशतत्रयै ३६० रंशैः भूपरिधियोजनानि लभ्यन्ते तदा ऽवन्त्यक्षांशेन किमित्यनुपातेन निरक्षदेशावन्त्योरन्तरयोजनान्यागछन्ति तत्स्वरूपम्।

$\frac{\text{भूपरिधियोजन} \times \text{अवन्त्यक्षांश}}{३६०}$ = निरक्ष देशावन्त्योरन्तरयोजनानि। अवन्तीदेशे-

ऽक्षांशाः=२२ । ३०=२२$\frac{१}{२}$=$\frac{४५}{२}$, अतः $\frac{\text{भूपरिधियोजन} \times ४५}{३६० \times २}$

$= \frac{\text{भूपरिधियोजन} \times ४५}{७२०}$ हरभाज्या (४५) वनेन भक्तौ तदा $\frac{\text{भूपरिधियोजन}}{\frac{७२०}{४५}}$

$= \frac{\text{भूपरिधियोजन}}{१६}$ = निरक्षदेशावन्त्योरन्तर योजनानि । चतुर्वेदाचार्येण 'पञ्च-दशे भागे' इत्येव कथ्यते यथा ऽऽचार्येण कथ्यते, कथं 'पञ्चदशे भागे' कथ्यते तत्र न कारणं किमपि प्रतिभाति । लङ्कातः सुमेरुः कुमेरुश्च नवत्यंशान्तरेऽस्ति' यतस्त-त्राक्षांशाः=९० सन्तीति ॥९॥

अब भूगोल में लङ्का और अवन्ती की संस्थिति कहते हैं ।

हि. भा.—मेरु से और कुमेरु से भूपरिधि के चतुर्थांशा (९० अंश) न्तर पर दक्षिण दिशा में लङ्का नामक नगरी है लङ्का से उत्तर दिशा में भूपरिधि के पञ्चदशां १५ शान्तर पर अवन्ती उज्जयिनी है । भास्कराचार्य अपने गोलाध्याय में 'निरक्ष देशात् क्षितिषोड़शांशे' इत्यादि से भूपरिधि के षोड़शांशान्तर पर गणित करके अवन्ती को कहते हैं । इसके लिये गणित इस तरह है । यदि भांश (३६०) में भूपरिधि योजन पाते हैं तो अवन्ती के अक्षांश में क्या इस अनुपात से निरक्ष देश और अवन्ती के अन्तर योजन आते हैं उसका स्वरूप $= \frac{\text{भूपरिधियो} \times \text{अवन्ती के अक्षांश}}{३६०}$ परन्तु अवन्ती के अक्षांश=२२ $\frac{१}{२}$=$\frac{४५}{२}$ अतः $\frac{\text{भूपरिधियो} \times ४५}{३६० \times २} = \frac{\text{भूपरिधियो} \times ४५}{७२०}$ = निरक्षदेश और अवन्ती के अन्तर योजन, यहां हर भाज्य को (४५) से भाग देने से $\frac{\text{भूपरिधियो}}{\frac{७२०}{४५}} = \frac{\text{भूपरिधियो}}{१६}$ = निरक्षदेश और अवन्ती के अन्तर योजन । इसको सोलह से गुणा करने से भूपरिधि योजन होता है । भूपरिधियोजन मान के लिये आचार्यों में मतभेद है । अपनी कथित भूपरिधि की समीचीनता की दृढ़ता के लिये बहुत जोर देकर गोलाध्याय में कहते हैं "शृङ्गोन्नतिग्रहयुतिग्रहणोदया-स्तच्छायादिकं परिधिना घटतेऽमुना हि । नान्येन तेन जगुरुक्तमहीप्रमाण प्रामाण्यमन्वययुजा-व्यतिरेकेण" अर्थात् चन्द्र की शृङ्गोन्नति, ग्रहयुति, ग्रहण (चन्द्रग्रहण और सूर्यग्रहण) ग्रहों का उदय समय और अस्त समय आदि हमारे ही भूपरिधि मान से ठीक समय पर होता है अन्यों के भूपरिधिमान से ठीक सयय पर नहीं होता है इसलिये हमारा ही कथित भूपरिधिमान ठीक है अन्याचार्यो का नहीं । आचार्य (ब्रह्मगुप्त) ने 'लङ्कोत्तरतोऽवन्ती भूपरिधेः परिधेः पञ्चदश भागे' से 'लङ्का से अवन्ती भूपरिधियोजन के पञ्चदशां १५ श पर हैं' जो कहा है इसमें कुछ युक्ति नहीं मिलती है । चतुर्वेदाचार्य ने आचार्योक्त पाठ ही का अनुमोदन किया है इति ॥ ९

इदानीं निरक्षस्वदेशान्तर योजनान्याह।

अक्षांशकुपरिधिवधान्मण्डलभागाप्त योजनैर्विषुवत्।
नतभागयोजनैरेवमुपरि सूर्योऽन्यदनुपातात् ॥१०॥

सु. भा.—अक्षांशानां भूपरिधेश्च वधात् मण्डलभागैश्चक्रांशैर्भक्ताद्यान्यवाप्तानि तैर्नतभागयोजनैः स्वदेशाद्विषुवन्निरक्षदेशो भवति। एवं जिनाल्पाक्षे देशे खस्वस्तिकोपरि यदा सूर्यो भवति तदा कैर्नतभागयोजनैर्विषुवद् देशो भवति। इत्यन्यच्च मेरुस्वदेशान्तरयोजनादिज्ञानं तत्तदन्तरभागतोऽनुपातात् कार्यमिति स्फुटम्। अत्र टीकायां चतुर्वेदाचार्यः 'कान्यकुब्जेऽक्षभागाः' २६। ३५' ॥१०॥

वि. भा.—अक्षांशभूपरिध्योर्घाताद् भांशैर्भक्ताल्लब्धैर्नतभागयोजनैः स्वदेशान्निरक्षदेशो भवति। विषुवच्छब्देनात्र निरक्षदेशो ज्ञेयः। जिनाल्पाक्षांशे देशे यदा सूर्यः खस्वस्तिकोपरि भवति तदा कैर्नतभागयोजनैर्निरक्षदेशो भवति। अन्यच्च मेरुस्वदेशान्तरयोजनादिज्ञानं तत्तदन्तरांशतोऽनुपातात्कार्यमिति ॥

अत्रोपपत्तिः।

यदि भांशैर्भूपरिधियोजनानि लभ्यन्ते तदा स्वदेशीयाक्षांशैः किमित्यनुपातेन लब्धयोजनानि स्वदेशनिरक्षदेशयोरन्तरयोजनानि भवन्ति। कस्मात् कस्माद्देशान्निरक्षदेशः कियदन्तरेऽस्तीति ज्ञानार्थं तत्तदेशीयाक्षांशवशेन पूर्वोक्तानुपातः कार्य इति ॥१०॥

अब स्वदेश और निरक्षदेश के अन्तर योजन को कहते हैं।

हि. भा.—अक्षांश और भूपरिधियोजन के घात में भांश ३६० से भाग देने से जो लब्धि हो उतने योजन पर स्वदेश से निरक्षदेश होता है। जिनाल्पा (चौबीस से कम) क्षांश देश में जब सूर्य खस्वस्तिक के ऊपर होता है तब कितने नतभाग योजन पर निरक्ष देश होता है। मेरु और स्वदेश का अन्तर योजनादि ज्ञान तत्तद्देश के अन्तरांश (अक्षांश) से करना चाहिये, यदि निरक्ष देश से किसी देश का अन्तर योजन ज्ञान करना हो तो पूर्वोक्त अनुपात से करना चाहिये। यदि साक्ष देश में दो देशों का अन्तर योजन करना हो तो दोनों देशों के अक्षांशान्तर से अनुपात (भांश में भूपरिधि योजन पाते हैं तो अक्षांशान्तर में क्या) द्वारा करना चाहिये।

उपपत्ति।

यदि भांश ३६° में भूपरिधि योजन पाते हैं तो स्वदेशीयाक्षांश में क्या इस अनुपात से लब्ध योजन निरक्षदेश और स्वदेश का अन्तरयोजन होता है अर्थात् लब्ध योजनान्तर पर

अपने देश से निरक्ष देश है। जिस किसी देश से निरक्ष देश की दूरी ज्ञात करनी हो तो उस देश के अक्षांश से पूर्वोक्तानुपात से करना चाहिये इति ॥१०॥

इदानीं खकक्षां ग्रहकक्षां चाह।

अम्बरयोजनपरिधिः शशिभगणाः शून्यखखजिनाग्निगुणाः ३२४००० ।
यस्य भगणैर्विभक्तास्तत्कक्षाऽर्को भषष्ट्यंशः ॥११॥

सु० भा०—कल्पे ये चन्द्रभगणास्ते ३२४००० एतैर्गुणा खकक्षा भवति। सा च यस्य ग्रहस्य कल्पभगणैर्विभक्ता तत्कक्षा तस्य ग्रहस्य कक्षा भवति। अर्कश्च भषष्ट्यंशः। अर्ककक्षा भकक्षायाः षष्टिभागः। अतोऽर्ककक्षा षष्टिगुणा भकक्षा भवतीति।

अत्रोपपत्तिः।

कल्पे चन्द्रभगणाः=५७७५३३'०००००) १८७१२०६'९२०००'००००० = खक(३२४०००
१७३२५९९
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अतो भास्करेणाचार्योक्तैव खकक्षा पठिता। शेषोपपत्तिर्भास्करोक्तविधिना स्फुटा ॥११॥

वि. भा.—कल्पे ये चन्द्रभगणास्ते ३२४००० एभिर्गुणास्तदाऽम्बरयोजनपरिधिः (खकक्षा) भवति। सा (खकक्षा) यस्य ग्रहस्य कल्पभगणैर्विभक्ता तस्य ग्रहस्य कक्षा भवति। भकक्षायाः षष्ट्यंशो (६०) शो रविकक्षा भवतीति ॥११॥

अत्रोपपत्तिः।

आकाशे चतुर्दिक्षु यावत् रवेः किरणानां व्याप्तिः (प्रसारः) तत्परिधेः प्रमाणमेव खकक्षाप्रमाणमित्यागमप्रामाण्येन मान्यम्। वस्तुतो रवेश्चलत्वादाकाशे किरणानां सञ्चारेण यावत्तमोहानिस्तदाकारो वृत्तवन्न भवति। अत एव कल्पकुदिनग्रहगतियोजनघातसमा पठितखकक्षा कल्पे ग्रहभ्रमणयोजनैः समेति वक्तुं

शक्यते । वेधेन गतियोजनज्ञानं भवितुमर्हति, तत्कल्पकुदिनघातसमेयं पठित-खकक्षा संख्या भवति न वेति परीक्षा न भवितुमर्हति । अत एव भास्कराचार्यः । "ब्रह्माण्डमेतन्मितमस्तु नो वा कल्पे ग्रहः क्रामति योजनानि । यावन्ति पूर्वैरिह तत्प्रमाणं प्रोक्तं खकक्षाख्यमिदं मतं नः ।" कल्पे चन्द्र भगणाः=५७७५३३०००० अतः कल्प चन्द्रभ × ३२४०००=१८७१२०६९२००००००००=खकक्षा भास्कराचार्येणाऽपि 'कोटिघ्नैर्नखनन्दषट्कनखभूभूभृद्भुजङ्गेन्दुभिर्ज्योतिःशास्त्रविदो वदन्ति नभसः कक्षामिमां योजनै' रित्यनेनाऽऽचार्योक्त खकक्षा समैव खक[१] क्षामितिः पठिता । खकक्षा तुल्यानि योजनानि कल्पे ग्रहः क्रामति, भगणाश्च पाठपठित-समाः । एकभगणभोगेन ग्रहः स्वकक्षावृत्तयोजनानि भ्रमति ततोऽनुपातो यदि कल्प ग्रहभगणैः खकक्षामितयोजनानि लभ्यन्ते तदैकेन भगणेन किमिति जाता ग्रह कक्षा $=\frac{\text{खकक्षा}}{\text{कग्रभ}}$, अर्कोभषष्टयंश इत्यागमप्रामाण्येन $\frac{\text{भकक्षा}}{६०}$ = रविकक्षा

∴ भकक्षा=६० रविकक्षा, एतैर्योजनैः सर्वेषां ग्रहाणामुपरि दूरे कतिपय नक्षत्राणां वृत्तं भ्रमति, एतेनाऽऽचार्योक्तमुपपन्नम् ॥११॥

अब खकक्षा और ग्रह कक्षा को कहते हैं ।

हि. भा.—कल्प में पठित चन्द्रभगण को ३२४००० से गुणा करने से खकक्षा योजन परिधि प्रमाण होता है । खकक्षा को जिस ग्रह के कल्प भगण से भाग देते हैं फल उस ग्रह की कक्षा होती है । नक्षत्र कक्षा का साठवां अंश रवि कक्षा होती है इति ।

उपपत्ति ।

आकाश में चारों तरफ रवि किरणों का प्रसार जहां तक होता है, उस परिधि का प्रमाण ही खकक्षा प्रमाण है यह आगम प्रमाण से माना जाता है । वस्तुतः रवि के चलत्व

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१ खकक्षा सम्बन्धे आचार्याणां भिन्नानि भिन्नानि मतानि सन्ति, सिद्धान्तशेखरे 'हिरण्यगर्भाण्डकटाहसंपुटप्रवेष्टकं तच्च बभाषिरे बुधाः । अदृश्यदृश्यं च गिरिं पुरातना जगुः खकक्षामिति गोलवेदिनः' हिरण्यगर्भो ब्रह्मा तस्याण्डकटाहस्य यत् संपुटं (परस्पराभिमुखं खण्डद्वयं) तदेव प्रवेष्टकं (करण्डकं यस्य तत्तथोक्तम्) बुधा गीतवन्तः । अर्थात् ब्रह्माण्ड-करण्डकान्तः स्थितमाकाशवृत्तमिति यावत् । गोलवेदिनो दृश्यादृश्यं गिरिं (लोकालोकाख्यं गिरिं) खकक्षा मिति गीतवन्तः' इति मतान्तरं श्रीपतिना कथितम् । स्वमतसम्बन्धे तेनैवं 'श्रीमदार्यभटजिष्णुनन्दन श्री त्रिविक्रमसुतादिसूरिभिः । सिद्धिरम्बरचरस्य कक्षया या कृताऽथ मयकाऽपि सोच्यते' कथ्यते । जिष्णुनन्दनो ब्रह्मगुप्तः । श्रीत्रिविक्रमसुतो लल्लः, आदिशब्देन सूर्यसिद्धान्तादिकारः कश्चिदिति बोध्यम् ॥

से आकाश में किरणों के संचार से जितनी दूर तक अन्धकार नष्ट होता है उसकी आकृति वृत्ताकार नहीं होती है। इसलिये कल्प कुदिन और ग्रहगति योजन के घाततुल्य यह खकक्षा कल्प में ग्रहों के भ्रमण योजन 'अर्थात् कल्प में जितने योजन ग्रह भ्रमण करते हैं' के बराबर होती है यह कह सकते हैं। खकक्षा के सम्बन्ध में आचार्यों का मत भिन्न भिन्न है इसलिये सिद्धान्तशिरोमणि में 'ब्रह्माण्डमेतन्मितमस्तु नो वा कल्पे ग्रहः क्रामति योजनानि' से भास्कराचार्य कहते हैं कि कल्प में जितने योजन ग्रह भ्रमण करते हैं तत्तुल्य ही खकक्षा योजन है यह मेरा मत है।

कल्प में चन्द्रभगण = ५७७५३३०००० अतः कल्प चंभगण × ३२४००० = १८७१२०६९२००००००००० = खकक्षा। भास्कराचार्य ने भी 'कोटिघ्नैर्नखनन्दषट्कनख भू' इत्यादि से आचार्योक्त खकक्षा के बराबर ही खकक्षा मान पठित किया है। ग्रहकल्प में खकक्षा तुल्य योजन भ्रमण करते हैं, एक भगण भोग से ग्रह स्वकक्षावृत्त योजन भ्रमण करते हैं। तब अनुपात करते हैं यदि कल्प ग्रहभगण में खकक्षायोजन पाते हैं तो एक भगण में क्या इस अनुपात से ग्रह कक्षा आती है $\frac{\text{खकक्षा}}{\text{कग्रभ}}$ = ग्रहकक्षा, 'अर्को भपष्टचंशः' अर्थात् नक्षत्र कक्षा का साठवां भाग रवि कक्षा है' इस आगमप्रमा से $\frac{\text{भकक्षा}}{६०}$ = रविकक्षा ∴ भकक्षा = ६० × रविकक्षा। इतने योजन पर सब ग्रहों से ऊपर दूर में कितने नक्षत्र का वृत्त है, सूर्य सिद्धान्त में 'भवेद्भकक्षा तीक्ष्णांशोर्भ्रमणं षष्टिताडितम्। सर्वोपरिष्टात् भ्रमति योजनैस्तैर्भमण्डलम्' सूर्यांश पुरुष की इस उक्ति के सदृश ही आचार्य ने कहा है 'यस्य भगणैर्विभक्तास्तत्कक्षा' यह आचार्योक्त भी 'सैव यत्कल्प भगणैर्भक्ता तद्भ्रमणं भवेत्' इस सूर्यांश पुरुषोक्त के अनुरूप ही है ॥११॥

ग्रहाः कियन्ति योजनानि भ्रमन्तीत्याह।

भपरिधिसमानि षष्ट्या खपरिधितुल्यानि कल्परविवर्षैः।
गच्छन्ति योजनानि ग्रहाः स्वकक्षासु तुल्यानि ॥१२॥

सु० भा०—षष्टया रविवर्षषष्टया ग्रहाः स्वकक्षासु भूपरिधिसमानि नक्षत्रकक्षासमानि योजनानि कल्परविवर्षैश्च खपरिधितुल्यानि खकक्षासमानि योजनानि गच्छन्ति। तथा सर्वे ग्रहाः कल्पे तुल्यान्येव योजनानि खकक्षामितानि गच्छन्ति।

अत्रोपपत्तिः।

भास्करोक्तेन विधिना स्फुटा। नकक्षा = ६० रकक्षा = $\frac{\text{खक}}{\text{क सौव}}$ × ६०

खक = $\frac{\text{नक} \times \text{कसौव}}{६०}$ ।

कल्पसौरवर्षैः खकक्षामितयोजनानि तदा सौरवर्षषष्ट्या किम्। लब्धानि ग्रहभ्रमणयोजनानि = नक्षत्रकला। अत उपपन्नं भपरिधिसमानि षष्ट्येति। संप्रति वेधेन नवीनानां मते ग्रहाणां योजनात्मिका गतिर्न समानेति सुधीभिश्चिन्त्यम् ॥१२॥

वि. भा.—षष्ट्या (सौरवर्षषष्ट्या) कल्परविवर्षैश्च खकक्षातुल्यानि नक्षत्रकक्षासमानि योजनानि ग्रहाः स्वकक्षासु गच्छन्ति। तथा सर्वे ग्रहाः कल्पे तुल्यान्येव योजनानि खकक्षातुल्यानि परिभ्रमन्तीति।

अत्रोपपत्तिः।

अर्को भषष्ट्यंश इत्यागमप्रामाण्यात् $\frac{\text{नक्षत्रकक्षा}}{६०}$ = रविकक्षा, अतः नक्षत्रकक्षा = ६० × रविकक्षा = $\frac{\text{खकक्षा}}{\text{कल्परविभगण}}$ × ६० = $\frac{\text{खकक्षा}}{\text{कल्पसौरवर्ष}}$ × ६०, अतः $\frac{\text{नक्षत्रक} \times \text{कल्पसौवर्ष}}{६०}$ = खकक्षा।

यदि कल्पसौरवर्षैः खकक्षा तुल्यानि योजनानि तदा सौरवर्षषष्ट्या किं समागच्छन्ति ग्रहभ्रमणयोजनानि नक्षत्रकक्षासमानानि अत उपपन्नमाचार्योक्तमिति ॥१२॥

अब ग्रह कितने योजन भ्रमण करते हैं सो कहते हैं।

हि. भा.—ग्रह अपनी कक्षा में साठ सौरवर्ष से नक्षत्र कक्षातुल्य योजन कल्प रवि वर्ष से खकक्षा तुल्य योजन परिभ्रमण करते हैं. और सब ग्रह कल्प में खकक्षा तुल्य ही योजन परिभ्रमण करते हैं।

उपपत्ति।

नक्षत्र कक्षा का षष्ट्यंश रविकक्षा है इस आगम प्रमाण से $\frac{\text{नक्षत्रकक्षा}}{६०}$ = रविकक्षा, अतः नक्षत्रक = ६० रविक = $\frac{\text{खकक्षा}}{\text{कल्परविभगण}}$ × ६० = $\frac{\text{खकक्षा}}{\text{कल्पसौरवर्ष}}$ × ६०

∴ $\frac{\text{नक्षत्रकक्षा} \times \text{कल्पसौवर्ष}}{६०}$ = खकक्षा।

यदि कल्प सौरवर्ष में खकक्षा योजन पाते हैं तो साठ सौरवर्ष में क्या इससे लब्ध ग्रहभ्रमणयोजन नक्षत्रकक्षा के समान आता है इति ॥१२॥

इदानीं ग्रहकक्षाक्रममाह।

भगणस्याधः शनिगुरुभूमिजरविशुक्रसौम्यचन्द्राणाम्।
कक्षा क्रमेण शीघ्राः शनैश्चराद्याः कलाभुक्त्या ॥१३॥

सु. भा:—भगणस्याधो भकक्षाया अधः क्रमेण शनि-गुरु-कुज-रवि-शुक्र-बुध-चन्द्राणां कक्षाः सन्ति। कलाभुक्त्या शनैश्चराद्याः शीघ्राः शीघ्रगतयः सन्ति शनेर्गुरुः शीघ्रगामी। गुरोर्भौमः। भौमाद्रविरित्यादि। एवं शीघ्रतमः शशी भवतीति। यदि शशिन ऊर्ध्वक्रमेण कक्षापाठः क्रियते तदा 'भूमेः पिण्डः शशाङ्कज्ञकविरविकुजे' इत्यादि भास्करोक्तमेतदनुरूपमेव।

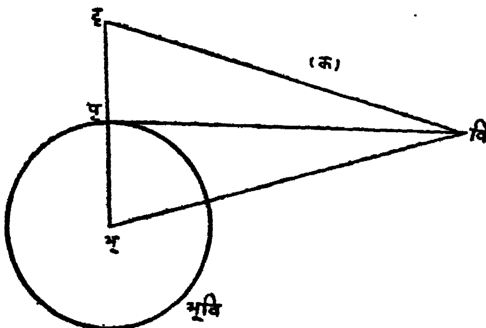
अत्रोपपत्तिः।

'कक्षाः सर्वा अपि दिविषदाम्' इत्यादिभास्करविधिना शनैश्चराद्याः शीघ्रा भवन्ति। कक्षाक्रमश्च वेधोपलब्ध्या। संप्रति वेधेन सर्वे ग्रहा दीर्घवर्तुले भ्रमन्ति। यदेकनाभौ रविरचल इति सर्वमुपलभ्यते। प्राचीनैर्भ्रमाद्ग्रहाणां कक्षा वृत्ताभा भूकेन्द्रकाश्च निश्चिता इति॥१३॥

वि. भा.—नक्षत्रकक्षाया अधः क्रमेण शनि-गुरु-मङ्गल-रवि–शुक्र-बुध-चन्द्राणां कक्षाः स्युः। कलात्मकगत्या शनैश्चराद्या ग्रहाः शीघ्रगतयः सन्ति। शनितोगुरुः, गुरोर्मङ्गलः, मङ्गलाद्रविरित्यादयः शीघ्रगामिनः सन्ति। एतेन चन्द्रः सर्वग्रहापेक्षया शीघ्रगामी भवति; यदि चन्द्रादूर्ध्वक्रमेण ग्रहकक्षास्थितिर्दृश्यते तदा 'भूमेः पिण्डः शशाङ्कज्ञकविरविकुजेज्यार्किनक्षत्रकक्षावृत्तै' रित्यादि भास्कराचार्योक्ता ग्रहकक्षास्थितिरेवाऽऽयातीति।

अत्रोपपत्तिः।

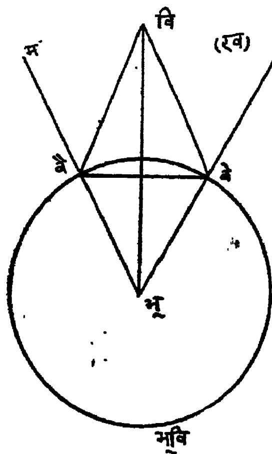
ग्रहकक्षानिवेशः कथमीदृश एतज्ज्ञानं बिम्बीयकर्णज्ञानाधीनमस्ति, यस्माद् ग्रहबिम्बीयकर्णाद्यस्य बिम्बीयकर्णमानमधिकं भवेत्तत्कक्षा महती भवत्यर्थाद्यस्य कर्णमानमल्पमस्ति तत्कक्षातः सा कक्षा (यस्यकर्णमानमधिकं तदीया) परिगता भवत्यतो वेधेन बिम्बीयकर्णसाधनं क्रियते।



भू=भूकेन्द्रम्। पृ=भूपृष्ठस्थानम्। वि=ग्रहबिम्बकेन्द्रम्। दृ=दृष्टिस्थानम्। पृदृ=नरोच्छ्रितिः। भूवि = बिम्बीयकर्णः। भूपृ = भूव्यासार्धम्। भूव्यासार्धं विदितमस्ति, तथा नरोच्छ्रितिरपि बिदितास्ति। विपृदृ, विदृपृ तुरीय यन्त्रद्वारामापनेन। विदितौ ततः १८०–(<विपृदृ+<विदृपृ)=<पृविदृ अयमपि कोणो विदितो जातस्तदा विपृदृ त्रि-

भुजेऽनुपातेन $\frac{\text{पृह} \times \text{ज्या} < \text{पृहवि}}{\text{ज्या} < \text{पृविह}}$ = पृवि, कोणज्या कोणोनभार्धांशज्ययोस्तुल्यत्वात् ज्या < विपृह = ज्या (१८० — < विपृह) < विपृभू कोणस्यापिज्ञानं जातम् । तदा विपृभू त्रिभुजे विपृ, भूपृ भुजयोस्तदन्तर्गतकोणस्य ज्ञानात् 'भूसंमुखास्रोद्भव कोटिशिञ्जिनीत्या' दि प्रकारेण भूवि भुजस्य ज्ञानं भवेदयमेव बिम्बीयकर्ण इति ।

अथवा वेधेन बिम्बीयकर्णानयनम् ।



भू = भूकेन्द्रम् । वि = ग्रह बिम्बकेन्द्रम् । वे = प्रथमवेधस्थानम् । वे' = द्वितीयवेधस्थानम् । भूवि = ग्रहबिम्बीयकर्णः । विवेन, विवे'म कोणौ तुरीययन्त्रद्वारा मापनेन विदितौ, वेवे' = वेधस्थानान्तरं विदितमस्ति तदा तत्पूर्णज्याऽपि विदिता भवेत् । भूवे = भूवे' = भूव्यासार्धम् । तदा भूवेवे' त्रिभुजे भुजत्रयज्ञानात् कोणत्रयस्यापि ज्ञानं भवेदेव १८० — (< विवेन + < भूवेवे') = < विवेवे' एवं १८० — (< विवे'म + ∠ भूवे'वे) = < विवे'वे इति कोणद्वयस्य ज्ञानात् १८० — (< विवेवे' + < विवे'वे) = < विवे'वे एतत्कोणस्यापि ज्ञानं जातम् । तदा वेविवे' त्रिभुजेऽनुपातेन $\frac{\text{वेवे}' \times \text{ज्या} < \text{विवे}'\text{वे}}{\text{ज्या} < \text{वेविवे}'}$ = वेवि ततः भूवेवि त्रिभुजे भूवे, वेवि भुजयोस्तदन्तर्गतकोणस्य च ज्ञानात् 'भूसंमुखास्रोद्भवकोटिशिञ्जिनी' त्यादिना भूवि आधारस्य ज्ञानं भवेदयमेव बिम्बीयकर्णः ।

एतद्वेधेन कर्णानयनेन सर्वग्रहकर्णापेक्षया चन्द्रस्य कर्णोऽल्प उपलब्धोऽतः सर्वेषां ग्रहाणां कक्षापेक्षया चन्द्रकक्षालघ्वी, चन्द्रबिम्बीयकर्णाद्बुधबिम्बीयकर्णोऽधिकस्ततोऽधिकः शुक्रस्येत्यादेर्यथा यथाऽधिकः कर्ण उपलब्धस्तथातथोपर्युपरि चन्द्रबुधशुक्ररविकुजगुरुशनैश्चराणां कक्षा आचार्येणोक्ताः । वेधादिना सूर्यकेन्द्राद् ग्रहाणां बिम्बान्तरसूत्रज्ञानेन ग्रहाः सूर्यपरितो दीर्घवृत्ताकारकक्षासु भ्रमन्तीति नव्यानां मतेन सिध्यति ॥१३॥

अब ग्रहकक्षाक्रम को कहते हैं ।

हि. भा.—नक्षत्र कक्षा के नीचे क्रम से शनि-गुरु-मङ्गल-रवि-शुक्र-बुध-चन्द्र

ग्रहों की कक्षाएं हैं। कलात्मक गति से शनैश्चरादिग्रह शीघ्रगतिक है अर्थात् शनि से गुरु शीघ्रगतिक है, गुरु से मङ्गल, मङ्गल से रवि, रवि से शुक्र, शुक्र से बुध, बुध से चन्द्र शीघ्रगामी है। इससे चन्द्र सब ग्रहों से अधिक शीघ्रगतिक सिद्ध होता है। यदि चन्द्र से उर्ध्व क्रम से ग्रह कक्षा स्थिति को देखा जाय तो सिद्धान्तशिरोमणि में 'भूमेः पिण्डः शशाङ्कज्ञ कविरविकुजेज्यार्कि नक्षत्रकक्षा' इत्यादि भास्कराचार्योक्त ग्रह कक्षा स्थिति ही देखने में आती है।

उपपत्ति।

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये। ग्रह कक्षाओं का निवेशक्रम ऐसा (भाष्य में लिखित के अनुसार) क्यों हैं इसका ज्ञान ग्रहों के बिम्बीय कर्णों के ज्ञान से होता है। जिस ग्रह के बिम्बीय कर्ण से जिस ग्रह का बिम्बीय कर्ण अधिक होता है उसकी कक्षा बड़ी होती है अर्थात् जिसका विम्बीय कर्ण अल्प है उसकी कक्षा से वह कक्षा (जिसका बिम्बीय कर्ण अधिक है) ऊपर होती है। अतः वेध से बिम्बीय कर्णानयन करते हैं।

भू = भूकेन्द्र, पृ = भूपृष्ठस्थान, वि = ग्रह विम्बकेन्द्र, दृ = दृष्टिस्थान, पृदृ = नरोच्छ्रिति, भूवि = बिम्बीयकर्ण, भूपृ = भूव्यासार्ध, भूव्यासार्ध और नरोच्छ्रिति विदित है, विपृदृ, विदृपृ दोनों कोण तुरीय यन्त्र से मापन करके जान लिये तव १८०−($<$ विपृदृ + $<$ विदृपृ) = $<$ पृविदृ यह कोण भी विदित हो गया, अब विपृदृ त्रिभुज में अनुपात करते हैं।
$\frac{\text{पृदृ} \times \text{ज्या} < \text{पृदृवि}}{\text{ज्या} < \text{पृविदृ}}$ = पृवि, कोणज्या और कोणोन भार्धांशज्या बराबर होती है अतः ज्या $<$ विपृदृ = ज्या (१८० — $<$ विपृदृ) से $<$ विपृभू कोण का भी ज्ञान हो गया तब विपृभू त्रिभुज में विपृ, भूपृ इन दोनों भुजों के तथा उसके अन्तर्गत कोण के ज्ञान से 'भूसंमुखास्रोद्भव कोठिशिञ्जिनी' इत्यादि प्रकार से भूवि भुज (आधार) का ज्ञान हो जायगा यही बिम्बीय कर्ण है इति।

प्रकारान्तर से बिम्बीय कर्णानयन करते हैं।

यहां संस्कृतोपपत्ति में लिखित (ख) क्षेत्र को देखिये। भू = भूकेन्द्र, वि = ग्रहबिम्बकेन्द्र, वे = प्रथम वेध स्थान, वे' = द्वितीय वेधस्थान। भूवि = बिम्बीयकर्ण, विवेन, विवे'म दोनों कोणों को तुरीय यन्त्र से मापन कर जान लिया, वेवे' = वेधस्थानान्तर विदित है, तब वेवे' चाप की पूर्णज्या भी विदित हो जायगी, भूवे = भूवे' = व्यासार्ध तब भूवेवे' त्रिभुज में तीनों भुजों के ज्ञान से तीनों कोणों का भी ज्ञान हो जायगा, १८० — ($<$ विवेन + $<$ भूवेवे') = $<$ विवेवे', एवं १८० — ($<$ विवे'म + $<$ भूवे'वे) = $<$ विवे'वे इन दोनों कोणों के ज्ञान से १८० — ($<$ विवे'वे + $<$ विवेवे') = $<$ वेविवे' इस कोण का भी ज्ञान होगया तब वेविवे' त्रि-

भुज में अनुपात करने हैं $\frac{\text{वेवे}' \times \text{ज्या} < \text{विवेवे}'}{\text{ज्या} < + \text{विवेवे}'}$ = वेवि, तब भूवेवि त्रिभुज में भूवे, वेवि दोनों भुजों के तथा तदन्तर्गत कोण के ज्ञान से 'भूसंमुखास्रोद्भव कोटिशिञ्जिनी' इत्यादि से भूवि आधार ज्ञान हो गया यही बिम्बीय कर्ण है।

इस वेध द्वारा कर्णानयन से सब ग्रहों के विम्बीय कर्णों की अपेक्षा चन्द्र का बिम्बीय कर्ण अल्प उपलब्ध होता है अत: सब ग्रहों की कक्षा की अपेक्षा चन्द्र कक्षा छोटी है, चन्द्र कर्ण से बुध का कर्ण अधिक होता है, अत: चन्द्र कक्षा से बुध कक्षा बड़ी होती है, बुध कर्ण से शुक्र का कर्ण अधिक होता है अत: बुध कक्षा से शुक्र कक्षा बड़ी होती है, एवं शुक्र कक्षा से रवि कक्षा, रवि कक्षा से कुज कक्षा, कुज कक्षा से गुरु कक्षा इत्यादि कक्षाओं की छोटी बड़ी होने का कारण बिम्बीय कर्ण की न्यूनाधिकता है तथा कक्षाएं एक केन्द्रिक है इसलिये उपर्युपरि आचार्योक्त कक्षाक्रम पाठ के सदृश है, सूर्य सिद्धान्त में 'मन्दामरेज्यभूपुत्रसूर्य-शुक्रेन्दुजेन्दव: परिभ्रमन्त्यधोऽध: स्था:' इस सूर्यांश पुरुषोक्त कक्षाक्रम पाठ के अनुरूप ही आचार्योक्त पाठ है इति ।।१३।।

इदानीं शनैश्चराद्या: कथं शीघ्रा इत्यस्य कारणमाह।

लघवोऽल्पे राश्यंशा महति महान्तोऽल्पवृत्तमल्पेन।
पूरयतीन्दुर्महता कालेन महच्छनैश्चारी ।।१४।।

सु. भा.—अल्पे वृत्ते राश्यंशाश्चक्रांशविभागा लघवो महति वृत्ते च महान्तो भवन्ति। अत इन्दुश्चन्द्रोऽल्पवृत्तं स्वकक्षाया अल्पेन कालेन शनैश्चारी शनिश्च महद्वृत्तं स्वकक्षाया महता कालेन पूरयति।

अत्रोपपत्तिश्चैककेन्द्रवृत्तानां चक्रांशविभागेनैव स्फुटा ।।१४।।

वि. भा.—अल्पे वृत्ते भगणांशविभागा लघवो भवन्ति, महति वृत्ते ते विभागा महान्तो भवन्ति। अस्मात् कारणात् चन्द्रोऽल्पवृत्तं स्वकक्षाया अल्पेन कालेन पूरयति, शनैश्चारी (शनि:) महद्वृत्तं स्वकक्षाया महता कालेन पूरयतीति।

अत्रोपपत्ति:।

सर्वेषां ग्रहाणां योजनात्मकगतयस्तुल्या एव भवन्ति, 'कल्पोद्भवै: क्षिति-दिनैर्गगनस्य कक्षा भक्ता भवेद्दिनगतिर्गगनेचरस्य। पादोनगोऽक्षधृतिभूमित योजनानी' त्यादि भास्करोक्ते:। सर्वासां ग्रहकक्षाणां कलानां वैषम्यात् कलादिका गतयस्तुल्या न भवंति। अर्थात् ग्रहा: स्वस्वकक्षावृत्ते भ्रमन्ति, कक्षावृत्तानि च चक्रकलाभिरङ्कितानि सन्ति तेन यदि ग्रहकक्षायोजनैश्चक्रकला लभ्यन्ते तदा

ग्रहगतियोजनैः किमित्यनुपातेन योजनगतिसम्बन्धिकलाः समायान्ति। तस्माद्यस्य ग्रहस्य कक्षा महती तस्य कलाया लघुत्वं, यस्य कक्षा लघ्वी तस्य कलाया महत्वं सिध्यति। शनि कक्षाऽन्यग्रहापेक्षया महती, चन्द्रकक्षा च लघ्वी, अतः शनैश्चरस्य कलात्मिका मध्यगतिर्लघुतमा, चन्द्रस्य च महत्तमा भवति, चन्द्रापेक्षया बुधोऽल्पगतिः। बुधापेक्षया शुक्रोऽल्पगतिः। शुक्रापेक्षया रविरल्पगतिरित्यादि। सिद्धान्तशेखरे 'तुल्या गतिर्योजनवर्त्मनैषां लिप्ता प्रकृत्या मृदुशीघ्रभावः' ऽप्येवमेवास्ति। सिद्धान्तशिरोमणौ "कक्षाः सर्वा अपि दिविषदां चक्रलिप्ताङ्किताःस्ता वृत्ते लघ्व्यो लघुनि महति स्युर्महत्यश्च लिप्ताः। तस्मादेते शशिजभृगुजादित्यभौमेज्यमन्दा मन्दाक्रान्ता इव शशधराद् भान्ति यान्तः क्रमेण' इत्यनेन भास्कराचार्येणाप्याचार्योक्तानुरूपमेव कथ्यत इति ॥१४॥

अब शनैश्चरादिग्रह कैसे शीघ्रगतिक होते हैं इसके कारण कहते हैं।

हि. भा.—स्वल्पवृत्त में राश्यंश विभाग लघु होते हैं। महद्वृत्त में वे विभाग महान् (बड़े) होते हैं। इस कारण से चन्द्र छोटी अपनी कक्षा को अल्प समय में ही पूरा करते हैं अर्थात् सम्पूर्ण कक्षा में घूम जाते हैं, और शनैश्चर अपनी बड़ी कक्षा को बहुत समय में पूरा करते हैं अर्थात् सम्पूर्ण कक्षा में घूमते हैं।

उपपत्ति

सब ग्रहों की योजनात्मक गति तुल्य ही होती है, 'समा गतिस्तु योजनैर्नभः सदां सदा भवेदि' ति भास्करोक्तेः सिद्धान्तशेखरेऽपि 'तुल्यागतिर्योजनवर्त्मनैषां' श्रीपत्युक्तेः। सब ग्रह कक्षाओं की कलाओं की असमता के कारण कलादिक गति तुल्य नहीं होती है अर्थात् अपनी अपनी कक्षा में भ्रमण करते हैं। कक्षा वृत्तों में चक्रकला अङ्कित है अतः यदि ग्रह कक्षा योजन में चक्र कला पाते हैं तो ग्रहगति योजन में क्या इस अनुपात से योजन गति सम्बन्धी कला आती है। इस कारण से जिस ग्रह की कक्षा बड़ी हैं उसकी कला छोटी होती है और जिसकी कक्षा छोटी है उसकी कला बड़ी होती है यह सिद्ध हुआ। शनि कक्षा सब ग्रहों की कक्षाओं से बड़ी है इसलिये शनैश्चर की कलात्मक मध्यमगति सब ग्रहों की गति से छोटी होती है, चन्द्रकक्षा सब ग्रहों की कक्षा से छोटी है इसलिए चन्द्र की कलात्मक मध्यमगति सब ग्रहों की मध्यम गति से बड़ी होती है। अतः सबसे शीघ्रगतिक चन्द्र होता है। चन्द्र से अल्पगतिक बुध, बुध से अल्पगतिक शुक्र, शुक्र से अल्पगतिक रवि इत्यादि कक्षाक्रम के अनुसार शीघ्रगतिक और मन्दगतिक होते हैं। सिद्धान्तशेखर में 'तुल्यागतिर्योजनवर्त्मनैषां लिप्ता प्रकृत्या मृदुशीघ्रभावः' इससे श्रीपति ने भी शीघ्रगतिक और मन्दगतिक होने का कारण यही कहा है। सिद्धान्त शिरोमणि में 'कक्षाः सर्वा अपि दिविषदां' इत्यादि में भास्कराचार्य भी आचार्योक्त के अनुरूप ही कहा है इति ॥१४॥

इदानीं वृत्तपरिधेर्व्यासानयनमाह।

यन्मूलं तद्व्यासो मण्डललिप्ताकृतेर्दशहृतायाः।
तस्यार्धं व्यासार्धं योजनकर्णप्रमाणार्धम् ॥१५॥

सु. भा.—मण्डललिप्ताकृतेश्चक्रकलाकृतेर्दशहृताया यन्मूलं तच्चक्रकलापरिधेर्व्यासो भवति तस्यार्धं व्यासार्धं भवति। तद्व्यासार्धं ग्रहकक्षायोजनैर्गुणं चक्रकलाहृतं फलं ग्रहयोजनकर्णप्रमाणं भवति। एवं योजनकर्ण प्रमाणार्थमिदं व्यासार्धमुपयुक्तमस्ति। इदं व्यासार्धं स्थूलं स्थूलाद्ग्रहयोजनकर्णप्रमाणं च स्थूलं सुखार्थमङ्गीकृतम्। वस्तुतो वृत्तपरिधिवर्गस्य दशहृतस्य मूलं व्यासो न सूक्ष्मो भवतीति सूचितम्। ज्यादीनामानयने स्थूलत्वादयं व्यासो न युक्त इत्येतदर्थं वक्ष्यति चेति ॥१५॥

वि. भा.—दशभक्तस्य चक्रकलावर्गस्य यन्मूलं तच्चक्रकला परिधेर्व्यासो भवति। तस्यार्धं व्यासार्धं भवति। तद्व्यासार्धं ग्रह कक्षायोजनैर्गुणं चक्रकलाभक्तं तदा ग्रहयोजनकर्णप्रमाणं भवति, इदं साधितं व्यासार्धं योजनकर्णप्रमाणार्थमुपयुक्तमस्तीति।

अत्रोपपत्तिः।

व्यासे भनन्दाग्निहते विभक्ते खबाणसूर्यैरित्यादि भास्करोक्तपरिध्यानयनप्रकारेण वृत्तपरिधिः $= \frac{\text{व्या} \times ३९२७}{१२५०}$, अत्र $\frac{३९२७}{१२५०}$ स्य विततरूपकरणेनाऽऽसन्नमानानि $\frac{२२}{७}$, $\frac{३५५}{११३}$, $\frac{३९२७}{१२५०}$ व्यास परिध्योः सम्बन्धः $= \frac{२२}{७}$ $\frac{३५५}{११३}$, $\frac{३९२७}{१२५०}$ भास्करेण व्यास $\times$ सम्बन्ध $= \frac{\text{व्या} \times ३९२७}{१२५०}$ $=$ सूक्ष्मपरिधिः कथ्यते, तथा $\frac{२२ \times \text{व्या}}{७}$ $=$ स्थूलपरिधिः कथ्यते, पर $\frac{३५५}{११३}$ मिदं कथं न गृहीतं, एतद्ग्रहणेन तु-भास्करोक्तसूक्ष्मपरिधितोऽपि सूक्ष्मतरः परिधिर्भवितुमर्हति। $\frac{\text{परिधि}}{\text{व्या}} = \text{सम्बन्ध} = \text{सं} = \frac{२२}{७} = ३ + \frac{१}{७}$ अत्राऽस्य वर्गः $\text{सं}^२ = \left(३ + \frac{१}{७}\right)^२$ $= १०$ स्वल्पान्तरात् $\therefore \frac{\text{परिधि}^२}{\text{व्या}^२} = १० \therefore \text{परिधि}^२ = १० \times \text{व्या}^२$ पक्षौ १० भक्तौ तदा $\frac{\text{परिधि}^२}{१०} = \text{व्या}^२$, मूलेन $\sqrt{\frac{\text{परिधि}^२}{१०}} =$ व्यासः, परन्तु $\left(३ + \frac{१}{७}\right)^२ < १०$ अतः 'तद्वर्गतो दशगुणात्पदं परिधिरि' तिसूर्यसिद्धान्तोक्तपरिध्यानयने नव्याः "तद्वर्गतोऽदशगुणात् पदं परिधिः" न दशेत्यदश किञ्चिन्न्यूना दश तैर्गुणात् पदं परिधिरेवं कथयन्ति दशगुणक एव समीचीन इति कमलाकरेण सौरवासनायां सिद्धान्ततत्त्वविवेके च सर्वं युक्ति शून्यं प्रलपितं रङ्गनाथेन स्वगूढार्थप्रकाशे दशगुणकः स्थूल उक्तः। एवं सौरभाष्ये नृसिंहेनापि व्यासः किञ्चिदधिकत्रिभिर्गुणितः

परिधिर्भवति, तत्र किञ्चिदधिकत्रयाणां वर्गो दशमितः कृतस्तेन व्यासवर्गो दशभिर्गुणितस्तन्मूलं स्थूलः परिधिरेव भवितुमर्हति, दशग्रहणाद् दोषावहमेव व्याख्यातमतो मन्नव्यानां व्याख्यानमेव समीचीनमिति सूर्यसिद्धान्तस्य सुधावर्षिणीटीकायां म.म. पण्डित सुधाकरद्विवेदिनः कथयन्ति । स्थूलपरिधितः साधितं व्यासार्धं स्थूलमेव भवेत् । वस्तुतो दश भक्तस्य वृत्तपरिधिवर्गस्य मूलं सूक्ष्मो व्यासो न भवति, अयं साधितो व्यासः स्थूलः, ज्यादीनामानयनोपयुक्तो नहि तत एवाग्रे कथयतीति ॥१५॥

अब परिधि से व्यास के आनयन को कहते हैं ।

हि. भा.—चक्रकला वर्ग को दश से भाग देने से जो लब्ध हो उसका मूल चक्र कला परिधि का व्यास होता है उसका आधा व्यासार्ध है । उस व्यासार्ध को ग्रह कक्षा योजन से गुणा कर चक्रकला से भाग देने से ग्रह योजन कर्ण प्रमाण होता है । यह साधित व्यासार्ध योजन कर्ण प्रमाण के लिये उपयुक्त है ।

उपपत्ति ।

'व्यासे भनन्दाग्निहते विभक्ते खबाणसूर्यैः' इत्यादि भास्करोक्तपरिध्यानयन से वृत्तपरिधि$=\frac{३९२७\times व्या}{१२५०}$ यहां इसका विततरूप करने से आसन्न मान $\frac{२२}{७}$, $\frac{३५५}{११३}$ $\frac{३९२७}{१२५०}$ आते हैं, व्यास और परिधि का सम्बन्ध$=\frac{२२}{७}$, $\frac{३५५}{११३}$, $\frac{३९२७}{१२५०}$ व्या $=$ व्यास, परिधि $=$ प, व्यास और परिधि का सम्बन्ध $=$ सं व्या$\times$प $=\frac{व्या\times ३९२७}{१२५०}$ $=$भास्करोक्त सूक्ष्म परिधि, तथा $\frac{२२\times व्या}{७}=$स्थूलपरिधि, परन्तु $\frac{३५५\times व्या}{११३}$ यह भास्करोक्त सूक्ष्म परिधि से सूक्ष्मतर परिधि है, जिसको भास्कराचार्य ने नहीं कहा है । इस के सम्बन्ध में "व्यासे पञ्चशराग्नि क्षुण्णे दहनेशभाजिते परिधिः । आचार्योक्तात्सूक्ष्मात्परिधेरपि भवति सूक्ष्मतरः" यह संशोधक (बापूदेव शास्त्री जी) कहते हैं । $\frac{परिधि}{व्यास}=सं^२$ $=स^२$ इसका वर्ग$=\left(३+\frac{१}{७}\right)^२=१०$ स्वल्पान्तर से, अतः $\frac{प^२}{व्या^२}=१०$ ∴ $प^२$ $=$आधार दोनों पक्षों को दश से भाग देने से $\frac{प^२}{१०}=$व्या, मूल लेने से $\sqrt{\frac{प^२}{१०}}=$ व्या, परन्तु $\left(३+\frac{}{७}\right)^२>१०$ अतः 'तद्वर्गतोदशगुणात्पदं परिधिः' इस सूर्यसिद्धान्तोक्त परिध्यानयन में नवीन लोग 'तद्वर्गतोऽदशगुणात् पदं परिधिः' नहीं जो दश वह अदश हुआ

अर्थात् किञ्चिन्न्यून दश से परिधि को गुणा कर मूल लेने से व्यास होता हैं इस तरह कहते हैं। दश गुणक ही ठीक हैं यह बात कमलाकर ने 'सौरवासना में' और सिद्धान्त तत्त्व विवेक में सब युक्ति शून्य कही है। रङ्गनाथ ने अपनी गूढार्थ प्रकाश टीका में दश गुणक को स्थूल कहा है। एवं सौर भाष्य में नृसिंह ने भी व्यास को तीन से कुछ अधिक गुणक से गुणा करने से परिधि मान बताया है, वहाँ कुछ अधिक तीन का वर्ग दश लिया है। अतः व्यास वर्ग को दस से गुणाकर मूल लेने से स्थूल परिधिमान हो सकता है दश ग्रहण से दोषावह ही व्याख्या की गई है इसलिये हम नवीनों के व्याख्यान ही समीचीन हैं ये बातें सूर्यसिद्धान्त की सुधावर्षिणी टीका में म.म. पण्डित सुधाकर द्विवेदीजी कहते हैं। स्थूल परिधि से साधित व्यासार्ध स्थूल ही है। वस्तुतः वृत्तपरिधि वर्ग को दस से भाग देकर मूल लेने से सूक्ष्म व्यास नहीं होता है, यह साधित व्यास स्थूल है, ज्या आदियों के साधन के लिये उपयुक्त नहीं है इसलिये आगे कहते हैं इति ।।१५।।

इदानीं तदेव प्रतिपादयति।

भगणकला व्यासार्धं भवति कलाभिर्यतो न सविकलं हि।
ज्यार्धानि न स्फुटानि च ततः कृतं व्यासदलमन्यत् ।।१६।।

सु. भा.—यतो भगणकलाव्यासार्धं पूर्वप्रकारेण सकलाभिः सावयवाभिः कलाभिरपि स्फुटं न भवति ततस्तस्माद्व्यासार्धाज्ज्यार्धानि च न स्फुटानि भवन्ति, तस्माज्ज्यासाधने स्फुटार्थं मया चक्रकलापरिधिव्यासार्धमन्यत् कृतमित्याचार्योक्तिर्गोलयुक्तियुक्ताऽतिसमीचीनेति सिद्धान्तविदां स्फुटमिति। चतुर्वेदाचार्यसम्मतः पाठः 'सविकलम्'—इति। सविकलं सशेषमित्यर्थः ।।१६।।

इति सामान्यगोल प्रकरणम्।

वि. भा.—हि (यतः) भगणकलाव्यासार्धं पूर्वप्रकारेण सावयवाभिः कलाभिरपि स्फुटं न भवति, ततः (तस्मात्) ज्यार्धानि स्फुटानि न भवन्ति, अस्मात् मया स्फुटार्थं चक्रकलापरिधि व्यासार्धं अन्यत्[1] कृतमित्याचार्योक्तिर्गोलयुक्तियुक्ता। सविकलं (सशेषम्) इति ।।१६।।

इति सामान्यगोल प्रकरणम्

अब उसी को कहते हैं।

हि. भा.—जिस हेतु से सावयव कलाओं से भी भगण कला व्यासार्ध स्फुट नहीं होता है, इससे ज्यार्ध भी स्फुट नहीं होते हैं, इस कारण से मैंने स्फुटार्थ चक्रकला परिधि व्यासार्ध अन्य किया है यह आचार्य की उक्ति गोलयुक्ति से युत है इति ।।१६।।

इति सामान्य गोल प्रकरण समाप्त हुआ।

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१. दूसरा।

अथ ज्याप्रकरणं प्रारभ्यते

तत्र प्रथमं ज्याखण्डानयनमाह ।

राश्यष्टांशेष्वङ्कान् पदसन्धिभ्यः क्रमोत्क्रमात् कृत्वा ।
बध्नीयात् सूत्राणि द्वयोर्द्वयोर्ज्यास्तदर्धानि ॥१७॥
ज्यार्धानि ज्यार्धानां ज्याखण्डान्यन्तराणि तान्येव ।
व्यस्तान्यन्त्यादथवेषुरुत्क्रमज्या धनुस्ताभ्याम् ॥१८॥

सु. भा.—इष्टत्रिज्यया वृत्तमुत्पाद्य लम्बरूपाभ्यां व्यासाभ्यां वृत्तचतुर्भागं कृत्वा चत्वारि पदानि कार्याणि। तत्र कस्माच्चिदपि पदसन्धितो ऽष्टादशशतकलानामष्टांशसमं शरद्विदस्रकलात्मकं धनुः क्रमादुत्क्रमात् कृत्वाऽर्थादुभयतो दत्त्वा द्वयोरग्रयोः सूत्रं बध्नीयादेवं द्विगुणशरद्विदस्रकलाचापं पदसन्धित उभयतो दत्त्वा द्वयोरग्रयोः सूत्रं बध्नीयात्। एवं त्रिगुणचतुर्गुणादि प्रथमचापवशतः सूत्राणि बध्नीयात्। एवं द्वयोर्द्वयोरग्रयोर्बद्धानि सूत्राणि ज्याः पूर्णज्या भवन्ति। तासामर्धानि ज्यार्धानि चतुर्विंशतिर्भवन्ति ज्यार्धानामन्तराणि ज्याखण्डानि भवन्ति। तान्येवान्त्याद्व्यस्तानि स्थाप्यानि तदोत्क्रमज्या उत्क्रमज्या खण्डान्यथवेषुः शरखंण्डानि भवन्ति। ताभ्यां क्रमोत्क्रमज्याखण्डानां धनुः साधनीयम्।

अत्रोपपत्तिः।

'इष्टाङ्गुलव्यासदलेन वृत्तम्'—इत्यादि विधिना तथा 'स्यादुत्क्रमज्याऽत्र विलोमखण्डैः'—इत्यादि विधिना भास्करोक्तेन स्फुटा ॥१७-१८॥

वि. भा.—इष्टत्रिज्यया वृत्तं विलिख्य लम्बरूपाभ्यां व्यासाभ्यां वृत्तचतुर्भागं विधाय पदानि कल्प्यानि, तत्र कस्माच्चिदपि व्यासप्रान्तासक्त (पदसन्धि) बिन्दोः राशिकलानां (अष्टादशशतकलानां) अष्टमांशेषु (शरद्विदस्रकलात्मकेषु) प्रत्येकमङ्कान्–लाञ्छनान् (चिह्नानि) क्रमादुत्क्रमात् कृत्वाऽर्थादुभयभागतो दत्त्वा द्वयोर्द्वयोः संमुखस्थचिन्ह्योः सूत्राणि बध्नीयात् तानि ज्याः (पूर्णज्याः) भवन्ति, तासां पूर्णज्यानामर्धानि ज्यार्धानि चतुर्विंशतिर्भवन्ति। ज्यार्धानामन्तराणि यानि तानि ज्याखण्डानि भवन्ति। तान्येवान्त्याद्व्यस्तानि स्थाप्यानि तदोत्क्रमज्या खण्डानि, अथवेषुः शरखण्डानि भवन्ति, ताभ्यां (क्रमोत्क्रमज्या खण्डाभ्यां) धनुः (चापं) साध्यमिति ॥

अत्रोपपत्तिः ।

सिद्धान्तशेखरे "राश्यष्टभागेषु विधाय लाञ्छनान् सन्धेः पदानां तदनु द्वयोर्द्वयोः । निवध्य सूत्राणि परस्परं तयोः क्रमात् क्रमज्या शकलानि तद्दलम् ।। जीवादलानां विवराणि यानि ज्याखण्डकानीह भवन्ति तानि । व्यस्तानि वान्त्यादिषुवत् स्थितानि भचक्रषड्गोंऽशधनुर्दलस्य ।।" इति सर्वथैवाऽऽचार्योक्तमेव श्लोकान्तरेणोक्तं श्रीपतिना । भास्करोऽप्यमुमेवाशयं किञ्चिद्विशदीकृत्य इष्टाङ्गुल व्यास दलेन वृत्तं कार्यं दिगङ्कं भलवाङ्कितं च । ज्यासंख्ययाप्ता नवतेर्लवा ये तदाद्यजीवा धनुरेतदेव ।। द्वित्र्यादिनिघ्नं तदनन्तराणां चापे तु दत्वोभयतो दिगङ्कात् । ज्ञेयं तदग्रद्वयवद्धरज्जोरर्धं ज्यकार्धं निखिलानि चैवम् ।। ज्याचापमध्ये खलुवाणरूपा स्यादुत्क्रमज्याऽत्र विलोमखण्डैः ।।" एवमाह पूर्वं पठिताः क्रमज्या उत्क्रमज्याश्च कथमानीयन्ते इत्येतदर्थमियमुपपत्तिरेव ज्यासाधनस्य । त्रिज्यादि कल्पनयाऽनेन विधिना ज्यार्धानां प्रमाणान्यानेतुं शक्यन्त एवेति ।।१७।१८।।

अब ज्या प्रकरण प्रारम्भ किया जाता है ।

उसमें पहले ज्याखण्डानयन कहते हैं ।

हि. भा.—इष्ट त्रिज्या से वृत्त बना कर लम्बरूप दोनों व्यासों से वृत्त को चार भाग करने से चार पद होते हैं । उसमें किसी पद सन्धि से अठारह सौ कलाओं के अष्टांश २२५ दो सौ पचीस कला तुल्य चाप को क्रम से और विलोम से अर्थात् दोनों तरफ से देकर दोनों के अग्र में सूत्र को बाँध देना चाहिए । एवं द्विगुणित दो सौ षचीस कला को पद सन्धि से दोनों तरफ से देकर दोनों के अग्र में सूत्र को बाँध देना चाहिए । इस तरह दो दो के अग्र में बाँधे हुए सूत्र पूर्णज्याएं होती हैं । उनके आधे चौबीस ज्यार्ध (अर्धज्या) होते हैं । ज्यार्धों के अन्तर ज्याखण्ड होते हैं । उन्हीं को अन्त्य से व्यस्त (उल्टा) स्थापन करना । तब क्रमज्याखण्ड अथवा शरखण्ड होते हैं । उन दोनों खण्डों (क्रमज्या खण्ड औरउत्क्रमज्याखण्ड) से चाप साधन करना चाहिए ।।

उपपत्ति ।

सिद्धान्तशेखर में 'राश्यष्ट भागेषु विधाय लाञ्छनान् सन्धेः पदानां' इत्यादि संस्कृतोपपत्ति में लिखित श्लोकों से श्रीपति ने आचार्योक्त ही को सर्वथा श्लोकान्तर से कहा है । भास्कराचार्य भी इसी आशय को कुछ विशद कर 'इष्टाङ्गुलव्यासदलेन वृत्तं कार्यं दिगङ्कं भलवाङ्कितं च' इत्यादि श्लोकों से इस तरह कहते हैं । क्रमज्याएं और उत्क्रमज्याएं कैसे लायी जाती हैं इसके लिये ज्यासाधन की यही उपपत्ति है त्रिज्यादि कल्पना कर इसी विधि से ज्यार्धों के प्रमाण ला सकते हैं इति ।।१७–१८।।

इदानीं गणितेन ज्यार्धानयनमाह ।

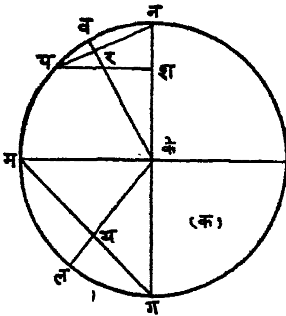
एकद्वित्रिगुणाया व्यासार्धकृतेः पृथक् चतुर्थेभ्यः ।
मूलान्यष्टद्वादशषोडशखण्डान्यतोऽन्यानि ॥१९॥

सु. भा.—व्यासार्धकृतेस्त्रिज्याकृतेः किंभूतायाः । एकगुणायास्तथा द्विगुणायास्तथा त्रिगुणायाः पृथक् चतुर्थेभ्यश्चतुर्भागेभ्यो मूलानि क्रमेण अष्ट द्वादश षोडश ज्याखण्डानि ज्यार्धानि भवन्ति । अत एभ्यो ज्यार्धेभ्योऽन्यानि वक्ष्यमाणविधिना साध्यानि । अत्रैतदुक्तं भवति । त्रिज्यावर्ग एकगुणश्चतुर्भक्तस्तन्मूलं राशिज्याऽष्टमी ज्या । त्रिज्यावर्गो द्विगुणश्चतुर्भक्तस्तन्मूलं शरवेदभागज्या द्वादशी ज्या । त्रिज्यावर्गस्त्रिगुणश्चतुर्भक्तस्तन्मूलं षष्टिभागज्या षोडशी ज्या ।

अत्रोपपत्तिः । भास्करज्योत्पत्त्या स्फुटा । भास्करेणापि तथैव पठितत्वादिति ॥१९॥

वि. भा.—एकगुणितत्रिज्यावर्गस्य, तथा द्विगुणितत्रिज्यावर्गस्य, तथा त्रिगुणितत्रिज्यावर्गस्य पृथक् चतुर्विभक्तस्य मूलानि क्रमेण अष्ट-द्वादश-षोड़श ज्यार्धानि भवन्ति, अत एभ्यो ज्यार्धेभ्योऽन्यानि ज्यार्धानि वक्ष्यमाणविधिना साध्यानीति ।

अत्रोपपत्तिः ।



के=वृत्तकेन्द्रम् । नपचापम्=६०°, वनचापम्=३०°, नर=ज्या३०, पश = ज्या ६०, पन = पूर्णज्या (६०°) । नश=ज्याउ ६०, ज्याउ=उत्क्रमज्या तदा केनर, पनश त्रिभुजयोः साजात्यादनुपातेन $\frac{\text{नश} \times \text{केर}}{\text{पश}}$

$= \text{नर} = \frac{\text{ज्याउ } ६० \times \text{ज्या } ६०}{\text{ज्या } ६०} = \text{ज्या}३० =$

ज्याउ ६०=त्रि—ज्या ३० समयोजनेन त्रि=ज्या ३०+ज्या ३०=२ ज्या ३० पक्षौ द्वाभ्यां भक्तौ तदा $\frac{\text{त्रि}}{२}$=ज्या ३०=अष्टमं ज्यार्धम्=अष्टमी ज्या । अथ

$\text{त्रि}^2 - \text{ज्या}^2\, ३० = \text{कोज्या}^2\, ३० = \text{ज्या}^2\, ६० = \text{त्रि}^2 - \left(\frac{\text{त्रि}}{२}\right)^2 = \text{त्रि}^2 - \frac{\text{त्रि}^2}{४}$

$= \frac{४\,\text{त्रि}^2 - \text{त्रि}^2}{४} = \frac{३\,\text{त्रि}^2}{४}$ मूल ग्रहणेन ज्या ६० $= \sqrt{\frac{३\,\text{त्रि}^2}{४}}$ =षोड़शी

ज्या । त्रि=त्रिज्या । केम=केग=त्रि । मग=पूर्णज्या (९०), मय=गय=ज्या ४५, ल=मगचापार्धविन्दुः । केम^{२}+केग^{२}=पूज्या^{२} (९०)=त्रि^{२}+त्रि^{२}=२ त्रि^{२}, पक्षौ चतुर्भिर्भक्तौ तदा $\frac{\text{पूज्या}^{२} (९०)}{४} = \frac{२ \text{ त्रि}^{२}}{४}$ =ज्या^{२} ४५ मूलेन $\sqrt{\frac{२ \text{ त्रि}^{२}}{४}}$ =ज्या ४५=द्वादशी ज्या, एतेनैकगुणितत्रिज्यावर्गश्चतुर्भक्तस्तन्मूलमष्टमी ज्या =राशिज्या=त्रिंशदंशज्या, त्रिज्यावर्गो द्विगुणश्चतुर्भक्तस्तन्मूलं पञ्चचत्वारिंशदंशज्या=द्वादशी ज्या त्रिज्यावर्गस्त्रिगुणश्चतुर्भक्तस्तन्मूलं षष्टिभागज्या=षोड़शीज्या, आचार्योक्तमुपपन्नम् । सिद्धान्तशेखरे "शशियमदहनघ्नात् व्यासखण्डस्य वर्गात् पृथगुदधिविभक्तात् त्रीणि मूलानि यानि । वसुरविनृपसंख्याभाञ्जि जीवादलानि क्रमश इह भवेयुर्नूनमन्यानि तेभ्यः ।" इत्यनेन श्रीपतिनाऽऽचार्योक्तमेव श्लोकान्तरेणोक्तम् । भास्करेणापि "त्रिज्यार्धं राशिज्या तत्कोटिज्या च षष्टिभागानाम् । त्रिज्यावर्गार्धपदं शरवेदांशज्यका भवति ।" इत्युक्त्या तदेवोक्तमिति ॥१९॥

अब गणित से ज्यार्धानयन को कहते हैं ।

हि. भा.—एक गुणित त्रिज्यावर्ग को चार से भाग देकर मूल लेने से अष्टमज्यार्ध =अष्टमीज्या=तीस अंश की ज्या होती है, तथा द्विगुणित त्रिज्यावर्ग को चार से भाग देकर मूल लेने से पैंतालीस अंश की ज्या=द्वादशीज्या होती है, एवं त्रिज्यावर्ग को तीन से गुणाकर चार से भाग देकर मूल लेने से साठ अंश की ज्या=षोड़शी ज्या होती है इति ।

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । के=वृत्तकेन्द्र । मपचाप =६०° । वनचाप=३०°, नर=ज्या ३०, पश=ज्या ६०, वन=पूर्णज्या (९०) । नश =ज्याउ ६० । ज्याउ=उत्क्रमज्या, तब केनर, पनश दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं $\frac{\text{नश} \times \text{केर}}{\text{पश}}$ =नर= $\frac{\text{ज्याउ } ६० \times \text{ज्या } ६०}{\text{ज्या } ६०}$ =ज्या ३० =ज्याउ ६०=त्रि—ज्या ३० दोनों पक्षों में ज्या ३० जोड़ने से त्रि=ज्या ३०+ज्या ३०=२ ज्या ३० दोनों पक्षों को दो से भाग देने से $\frac{\text{त्रि}}{२}$ =ज्या ३०=अष्टमीज्या=राशिज्या। तथा

त्रि^{२} — ज्या^{२} ३० = कोज्या^{२} ३० = ज्या^{२} ६० = त्रि^{२}—$\left(\frac{\text{त्रि}}{२}\right)^{२}$=त्रि^{२}—$\frac{\text{त्रि}^{२}}{४}$

= $\frac{४ \text{ त्रि}^{२} — \text{त्रि}^{२}}{४} = \frac{३ \text{ त्रि}^{२}}{४}$ मूल लेने से ज्या ६०= $\sqrt{\frac{३ \text{ त्रि}^{२}}{४}}$ =षोड़शीज्या ।

तथा केम=केग=त्रि । मग चाप पूर्णज्या=पूज्या (९०) । मय=गय=ज्या ४५ । ल=

मगचापार्धं बिन्दु केम^2+केग^2=पूज्या^{2} (९०)=२ त्रि^{2} दोनों पक्षों में चार से भाग देने से $\frac{\text{पूज्या}^2 (९०)}{४}$=ज्या^{2} ४५=$\frac{२\ \text{त्रि}^2}{४}$ मूल लेने से $\sqrt{\frac{२\ \text{त्रि}^2}{४}}$=ज्या ४५=द्वादशी ज्या, इससे आचार्योक्त उपपन्न हुआ। सिद्धान्तशेखर में 'शशियमदहनघ्नात्' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने आचार्योक्त ही को श्लोकान्तर से कहा है। भास्कराचार्य ने भी 'त्रिज्यार्धं राशिज्या' इत्यादि से वही कहा है इति ॥१९॥

इदानीमर्धांशज्यानयनमाह।

तुल्यक्रमोत्क्रमज्यासमखण्डकवर्गयुतिचतुर्भागम्।
प्रोह्यानष्टं व्यासार्धवर्गतस्तत्पदे प्रथमम् ॥२०॥

तद्दलखण्डानि तदूनजिनसमानि द्वितीयमुत्पत्तौ।
कृतयमलैकदिगीशेषु सप्तरसगुणनवादीनाम् ॥२१॥

सु. भा.—तुल्यचापस्यैकस्यैव चापस्य समक्रमज्योत्क्रमज्ययोर्वर्गयुतेश्चतुर्थांशमनष्टं व्यासार्धकृतेः प्रोह्य हित्वा तत्पदे अनष्टस्य शेषस्य च पदे ग्राह्ये। तत्र प्रथमं पदं तद्दलखण्डानि तच्चापार्धज्या द्वितीयं च तदूनजिनसमानि तदर्धचापकोटिज्या स्यात्। एवमुत्पत्तौ ज्योत्पत्तौ पुनः पुनः समज्यार्धादष्टमाद् द्वादशाच्च कर्मणि कृते कृतयमलैकदिगीशेषु सप्तरसगुणनवादीनां ज्यार्धानामुत्पत्तिः स्यात्।

यथाऽष्टमाज्ज्यार्धात् तदर्धभागज्यया तत्कोटचर्धभागज्यया च

४	२०	१०	१४	५	१९	७	१७
२	२२	११	१३				
१	२३						

द्वादशाज्ज्यार्धाच्च

६	१८	९	१५
३	२१		

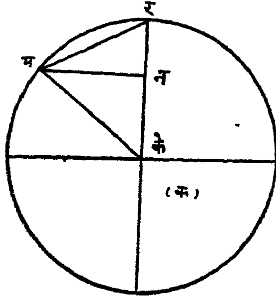
एतानि सिध्यन्ति।

द्वादशं षोडशं चतुर्विंशतिसङ्ख्यं त्रिज्येति त्रयं च ज्ञातमेव। अत इष्टव्यासार्धे तदर्धज्यानयनेन चतुर्विंशतिज्याः सिध्यंति।

अत्रोपपत्तिः। 'क्रमोत्क्रमज्याकृतियोगमूलाद्' इत्यादिभास्करविधिना स्फुटा ॥२०-२१॥

वि. भा.—एकस्यैव चापस्य क्रमज्योत्क्रमज्ययोर्वर्गयुतेश्चतुर्थांशमनष्टं त्रिज्यावर्गाद्विशोध्य तन्मूले (अनष्टस्य शेषस्य च) ग्राह्ये, तत्र प्रथममूलं तच्चापार्धज्या द्वितीयं च तदूनजिनसमानि तदर्धचापकोटिज्या स्यात्। एवमुत्पत्तौ (ज्योत्पत्तौ)

पुनः पुनः समज्यार्धादष्टमाद् द्वादशाच्च कार्यंकरणेन कृत ४ यमलै २ क १ दिगी १० शे११ षु ५ सप्तरसगुणनवादीनां ज्यार्धानामुत्पत्तिर्भवेत् ।



अत्रोपपत्तिः ।

के = वृत्तकेन्द्रम् । रय = इष्टचापम् । यन = चापज्या रन = चापस्योत्क्रमज्या, यर = चापपूर्णज्या, तदा यन^2 + रन^2 = यर^2 = चापपूर्णज्या^{2} पक्षौ चतुर्भिर्भक्तौ तदा

$$\frac{\text{यन}^2+\text{रन}^2}{4}=\frac{\text{चापज्या}^2+\text{चापोत्क्रमज्या}^2}{4}=\frac{\text{चापपूर्णज्या}^2}{4}$$

= चापार्धज्या^{2} = अनष्ट । त्रि^{2} — $\frac{\text{चापपूर्णज्या}^2}{4}$

= चापार्धकोटिज्या^{2} । द्वयोर्मूल ग्रहणेन $\sqrt{\frac{\text{चापज्या}^2+\text{चापोत्क्रमज्या}^2}{4}}$

= चापार्धज्या । $\sqrt{\text{त्रि}^2-\frac{\text{चापपूर्णज्या}^2}{4}}$ = चापार्धकोटिज्या ।

एतेन नियमेनाष्टमाज्ज्यार्धात् तदर्धांशज्यया तत्कोटच‌ंशार्धज्यया च अष्टमाज्ज्यार्धात् तदर्धज्या चतुर्थी ४ । तत्कोटिज्या विंशी २० । एवं चतुर्थात् द्वितीया २ द्वाविंशी २२ च, द्वितीयात् प्रथमा १ । त्रयोविंशी च । एवमष्टम्या ज्यायाः तदर्धांशज्यया तत्कोटचर्धांशज्यया च ४ । २०, २ । २२, १ । २३, १० । १४ ५ । १९, ७ । १७, ११ । १३, द्वादश्याश्च ६ । १८, ३ । २१, ९ ।१५, त्रिज्या चान्तिमा चतुर्विंशी ज्या भवतीति । सिद्धान्तशेखरे ।

"उत्क्रमक्रमसमानसमज्याखण्डवर्गं युतिवेदविभागम् ।
व्यासखण्डकृतितस्तमनष्टं शोधयेदथ पदे भवतो ये ॥
आद्यमूलमिह तद्दलसंख्यं तद्विहीनजिनसम्मितमन्यत् ।
ज्यार्धमेवमपराणि समेभ्यो ज्यादलानि न भवन्त्यसमेभ्यः ॥"

श्रीपत्युक्तस्यास्याऽचार्योक्तमादर्शरूपमस्ति । भास्कराचार्येणापि ।

"इष्टा त्रिज्या सा श्रुतिर्दोर्भुजज्या कोटिज्या तद्वर्गं विशेषमूलम् । दोःकोटच‌ंशानां क्रमज्ये पृथक् ते त्रिज्याशुद्धे कोटिदोरुत्क्रमज्ये । ज्याचापमध्ये खलु वाणरूपा स्यादुत्क्रमज्या त्रिभमौर्विकायाः । वर्गार्धमूलं शरवेदभागजीवा ततः कोटिगुणोऽपि तावान् । त्रिभज्यकार्धं खगुणांशजीवा तत्कोटि जीवा खरसांशकानाम् । क्रमोत्क्रमज्या कृतियोगमूलाद्दलं तदर्धांशकशिञ्जिनी स्यात् ।"

इत्ययमेवार्थः स्फुटोत्तचा सम्यगुक्त इति ॥२०-२१॥

अब अर्धांशज्यानयन को कहते हैं ।

हि. भा.—एक ही चाप की समक्रमज्या और उत्क्रमज्या के वर्ग योग के चतुर्थांश (अनष्ट) को त्रिज्या वर्ग में से घटाकर उनका (अनष्ट और शेष) मूल लेना चाहिये उन में

प्रथम मूल उस चापार्ध की ज्या होती है, और द्वितीय मूल चौवीस में से उसको घटाने से उस अर्धचाप की कोटिज्या होती है। इस तरह ज्योत्पत्ति में पुनः पुनः समज्यार्ध अष्टम से और बारहम से कर्म करने से ४ । २ । १ । १० । ११ । ५ । ७ । ६।३।६ आदि अर्धांशज्या होते हैं। जैसे अष्टमज्या की अर्धांशज्या और उसकी कोटिज्या से ४ । २०, २ । २२, १ । ३, १० । १४, ५ । ६, ७ । १७, ११ । १३ बारह बीज्या से ६ । १८, ३ । २१, ६ । १५ बारहवीं सोलहवीं चौवीसवीं (त्रिज्या) ये तीनों ज्या विदित ही हैं इन से इष्ट व्यासार्ध में उनके अर्धज्यानयन से चौवीस ज्याएं सिद्ध होती हैं इति।

उपपत्ति।

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये। के = वृत्तकेन्द्र। रय = इष्ट-चाप, यन = चापज्या। रन = चाप की उत्क्रमज्या। यर = चापपूर्णज्या। तब $\text{यन}^2 + \text{रन}^2 = \text{यर}^2 = \text{चापपूर्णज्या}^2$, दोनों पक्षों को चार से भाग देने से $\frac{\text{यन}^2 + \text{रन}^2}{4}$

$= \frac{\text{चापज्या}^2 + \text{चापोत्क्रमज्या}^2}{4} = \frac{\text{चापपूर्णज्या}^2}{4} = \text{चापार्धज्या}^2 = \text{अनष्ट}$, $\text{त्रि}^2 - \frac{\text{चापपूज्या}^2}{4} = \text{चापार्धकोटिज्या}^2$, दोनों का मूल लेने से $\sqrt{\frac{\text{चापज्या}^2 + \text{चापोत्क्रमज्या}^2}{4}}$

$= \text{चापर्धज्या}$ तथा $\sqrt{\text{त्रि}^2 - \frac{\text{चापपूज्या}^2}{4}} = \text{चापार्ध कोटिज्या}$। इससे आचार्योक्त सूत्र उपपन्न हुआ। सिद्धान्तशेखर में 'उत्क्रमक्रमसमानसमज्याखण्डवर्गयुतिवेदविभागम्' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपत्युक्त श्लोकों का आदर्श आचार्योक्त ही है, भास्कराचार्य ने भी "इष्टा त्रिज्या सा श्रुतिर्दोर्भुजज्या" इत्यादि संस्कृतोपपत्ति में लिखित श्लोकों से आचार्योक्त बात को ही स्पष्टतया कहा है इति ॥२०–२१॥

इदानीं विशेषमाह।

एवं जीवाखण्डाल्पानि बहूनि वाऽऽद्यखण्डानि।
ज्यार्धानि वृत्तपरिधेः षष्ठचतुर्थभागानाम् ॥२२॥

सु. भा.—एवं तदर्धज्यानयनेन गणकेनाल्पानि वा बहूनि यथेप्सितानि जीवाखण्डानि साध्यानि। आचार्येण च स्वग्रन्थे चतुर्विंशतिर्ज्यार्धानि साधितानि यदीप्सितानि ९६ ज्यार्धानि स्युस्तदा पुनस्तदर्धभागज्याविधिः कार्यः। अर्धभाग-ज्याविधौ सर्वत्र त्रिज्यार्धं त्रिज्यावर्गार्धपदं त्रिगुणत्रिज्यावर्गचतुर्थांशपदं क्रमेण वृत्तपरिधेः षष्ठचतुर्थत्रिभागानां ज्यार्धानि चाद्यखण्डानि व्यक्तानि। परिधिषष्ठ-भागस्य षष्टिभागानां या ज्या पूर्णज्या तस्या अर्धं त्रिज्यार्धम् चतुर्थभागस्य नवते-

ज्यार्धं त्रिज्यावर्गार्धपदम् । त्रिभागस्य विंशत्यधिकशतभागानां ज्यार्धं त्रिगुणत्रिज्यावर्गचतुर्थांशपदम् । इति ज्यार्धान्याद्यानि विज्ञाय ततस्तदर्धभागज्यानयन विधानेन वृत्तपादे यथेप्सितानि ज्याखण्डानि साध्यानीति सर्वं स्फुटम् ।

वि. भा.—एवं पूर्वोक्तार्धज्यानयनविधिनाऽल्पानि बहूनि वेप्सितानि ज्याखण्डानि ज्योतिर्विद्भिः साध्यानि आचार्येण चतुर्विंशतिर्ज्यार्धानि साधितानि यदि ९६ संख्यकज्यार्धानीप्सितानि भवेयुस्तदा पुनस्तदर्धांशज्याविधिः कार्यः । अर्धांशज्याविधौ त्रिज्यार्धं-त्रिज्यावर्गार्धमूलं-त्रिगुणत्रिज्यावर्गचतुर्थांशमूलं क्रमेण वृत्तपरिधेः षष्ठचतुर्थत्रिभागा (६०, ९०, १२०) नां ज्यार्धानि चाद्यखण्डानि व्यक्तानि । वृत्तपरिधिषष्ठांशस्य षष्ट्यंशस्य पूर्णज्यार्धं त्रिंशदंशज्या $= \frac{\text{त्रि}}{२}$ वृत्तपरिधेश्चतुर्थांशस्य नवतेः पूर्णज्यार्धं पञ्चचत्वारिंशदंशज्या $= \sqrt{\frac{\text{त्रि}^{२}}{२}}$ वृत्तपरिधेस्तृतीयांशस्य विंशत्यधिक शतमितांशानां ज्यार्धं $=$ ज्या ६० $= \sqrt{\frac{३ \text{ त्रि}^{२}}{४}}$

इति ज्यार्धान्याद्यानि ज्ञात्वा ततस्तदर्धांशज्यानयनविधिना वृत्तपादे (नवत्यंशतुल्ये) यथेप्सितानि ज्याखण्डानि साध्यानीति ॥२२॥

अब विशेष कहते हैं ।

हि. भा.—एवं पूर्व कथित अर्धज्यानयन से अल्प वा बहुत यथेच्छ ज्याखण्ड साधन करना चाहिये । आचार्य अपने ग्रन्थ में चौबीस ज्यार्ध साधन किया है, यदि ९६ संख्यक ज्यार्ध अभीष्ट हो तो फिर अर्धांशज्या विधि करनी चाहिये । अर्धांशज्या विधि में सब जगह त्रिज्या का आधा, त्रिज्यावर्ग के आधा का मूल, त्रिगुणित त्रिज्यावर्ग के चतुर्थांश का मूल क्रम से वृत्तपरिधि का षष्ठांश, चतुर्थांश और तृतीयांश का ज्यार्ध आद्यखण्ड व्यक्त है वृत्तपरिधि का षष्ठांश $\frac{३६०}{६} = ६०$ की पूर्णज्या का आधा त्रिज्यार्ध, परिधि का चतुर्थांश $\frac{३६०}{४} = ९०$ की पूर्णज्या का आधा पैंतालीस अंश की ज्या $= \sqrt{\frac{\text{त्रि}^{२}}{२}}$, परिधि का तृतीयांश $= \frac{३६०}{३} = १२०$ इसका ज्यार्ध (पूर्णज्यार्ध) $=$ ज्या ६० $= \sqrt{\frac{३ \text{ त्रि}^{२}}{४}}$, इन ज्यार्धों को जान कर अर्धांशज्यानयन विधि से वृत्तपाद (९०°) में यथेप्सित ज्याखण्डों का साधन करना चाहिये इति ॥२२॥

इदानीं प्रकारान्तरेणार्धांशज्यानयनमाह ।

उत्क्रमसमखण्डगुणाद् व्यासादथवा चतुर्थभागाद्यत् ।
कृत्वोक्तखण्डकानि ज्यार्धानयनं न लघ्वस्मात् ॥२३॥

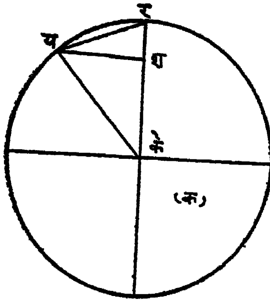
सु० भा०—अथवोत्क्रमसमखंडं समसङ्ख्यकज्यायाः उत्क्रमज्या तया गुणाद् व्यासात् किंविशिष्टात् चतुर्थभागाच्चतुर्विभक्ताद्यल्लब्धं तदुक्तखण्डानि क्रमोत्क्रमज्या वर्गयुतसमानि कृत्वा ज्यार्धानयनं प्राग्वत् कार्यम् । अस्मादानयनादन्यदानयनं न लघ्वस्तीति । अनेन प्रकारेण लाघवेन ज्यार्धानि सिध्यन्तीत्यर्थः ।

अत्रोपपत्तिः ।

'त्रिज्योत्क्रमज्यानिहतेर्दलस्य' इत्यादि भास्करविधिना स्फुटज्योत्पत्तावन्ये विशेषा भास्करान्त्यज्योत्पत्तौ प्रसिद्धा एव ॥२३॥

वि. भा.—यत्संख्यकाया ज्याया अर्धज्या आनीयते तत्संख्यका या उत्क्रमज्या तया गुणाद् व्यासाच्चतुर्विभक्ताद्यल्लब्धं तदुक्तखण्डानि क्रमोत्क्रमज्यावर्गयुत समानि कृत्वा पूर्ववज्ज्यार्धानयनं कार्यम् । अस्मादानयनादन्यदानयनं न लघ्वस्ति, अर्थादनेन प्रकारेण लाघवेन ज्यार्धानि सिध्यन्तीति ।

अत्रोपपत्तिः ।



के=वृत्तकेन्द्रम् । रयचापम्=अ, अस्यैव चापस्यार्धांशज्यानयनमभीष्टम् । यश=ज्याअ, रश=उज्या अ । रय=अ चापस्य पूर्णज्या । केश=चापकोटिज्या =कोज्याअ । त्रि=त्रिज्या=केर, तदा केर—केश =रश=त्रि—कोज्याअ=उज्याअ वर्गं करणेन $त्रि^2 - २\, त्रि.\, कोज्याअ + कोज्या^2 अ = उज्या^2 अ$ परन्तु $यश^2 + रश^2 = अ\, चापपूर्णज्या^2 = ज्या^2 अ + उज्या^2 अ = त्रि^2 - २\, त्रि.\, कोज्याअ + कोज्या^2 अ + ज्या^2 अ = त्रि^2 - २\, त्रि.\, कोज्याअ + त्रि^2 = २\, त्रि^2 - २\, त्रि.\, कोज्याअ$ $= २\, त्रि\, (त्रि - कोज्याअ) = २\, त्रि.\, उज्याअ$ पक्षौ चतुर्भिर्भक्तौ तदा $\frac{२ त्रि.\, उज्याअ}{४}$

$$= \frac{अचापपूज्या^2}{४} = ज्या^2 \frac{१}{२} अ \text{ मूल ग्रहणेन} \sqrt{\frac{२\, त्रि\, उज्याअ}{४}}$$

$$= \sqrt{\frac{त्रि.\, उज्याअ}{२}} = ज्या \frac{१}{२} अ \cdots\cdots(१) \sqrt{\frac{व्या\, उज्याअ}{४}} \text{ अस्मात्}$$

'तुल्यक्रमोत्क्रमज्या समखण्डकवर्गयुतिचतुर्भागमि' त्याचार्योक्तप्रकारेण अर्धांशज्याभिस्तत्कोटिज्याभिश्च ज्यार्धानि भवन्त्येनाचार्योक्तमुपपन्नम् । सिद्धान्तशेखरे "उत्क्रमाविषमखण्डविनिघ्नात् व्यासतो भवति यो युगभागः । तेन पूर्वकथिताच्च

(१) एतेन 'त्रिज्योत्क्रमज्या निहतेर्दलस्य मूलं तदर्धांशकशिञ्जिनी वा' भास्करोक्तमिदमुपपद्यते ।

विधानात् ज्यादलानि यदि वाऽत्र भवन्ति" इत्यनेन श्रीपतिनाऽऽचार्योक्तमेव पुनरुक्तीकृतम् । सिद्धान्तशिरोमणौ भास्कराचार्येणापि—"त्रिज्योत्क्रमज्यानिहतेर्दलस्य मूलं तदर्धांशक शिञ्जिनी वा । तस्याः पुनस्तद्दलभागकानां कोटेश्च कोटयंशदलस्य चैवम् ।" इत्यनेन तदेवोक्त्वा वासनाभाष्ये सम्यगुपपादितमिति ॥२३॥

इति ज्या प्रकरणम्

अब प्रकारान्तर से अर्धांशज्यानयन को कहते हैं

हि. भा.—यत्संख्यक ज्या की अर्धज्या लाते हैं तत्संख्यक उत्क्रमज्या से व्यास को गुणा कर चार से भाग देने से जो लब्ध हो उससे पूर्ववत् ज्यार्धानयन करना चाहिये। इस आनयन प्रकार से अन्य आनयन प्रकार छोटा नहीं है अर्थात् इस प्रकार से लाघव ही से ज्यार्ध सिद्ध होता है।

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । के=वृत्तकेन्द्र । रयचाप =अ, इसी चाप का अर्धांशज्यानयन करना है। यश=ज्याअ, रश=उज्याअ, रय=अ-चाप की पूर्णज्या, केश=चापकोटिज्या=कोज्याअ केर=त्रिज्या=त्रि। तब केर—केश= रय=त्रि—कोज्याअ=उज्याअ, वर्ग करने से $त्रि^2 - २\ त्रि.\ कोज्याअ + कोज्या^2अ = उज्ला^2अ$ परन्तु $यश^2 + रश^2 = अचाप\ पूर्णज्या^2 = ज्या^2अ + उज्या^2अ = त्रि^2 - २\ त्रि\ कोज्याअ + कोज्या^2अ + ज्या^2अ = त्रि^2 - २\ त्रि.कोज्याअ + त्रि^2 = २\ त्रि^2 - २\ त्रि.\ कोज्याअ = अचापपूज्या^2$ $= २\ त्रि\ (त्रि - कोज्याअ) = २\ त्रि.\ उज्याअ = व्या \times उज्याअ$ दोनों पक्षों को चार से भाग देने से $\frac{व्यास - उज्याअ}{४} = \frac{अचापपूज्या^2}{४} = ज्या^2 \frac{१}{२} अ$ इससे 'तुल्य क्रमोत्क्रमज्या समखण्डकवर्गयुतिचतुर्भागम्" इस पूर्वोक्त प्रथम प्रकार से अर्धांशज्या और उसकी कोटिज्या से ज्यार्ध होता है इससे आचार्योक्त उपपन्न हुआ। २ त्रि (त्रि—कोज्याअ)=$अचापपूज्या^2$ =२ त्रि. उज्याअ दोनों पक्षों को चार से भाग देने से $\frac{२\ त्रि.\ उज्याअ}{४} = \frac{त्रि.\ उज्याअ}{२}$

$$= \frac{अचापपूज्या^2}{४} = ज्या^2 \frac{१}{२}अ,$$ मूल लेने से $$\sqrt{\frac{त्रि\ उज्याअ}{२}} = ज्या \frac{१}{२} अ,$$ इस से

'त्रिज्योत्क्रमज्या निहतेर्दलस्यमूलम्' इत्यादि भास्करोक्त उपपन्न होता है। सिद्धान्तशेखर में 'उत्क्रमाविषमखण्डविनिघ्नात्' इत्यादि श्रीपत्युक्त आचार्योक्त की ही पुनरुक्ति है। भास्कराचार्य ने भी 'त्रिज्योत्क्रमज्या निहतेर्दलस्य' इत्यादि इससे उसी को कह कर वसनाभाष्य में अच्छी तरह कहा है इति ॥२३॥

इति ज्या प्रकरण समाप्त हुआ

अथ स्फुटगति वासना ।

तत्रादौ स्पष्टीकरणे छेद्यकमाह ।

कक्षामण्डलमध्यं भूमध्ये मध्यमः स्वकक्षायाम् ।।
अनुलोमं मन्दोच्चात् प्रतिलोमं भ्रमति शीघ्रोच्चात् ।। २४ ।।

सु. भा.—भूमध्ये कक्षामण्डलस्य मध्यं केन्द्रमस्ति । मध्यमो ग्रहः स्वकक्षायां प्रतिवृत्ते मन्दोच्चादनुलोमं शीघ्रोच्चाच्च प्रतिलोमं भ्रमति । 'भूमेर्मध्ये खलु भूवलयस्यापि मध्यम्' –इत्यादिना तथा 'मन्दोच्चितोऽग्रे प्रतिमण्डले प्राग्ग्रहोऽनु–लोमं निजकेन्द्रगत्या'—इत्यादिना भास्करविधिनाऽपीयमेव स्थितिः ।।२४।।

वि. भा.—भूमध्ये (भूकेन्द्रे) कक्षावृत्तस्य केन्द्रमस्ति, मध्यमो ग्रहः स्वकक्षायां (प्रतिवृत्ते) मन्दोच्चादनुलोमं शीघ्रोच्चाच्च विलोमं भ्रमति । मन्दोच्चादनुलोमं राश्यादिगणनयाऽग्रतः शीघ्रोच्चाच्च विलोमत इति राश्यादिगणनया पृष्ठतो यथोत्तरं भ्रमति । ग्रहगत्यपेक्षया शीघ्रोच्चगतिर्महती भवतीति तत्र यदि शीघ्रोच्चं स्थिरं मन्यते तदा ग्रहो विपरीतगमन इव लक्ष्यते । मन्दोच्चस्य चालक्ष्याल्पगतित्वात् सदैव ग्रहो राश्यादिगणनया अनुगामी भवतीति । सिद्धान्त शेखरे "मध्यः स्वकक्षा परिधौ स्फुटस्तु स्वकेन्द्रवृत्ते भ्रमति द्युचारी । स्वमन्दतुङ्गादनुलोमगत्या विलोमतो याति च शीघ्रतुङ्गात्" श्रीपतिनैवं कथितम् । अत्र लल्लः—"अनुलोमं निजमन्दात् प्रतिलोमं गच्छति स्वशीघ्रोच्चात् । कक्षावृत्ते मध्यः स्वकेन्द्रवृत्ते ग्रहाः स्पष्टाः ।। " स्वकेन्द्रवृत्ते (स्वीये प्रतिवृत्ते) । भास्करश्च "मन्दोच्चतोऽग्रे प्रतिमण्डले प्राक् ग्रहोऽनुलोमं निजकेन्द्रगत्या । शीघ्राद्विलोमं भ्रमतीव भाति विलम्बितः पृष्ठत एव· यस्मात्" एवमेव ग्रहभ्रमणव्यवस्थां प्रतिपादयतीति ।। २४ ।।

अब स्फुटगति वासना प्रारम्भ की जाती है ।

उसमें पहले स्पष्टी करण में छेद्यक को कहते हैं ।

हि. भा.—भूकेन्द्र कक्षावृत्त का केन्द्र है । मध्यमग्रह अपनी कक्षा में मन्दोच्च से अनुलोम (क्रमिक) और शीघ्रोच्च से विलोम (उल्टा) भ्रमण करते हैं मन्दोच्च से अनुलोम अर्थात् राश्यादि गणना से आगे और शीघ्रोच्च से विलोम अर्थात् राश्यादि गणना से पीछे भ्रमण करते हैं । ग्रहगति की अपेक्षा शीघ्रोच्चगति अधिक हैं यदि शीघ्रोच्च को स्थिर माना जाय तो ग्रह विपरीत चलते हुए लक्षित होते हैं । मन्दोच्च की अत्यन्त अल्प गति के कारण राश्यादि गणना से ग्रह सर्वदा अनुगामी होते हैं । सिद्धान्त शेखर में 'मध्यः स्वकक्षा परिधौ'

इत्यादि से श्रीपति ने आचार्योक्त के अनुसार ही कहा है। 'अनुलोमं निजमन्दात् प्रतिलोमं' इत्यादि विज्ञान भाष्य में लिखित श्लोक से लल्लाचार्य तथा 'मन्दोच्चऽतोग्रे प्रतिमण्डले प्राक्' इत्यादि विज्ञान भाष्य में लिखित श्लोक से भास्करा चार्य ने भी इसी तरह ग्रहभ्रमण व्यवस्था कही है इति ॥ २४ ॥

इदानीं नीचोच्चवृत्तभङ्गिमाह।

नीचोच्चवृत्तमध्यं मध्ये तद्भ्रमति मध्यगः स्वोच्चात्।
तत्परिधौ प्रतिलोमं मन्दोच्चाद् भ्रमति शीघ्रोच्चात् ॥ २५ ॥
अनुलोमं मध्यसमं भूस्थः पश्यति यतो न कक्षायाम्।
स्पष्टं तन्मध्यान्तरमृणं धनं वा ग्रहे मध्ये ॥ २६ ॥

सु. भा.—कक्षायां यत्र मध्यग्रहचिह्नं तस्मिन् मध्ये नीचोच्चवृत्तस्य मध्यं नीचोच्चवृत्तकेन्द्रं भवति तत् केन्द्रं च मध्यचलनाद् भ्रमति। शेषं भास्करभङ्ग्या स्फुटम् ॥२५-२६॥

वि. भा.—कक्षायां यत्रमध्यग्रहचिन्हं तत्र मध्ये नीचोच्चवृत्तस्य मध्यं (केन्द्रं) भवति। नीचोच्चवृत्तपरिधौ मन्दोच्चात् प्रतिलोमं शीघ्रोच्चाच्चानुलोमं ग्रहो भ्रमति। यतो (यस्मात्कारणात्)भूस्थो द्रष्टा कक्षायां मध्यग्रहतुल्यं स्पष्टग्रहं न पश्यति तस्मात् कारणात् स्पष्टमध्यग्रहयोरन्तरं फलं मध्यमग्रहे ऋणं धनं वा क्रियते तदा स्पष्टग्रहो भवति। अर्थात् समायां भूमौ बिन्दुं कृत्वा तं केन्द्रं प्रकल्प्य त्रिज्यातुल्येन कर्कटकेन कक्षावृत्तं विलिखेत्। तद्भगणाङ्कितं कृत्वा मेषादेरारभ्य ग्रहमुच्चं च दत्त्वा चिन्हे कार्ये। भूकेन्द्रादुच्चोपरिगता रेखा कार्या सोच्चरेखा कथ्यते। भूकेन्द्रादुच्चरेखोपरि लम्बरेखा(तिर्यग्रेखा)कार्या, भूकेन्द्रादु पर्यन्त्यफलज्यामुच्चोन्मुखीं दत्त्वा तदग्रात् त्रिज्या व्यासार्धेनैव प्रतिवृत्तं कार्यम्। उच्चरेखया सह यत्रास्य सम्पातस्तत्र प्रतिवृत्तेऽप्युच्चं ज्ञेयम्। तस्मादुच्चभोगं विलोमेन देयम्। ततो ग्रहमनुलोमं दत्त्वा तत्र चिन्हं कार्यम्। प्रतिवृत्तकेन्द्रादुच्चरेखोपरि लम्बरेखा प्रतिवृत्तीयतिर्यग्रेखा कार्या, तिर्यग्रेखयोरन्तरमन्त्यफलज्या तुल्यमेव सर्वत्र भवति। ग्रहोच्चरेखयोर्ज्यारूपमत्तरं दोर्ज्या (भुजज्या) भवति। ग्रहप्रतिवृत्ततिर्यग्रेखयोरन्तरं कोटिज्या, ग्रह कक्षामध्यगतिर्यग्रेखयोरूर्ध्वाधरमन्तरं स्फुटा कोटिः। भूकेन्द्रात्प्रतिवृत्तस्य ग्रहावधि सूत्रं कर्णः। कर्णसूत्रं यत्र कक्षा वृत्तेलगति तत्र स्फुटो ग्रहः कक्षावृत्ते स्फुटमध्यग्रहयोरन्तरं फलं तच्च मध्यग्रहात् स्फुटग्रहेऽग्रस्थे धनं मेषादिकेन्द्रे पूर्वाकर्षणेनोत्पद्यते। मध्यग्रहात् स्फुटग्रहे पृष्ठस्थे फलमृणं तुलादिकेन्द्रे पश्चादाकर्षणेन भवति ॥ सिद्धान्तशेखरे "द्रष्टा स्फुटं पश्यति मध्यतुल्यं भान्तस्थिते भार्धगते च केन्द्रे। यस्मादभावोऽत्र फलस्य तस्मात् भवेद् ग्रहस्योर्ध्वमधःस्थितस्य ॥ ऊनाधिकं पश्यति मध्य-

माच्च स्फुटं नरस्तद्विवरं फलं हि। ऋणं धनं च क्रियतेऽत एव मध्यग्रहे स्पष्टबुभुत्सुभिस्तत् ॥" श्रीपतिनैवमेवं कथितम्। लल्लाचार्यस्तु प्रथममार्यभटोक्त स्पष्टीकरणक्रियाया उपपत्तिमेवाह। "मध्यमतुल्यं स्पष्टं भान्तगते भार्धगेऽपि वा केन्द्रे। द्रष्टा पश्यति यस्मान्मध्यस्यातः फलाभावः ॥ स्पष्टं पश्यति यस्मान्मध्यादूनाधिकं नरस्तस्मात्। विवरं तयोः फलमृणं धनं च मध्यग्रहे क्रियते ॥" भास्कराचार्येणापि "भूमेर्मध्ये खलु भवलयस्यापि मध्यं यतः स्याद्यस्मिन् वृत्ते भ्रमति खचरो नास्य मध्यं कुमध्ये। भूस्थो द्रष्टा नहि भवलये मध्यतुल्यं प्रपश्येत्, तस्मात् तज्ज्ञैः क्रियतइह तद्दोः फलं मध्यखेटे ॥" इत्यनेन प्रथममेकेनैव श्लोकेन प्राचीनोक्तो मध्यमग्रहस्य स्पष्टताविधायको विधिरुपपादितः पश्चाद्विशदव्याख्यया उपपादित इति।

अथ ग्रह स्पष्टीकरणे छेद्यकाद्युपपत्तौ किमर्थं प्राचीनैः कक्षावृत्तप्रतिवृत्तादिकल्पना कृता तदर्थं किञ्चिदुच्यते। भूकेन्द्रमिति कल्पितात् कस्माच्चिदपि बिन्दोरभीष्टत्रिज्याव्यासार्धेन कक्षावृत्तसंज्ञकं वृत्तं कार्यम्, वस्तुत इदं वेधवलयं, एतद्वृत्तकेन्द्रात् तत्तद्गोलस्थग्रहेषु सूत्रं यत्र यत्राऽस्मिन् वृत्ते लगति तत्र तत्र स ग्रहः परिणतः कल्प्यते। कक्षावृत्तकेन्द्रात् (भूकेन्द्रात्) कक्षावृत्तस्योर्ध्वाधरा व्यासरेखा कार्या, केन्द्रत एतदुपरि लम्बरूपाऽन्या तिर्यग्रेखा च कार्या, केन्द्रादूर्ध्वाधरव्यासरेखायामिष्टग्रहस्य वेधावगतान्त्यफलज्यासमं खण्डं छित्वा छेदितबिन्दोस्तत्त्रिज्या व्यासार्धेनैव वृत्तं शीघ्रप्रतिवृत्तसंज्ञकं कार्यम्। इदमेव वृत्तं मन्दस्पष्टग्रहभ्रमणवृत्तम्। वृत्तस्याप्यस्य केन्द्रं भूकेन्द्र (कक्षावृत्तकेन्द्रं) मेव कथं नेति प्रतिदिनं वेधविधिना कर्णज्ञानेन निश्चितम्। अथ स बिन्दुर्भूकेन्द्रात् कियदन्तरेऽस्ति यस्मात्प्रतिवृत्तपर्यन्तं नीयमानं सूत्रं तुल्यं भवतीत्यस्यापि ज्ञानं वेधविधिना कृत्वा स एव बिन्दुः प्रतिवृत्तस्य केन्द्ररूपः कल्पितः। कक्षावृत्तप्रतिवृत्तयोः केन्द्राभ्यां भगोलीयमेषादिगते रेखे यत्र यत्र कक्षावृत्ते प्रतिवृत्ते च लग्ने तत्र तत्र तद्वृत्तद्वये मेषादिबिन्दू भवतः। भूकेन्द्रात्प्रतिवृत्तस्य यो बिन्दुः सर्वबिन्द्वपेक्षयाऽतिदूरे भवेत्स उच्चसंज्ञकस्तस्य राश्यादिज्ञानं कृत्वातन्मितमेव कक्षावृत्तेऽप्युच्चं परिकल्प्य ग्रहानयनं भवति, इतोऽन्यथा नेति, तथोच्चयोस्तुल्यत्वे एतयोः सूत्रयोर्भगोलीयमेषादिबिन्दौ योगे सत्यपि समानान्तरत्वं स्वीकृत्यानन्तदूरे यस्मिन् बिन्दौ सूत्रद्वयस्य योगो भवेत्ते सूत्रे अपि समानान्तरे भवत इति प्राचीनाः स्वीकृतवन्तः। इह वास्तवभगोलस्तावति दूरेऽस्ति यत्र भूकेन्द्रमारभ्य शनिकक्षानिष्ठादपि कस्माच्चन बिन्दुतो नीयमाना रेखाऽनन्ता भवति। ग्रहसाधनगणिते भूकेन्द्राच्छनिकक्षापर्यन्तमेव भगोलबिन्दुगतरेखयोः समानान्तरत्वं स्वीक्रियते। अतोऽत्र भगोलस्य केन्द्रं यत्र कुत्रापि कल्पयितुं शक्यते। भूकेन्द्रात् प्रतिवृत्तस्य को बिन्दुरतिदूरेऽस्ति यदुच्चसंज्ञकं वृत्तद्वयकेन्द्रगतैव रेखा सर्वाधिका भवत्यतः प्रतिवृत्तस्यापीयमेव रेखोच्चरेखा भवेत्। वस्तुतः प्रतिवृत्त एवोच्चमस्ति। अनुपातागतं राश्याद्युच्चं कक्षावृत्ते दत्तं भूकेन्द्रात्तद्गतरेखैव प्रतिवृत्तीयोच्चरेखा भवतीति विलोमेन प्रतिवृत्ते मेषादिज्ञानं भवेत्। अथ यदि कया-

ऽपि रीत्या प्रतिवृत्तीयग्रहस्य ज्ञानं भवेत्तदा तस्मात् स्थानादुच्चरेखायाः समानान्तर-रेखा यत्रकक्षावृत्ते लगति तत्र तत्तुल्यो ग्रहः कक्षावृत्ते भवति, भूकेन्द्रात्प्रतिवृत्तस्थ ग्रहगता रेखा यत्र कक्षावृत्ते लगति तत्रैव स (प्रतिवृत्तीयः) ग्रहो दृग्गोचरीभूतो भवत्यतस्तयोरन्तरं ग्रहस्य शीघ्रफलम् । अथ प्रतिवृत्ते मेषादितो मन्दोच्चराश्यादि दत्वा तदग्रे प्रतिवृत्तकेन्द्रारेखानेया तत्र मन्दान्त्यफलज्या तुल्यं दानं दत्त्वा दाना-ग्रविन्दुतस्त्रिज्या व्यासार्धेन वृत्तं कार्यं तन्मन्दप्रतिवृत्तम् । अत्रापि मेषादिज्ञानं विपरीतगणनया भवेत् । शीघ्रप्रतिवृत्तमन्दप्रतिवृत्त केन्द्राभ्यां भगोलीयमेषादि-गतरेखयोः समानान्तरत्वमत्रापि स्वीक्रियते । अतस्ततो राश्यादिगणनयाऽनु-लोममेव मन्दस्पष्टग्रहो दत्तः । मन्दप्रतिवृत्तीयमन्दस्पष्टग्रहात्तत्रत्योच्चरेखायाः समानान्तरा रेखा यत्र शीघ्रप्रतिवृत्ते लगति तत्र मन्दप्रतिवृत्तीयमन्दस्पष्टग्रहतुल्य एव मन्दस्पष्टग्रहः । शीघ्रप्रतिवृत्तकेन्द्रमन्दप्रतिवृत्तीय मन्दस्पष्टग्रहगतारेखा यत्र शीघ्रप्रतिवृत्ते लगति तत्रैव तं ग्रहं शीघ्रप्रतिकेन्द्रस्थद्रष्टा पश्यति, अतः शीघ्रप्रति-वृत्तकेन्द्रान्मन्दप्रतिवृत्तीयमन्दस्पष्टग्रहगत खा-तथोच्चरेखायाः समानान्तररेखा-याश्च शीघ्रप्रतिवृत्ते यदन्तरं तन्मन्दफलम् । मन्दप्रतिवृत्त केन्द्राच्छीघ्र प्रतिवृत्तीय मन्दस्पष्टग्रहगता रेखा यत्र मन्दप्रतिवृत्ते लगति स एव बिन्दुर्मन्दप्रतिवृत्तीयो मन्दस्पष्टग्रहः । अथ मन्दस्पष्टो निरूप्यते । वेधेन प्रथमं स्पष्टग्रहस्यैव ज्ञानं भवत्यतो वेधवृत्ते यत्र ग्रहविम्बमुपलभ्यते तदुपरि तत्केन्द्राद्गतारेखा यत्र ग्रहगोले लगति तत्रैव वास्तवं ग्रह बिम्बं तदुपरितद्गोलीयकदम्बप्रोतवृत्तं कार्यं तद्यत्रशीघ्रप्रतिवृत्ते लगति तत्रैकविधः शरसाधनोपयुक्तो मन्दस्पष्टग्रहः । वेधवलये यत्र बिम्बमुपलब्धं तदुपरि-तद्गोलीय कदम्बप्रोतवृत्तं कार्यं तत्कक्षावृत्ते यत्र लग्नं भूकेन्द्रात्तद्गता रेखा शीघ्र-प्रतिवृत्ते यत्र लगति सोऽन्यो मन्दस्पष्टग्रहः । प्राचीनैरेतयोर्मन्दस्पष्टग्रहयोर्भेदो न स्वीक्रियते । स्पष्टग्रहज्ञानं विना मन्दस्पष्टग्रहज्ञानं भवतु तदर्थं तदुपकरणरूपमेकं मन्दप्रतिवृत्ते भ्रमन्तं मध्यमग्रहं कल्पितवन्तः प्राचीनाः । अतोऽत्र मन्दप्रतिवृत्तीयो वास्तवो ग्रहो मध्यमग्रह एव, स तत्तुल्यराशेर्यदन्तरेण शीघ्रप्रतिवृत्तेऽवलोक्यते तदेव मन्द फलम् । स एव च मन्दस्पष्टो ग्रहः । ततः सोऽपि मन्दस्पष्टग्रहो वेधवृत्ते तत्तुल्यराशेर्यदन्तरेणावलोक्यते तदेव शीघ्रफलं स एव च स्पष्टग्रह इति कल्पनेऽपि न किमपि तारतम्यमिति कक्षावृत्तं यथार्थतः शीघ्रप्रतिवृत्तमेव मन्दफलसाधनार्थम् ।

अत्र तद्वेधाकरणेऽभीष्ट बिन्दुरेव ग्रहगोलकेन्द्रमतः कक्षावृत्तमेव ज्ञात्वा फलानयनं कृतम् । प्रतिवृत्तीया कोटिरेखा (उच्चरेखा समानान्तरा रेखा) कक्षावृत्ते यत्र लगति तत्रैव शीघ्रप्रतिवृत्तीयमन्दस्पष्टसमानराश्यात्मको बिन्दुः । भूकेन्द्रादेत-द्विन्दुगता रेखा यत्र कक्षावृत्ते लगति तत्रैव सोऽवलोकितो भवति, तदन्तरं फल-मेवेति । तत्साधनोपायः समीचीन एव । यतः प्रथमतः कल्पितकक्षावृत्तं शीघ्र प्रतिवृत्तमस्ति । तत्र वेधाकरणे तावदिष्टस्थान एव मेषादिः कल्पितः । वृत्तकेन्द्रा-त्तदुपरि गतोच्चरेखैवात्रत्योच्चरेखा । मेषादेर्मन्दप्रतिवृत्तीयसमानो मध्यग्रहो दत्तः ।

मन्दकेन्द्रं वेदितव्यम् । अथ चैषां तत्रैव वास्तवावस्थानमिति यथैतत्तुल्यं केन्द्रं तत्रापि भवेत्तथा मन्दप्रतिवृत्ते मेषादिः स्वीकृतः । मध्यस्य यत्रोपलम्भः स एव मन्दस्पष्टोऽतोऽत्रत्यं फलाद्यानयनं समीचीनं तत्संस्कारेण मन्दस्पष्टग्रहोऽपि समीचीनः । अथ चैतेन प्रदर्शितमार्गेण वास्तवं शीघ्रप्रतिवृत्तं यत्तत्रत्यस्य मन्दस्पष्टग्रहस्योच्चस्य मेषादेश्च ज्ञानं जातम् । अथात्रवेधं विना ज्ञातव्यस्थितावेव पुनरभीष्टबिन्दोः कृतं कक्षावृत्तं वास्तवकक्षावृत्तम् । अत्र मेषादिबिन्दु-शीघ्रोच्चमन्द स्पष्टग्रहश्च पूर्वोक्तविधिनाऽङ्किताः । शीघ्रप्रतिवृत्ते या स्थितिरागता प्रथमं तथैव प्रयोजनमतोऽत्र मन्दस्पष्टादेर्दीयमानत्वात्तत्तुल्या एव ते स्वस्थाने शीघ्रप्रतिवृत्तसंज्ञके यथा भवेयुस्तथा मेषादिकल्पना कृता । प्रतिवृत्ते यो मन्दस्पष्ट बिन्दुः ततस्तदुच्चरेखायाः समानान्तरा रेखा यत्र कक्षावृत्ते लगति तत्रैव तन्मन्दस्पष्टसमानं खण्डं मेषादितो भवितुमर्हति । भूकेन्द्रात्तत्प्रतिवृत्तीयमन्दस्पष्टग्रहगता कर्णरेखा कक्षावृत्ते यत्र लगति तत्र तदुपलब्धिः । कोटिकर्णरेखयोरन्तरं फलमिति तत्साधनार्थं यान्युपकरणानि तैस्तज्ज्ञानं सुगममिति ॥ २५-२६ ॥

अब नीचोच्चवृत्त भङ्गी को कहते हैं ।

हि. भा.—कक्षावृत्त में जहाँ मध्यमग्रह चिन्ह है वही नीचोच्चवृत्त का केन्द्र है । नीचोच्चवृत्त परिधि में मन्दोच्च से विलोम और शीघ्रोच्च से अनुलोम ग्रह भ्रमण करते हैं । जिस प्रकार भूकेन्द्र स्थित द्रष्टा (दर्शक) कक्षा में मध्यम ग्रह के बराबर स्पष्ट ग्रह को नहीं देखते हैं उसी प्रकार स्पष्ट ग्रह और मध्यम ग्रह का अन्तर (फल) मध्यम ग्रह में ऋण वा धन किया जाता है तब स्पष्ट ग्रह होते हैं । अर्थात् समान भूमि में इष्ट बिन्दु को केन्द्र मान कर इष्ट त्रिज्या व्यासार्ध से कक्षावृत्त बनाकर उसको भगणाङ्कित कर मेषादि से उच्च और ग्रह को देखकर चिह्नित करना चाहिये । भूकेन्द्र से उच्चोपरि गत रेखा उच्चरेखा कहलाती हैं । भूकेन्द्र से उच्चरेखा के ऊपर लम्ब रेखा (तिर्यक्रेखा) करनी चाहिये । भूकेन्द्र से उच्च की ओर उच्चरेखा में अन्त्य फलज्या तुल्य देकर दानाग्र बिन्दु के द्वारा उसी त्रिज्या व्यासार्ध से प्रतिवृत्त बनाना चाहिये । इस प्रतिवृत्त में उच्चरेखा ऊर्ध्व भाग में जहां लगती है वहां प्रतिवृत्त में उच्च होता है । बहां से प्रतिवृत्त में उच्च भोग विलोम देना चाहिये । वहां से ग्रह को अनुलोम देकर चिह्न कर देना चाहिये । प्रतिवृत्त केन्द्र से उच्च रेखा के ऊपर लम्ब रेखा प्रतिवृत्तीय तिर्यक् रेखा करनी चाहिये । दोनों तिर्यक् रेखाओं का अन्तर सर्वत्र अन्त्यफलज्या तुल्य ही होता है । ग्रह और उच्च का ज्यारूप अन्तर दोर्ज्या (भुजज्या) होती है । ग्रह से प्रतिवृत्तीय तिर्यग्रेखा पर्यन्त कोटिज्या होती है । ग्रह से कक्षा मध्यगतिर्यग्रेखा पर्यन्त स्फुट कोटि है । भूकेन्द्र से प्रतिवृत्तस्थ ग्रह पर्यन्त रेखा कर्ण है । कर्ण रेखा जहाँ कक्षावृत्त में लगती है वही स्पष्ट ग्रह है । कक्षावृत्त में स्फुट ग्रह और मध्यम ग्रह का अन्तर फल है । मध्यम ग्रह से स्फुट ग्रह के आगे रहने से मध्यम ग्रह में उस फल को धन करने से स्फुट ग्रह होते हैं । मध्यम ग्रह से स्फुट ग्रह के पीछे रहने से मध्यम ग्रह में से उस फल को ऋण करने से स्फुट

ग्रह होते हैं ।। सिद्धान्तशेखर में 'द्रष्टा स्फुटं पश्यति मध्यतुल्यं भान्तस्थिते भार्धगते च केन्द्रे' इत्यादि विज्ञान भाष्य में लिखित श्लोकों से श्रीपति ने इसी तरह कहा है । लल्लाचार्य ने पहले आर्यभटोक्त स्पष्टी करण क्रिया की उपपत्ति ही कही है । 'मध्यमतुल्यं स्पष्टं भान्तरते भार्धगेऽपि वा केन्द्रे' इत्यादि विज्ञान भाष्य में लिखित श्लोकों से भास्कराचार्य ने भी 'भूमेर्मध्ये खलु भवलस्यापि मध्यं यतः स्यात्' इत्यादि विज्ञान भाष्य में लिखित श्लोक (एक ही) से पहले प्राचीनोक्त मध्यम ग्रह की स्पष्टता विधायक विधि को कहा हैं । पश्चात् विशद व्याख्या से प्रतिपादन किया है । ग्रहों के स्पष्टी करण में छेद्यक आदि की उपपत्ति में प्राचीनाचार्यों ने कक्षावृत्त-प्रतिवृत्तादियों की कल्पना क्यों की इसके सम्बन्ध में कुछ कहते हैं । किसी इष्ट बिन्दु (कल्पित भूकेन्द्र) से इष्ट त्रिज्या व्यासार्ध से कक्षावृत्त संज्ञक वृत्त बनाना वस्तुतः यह वेधवलय (वेधवृत्त) है इस वृत्त के केन्द्र से तत्तत् ग्रह गोलस्थ ग्रह गत सूत्र जहां जहां इस वृत्त (कक्षावृत्त) में लगते हैं तहां तहां वे ग्रह परिणत होते हैं । कक्षा वृत्त केन्द्र (भूकेन्द्र) से कक्षावृत्त की ऊर्ध्वाधर व्यास रेखा और केन्द्र से उसके ऊपर लम्बरूप तिर्यक् व्यास रेखा करनी चाहिये । ऊर्ध्वाधार व्यास रेखा में केन्द्र से उच्चाभिमुख वेध विदित ग्रह की अन्त्यफलज्या तुल्य दान देकर दानाग्र बिन्दु से उसी त्रिज्या व्यासार्ध से वृत्त बनाना यह शीघ्र प्रतिवृत्त कहलाता है । यही वृत्त मन्दस्पष्टग्रह भ्रमणवृत्त हैं । इस वृत्त का भी केन्द्र भूकेन्द्र ही क्यों नहीं होता है इसका ज्ञान प्रति दिन वेधविधि से कर्ण ज्ञान द्वारा होता है । वह बिन्दु भूकेन्द्र से कितने अन्तर पर हैं जहाँ से प्रति वृत्त की प्रत्येक बिन्दु गत रेखा बरावर होती है वेध से इसको भी समझ कर उसी बिन्दु को प्रति वृत्त के केन्द्र की कल्पना की गयी, कक्षावृत्त और प्रतिवृत्त के केन्द्र से भगोलीय मेषादिगत रेखाद्वय वृत्तद्वय (कक्षावृत्त और प्रतिवृत्त) में जहां जहां लगता है वहां वहां वृत्तद्वय में मेषादि बिन्दु होते हैं । भूकेन्द्र से प्रतिवृत्त का जो प्रदेश सब बिन्दुओं से अति दूर है वह उच्च संज्ञक है, उसके राश्यादि जानकर तत्तुल्य ही उच्च कक्षावृत्त में कल्पना कर ग्रहानयन होता है । इससे अन्यथा नहीं होता है । तथा उच्चद्वय के तुल्यत्व में इन दोनों रेखाओं को भगोलीय मेषादि बिन्दु में योग रहने पर भी समानान्तरत्व स्वीकार कर अनन्त दूर में जिस बिन्दु में रेखा द्वय को योग होता है वह रेखाद्वय भी समानान्तर होता है इसको प्राचीनाचार्यों ने स्वीकार किया है । वास्तव भगोल इतनी दूर पर है जहां भूकेन्द्र से आरम्भ कर शनि कक्षानिष्ठ किसी बिन्दु से लायी गयी रेखा अनन्त होती है । ग्रह गणित में भूकेन्द्र से शनि कक्षापर्यंत ही भगोलीय बिन्दुगत रेखाद्वय का समानान्तरत्व स्वीकार किया जाता है । इसलिये भगोल का केन्द्र जहां तहां कल्पना कर सकते हैं । भूकेन्द्र से प्रतिवृत्त का कौन बिन्दु अति दूर है जो उच्च संज्ञक है वृत्तद्वय केन्द्र गत रेखा ही सर्वाधिक होती हैं, इसलिये यही रेखा प्रतिवृत्त की भी उच्च रेखा होती है, वस्तुतः प्रतिवृत्त ही में उच्च है, अनुपातागत राश्यादि उच्च को कक्षावृत्त में दिया जाता है भूकेन्द्र से तद्गत रेखा ही प्रतिवृत्तीय उच्च रेखा होती है इस विलोम से प्रतिवृत्त में मेषादि ज्ञान होता है। यदि किसी रीति से प्रति वृत्तीय ग्रह ज्ञान हो तो उस स्थान से उच्च रेखा की समानान्तर रेखा कक्षावृत्त में जहाँ

लगती है वहां उसी ग्रह के बरावर ग्रह कक्षा वृत्त में होते हैं, भूकेन्द्र से प्रतिवृत्तस्थ ग्रहगत रेखा कक्षा वृत्त में जहां लगती है वहीं पर वह (प्रतिवृत्तीय ग्रह) दृश्य होते हैं अतः उन दोनों का अन्तर ग्रह का शीघ्र फल है। प्रतिवृत्त में से मेषादि मन्दोच्चराश्यादि देकर उस के अग्र गत प्रतिवृत्त केन्द्र से जो रेखा होगी उसमें मन्दान्त्यफलज्या तुल्य प्रतिवृत्त केन्द्र से दान देकर दानाग्र बिन्दु से त्रिज्या व्यासार्ध से जो वृत्त होता है वह मन्द प्रतिवृत्त है, इसमें भी मेषादिज्ञान विपरीत गणना से होता है। शीघ्र प्रतिवृत्त और मन्द प्रतिवृत्त के केन्द्र से भगोलीय मेषादि गत रेखाद्वय का समानान्तरत्व यहां भी स्वीकार करते हैं। अतः मेषादि से राश्यादि गणना से अनुलोम ही मन्द स्पष्ट ग्रह को देना चाहिये। मन्द प्रतिवृत्तीय मन्द स्पष्टग्रह से उच्च रेखा की समानान्तर रेखा शीघ्र प्रतिवृत्त में जहां पर लगती है वहां मन्द प्रतिवृत्तीय मन्द स्पष्टग्रह के बरावर ही मन्द स्पष्टग्रह होते हैं। शीघ्र प्रतिवृत्त के केन्द्र से मन्द प्रतिवृत्तीय मन्द स्पष्ट ग्रहगत रेखा शीघ्र प्रतिवृत्त में जहां लगती है वहीं पर उस ग्रह को शीघ्र प्रतिवृत्त केन्द्रस्थ द्रष्टा देखता है इसलिये शीघ्र प्रतिवृत्त केन्द्र से मन्द प्रतिवृत्तीय मन्द स्पष्ट ग्रहगत रेखा और उच्च रेखा की समानान्तर रेखा का शीघ्र प्रतिवृत्त में जो अन्तर होता है वह मन्द फल है। मन्द प्रतिवृत्त के केन्द्र से शीघ्र प्रतिवृत्तीय मन्द स्पष्टग्रह गत रेखा मन्द प्रतिवृत्त में जहां लगती है वही बिन्दु मन्द प्रतिवृत्तीय मन्द स्पष्ट ग्रह है। अब मन्द स्पष्टग्रह का निरूपण करते हैं। वेध से पहले स्पष्टग्रह ही का ज्ञान होता है अतः वेध वृत्त में जहां बिम्ब उपलब्ध होता है केन्द्र से तद्गत रेखाग्रह गोल में जहां लगती है वहीं पर वास्तव ग्रहबिम्ब होता है, उसके ऊपर तद्गोलीय कदम्ब प्रोतवृत्त शीघ्र प्रतिवृत्त में जहां लगती है वहां एक तरह के शरसाधनोपयुक्त मन्द स्पष्टग्रह होते हैं। वेधवलय में जहां बिम्ब उपलब्ध होता है उसके ऊपर तद्गोलीय कदम्ब प्रोतवृत्त करने से वह कक्षावृत्त में जहां लगता है भूकेन्द्र से तद्गत रेखा शीघ्र प्रतिवृत्त में जहां लगती है वह अन्य मन्द स्पष्ट ग्रह है; प्राचीनाचार्य इन दोनों मन्द स्पष्ट ग्रहों में भेद नहीं मानते हैं। स्पष्ट ग्रह ज्ञान बिना मन्द स्पष्ट ग्रह ज्ञान हो इसके लिये उसके उपकरण रूप मन्द प्रतिवृत्त में भ्रमण करते हुए एक मध्यम ग्रह को प्राचीनों ने कल्पित किया। इसलिये मन्द प्रतिवृत्तीय वास्तव ग्रह मध्यम ग्रह ही है वह जितना अन्तरित करके शीघ्र प्रतिवृत्त में देखे जाते हैं वही मन्द फल है, वही (मध्यम ग्रह) मन्द स्पष्ट ग्रह है। वह मन्द स्पष्ट ग्रह वेधवृत्त में तत्तुल्य राशि से जितना अन्तर करके देखे जाते हैं वही शीघ्र फल है, वही स्पष्टग्रह है इस कल्पना में किसी तरह का तारतम्य नहीं है, यथार्थतः मन्द फल साधनार्थ शीघ्र प्रतिवृत्त ही कक्षा वृत्त है, यहां वेध न करने से अभीष्ट बिन्दु ही ग्रह गोल का केन्द्र है अतः कक्षावृत्त ही का जान कर फलानयन किया। प्रतिवृत्तीय कोटि रेखा (उच्च रेखा की समानान्तर रेखा) कक्षावृत्त में जहां लगती है वहीं पर शीघ्र प्रतिवृत्तीय मन्द स्पष्ट समान राश्यात्मक बिन्दु है। इस बिन्दु में भूकेन्द्र से रेखा लाने से कक्षावृत्त में जहां लगती है वहीं पर वह देखे जाते हैं उन दोनों का अन्तर फल ही है। उसके साधन के उपाय समीचीन ही है क्योंकि प्रथम कल्पित कक्षावृत्त प्रतिवृत्त ही है। वहां बिना वेध के इष्ट स्थान ही

की मेषादिं कल्पना की गयी। वृत्त केन्द्र से तदुपरिगत उच्च रेखा ही यहां की उच्च रेखा है, मेषादि से मन्द प्रतिवृत्तीय समान मध्यमग्रह देकर मन्दकेन्द्र जानना चाहिये। मध्यम ग्रह की उपलब्धि जहां होती हैं वही मन्द स्पष्ट है इसलिये यहां के फलादियों का आनयन समीचीन ही है उसके संस्कार से मन्द स्पष्ट ग्रह भी समीचीन ही होते हैं। इस प्रदर्शित मार्ग से वास्तव शीघ्र प्रतिवृत्तीय मन्द स्पष्ट ग्रह-उच्च और मेषादि का ज्ञान हुआ। यहां वेध बिना जानने योग्य स्थिति ही में पुनः अभीष्ट बिन्दु से जो कक्षावृत्त होता है वह वास्तव कक्षा वृत्त है। इसमें मेषादि बिन्दु, शीघ्रोच्च और मन्द स्पष्टग्रह पूर्वोक्त विधि से अङ्कित करना। शीघ्र प्रतिवृत्तीय मन्द स्पष्ट बिन्दु से उच्च रेखा की समानान्तर रेखा कक्षा वृत्त में जहां लगती है वहीं मेषादि से मन्द स्पष्टग्रह के तुल्य खण्ड होता है। भूकेन्द्र से प्रतिवृतीय मन्द स्पष्ट-ग्रह गत कर्ण रेखा कक्षा वृत्त में जहां लगती है वहीं पर उसकी उपलब्धि होती है। कोटि रेखा और कर्ण रेखा का अन्तर फल है उसके साधन के लिये जो उपकरण (सामग्री) हैं उनसे उसका साधन सुगम ही है इति ॥२५-२६॥

इदानीं नीचोच्चवृत्तभङ्ग्या शीघ्रफलं साधयति।

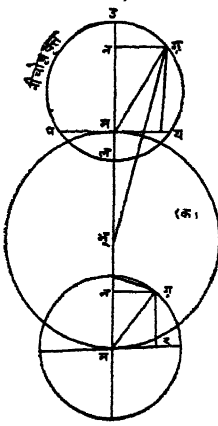
कोटिफलं व्यासार्धात् पदयोराद्यन्तयोर्भवत्युपरि।
द्वितृतीययोर्यतोऽधस्तद्युक्तोनं ततः कोटिः॥ २७॥
कर्णस्तद् भुजफलकृतिसंयोगपदं तदुद्धृता त्रिज्या।
भुजफल गुणिताप्तधनुर्गणितेनैवं फलं शीघ्रे॥ २८॥

सु. भा.—स्पष्टार्थमार्याद्वयं भास्करोक्तभङ्ग्या ॥२७–२८॥

वि. भा.—यत आद्यन्तयोः (प्रथम चतुर्थयोः) पदयोः-व्यासार्धात् (त्रिज्यातः) कोटिफलमुपरि भवति। द्वितीयतृतीयपदयोश्च कोटिफलं त्रिज्यातोऽधो भवति, तस्मात् कारणात् तेन कोटिफलेन युक्तं हीनं च व्यासार्धं (त्रिज्यामानं) नीचोच्च वृत्तीया स्फुटा कोटिर्भवति। तस्याः (स्फुटकोटेः) भुजफलस्य वर्गयोगमूलं शीघ्र-कर्णो भवति। त्रिज्या भुजफलेन गुणिता तेन शीघ्रकर्णेन भक्ता लब्धस्य चापं शीघ्रे कर्मणि फलं (शीघ्रफलं) भवतीति।

अत्रोपपत्तिः।

उ=उच्चम्। ग्र=पारमार्थिको ग्रहः। भू=भूकेन्द्रम्। म=मध्यमग्रहः। मग्र=शीघ्रान्त्यफलज्या=अंफज्या। भूम=त्रिज्या=त्रि। ग्रन=शीघ्रभुजफलम्। मन=ग्रर=कोटिफलम्=कोफ। म केन्द्राच्छीघ्रान्त्यफलज्या व्यासार्धेन शीघ्र-नीचोच्चवृत्तम्। पय=नीचोच्चवृत्तीय तिर्यग्रेखा।



कक्षावृत्ते मध्यमग्रहस्थानं केन्द्रं प्रकल्प्यान्त्यफलज्यामितेन व्यासार्धेन नीचोच्चवृत्तं विलिख्य भूकेन्द्रान्मध्यग्रहस्थानगता रेखा कार्या साऽत्रोच्चरेखा, नीचोच्चवृत्तस्योच्चरेखया सह यौ योगौ तयोरूपरितन उच्चसंज्ञकः। अधस्तनो नीचसंज्ञकः। उच्चरेखोपरि मध्यग्रहस्थानात्कृता लम्बरेखा नीचोच्चवृत्तीयतिर्यग्रेखा, नीचोच्चवृत्तमुच्चप्रदेशाद् भांशैरङ्कनीयम्। तत्रोच्चाच्छीघ्रकेन्द्रमनुलोमं देयम्। तत्र शीघ्रकेन्द्राग्रे पारमार्थिको ग्रहः। अत्र ग्रहोच्चरेखयोस्तिर्यगन्तरं शीघ्रभुजफलम्। ग्रह तिर्यग्रेखयोररन्तरं कोटिफलम्। भूकेन्द्र ग्रहयोरन्तरं शीघ्रकर्णः। एतदानयनम्। मकरादिकेन्द्रे (प्रथम पदे) भूम त्रिज्यात उपरिमन कोटिफलं दृश्यते अतः भूम $+$ मन $=$ त्रि $+$ कोफ $=$ भून $=$ स्पष्टा कोटिः। भून^{2} $+$ ग्रन^{2} $=$ भूग्र^{2} $=$ स्पष्टाको^{2} $+$ भुजफ^{2} $=$ (त्रि $+$ कोफ)^{2} $+$ भुजफ^{2} $=$ शीघ्रकर्ण^{2} मूलेन $\sqrt{(\text{त्रि}+\text{कोफ})^{2}+\text{भुजफ}^{2}}$ $=$ शीघ्रफलम्। एवमेव चतुर्थे पदे, अत्रोर्ध्वभागे क्षेत्रे मकरादि केन्द्रं वोध्यम्। अधोभागे च कर्क्यादिकेन्द्रम्। कर्क्यादिकेन्द्रे (द्वितीय पदे तृतीयपदे च) भूम $=$ त्रिज्या, ग्रर $=$ कोटिफलं $=$ मन ग्रन $=$ भुजफलम्। भूग्र $=$ शीघ्रकर्णः। अत्र भूम त्रिज्यातः मन कोटिफलमधो दृश्यतेऽतः भूम $-$ मन $=$ भून $=$ त्रि $-$ कोटिफ $=$ स्पष्टाकोटि, मन^{2} $+$ ग्रन^{2} $=$ स्पष्टाको^{2} $+$ भुजफ^{2} $=$ (त्रि $-$ कोफ)^{2} $+$ भुजफ^{2} $=$ शीघ्रकर्ण^{2} मूल ग्रहणेन $\sqrt{(\text{त्रि}-\text{कोफ})^{2}+\text{भुजफ}^{2}}$ $=$ शीघ्रक।

अथ शीघ्रफलानयनम्। शीघ्रकर्ण एकोऽवयवः। भुजफलं द्वितीयोऽवयवः। स्पष्टा कोटिस्तृतीयोऽवयवः' इत्यवत्रयैवत्पन्नमेकं जात्यत्रिभुजम्। त्रिज्यैकोऽवयवः। शीघ्रफलज्या द्वितीयोऽवयवः। शीघ्रफल कोटिज्या तृतीयोऽवयवः, इत्यवयवत्रयैरुत्पन्नं द्वितीयं जात्यत्रिभुजम्। एतयोस्त्रिभुजयोः साजात्यादनुपातो यदि शीघ्रकर्णेन भुजफलं लभ्यते तदा त्रिज्ययाकिमित्यनुपातेन समागच्छति शीघ्रफलज्या तत्स्वरूपम् $= \frac{\text{भुजफ}\times\text{त्रि}}{\text{शीघ्रकर्ण}}$ $=$ शीफज्या, अस्याश्चापम् $=$ शीघ्रफलम्। एतेनाऽऽचार्योक्तमुपपन्नम्। सूर्य सिद्धान्ते "शैघ्र्यं कोटिफलं केन्द्रे मकरादौ घनं स्मृतम्। संशोध्यं तु त्रिजीवायां कर्क्यादौ कोटिजं फलम्॥ तद्बाहुफलवर्गैक्यान्मूलं कर्णश्चलाभिधः। त्रिज्याभ्यस्तं भुजफलं चलकर्णविभाजितम्। लब्धस्य चापं लिप्तादिफलं शैघ्र्यमिदं स्मृतमिति सूर्यसिद्धान्तकारोक्तानुरूपमेवाचार्योक्तमस्ति। सिद्धान्त शेखरे "त्रिज्यकायां पदैस्तत् फलमथ खलु कोटेः कोटिसिद्धयै विधेयम्। कोटिवाहु फलवर्गसमासाद्यत्पदं तदिह कर्णमवेहि। दोः फल त्रिगुणयोरभिघातात् कर्णलब्ध-

धनुराशुफलं स्यात् ॥" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवेति । सिद्धान्तशिरोमणौ 'त्रिज्योर्ध्वतः कोटिफलं मृगादौ कर्क्यादिकेन्द्रे तदधो यतः स्यात् । अतस्तदैक्यान्तरमत्र कोटिरि'त्यादि भास्करोक्तमप्याचार्योक्तानुरूपमेवेति ॥ २७–२८ ॥

अब नीचोच्चवृत्तभङ्गी से शीघ्रफलानयन करते हैं ।

हि. भा.—प्रथम पद और चतुर्थपद (मकरादि केन्द्र) में त्रिज्या से कोटिफल ऊपर होता है । द्वितीयपद और तृतीयपद (कर्क्यादिकेन्द्र) में कोटिफल त्रिज्या से नीचा होता है इसलिये मकरादि केन्द्र में त्रिज्या में कोटिफल को जोड़ने से और कर्क्यादि केन्द्र में त्रिज्या में कोटिफल को घटाने से नीचोच्चवृत्तीय स्पष्टा कोटि होती हैं, स्पष्टकोटि और भुजफल के वर्गयोग का मूल शीघ्र कर्ण होता है । त्रिज्या को भुजफल से गुणाकर शीघ्रकर्ण से भाग देने से जो लब्ध हो उसका चाप शीघ्रफल होता है इति ।

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । उ = उच्च । ग्र=पारमार्थिक-ग्रह । भू=भूकेन्द्र, म=मध्यमग्रह । मग्र=शीघ्रान्त्यफलज्या=अंफज्या । भूम=त्रिज्या =त्रि । ग्रन=शीघ्रभुजफल । मन = ग्रर= कोटिफल=कोफ । म केन्द्र से शीघ्रान्त्यफलज्या व्यासार्ध से जो वृत्त होता है वह शीघ्रनीचोच्चवृत्त है । पय=नीचोच्चवृत्तीय तिर्यग्रेखा. उल=उच्चरेखा । कक्षावृत्तीय मध्यम ग्रहस्थान को केन्द्र मान कर अन्त्यफलज्या व्यासार्ध से नीचोच्चवृत्त लिखकर भूकेन्द्र से मध्यमग्रह स्थान गत रेखा करनी चाहिये, वही यहां उच्च रेखा है । उच्च रेखा और नीचोच्चवृत्त का ऊपर भाग में योग उच्च संज्ञक है । अधोभाग में योग नीच संज्ञक है । उच्च रेखा के ऊपर मध्यमग्रह स्थान से लम्ब रेखा नीचोच्चवृत्तीय तिर्यग्रेखा है । नीचोच्चवृत्त में उच्च प्रदेश से भांश ३६० अङ्कित करना, उस (नीचोच्च-वृत्त) में उच्च से शीघ्र केन्द्र को अनुलोम दान देना, वहां शीघ्र केन्द्राग्र में पारमार्थिक ग्रह होता है । यहाँ ग्रह और उच्चरेखा का तिर्यक् अन्तर शीघ्र भुजफल है । ग्रह और तिर्यक् रेखा का अन्तर कोटिफल है । भूकेन्द्र और ग्रह का अन्तर शीघ्रकर्ण है । इसका आनयन करते हैं । मकरादि केन्द्र में (प्रथम पद में और चतुर्थपद में) भूम त्रिज्या से ऊपर मन कोटिफल को देखते हैं अतः भूम+मन=भून=त्रि+कोफ=स्पष्टाकोटि, $\text{भून}^2+\text{ग्रन}^2 = \text{भूग्र}^2=\text{स्पष्टाको}^2+\text{भुजफ}^2= (\text{त्रि}+\text{कोफ})^2+\text{भुजफ}^2 = \text{शीघ्रकर्ण}^2$ मूल लेने से $\sqrt{(\text{त्रि}+\text{कोफ})^2+\text{भुजफ}^2}=\text{शीघ्रक}$ । इसी तरह चतुर्थपद में भी होता है । क्षेत्र के ऊर्ध्व भाग में मकरादि केन्द्र समझना चाहिये । अधोभाग में कर्क्यादिकेन्द्र समझना चाहिये । द्वितीय पद में भूम = त्रिज्या, ग्रर= कोटिफल = मन । ग्रन=भुजफल, भूग्र = शीघ्रकर्ण, यहां भूम त्रिज्या से मन कोटि फल को नीचा देखते हैं अतः भूम—मन=भून=त्रि— कोफ =स्पष्टाको । $\text{भून}^2+\text{ग्रन}^2=\text{स्पको}^2+\text{भुजफ}^2= (\text{त्रि}-\text{कोफ})^2+\text{भुजफ}^2=\text{शीघ्रक}^2$ मूल लेने से $\sqrt{(\text{त्रि}-\text{कोफ})^2+\text{भुजफ}^2}=\text{शीघ्रक}$, अवशीघ्रफलानयन करते हैं । शीघ्र कर्ण एक

भुज, भुजफल द्वितीयभुज, स्पष्टा कोटि तृतीयभुज, इन तीनों भुजों से उत्पन्न एक जात्य त्रिभुज है। तथा त्रिज्या एक भुज, शीघ्र फलज्या द्वितीयभुज, शीघ्रफल कोटिज्या तृतीय भुज इन तीनों भुजों से उत्पन्न द्वितीय जात्य त्रिभुज है। इन दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं यदि शीघ्र कर्ण में शीघ्र भुजफल पाते हैं तो त्रिज्या में क्या इस अनुपात से शीघ्र फलज्या आती है उसका स्वरूप $= \frac{\text{शीभुफ} \times \text{त्रि}}{\text{शीकर्ण}} =$ शी फज्या, इसका चाप $=$ शीफल, इससे आचार्योक्त उपपन्न हुआ। सूर्यसिद्धान्त में "शैघ्र्यं कोटिफलं केन्द्रमकरादौ धनं स्मृतम्। संशोध्यं तु त्रिजीवायां' इत्यादि संस्कृतोपपत्ति में लिखित सूर्यसिद्धान्तकारोक्त श्लोकों के अनुरूप ही आचार्योक्त है। सिद्धान्तशेखर में 'त्रिज्यकायां पदैस्तत्। फल मथ खलु कोटेः कोटिसिद्धयै विधेयम्' इत्यादि श्रीपत्युक्त आचार्योक्त के अनुरूप ही है। सिद्धान्तशिरोमणि में 'त्रिज्योर्ध्वतः कोटिफलं मृगादौ कर्क्यादि केन्द्रे तदधो यतः स्यात्' इत्यादि भास्करोक्त भी आचार्योक्त के अनुरूप ही है इति ॥२७–२८॥

इदानीं मन्दकर्मणि कर्णः किमु न क्रियते इत्यत्र कारणमाह।

त्रिज्याभक्तः परिधिः कर्णगुणो बाहुकोटिगुणकारः।
असकृन्मान्दे तत्फलमाद्यसमं नात्रकर्णोऽस्मात् ॥ २९ ॥

सु. भा.—'स्वल्पान्तरत्वान्मृदुकर्मणीह'—इत्यादि भास्करोक्तेन स्पष्टेयमार्या ॥ २९ ॥

वि. भा.—मन्दफलसाधने मन्दपरिधिर्मन्दकर्णेन गुणितः त्रिज्याभक्तः सन् भुजकोटयोर्गुणकोऽसकृत् वारं वारं क्रियया स्यात्। ततश्च परिधेः मान्दं फलमाद्यसममेव कर्णानुपातं विनैवानीते न मन्दफलेन सममेवेति तस्मान्मन्दफलानयनक्रियायां कर्णो न कृतोऽर्थात् कर्णाग्रे यदि मन्दफलं तदा त्रिज्याग्रे किमिति त्रैराशिकार्थं कर्णानयनं न कृतमित्यर्थः। सिद्धान्तशेखरे "त्रिज्याहृतः श्रुतिगुणः परिधिर्यतो दोः कोटयोर्गुणो मृदुफलानयनेऽसकृत् स्यात्। स्यान्मान्दमाद्यसममेव फलं ततश्च कर्णः कृतो न मृदुकर्मणि तन्त्रकारैः ॥" इह मन्दफल साधनेऽपि कर्णानुपातेन यत्फलं तदेव समीचीनमिति कर्णः कथं न कृत इत्यस्योपपत्तिरूपोऽयं श्रीपतेः श्लोक आचार्योक्त श्लोकस्यानुवादरूप एव। भास्कराचार्येणापि "स्वल्पान्तरत्वान्मृदुकर्मणीह कर्णः कृतो नेति वदन्ति केचित्। त्रिज्योद्धृतः कर्णगुणः कृतेऽपि कर्णे स्फुटः स्यात् परिधिर्यतोऽत्र ॥ तेनाद्यतुल्यं फलमेति तस्मात् कर्णः कृतो नेति च केचिदूचुः। नाशङ्कनीयं न चले किमित्थं यतो विचित्रा फलवासनाऽत्र ॥" इह कर्णेन यत्फलमानीयते तदेव समीचीनम्। यन्मन्दकर्मणि कर्णेन कृतस्तत्स्वल्पान्तरात्। मन्दफलानि हि स्वल्पानि तदन्तरं चातिस्वल्पमिति केषांचित् पक्षः।

आचार्योऽत्र कारणमाह । मन्दकर्मणि मन्दकर्णतुल्येन व्यासार्धेन यद्वृत्तमुत्पद्यते तत्कक्षावृत्तम् । तेन ग्रहो गच्छति । यो मन्दपरिधिः पाठपठितः स त्रिज्यापरिणतः । अतोऽसौ कर्णव्यासार्धे परिणाम्यते । यदि त्रिज्यावृत्तेऽयं परिधिस्तदा कर्णवृत्ते क इति स्फुटपरिधिः । तेन भुजज्या गुण्या भांशैः ३६० भाज्या, ततस्त्रिज्यया गुण्या कर्णेन भाज्या तदा जातं स्वरूपम् $= \frac{\text{परिधि. कर्ण} \times \text{भुज्या} \times \text{त्रि}}{\text{त्रि} \times ३६० \times \text{कर्ण}}$ $= \frac{\text{परिधि} \times \text{भुज्या}}{३६०}$ पूर्वफलतुल्यमेव फलमागच्छतीत्याचार्यमतम् ।

अथ यद्येवं परिधेः कर्णेन स्फुटत्वं तर्हि शीघ्रकर्मणि किं न कृतमत्र चतुर्वेदाचार्य आह । चले कर्मणीत्थं किं न कृतमिति नाशङ्कनीयम् । यतः फलवासना विचित्रा । शुक्रस्यान्यथा परिधेः स्फुटत्वं कुजस्यान्यथा तथा किं न बुधादीनामिति नाशङ्कनीयमत आचार्योक्तिरत्र सुन्दरी ॥ २९ ॥

अब मन्द कर्म में कर्णानुपात क्यों नहीं किया जाता है इसके कारण कहते हैं ।

हि. भा.—मन्द फल साधन में मन्द परिधि को कर्ण से गुणाकर त्रिज्या से भाग देने से भुज और कोटि का गुणक बार-बार क्रिया से होता है । उस परिधि से मान्दफल आद्य सम ही होता है अर्थात् बिना कर्णानुपात के समागत मन्दफल के बराबर ही होता है । इसलिये मन्दफलानयन में कर्णानुपात नहीं किया गया अर्थात् यदि कर्णाग्र में मन्दफल पाते हैं तो त्रिज्याग्र में क्या इस त्रैराशिक के लिये कर्णानुपात नहीं किया जाता है । सिद्धान्तशेखर में 'त्रिज्याहृतः श्रुतिगुणः परिधिः' इत्यादि विज्ञानभाष्य में लिखित श्लोक से मन्दफल साधन में भी कर्णानुपात से जो फल आता है वही समीचीन है । इसलिये कर्णानुपात क्यों नहीं किया गया इसके उपपत्तिरूप श्रीपत्युक्तश्लोक आचार्योक्त श्लोक के अनुवादरूप ही है । भास्कराचार्य भी 'स्वल्पान्तरत्वान्मृदुकर्मणीह' इत्यादि विज्ञानभाष्य में लिखित श्लोकों से यहां कर्ण से जो फल लाते हैं वही समीचीन हैं, मन्दकर्म में कर्णानुपात स्वल्पान्तर से नहीं किया गया, मन्दफल स्वल्प है उसका अन्तर अतिशयेन स्वल्प है यह किसी-किसी का पक्ष है । यहां आचार्य कारण कहते हैं । मन्दकर्म में मन्दकर्ण तुल्य व्यासार्ध से जो वृत्त होता है वह कक्षावृत्त है । उसमें ग्रह भ्रमण करते हैं । पाठपठित मन्द परिधि त्रिज्याग्र में परिणत है । उसको कर्ण व्यासार्ध में परिणत करते हैं, यदि त्रिज्यावृत्त में यह पाठ-पठित मन्दपरिधि पाते हैं तो कर्णवृत्त में क्या इससे स्फुट परिधि प्रमाण आता है, इसको भुजज्या से गुणाकर ३६० भांश से भाग देकर जो फल होता है उसको त्रिज्या से गुणाकर कर्ण से भाग देना चाहिये तब उसका स्वरूप $= \frac{\text{परिधि. कर्ण. भुज्या. त्रि}}{\text{त्रि. ३६०. कर्ण}} = \frac{\text{परिधि. भुज्या.}}{३६०}$ पूर्वफल तुल्य ही फल आता है यह आचार्य का मत है यदि इस तरह कर्ण से परिधि का स्फुटत्व होता है तब शीघ्रकर्म में क्यों नहीं किया गया इसके लिये चतुर्वेदाचार्य कहते हैं ।

शीघ्रकर्म में इस तरह क्यों नहीं किया गया यह आशङ्का नहीं करनी चाहिये क्योंकि फलोपपत्ति विचित्र है, यहां ब्रह्मगुप्तोक्त ही वहुत सुन्दर है इति ॥ २९ ॥

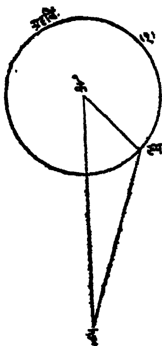
इदानीं विशेषमाह ।

प्रतिपादनार्थमुच्चं प्रकल्पितं ग्रहगतेस्तथा पातः ।
भुक्तेरूनाधिकता मानस्य च भवति कर्णवशात् ॥ ३० ॥

सु. भा.—ग्रहगतेः प्रतिपादनार्थमुच्चं प्रकल्पितं तथा पातश्च प्रकल्पितः क्रान्तिवृत्तीयगत्यर्थमुच्चं विमण्डलीयगत्यर्थं पातः प्रकल्पित इति । कर्णस्य न्यूनाधिकवशात् भुक्तेर्बिम्बमानस्य च न्यूनाधिकता भवतीति । एवं मन्दस्पष्टग्रहे स्थितिर्भवति । भौमादीनां शीघ्रकर्णवशतश्च बिम्बमाने न्यूनाधिकता भवति परन्तु स्पष्टगतौ कर्णवशेन न न्यूनाधिकतोत्पद्यत इति छेद्यकेन सर्वं स्फुटम् । 'यः स्यात् प्रदेशः प्रतिमण्डलस्य' इत्यादि तथा 'उच्चस्थितो व्योमचरः सुदूरे' इत्यादि च भास्करोक्तमेतदनुरूपमेव ॥३०॥

वि. भा.—ग्रहगतेः प्रतिपादनार्थमुच्चं प्रकल्पितं तथा पातश्च प्रकल्पितः । उच्चं क्रान्तिवृत्तीयगत्यर्थं विमण्डलीयगत्यर्थं च पातः प्रकल्पित इत्यर्थः । कर्णस्य न्यूनाधिक्यवशाद् भुक्तेर्बिम्बमानस्य च न्यूनाधिकता भवति । मन्दस्पष्टग्रहे एवं स्थितिर्भवति । मङ्गलादीनां ग्रहाणां शीघ्रकर्णवशाद्बिम्बमाने न्यूनाधिकत्वं भवति । परं स्फुटगतौ कर्णवशेन न्यूनाधिकता नोत्पद्यते । कर्णवशेन बिम्बमाने न्यूनाधिकत्वं कथं भवति तदर्थं भास्करेण 'उच्चस्थितो व्योमचर ; सुदूरे नीचस्थित इत्यादिना युक्तियुक्तं कथितम् । यथा

(ख)



दृ = दृष्टिस्थानम् = भूकेन्द्रम् । दृके = ग्रहकर्णः । केस्प = बिम्ब व्यासार्धम् । दृकेस्प त्रिभुजेऽनुपातः क्रियते । यदि ग्रहकर्णेन त्रिज्या लभ्यते तदा बिम्ब व्यासार्धेन किं जाता बिम्बार्धकलाज्या तत्स्वरूपम् $= \frac{\text{त्रि. विव्या }\frac{1}{2}}{\text{ग्रहक}}$, उच्चस्थानीय कर्णः > अन्यस्थानीय क अत उच्चस्थाने हरस्याधिकत्वाद्बिम्बमानमन्यस्थानीय-बिम्बमानादल्पं भवेत् । नीचस्थानीयकर्णः < अन्यस्थानीय कर्ण, अतो नीचस्थाने हरस्याल्पत्वादन्यस्थानीय बिम्बमानादधिकं बिम्बमानं भवितुमर्हतीति ॥ ३० ॥

अब विशेष कहते हैं।

हि. भा.—ग्रहगति ज्ञान के लिये उच्च की कल्पना की गई है तथा पात की कल्पना की गयी है। अर्थात् क्रान्ति वृत्तीय गति के लिये उच्च कल्पित है, और विमण्डलीय गति के लिये पात कल्पित है। कर्ण की न्यूनाधिकतावश से ग्रहगति और बिम्बमान में न्यूनाधिकता होती है, इस तरह की स्थिति मन्दस्पष्ट ग्रह में होती है। कुजादिग्रहों के शीघ्रकर्णवश से विम्बमान में न्यूनाधिकता होती है। लेकिन स्पष्टगति में कर्णवश से न्यूनाधिकता नहीं होती है। कर्णवश से बिम्वमान में न्यूनाधिकत्व क्यों होता है, नीचे लिखी हुई युक्ति से स्पष्ट है।

संस्कृत भाष्य में लिखित (१) क्षेत्र को देखिये। दृ=दृष्टिस्थान=स्वल्पान्तर से भूकेन्द्र। के=बिम्बकेन्द्र। दृके=ग्रहकर्ण केस्प=बिम्ब व्यासार्ध। दृकेस्प त्रिभुज में अनुपात करते हैं। यदि ग्रहकर्ण में त्रिज्या पाते हैं तो बिम्ब व्यासार्ध में क्या इस अनुपात से विम्बार्ध कलाज्या आती है। इसका स्वरूप $= \frac{\text{त्रि. विंव्या } \frac{1}{2}}{\text{ग्रह कर्ण}}$ = ज्या $\frac{1}{2}$ विंक। उच्च-स्थानीय ग्रहकर्ण > अन्यस्थानीयग्रहकर्ण, इसलिये उच्चस्थान में हर की अधिकता से बिम्बमान अन्य स्थानीय बिम्बमान से अल्प होता है। तथा नीचस्थानीय कर्ण > अन्यस्थानीय कर्ण, अतः नीचस्थान में हर की अल्पता से बिम्बमान अन्यस्थानीय बिम्ब-मान से अधिक होता है इति ॥ ३० ॥

इदानीं स्फुटयोजनात्मककर्णानयनमाह।

कक्षा व्यासार्धगुणा मण्डललिप्ता विभाजिता कर्णः।
स्वकलाकर्णेन गुणः कर्णस्त्रिज्याहृतः स्पष्टः ॥३१॥

सु. भा.—ग्रहकक्षा व्यासार्धेन त्रिज्यया गुणा मण्डललिप्ताभिश्चक्रकलाभि-र्विभाजिता फलं मध्यमयोजनकर्णः स्यात्। स कर्णः स्वकलाकर्णेन स्फुटशीघ्र-कर्णेन गुणस्त्रिज्याहृतः स्पष्टो योजनकर्णः स्यात्।

अत्रोपपत्तिः।

पूर्वार्धस्य परिधितो व्यासार्धानयनेन स्फुटा। त्रिज्यातुल्येन कलाकर्णेन मध्यो योजनकर्णस्तदा स्वेष्टकलाकर्णेन किमित्यनुपातेन स्फुटो योजनकर्णो भवति। 'लिप्ताश्रुतिघ्नस्त्रिगुणेन भक्तः'—इत्यादि भास्करोक्तमेतदनुरूप-मेव ॥३१॥

वि. भा.—ग्रहकक्षा त्रिज्यया गुणा मण्डलकलाभिः (चक्रकलाभिः) भक्ता तदा मध्यमयोजनकर्णो भवेत् स कर्णः स्फुटशीघ्रकर्णनगुणः, त्रिज्यया भक्तस्तदा स्फुटो योजनकर्णः स्यादिति।

अत्रोपपत्तिः।

यदि चक्रकलाभिर्ग्रहकक्षा योजनानि लभ्यन्ते तदा त्रिज्यया किं समागच्छति मध्यमयोजनकर्णः। पुनरनुपातो यदि त्रिज्ययाऽयं मध्यमयोजनकर्णो लभ्यते तदा स्फुटशीघ्रकर्णेन किं समागच्छति स्फुटो योजनकर्णः। एतावताऽऽचार्योक्तमुपपन्नम्। सिद्धान्तशिरोमणौ 'लिप्ताश्रुतिघ्नस्त्रिगुणेन भक्तः स्पष्टो भवेद्योजनकर्ण एवमिति' भास्करोक्तमाचार्योक्तानुरूपमेवास्तीति ॥३१॥

अब स्पष्ट योजनात्मक कर्णानयन को कहते हैं।

हि. भा.—ग्रहकक्षा को त्रिज्या से गुणा कर चक्रकला से भाग देने से मध्यमयोजन कर्ण होता है। मध्यमयोजन कर्ण को स्फुट शीघ्र कर्ण से गुणाकर त्रिज्या से भाग देने से स्फुट योजन कर्ण होता है।

उपपत्ति। -

यदि चक्र कला में ग्रह कक्षा योजन पाते हैं तो त्रिज्या में क्या इस अनुपात से मध्यमयोजन कर्णप्रमाण आता है। पुनः अनुपात करते है यदि त्रिज्या में यह मध्यम योजन कर्ण पाते हैं तो स्फुट शीघ्र कर्ण में क्या इससे स्फुट योजन कर्ण आता है। इससे आचार्योक्त उपपन्न हुआ। सिद्धान्तशिरोमणि में 'लिप्ताश्रुतिघ्नस्त्रिगुणेन भक्तः' इत्यादि भास्करोक्त आचार्योक्त के अनुरूप ही है इति ॥३१॥

इदानीं भूरविचन्द्राणां योजनव्यासानाह।

मृद्दहनजलमयानां विष्कम्भो योजनैः क्विनेन्दूनाम्।
शशिवसुतिथिभि १५८१ र्यमपक्षशररसै ६५२२ शून्यवसुवेदैः ॥३२॥

सु. भा.—क्विनेन्दूनां भूरविचन्द्राणां किंविशिष्टानां मृद्दहनजलमयानां क्रमेण शशिवसुतिथिभिर्यमपक्षशररसैः शून्यवसुवेदैर्योजनैर्विष्कम्भो ज्ञेयः। भूगोलस्य मृण्मयस्य व्यासः=१५८१। सूर्यगोलस्याग्निमयस्य व्यासः=६५२२। जलमयस्य चन्द्रस्य व्यासः=४८०। योजनात्मको ज्ञेय इत्यर्थः।

अत्रोपपत्तिः। भास्करविधिना 'पुरान्तरं चेदिदमुत्तरं स्यात्'—इत्यादिना तथा 'बिम्बं रवेर्द्विद्विशरर्तुसंख्यानि' इत्यादिना तत्तद्वासनया च स्फुटा ॥३२॥

वि. भा.—मृण्मयस्य भूगोलस्य व्यासः=१५८१, अग्निमयस्य सूर्यगोलस्य व्यासः=६५२२, जलमयस्य चन्द्रस्य व्यासः=४८०, योजनात्मको भवतीति।

अत्रोपपत्तिः ।

के=ग्रहबिम्बकेन्द्रम् । दृ=दृष्टिस्थानम् । दृके=दृष्टिसूत्रम् । दृष्टिस्थानाद्ग्रहबिम्बस्पर्शरेखा=दृस्प, केस्प=ग्रहबिम्बव्यासार्धम् । ग्रहबिम्बव्यासार्धसंमुखः कोणो दृष्टिस्थानगतः=स्फुटबिम्बार्धकला । $<$ दृस्पके=९०, तदा दृकेस्प त्रिभुजे ऽनुपातेन $\frac{\text{त्रि. केस्प}}{\text{दृके}}$

$=$ज्या$<$स्पदृके=ज्या $\frac{\text{स्फुविं}}{२}=\frac{\text{त्रि. ½ योव्या}'}{\text{क}}$

=स्फुविं ½ स्वल्पान्तराज्ज्याचापयोरभेदात् । अतः $\frac{\text{त्रि. योव्या}}{\text{मक}}$=मविं, $\frac{\text{त्रि योव्या}'}{\text{क}}$

=स्फुविं, मक=मध्यमकर्णः ततः $\frac{\text{स्फुविं}}{\text{मविं}}=\frac{\text{त्रि. योव्या}'\text{ मक}}{\text{त्रि. योव्या क.}}$, यदि स्वल्पान्तरात् योव्या$'$ = योव्या तदा $\frac{\text{स्फुविं}}{\text{मविं}}=\frac{\text{मक}}{\text{क}}$, उच्चस्थाने ग्रहबिम्बं लघु, गतिश्च लघ्वी, नीचस्थाने बिम्बं महत्, गतिश्च महती, अतो बिम्बयोर्निष्पत्तिर्गत्योर्निष्पत्तिसमा, अतः $\frac{\text{मक}}{\text{क}}=\frac{\text{स्फुविं}}{\text{मविं}}=\frac{\text{स्फुग}}{\text{मग}}$ अतः $\frac{\text{मक मग}}{\text{स्फुग}}$

=क स्फुट बिम्बेऽस्योत्थापनेन स्फुविं=$\frac{\text{त्रि. योव्या}'}{\text{क}}=\frac{\text{त्रि.स्फुग}}{\text{मक}}\times\frac{\text{योव्या}}{\text{मग}}$

स्वल्पान्तरात् । अत्र यदि स्वल्पान्तरात् मध्यमकर्णः स्फुटकर्णसमस्तदा $\frac{\text{त्रि स्फुग. योव्या.}}{\text{क. मग}}$=स्फुविं, अतः $\frac{\text{क. स्फुविं}}{\text{त्रि}}$=योव्या$'$=$\frac{\text{स्फुग. योव्या}}{\text{मग}}$ मध्यगतिस्थाने दृके, दृस्प यष्टिभ्यां वेधेन यत् केस्प मानं तदेव द्विगुणं तदा योव्या मानं भवेत् । तथा स्फुट गति स्थाने यत् केस्प मानं तदेव द्विगुणं तदा योव्या$'$ मानं बोध्यम्, अनया रीत्या रवि चन्द्रयोर्योजनव्यासानयनं कार्यम् । भूव्यासानयनं वेधेन भवति तदर्थं वटेश्वर सिद्धान्ते मट्टीका द्रष्टव्येति ॥३२॥

अब भू (पृथ्वी) रवि और चन्द्र के योजन व्यास को कहते हैं ।

हि. भा.—मृण्मय भूगोल का योजनात्मक व्यास=१५८१, अग्निमय सूर्य गोल का योजनात्मक व्यास=६५२२ है जलमय चन्द्रगोल का योजनात्मक व्यास=४८०, है इति ।

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । के = ग्रहविम्बकेन्द्र । द्द = द्दष्टिस्थान । द्दके = द्दष्टि सूत्र । द्दष्टि स्थान से ग्रहबिम्ब की स्पर्शरेखा = द्दस्प, केस्प = ग्रहबिम्ब व्यासार्ध, ग्रहबिम्ब व्यासार्ध संमुख द्दष्टि स्थानगत कोण = स्फुट बिम्बार्धकला, $<$ द्दस्पके = ९०, तब द्दकेस्प त्रिभुज में अनुपात से $\frac{\text{त्रि.केस्प}}{\text{द्दके}}$ = ज्या $<$ स्पद्दके = ज्या $\frac{\text{स्फुबिं}}{२}$

$= \frac{\text{त्रि} \frac{१}{२} \text{योव्या}'}{\text{क}}$ = स्फुबिं $\frac{१}{२}$ स्वल्पान्तर से ज्या और चाप के अभेदत्व से अतः $\frac{\text{त्रि.योव्या}}{\text{मक}}$

= मबिं । $\frac{\text{त्रि.योव्या}'}{\text{क}}$ = स्फुबिं । मक = मध्यम कर्ण, स्फुट बिम्ब में मध्यम बिम्ब से भाग

देने से $\frac{\text{स्फुबिं}}{\text{मबिं}} = \frac{\text{त्रि. योव्या. मक}}{\text{त्रि. योव्या. क}}$ यदि स्वल्पान्तर से योव्या' = योव्या तब $\frac{\text{स्फुबिं}}{\text{मबिं}} = \frac{\text{मक}}{\text{क}}$

उच्चस्थान में ग्रहबिम्ब छोटा होता है, ग्रह गति भी छोटी होती है । नीच स्थान में ग्रह बिम्ब बड़ा होता है, गति भी बड़ी होती है अतः बिम्बों की निष्पत्ति गति की निष्पत्ति के बराबर होती है, अतः $\frac{\text{मक}}{\text{क}} = \frac{\text{स्फुबिं}}{\text{मबिं}} = \frac{\text{स्फुग}}{\text{मग}}$, अतः $\frac{\text{मक.मग}}{\text{स्फुग}}$ = क स्फुट बिम्ब में इसके उत्थापन

से स्फुबिं = $\frac{\text{त्रि. योव्या}'}{\text{क}} = \frac{\text{त्रि. स्फुग}}{\text{मक}} \times \frac{\text{योव्या}}{\text{मग}}$ स्वल्पान्तर से । यहां स्वल्पान्तर से

यदि मध्यमकर्ण = स्फुट कर्ण तब $\frac{\text{त्रि. स्फुग. योव्या}}{\text{क. मग}}$ = स्फुबिं, अतः $\frac{\text{क.स्फुबिं}}{\text{त्रि}}$ = योव्या'

$= \frac{\text{स्फुग.योव्या}}{\text{मग}}$ मध्यम गति स्थान में द्दके, द्दस्प यष्टिद्वय से वेध से जो केस्प मान होता है उसको द्विगुणित करने से योव्या मान होता है । तथा स्फुट गति स्थान में जो केस्प मान होता है उसको द्विगुणित करने से योव्या' मान जानना चाहिये । इस रीति से रवि और चन्द्र का व्यासानयन करना चाहिये, भूव्यासानयन वेध से होता है उसके लिये वटेश्वर सिद्धान्त में मेरी टीका देखनी चाहिये इति ।।३२।।

इदानीं भूभाबिम्बानयनमाह ।

क्वर्कव्यासान्तरगुणमिन्दुस्फुटकर्णमर्ककर्णहृतम् ।
प्रोह्य भुवो भूच्छाया विष्कम्भश्चन्द्रकक्षायाम् ।।३३।।

सु० भा०—इन्दुस्फुटकर्णं क्वर्कव्यासान्तरगुणमर्ककर्णहृतं फलं भुवो

भूव्यासात् प्रोह्य चन्द्रकक्षायां भूच्छायाविष्कम्भो भवति । 'भूव्यासहीनं रविबिम्ब मिन्दुकर्णाहृतम्' इत्यादि भास्करोक्तमेतदनुरूपमेव ।

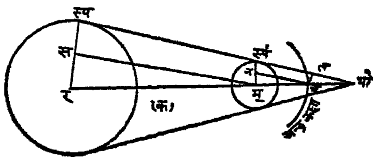
अत्रोपपत्तिः ।

भास्करोक्तेन विधिना स्फुटा । अनेन प्रकारेण चन्द्रकक्षायां भूभाव्यासो नायातीत्यस्य मीमांसा कमलाकरेण तत्त्वविवेकचन्द्रग्रहणाधिकारे समीचीना कृता । लाघवेन सूक्ष्मभूभाकला बिम्बानयनं मदुक्तं यथा

रवितनुदलजीवा लम्बनोर्व्या विहीना,
क्षितिजजनितया तत्कार्मुकं कार्यमार्यैः ।
द्विजपतिजपराख्यं लम्बनं तद्विहीनं ॥
भवति वसुमतीभाबिम्बखण्डं सुसूक्ष्मम् ।
अत्रोपपत्तिर्भूभाक्षेत्रेण त्रिकोणमित्या च सुगमा ॥

यदि रविभूबिम्बयोर्विरुद्धपालिभवा स्पर्शरेखा क्रियते तदा भूभाभोत्पद्यते यद्वशाच्चन्द्रबिम्बे मालिन्यमुपलभ्यते । भूभाभासाधनार्थमुपरिभूभानयनसूत्रे प्रथमपादे 'विहीना' स्थाने 'च युक्ता' तृतीयपादे 'तद्विहीन' मित्यत्र 'तद्युतं सत्' इति ज्ञेयम् । ग्रहणान्यविशेषार्थं मदीयं ग्रहणकरणं निरीक्षणीयमित्यर्थः ॥३३॥

वि. भा.—इन्दुस्फुटकर्णं (चन्द्रस्फुटकर्णं) कुवर्कव्यासान्तरेण (भूव्यासहीनरविव्यासेन) गुणं रविकर्णभक्तं लब्धं भूव्यासाद्विशोध्य चन्द्रकक्षायां भूभाव्यासो भवतीति ।

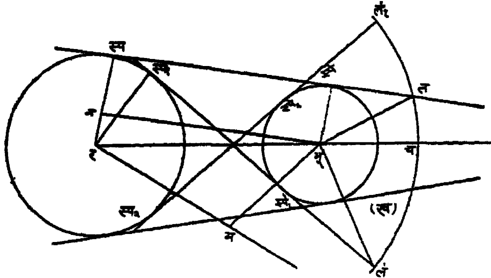


अत्रोपपत्तिः ।

रविबिम्बभूबिम्बयोः क्रमस्पर्शरेखा यत्र चन्द्रकक्षायां लगन्ति तद्विन्दुजनितमार्गो वृत्ताकारो भवति तदेव भूभावृत्तम् । सर्वाः स्पर्शरेखा वर्धितरविकर्णेन साकमेवस्मिन्नेव बिन्दौ मिलन्ति,स च योगबिन्दुः=यो,र=बिम्ब के, भू=भूकेन्द्रम् । रस्प=रविव्यासार्धम् । भूस्प' =भूव्यासार्धम् । भूबिन्दुतः स्पर्शरेखायाः समानान्तरा भूस रेखा कार्या च=चन्द्र केन्द्रम् । च बिन्दुतः स्पर्शरेखायाः समानान्तरा च न रेखा कार्या । सस्प=भूस्प' = भूव्यासार्धम् = भूव्या $\frac{1}{2}$ रस्प—सस्प=रव्या$\frac{1}{2}$—भूव्या$\frac{1}{2}$, भूर=रविकर्णः । भूच=चन्द्रकर्णः । च बिन्दुतः स्पर्शरेखोपरिलम्बो भूभाव्यासार्धसमः=नस्प', भूरस, भूचन त्रिभुजयोः साजात्यादनुपातेन $\frac{\text{रस} \times \text{भूच}}{\text{रभू}}$ = भून = $\frac{(\text{रव्या}\frac{1}{2} - \text{भूव्या}\frac{1}{2})\ \text{चन्द्रकर्ण}}{\text{रविकर्ण}}$ अतः भूस्प'—

भून=नस्प=भूव्या$\frac{1}{2}$—$\frac{(\text{रव्या } \frac{1}{2} - \text{भूव्या}\frac{1}{2}) \text{ चंकर्ण}}{\text{रकर्ण}}$=भूभाव्या$\frac{1}{2}$=चल द्विगुणीकरणेन भूव्या—$\frac{\text{चंकर्ण } (\text{रव्या} - \text{भूव्या})}{\text{रकर्ण}}$=भूभाव्यासः, एतेनाऽऽचार्योक्तमुपपन्नम् ।

अयं भूभाव्यासश्चन्द्रकक्षायां नायातीति क्षेत्रदर्शनेनैव स्फुटम् । अनेनैवे "भूव्यासहीनं रविबिम्बमिन्दुकर्णाहतं भास्कररकर्णभक्तम् । भूविस्तृतिर्लब्धफलेन हीना भवेत्कुभाविस्तृति रिन्दुमार्गे ।" ति भास्करोक्तमप्युपपद्यते । सिद्धान्तशेखरे "इन्दुश्रुतिः स्फुटमहर्यतिभूतधात्रि व्यासान्तरेण गुणिता रविकर्णभक्ता । भूविस्तृतेः फलमपोह्य वदन्ति शेषं छायां भुवः शशधरभ्रमणप्रदेशे ।" श्रीपत्युक्तमपीदमाचार्योक्तानुरूपमेवेति ।



र=रविबिम्बकेन्द्रम् । भू=भूकेन्द्रम् । भूर=रविकर्णः ।

रस्प=रविव्यासार्धम्=रव्या$\frac{1}{2}$ । भूस्प=भूव्यासार्धम्=भूव्या$\frac{1}{2}$, भूबिन्दुः स्पर्शरेखायाः समानान्तरा रेखा=भून, भूल=चन्द्रकर्णः । रन=रव्या$\frac{1}{2}$—भूव्या$\frac{1}{2}$

<रनभू=९०, भूरन त्रिभुजेऽनुपातः क्रियते $\frac{\text{त्रि } (\text{रव्या}\frac{1}{2} - \text{भूव्या}\frac{1}{2})}{\text{रक}}$ =ज्या<

रभून=$\frac{\text{त्रि. रव्या}\frac{1}{2}}{\text{रक}}$ — $\frac{\text{त्रि. भूव्या}\frac{1}{2}}{\text{रक}}$ =ज्या$\frac{1}{2}$ रविं ज्यारपलं, अस्याश्चापं

(चा) नवतेर्विशोध्यं तदा< नरभू=९०—चा=<च भूस्प, भूलस्प त्रिभुजेऽनुपातः $\frac{\text{त्रि. भूव्या}\frac{1}{2}}{\text{चक}}$=ज्या<भूलस्प=ज्याचंपलं, अस्याश्चाम्=चंपलं नवतेर्विशोध्यं तदा

<लभूस्प=९०—चंपलं, ततः <चभूस्प—<लभूस्प=९०—चा—(९०—चंपलं) =९०—चा—९०+चंपलं=चंपलं—चा=<चभूल=भूभाबिम्बार्धम् । अनेन "रवितनुदलजीवा लम्बस्य ज्ययोना क्षितिजजनितया तत्कार्मुकं कार्यमार्यैः । द्विजपतिजपराख्यं लम्बनं तद्विहीनं भवति वसुमतीभाबिम्बखण्डं सुसूक्ष्मम् ।" इति म.म. सुधाकरोक्तमुपपद्यते । अत्रैव यदि ज्याचापयोरभेदत्वं स्वीक्रियेत तदा $\frac{1}{2}$ रविं —रपलं=चा । परन्तु भूभाबिम्बार्धम्=चंपलं—चा=चंपलं—($\frac{1}{2}$ रविं—रपलं)

=चंपलं+रपलं—$\frac{1}{2}$रविं, एतेन "दिवाकर निशानाथपरलम्बनसंयुतिः। रवि बिम्बार्धं रहिता भूभाबिम्वदलं भवेत्।" इति यूरपदेशीयानां प्रकार उपपद्यत इति। एवं यदि स्प, $\overset{।}{\text{स्प}}$, स्प, $\overset{।}{\text{स्प}}$, विरुद्ध स्पर्शरेखे क्रियेते तदा चन्द्रकक्षायां $\overset{1}{\text{ल}}$, $\overset{।}{\text{ल}}$, विन्द्वोरन्तर्गतो भागः सर्वकिरणानां संयोगाभावात् म्लान इव भवति। अतस्तत्र प्रदेशत एव चन्द्रकान्तिमालिन्यम्। अत एव $\overset{।}{\text{ल}}$भूच इदं कोणमानं भूभाभाबिम्बार्धं कल्प्यते तदा र बिन्दुतः स्प, $\overset{।}{\text{स्प}}$, रेखायाः समानान्तरा रेखा कार्या तदुपरि भू बिन्दुतो लम्बः = भूम तदा भूम = $\frac{1}{2}$ रव्या + $\frac{1}{2}$ भूव्या ततो रभूभ त्रिभुजेऽनुपातेन

$\frac{\text{त्रि } (\frac{1}{2} \text{ रव्या} + \frac{1}{2} \text{ भूव्या})}{\text{रक}}$ = ज्या $\frac{1}{2}$ रविं + ज्यारपलं = ज्या < मरभू अस्याश्चापम् = चा, नवतेर्विशोध्यं तदा ९०—चा = < मभूर, तथा भू$\overset{।}{\text{ल}}\overset{।}{\text{स्प}}$, त्रिभुजेऽनुपातः

$\frac{\text{त्रि} \times \frac{1}{2} \text{ भूव्या}}{\text{चकं}}$ = ज्या < भू$\overset{।}{\text{ल}}\overset{।}{\text{स्प}}$, = ज्याचंपलं, अस्याश्चापं, नवतेर्विशोध्यं तदा

९०—चंपलं = < $\overset{।}{\text{ल}}$भू$\overset{।}{\text{स्प}}$, ∴ ∠ मभूर + < $\overset{1}{\text{ल}}$भूस्प, = ९०—चा + ९०— चंपलं = < रभू$\overset{।}{\text{ल}}$ = १८०—(चा+चंपलं)

∴ १८०—{१८०—(चा+चंपलं)} = १८०-१८०+ चा +चंपलं =चा +चंपलं = < चभू$\overset{।}{\text{ल}}$ = भूभाभाबिम्वार्धम्। एतेन "रवितनुदलजीवा लम्बनस्य ज्ययाऽऽढ्या क्षितिजजनितया तत्कार्मुकं कार्यमार्यैः। द्विजपतिजपराख्यं लम्बनं तद्युतंसद् भवति वसुमतीभाभावपुः खण्डमानम्।" इति म. म. सुधाकर द्विवेद्युक्तं सूत्रमुपपन्नम्।

अत्रैव यदि स्वल्पान्तराज्ज्या चापयोरभेदत्वं स्वीक्रियेत तदा चा = $\frac{1}{2}$ रविं + रपलं, तदा भूभाभाबिम्बार्धम् = चा + चंपलं = $\frac{1}{2}$ रविं + रपलं + चपलं, एतेन "दिवाकर निशानाथपरलम्बनसंयुतिः। रविबिम्बार्धसहिता भूभाभाविस्तृतेर्दलम्।" इति म. म. सुधाकरोक्तसूत्रमुपपद्यते। अत्रान्ये विशेषा वटेश्वरसिद्धान्तस्य मट्टीकायां विलोक्या इति ॥ ३३ ॥

अब भूभा बिम्बानयन कहते हैं।

हि. भा.—चन्द्रके स्फुटकर्ण को भूव्यासहीन रविव्यास से गुणाकर रविकर्ण से भाग देने से जो लब्ध हो उसको भूव्यास में घटाने से चन्द्रकक्षा में भूभाव्यास होता है। इति ॥

उपपत्ति।

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये। रविविम्ब और भूबिम्ब की क्रमस्पर्शरेखायें चन्द्रकक्षा में जहाँ जहां लगती है उन बिन्दु जनित मार्ग वृत्ताकार होता है, वही भूभावृत्त है; वर्धित रविकर्ण चन्द्रकक्षा में जहां लगता है वह विन्दु उस वृत्त का केन्द्र होता है। सब स्पर्शरेखायें वर्धित रविकर्ण के साथ एक ही बिन्दु में मिलती है। वह यह

बिन्दु है। र=रविबिम्ब केन्द्र। भू=भूकेन्द्र। रस्प=रविव्यासार्ध=$\frac{१}{२}$ रव्या। भूस्प=भूव्यासार्ध=$\frac{१}{२}$ भूव्या, भूर=रविकर्ण। च=चन्द्रकेन्द्र। भू बिन्दु से स्पर्शरेखा की समानान्तरा रेखा=भूस, च बिन्दु से स्पर्शरेखा की समानान्तरा रेखा=चन सस्प=भूस्प=$\frac{१}{२}$ भूव्या, रस्प—सस्प=$\frac{१}{२}$ रव्या—$\frac{१}{२}$ भूव्या, च बिन्दु से स्पर्शरेखा के ऊपर लम्ब=$\frac{१}{२}$ भूभाव्या =नस्प भूरस, भूचन दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं $\frac{\text{रस} \times \text{भूच}}{\text{रभू}}$

$$=\text{भून} = \frac{(\frac{१}{२}\ \text{रव्या} - \frac{१}{२}\ \text{भूव्या})\ \text{चंकर्ण}}{\text{रविक}}$$

अतः भूस्प— भून =नस्प= $\frac{१}{२}$ भूव्या—

$$— \frac{(\frac{१}{२}\ \text{रव्या} — \frac{१}{२}\ \text{भूव्या})\ \text{चंक}}{\text{रक}} = \frac{१}{२}\ \text{भूभाव्या} = \text{चल}$$

द्विगुणित करने से भूव्या—

$$— \frac{\text{चंक}\ (\text{रव्या} — \text{भूयव})}{\text{रक}} = \text{भूभाव्यास}$$

इससे आचार्योक्त उपपन्न हुआ। इसी से 'भूव्यासहीनं रवि बिम्बमिन्दुकर्णाहतं' इत्यादि संस्कृतोपपत्ति में लिखित भास्करोक्त सूत्र भी उपपन्न होता है। यह भूभाव्यास चन्द्रकक्षा में नहीं आता है। यह क्षेत्र देखने ही से स्फुट है।

अब यहां संस्कृतोपपत्ति में लिखित (ख) क्षेत्र को देखिये। र=रवि विम्बकेन्द्र। भू=भू केन्द्र, भूर=रविकर्ण रस्प=रविव्यासार्ध=$\frac{१}{२}$ रव्या। भूस्प=भूव्यासार्ध=$\frac{१}{२}$ भूव्या, भू बिन्दु से स्पर्शरेखा की समानान्तरा रेखा=भून, भूल = चन्द्रकर्ण, रन=$\frac{१}{२}$ रव्या — $\frac{१}{२}$ भूव्या, $<$ रनभू = ९०, भूरन त्रिभुज में अनुपात करते हैं।

$$\frac{\text{त्रि}\ (\frac{१}{२}\ \text{रव्या} - \frac{१}{२}\ \text{भूव्या})}{\text{रक}} = \text{ज्या} < \text{रभून} = \frac{\text{त्रि}.\ \frac{१}{२}\ \text{रव्या}}{\text{रक}} - \frac{\text{त्रि}.\ \frac{१}{२}\ \text{भूव्या}}{\text{रक}}$$

=ज्या $\frac{१}{२}$ रवि—ज्यारपलं, इसका चाप=चा, नवत्यंश में घटाने से $<$ नरभू=९०—चा = $<$ चभूस्प, भूलस्प त्रिभुज में अनुपात करते हैं। $\frac{\text{त्रि}.\ \frac{१}{२}\ \text{भूव्या}}{\text{चंकर्ण}}$ =ज्या $<$ भूलस्प =ज्या चंपलं, इसका चाप=चन्द्रपरम लम्बन=चंपलं, नवत्यंश में घटाने से $<$ लभूस्प =९०—चंपलं, अतः $<$ चभूस्प —$<$लभूस्प=९०– चा — (९० चंपलं) = ९० — चा — ९० + चंपलं=चंपलं—चा=$\frac{१}{२}$ भूभावि, इससे 'रवितनुदल जीवा लम्बनस्य ज्ययोना' इत्यादि संस्कृतोपपत्ति में लिखित म. म. पण्डित सुधाकर द्विवेदीजी का सूत्र उपपन्न हुआ। इनके प्रकार से वास्तव भूभा बिम्बार्ध आता है। यहीं पर ज्या और चाप का

अभेदत्व स्वीकार करने से $\frac{1}{2}$ रविं—रपलं = चा, परन्तु भूभा विम्बार्धं = चंपलं—चा । अतः चंपलं—($\frac{1}{2}$ रविं—रपलं) = चंपलं + रपलं $\frac{1}{2}$ रविं = भूभाविम्बार्ध, इससे 'दिवाकर-निशानाथ परलम्बनसंयुतिः' इत्यादि संस्कृतोपपत्ति में लिखित यूरप देशीय का प्रकार उपपन्न होता है ॥

एवं यदि स्प$_1$ स्प$'_1$, स्प$_2$ स्प$'_2$ विरुद्ध स्पर्शरेखायें की जाय तो चन्द्र कक्षा में ल$'$, ल$'_1$ बिन्दुओं के अन्तर्गत भाग सब किरणों के संयोग के अभाव से म्लान की तरह होता है, अतः वहां चन्द्रकान्ति की मलिनता होती है । अत एव ल$'$ भू च कोणमान को भूभाभा विम्बार्ध कल्पना करते हैं, तब र बिन्दु से स्प$_1$ स्प$'_1$ रेखा की समानान्तर रेखा के ऊपर भू बिन्दु से लम्ब = भूम, तब भूम = $\frac{1}{2}$ रव्या + $\frac{1}{2}$ भूव्या, अतः रभूम त्रिभुज में अनुपात से

$\frac{\text{त्रि}\ (\frac{1}{2}\ \text{रव्या} + \frac{1}{2}\ \text{भूव्या})}{\text{रक}}$ = ज्या $\frac{1}{2}$ रविं + ज्या रपलं = ज्या < मरभू, इसका चाप = चा,

नवत्यंश में घटाने से ९० — चा = < मभूर, तथा भूल$'$स्प$'_1$ त्रिभुज में अनुपात से

$\frac{\text{त्रि.}\ \frac{1}{2}\ \text{भूव्या}}{\text{चंक}}$ = ज्या < भूल$'$स्प$'_1$ = ज्या चंपलं इसके चाप को नवत्यंश में घटाने से

९०—चपलं = < ल$'$भूस्प$'_1$ अतः < मभूर + ल$'$भूस्प$'_1$ = ९० — चा + ९० — चपलं = < रभूल$'$

= १८०—(चा + चंपलं) ।

∴ १८०—{१८०—(चा + चंपलं)}

= चा + चंपलं = < चभूल$'$ = भूभाभा विम्बार्धं, इससे 'रवितनुदलजीवा लम्बनस्य ज्ययाऽऽदचा' इत्यादि संस्कृतोपपत्ति में लिखित, म. म. पण्डित सुधाकर द्विवेदीजी का सूत्र उपपन्न हुआ । यहां पर यदि ज्या और चाप में अभेदत्व स्वीकार किया जाय तो चा = $\frac{1}{2}$ रविं + रपलं, तब भूभाभा बिम्बार्धं = चा + चंपलं = $\frac{1}{2}$ रविं + रपलं + चंपलं, इससे "दिवाकरनिशानाथपरलम्बनसंयुतिः । रवि विम्बार्धं सहिता भूभाभा विस्तृतेर्दलम्" म. म. पण्डित सुधाकर द्विवेदीजी का सूत्र उपपन्न होता है । यहां अन्य विशेष बातें वटेश्वरसिद्धान्त की हमारी टीका में देखनी चाहिये इति ॥ ३३ ॥

इदानीं कलात्मकबिम्बान्याह ।

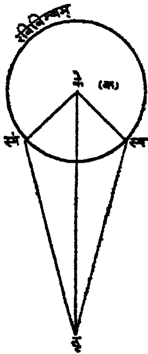
तद्गुणितं व्यासार्धं शशिकर्णहृतं तमः प्रमाणकलाः ।
एवं त्रिज्यारविशशिविष्कम्भगुणा स्वकर्णहृता ॥३४॥

सु. भा.—स्पष्टार्थम् । 'सूर्येन्दुभूभातनुयोजनानि त्रिज्याहतानि' इत्यादि भास्करोक्तमेतदनुरूपमेव ।

अत्रोपपत्तिः ।

त्रैराशिकेन भास्करोत्तया ।।३४।।

वि. भा.—भूभायायोजनात्मकबिम्बमानेन गुणितं त्रिज्याप्रमाणं चन्द्रकर्णेन भक्तं तदा कलात्मकं भूभाबिम्बं भवति । एवं योजनात्मकं रविबिम्बं त्रिज्यया गुणयित्वा रविकर्णेन भजेत्फलं कलात्मकं रविबिम्बं भवति । योजनात्मकं चन्द्रबिम्बं त्रिज्यया गुणयित्वा चन्द्रकर्णेन भजेत् फलं कलात्मकं चन्द्रबिम्बं भवतीति ।



अत्रोपपत्तिः ।

के = रविबिम्बकेन्द्रम् । दृ = दृष्टिस्थानम् = भूकेन्द्रम् । दृस्प दृस्प^1 दृष्टिस्थानाद्रविबिम्ब स्पर्शरेखे, दृके = रवि कर्णः । केस्प = केस्प^1 = रविबिम्ब व्यासार्धम् $<$ केस्पदृ = केस्प^{1}दृ = ९०, $<$ केदृस्प = $<$ केदृस्प^1 = रविबिम्ब कला । दृकेस्प त्रिभुजेऽनुपातेन $\frac{\text{त्रि} \times \text{केस्प}}{\text{दृके}}$

$= \frac{\text{त्रि} \times \frac{1}{2}\text{ रव्या}}{\text{रविकर्ण}}$ = ज्या $\frac{1}{2}$ रविंकला अस्याश्चापं द्विगुणितं तदा रविबिम्बकला प्रमाणं भवति । परन्त्वाचार्येण रविबिम्बकलार्धज्या (ज्या $\frac{1}{2}$ रविंक) प्रमाणं द्वाभ्यां गुणयित्वा चापं कृतं तद्बिम्बकलाप्रमाणं कथ्यते तन्न समीचीनं यतो द्विगुणितार्धज्या द्विगुणित चापपूर्णज्या भवति, पूर्णज्यातश्चापकरणविधिर्नास्त्यतो भास्कराचार्योक्तं न समीचीनम् । एवमेव चन्द्रस्यापि $\frac{\text{त्रि } \frac{1}{2}\text{ चंव्या}}{\text{चंकर्ण}}$

= ज्या $\frac{1}{2}$ चंविंक अस्याश्चापं द्विगुणितं तदा वास्तवं चन्द्रबिम्बकलाप्रमाणं भवति । एवं $\frac{\text{त्रि } \frac{1}{2}\text{ भूभाव्या}}{\text{चंकर्ण}}$ = ज्या $\frac{1}{2}$ भूभाविंक, अस्याश्चापं द्विगुणितं वास्तवं भूभाबिम्बकला प्रमाणं भवति, आचार्योक्तन्त्वसमीचीनमेव । सिद्धान्तशेखरे "एतानि भास्करमृगाङ्कमहीप्रमाणां त्रिज्याहतानि तनुविस्तृतियोजनानि । भक्तानि भानुशशिशीतकरश्रवोभिर्लिप्तामयानि हि भवन्ति यथाक्रमेण ।" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव तथा सिद्धान्तशिरोमणौ "सूर्येन्दुभूभातनुयोजनानि त्रिज्याहतान्यर्कशशीन्दुकर्णैः । भक्तानि तत्कार्मुकलिप्तिकास्तास्तेषां क्रमान्मानकला भवन्ति ।" भास्करोक्तमिदं च न समीचीनमिति पूर्वोक्तोपपत्त्या स्फुटमेवेति ।।३४।।

अब कलात्मक बिम्बानयन को कहते हैं।

हि. भा.—योजनात्मक भूभाबिम्ब को त्रिज्या से गुणा कर चन्द्रकर्ण से भाग देने से कलात्मक भूभाबिम्ब होता है एवं योजनात्मक रविबिम्ब को त्रिज्या से गुणाकर रविकर्ण से भाग देने से कलात्मक रविबिम्ब होता है। योजनात्मक चन्द्र बिम्ब को त्रिज्या से गुणा कर चन्द्रकर्ण से भाग देने से कलात्मक चन्द्र बिम्ब होता है इति।

उपपत्ति।

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये। के=रविबिम्बकेन्द्र। दृ=दृष्टिस्थान=भूकेन्द्र। दृस्प, दृस्प' दृष्टि स्थान से रवि बिम्ब की स्पर्श रेखा, दृके=रविकर्ण केस्प=केस्प'=रविबिम्बव्यासार्ध < केस्पदृ = < केस्प'दृ = ९०, < केदृस्प = < केदृस्प'=रवि विम्बकला, दृकेस्प त्रिभुज में अनुपात करते हैं $\frac{\text{त्रि.केस्प}}{\text{दृकं}} = \frac{\text{त्रि } \frac{1}{2} \text{ रव्या}}{\text{रकर्ण}}$ = ज्या < $\frac{1}{2}$ रविंक द्विगुणित करने से $\frac{\text{त्रि. रव्या}}{\text{रकर्ण}}$ = रविविंकला। एवं $\frac{\text{त्रि. चंव्या}}{\text{चंकर्ण}}$ = चंविकला। $\frac{\text{त्रि.भूभाव्या}}{\text{चंकर्ण}}$ = भूभाविंक इससे आचार्योक्त उपपन्न हुआ। शिद्धान्तशेखर में 'एतानि भास्करमृगाङ्कमहीप्रमाणां' इत्यादि संस्कृतोपपत्ति में लिखित श्रीपत्युक्त प्रकार आचार्योक्त के अनुरूप ही है। लेकिन ये प्रकार (आचार्योक्त तथा श्रीपत्युक्त) ठीक नहीं है। अनुपात से जो बिम्बकलार्धज्या आती है उसके चाप को द्विगुणित करने से बिम्बकला प्रमाण वास्तविक होता है, आचार्य विम्वकलार्धज्या को द्विगुणित कर बिम्बकला प्रमाण कहते हैं। सिद्धान्तशिरोमणि में 'सूर्येन्दुभूभातनुयोजनानि' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से भास्कराचार्य बिम्बकलार्धज्या को द्विगुणित कर विम्बकला प्रमाण को कहते हैं यह भी ठीक नहीं है क्यों कि विम्बकलार्धज्या को द्विगुणित करने से द्विगुणित बिम्बकलार्ध चाप की पूर्णज्या होती है। पूर्णज्या से चाप करने का नियम नहीं है अतः भास्करोक्त प्रकार भी ठीक नहीं हैं इति ॥३४॥

इदानीं छादकमाह।

भूच्छायेन्दुं चन्द्रः सूर्यं छादयति मानयोगार्धात्।
विक्षेपो यद्यूनः शुक्लेतरपञ्चदश्यन्ते ॥३५॥

सु. भा.—यदि मानयोगार्धात् मानैक्यखण्डाद्विक्षेप ऊनस्तदा शुक्ले पञ्चदश्यन्ते पूर्णान्ते भूच्छाया चन्द्रं छादयति। इतरपञ्चदश्यन्ते दर्शान्ते चन्द्रः सूर्यं छादयति। 'भूभाविधुं विधुरिनं ग्रहणे पिधत्ते' इति भास्करोक्तमेतदनुरूपमेव ॥३५॥

वि. भा.—यदि मानयोगार्धात् (बिम्बयोर्मानैक्यार्धात्) विक्षेपः (शरः) ऊनोऽल्पोभवेत्तदा शुक्ले पञ्चदश्यन्ते (पूर्णान्ते) भूच्छाया (भभा) चन्द्रं छादयति। इतरपञ्चदश्यन्ते (अमान्ते) चन्द्रः सूर्यं छादयतीत्यर्थाद्यदा रवितः षड्भान्तरे चन्द्रस्थानं तदा पूर्णान्तः। अतोऽमान्तकाले सूर्यचन्द्रस्थाने राश्यादिभिः सर्वावयवै-स्तुल्यौ स्यातां चन्द्रोपरिगतं कदम्बप्रोतवृत्तं क्रान्तिवृत्ते यत्र लगति तत्र चन्द्र-स्थानं तत्रैव च यदा रविस्तदाऽमान्तकाल इत्यमान्तस्य परिभाषातः, पौर्णमास्य-न्ते चैकोऽन्यस्मात् षड्भान्तरेऽतस्तदांऽशादिकौ समौ स्याताम्। अधःस्थश्चन्द्रो मेघवद्रवेश्छादको भवेदत एव कस्मिंश्चिद्देशे रविश्छन्नः क्वचिन्न छन्नो लक्ष्यते कक्षान्तरत्वात्। चन्द्रश्च पूर्वाभिमुखं गच्छन् भूभां प्रविशत्यत एव भूभैव चन्द्रस्य छादकः। ग्रस्तश्चन्द्रः सर्वत्रैव दर्शनयोग्ये समये लक्ष्यते। अनेनैव छादकनिर्णयेन रवेः पश्चिमतः स्पर्शश्चन्द्रस्य च पूर्वत इति ॥३५॥

इति ब्राह्मस्फुट सिद्धान्ते स्फुटगतिवासना

अब छादक को कहते हैं।

हि. भा.—छाद्य और छादक के मानैक्यार्ध से चन्द्रशर अल्प हो तब पूर्णान्त में भूभा चन्द्रबिम्ब को आच्छादित (ढकती) करती है, और अमान्त में चन्द्र सूर्य बिम्ब को आच्छा-दित करते हैं अर्थात् जब रविसे छः राशि पर चन्द्रस्थान रहता है तब पूर्णान्त होता है। इसलिये अमान्तकाले सूर्य और चन्द्र स्थान राश्यादि सर्वाबयव से बराबर होता है, चन्द्रोप-रिगत कदम्ब प्रोतवृत्त क्रान्तिबृत्त में जहां लगता है वही चन्द्र स्थान है, वहीं पर जब रवि होते हैं तो अमान्तकाल होता है इस अमान्त की परिभाषा से, पूर्णान्त में एक दूसरे से छः राश्यन्तर पर रहते हैं अतः तब अंशादि अवयव से दोनों बराबर होते हैं, चन्द्र पूर्वाभि-मुख जाते हुए भूभा में प्रवेश करते हैं इसलिये भूभा ही चन्द्र की छादिका है, रवि से अधः स्थित चन्द्र मेघ की तरह रवि के छादक होते हैं, अतः किसी देश में रवि छन्न, और किसी देश में नही छन्न लक्षित होते हैं कक्षान्तरत्व के कारण से। ग्रस्त चन्द्र सब जगह दर्शन योग्य समय में लक्षित होते हैं। इसी छादक निर्णय से रविग्रहण में पश्चिम से स्पर्श और चन्द्रग्र-हण में पूर्व से स्पर्श सिद्ध होता है इति ॥३५॥

इति ब्राह्मस्फुट सिद्धान्त में स्फुटगति वासना समाप्त।

अथ ग्रहणवासना प्रारभ्यते ।

तत्रादौ छादकनिर्णयमाह ।

महदिन्दोरावरणं कुण्ठविषाणो यतोऽर्धसञ्छन्नः ।
अर्धच्छन्नो भानुस्तीक्ष्णविषाणस्ततोऽस्याल्पम् ॥३६॥

सु. भा.—यतोऽर्धसञ्छन्नश्चन्द्रः कुण्ठविषाणो भवत्यत इन्दोरावरणं छादकमानं महत् । भानुश्चार्धच्छन्नस्तीक्ष्णविषाणो भवति ततस्तस्मादस्यावरणमल्पमस्तीत्यवगम्यते । लघुपरिधौ महापरिधिखण्डितेन विषाणयोः परिधियोगबिन्द्वोः कुण्ठता महापरिधौ च लघुपरिधिखण्डितेन विषाणयोस्तीक्ष्णतोत्पद्यते । अतश्चन्द्रस्य च्छादकः पृथुतरः सूर्यस्याल्पतर इति । 'छादकः पृथुतरस्ततो विधिः' इत्यादि भास्करोक्तमेतदनुरूपमेव ॥३६॥

वि. भा.—यस्मात् कारणात् अर्धच्छन्नश्चन्द्रः कुण्ठविषाणो भवति अतश्चन्द्रस्याऽऽवरणं (छादकमानं) महत् । भानुः (सूर्यः) अर्धच्छन्नः तीक्ष्णविषाणो भवति, तस्मात्कारणादस्याऽऽवरणमल्पमस्तीति । लघुपरिधेर्बृहत्परिधिना खण्डने परिधियोगबिन्दुरूपयोर्विषाणयोः कुण्ठता भग्नशृङ्गता जायते, बृहत्परिधेर्लघुपरिधिना खण्डने विषाणयोस्तीक्ष्णतोपपद्यते । अत एव चन्द्रस्याच्छादको महान् सूर्यस्य च लघुरिति । एतं प्राचीनोक्तयुक्तिवादमेव भास्कराचार्योऽपि "छादकः पृथुतरस्ततो विधोरर्धखण्डिततनोर्विषाणयोः । कुण्ठता च महती स्थितिर्यतो लक्ष्यते हरिणलक्षणग्रहे । अर्धखण्डिततनोर्विषाणयोस्तीक्ष्णता भवति तीक्ष्णदीधितेः । स्यात् स्थितिर्लघुरतो लघुः पृथक् छादको दिनकृतोऽवगम्यते । इत्यनेनोक्तवानिति ॥३६॥

अब ग्रहण वासना प्रारम्भ की जाती है ।
उसमें पहले छादक निर्णय को कहते हैं ।

हि. भा.—आधा आच्छादित चन्द्र का शृङ्गकुण्ठ (भोंथ) होता है इसलिये चन्द्र का छादक बड़ा है । आधे आच्छादित सूर्य के शृङ्ग तीक्ष्ण (नुकीले) होते हैं अतः सूर्य के छादक छोटे हैं । लघुपरिधि को बृहत् परिधि से काटने से परिधि के योग बिन्दुरूप शृङ्गद्वय की कुण्ठता होती है । बृहत्परिधि को लघु परिधि से काटने से दोनों शृङ्गों की तीक्ष्णता होती है अतः चन्द्र का छादक महान् है और सूर्य का छादक लघु है । इस प्राचीनोक्त युक्तिवाद ही को भास्कराचार्य ने भी "छादकः पृथुतरस्ततोविधोः' इत्यादि विज्ञान भाष्य में लिखित श्लोकों से कहा है इति ॥३६॥

इदानीं राहुकृतं ग्रहणं नेति वराहमिहिरादीनां मतं प्रतिपादयति ।

यदि राहुः प्राग्भागादिन्दुं छादयति किं तथा नार्कम् ।
स्थित्यर्धं महदिन्दोर्यथा तथा किं न सूर्यस्य ॥३७॥

किं प्रतिविषयं सूर्यो राहुश्चान्यो यतो रविग्रहणे ।
ग्रासान्यत्वं न ततो राहुकृतं ग्रहणमर्केन्द्वोः ॥३८॥

एवं वराहमिहिरश्रीषेणार्यभटविष्णुचन्द्राद्यैः ।
लोकविरुद्धमभिहितं वेदस्मृतिसंहिताबाह्यम् ॥३९॥

सु. भा.—आर्याद्वयं स्पष्टार्थम् । एवं वराहमिहिरादिभी राहुकृतं रवीन्द्वोर्न ग्रहणमिति लोकविरुद्धं वेदस्मृतिसंहिताबाह्यं चाभिहितम् ॥३७-३९॥

वि. भा.— यदि राहुः पूर्वतश्चन्द्रं छादयति अर्थाच्चन्द्रग्रहे पूर्वतः स्पर्शो भवति, तथा रविं कथं न छादयति अर्थात् सूर्यग्रहणेऽपि पूर्वत एव कथं न स्पर्शो भवति । चन्द्रग्रहणे स्थित्यर्धं महद्भवति तथा सूर्यस्य कथं न भवति । प्रत्येक देशे सूर्यो राहुश्च अन्योऽन्यो भवति किम् ? यतः सूर्यग्रहणे ग्रासान्यत्वं भवति तस्मात् कारणात् राहुकृतं सूर्याचन्द्रमसोर्ग्रहणं न भवतीति वराहमिहिर-श्रीषेणार्यभट-विष्णुचन्द्राद्यैर्लोकविरुद्धं वेदस्मृतिसंहिताबहिर्भूतं कथितमिति । यदि राहुकृतं सूर्यचन्द्रयोर्ग्रहणं तदा चन्द्रस्य प्राक्स्पर्शः, सूर्यस्य पश्चादिति कथम् । राहोरेक-रूपत्वात् । चन्द्रस्य पश्चान्मुक्तिः, रवेः प्राग् मुक्तिरिति कथम् । ग्रहणद्वये स्पर्श-मोक्षादेर्दर्शनं समानरूपेण भवितव्यम् । अर्धखण्डितस्य रवेर्विषाणयोः (शृङ्गयोः) तीक्ष्णता स्थितिश्च लघ्वी, रवेः क्वापि ग्रहणमस्ति क्वापि नास्तीत्यादि नोपपद्यते अत्र वराह मिहिरोक्तम् ।

"आवरणं महदिन्दोः कुण्ठविषाणस्ततोऽर्धसञ्छन्नः ।
स्वल्पं रवेर्यतोऽतस्तीक्ष्णविषाणो रविर्भवति ॥"

लल्लोक्तं च—

"प्रथमं रविमण्डलं ततो न ततः खण्डितमिन्दुमण्डलम् ।
न समाकृतिरीक्ष्यते स्थितिर्यदतो राहुकृतो न स ग्रहः ॥

सवितुश्च यदन्यथाऽन्यथा प्रतिदेशं सकलं समीक्ष्यते ।
न च कुत्रचिदित्यवैत्य कः कुरुते राहुकृते ग्रहे ग्रहम् ॥"

सिद्धान्तशेखरे

"राहुणा यदि पिधीयते ग्रहस्तिग्मशीतमहसोः स्वतृप्तये ।
नैकरूपमवलोक्यते कथं स्पर्शमोचनविमर्दपूर्वकम् ॥"

श्रीपतिना संक्षेपेणोक्तमिति ॥३७–३९॥

अब राहुकृत ग्रहण नहीं होता है वराहमिहिरादियों के मत को कहते हैं।

हि. भा.—यदि राहु पूर्वदिशा से चन्द्र को आच्छादित (ढकता) करता है अर्थात् यदि चन्द्र ग्रहण में पूर्व से स्पर्श होता है, तो उसी तरह सूर्य को क्यों नहीं आच्छादित करता है अर्थात् सूर्यग्रहण में भी पूर्व ही से क्यों स्पर्श नहीं होता है, चन्द्रग्रहण में स्थित्यर्ध बड़ा होता है वेसे ही सूर्यग्रहण में क्यों नहीं होता है। क्या प्रत्येक देश में सूर्य और राहु भिन्न होते हैं, क्यों कि सूर्य ग्रहण में ग्रास में भिन्नता होती है। इसलिये राहुकृत सूर्यग्रहण और चन्द्रग्रहण नहीं होता है ये बातें वराहमिहिर-श्रीषेण-आर्यभट-विष्णुचन्द्र आदि आचार्यों ने लोकविरुद्ध और वेद स्मृति संहिता से वहिर्भूत कही हैं यदि राहुकृत सूर्य-ग्रहण और चन्द्रग्रहण होता हैं तो चन्द्र के पूर्व तरफ स्पर्श और सूर्य के पश्चिम तरफ स्पर्श क्यों होता है क्योंकि राहु एक ही है। चन्द्र ग्रहण में पश्चिम में मोक्ष होता है, सूर्यग्रहण में पूर्व तरफ से क्यों ? दोनों ग्रहणों में स्पर्श मोक्ष आदि का दर्शन समान रूप से होना चाहिये, सो नहीं होता है, अर्ध खण्डित रविविम्ब के शृङ्गद्वय की तीक्ष्णता और स्थिति लघु, रवि ग्रहण कहीं दृश्य होता है कहीं नहीं इत्यादि उपपन्न नहीं होता है यहां वराह-मिहिरोक्त वचन 'आवरणं महदिन्दोः कुण्ठविषाणः' इत्यादि विज्ञान भाष्य में लिखित है। "प्रथमं रवि मण्डलं ततो न ततः खण्डितमिन्दुमण्डलम्' इत्यादि विज्ञान भाष्य में लिखित श्लोकों से राहुकृत ग्रहण का खण्डन लल्लाचार्य ने किया है। सिद्धान्तशेखर में 'राहुणा यदि पिधीयते ग्रहः' इत्यादि से श्रीपति ने भी राहुकृत ग्रहण का खण्डन किया है इति ॥३७-३९॥

इदानीं संहितामतमवलम्ब्य वराहादीन् निराकरोति।

यद्येवं ग्रहणफलं गर्गाद्यैः संहितासु यदभिहितम्।
तदभावे होमजपस्नानादीनां फलाभावः ॥४०॥

सु. भा.—गर्गाद्यै राहुवशतः संहितासु यद्ग्रहणफलमभिहितं तद् व्यर्थमेव। यद्येवमेव वराहमिहिरादीनां मतमिति। तदभावे राहुकृतग्रहणाभावे। शेषं स्पष्टार्थम् ॥४०॥

वि. भा.—यद्येवं वराहमिहिरादीनां मतं संहितासु राहुवशतो यद्ग्रहण-फलं कथितं तद्व्यर्थमेव भवेत्। तदभावे (राहुकृत ग्रहणाभावे) होमजपस्नाना-दीनामपि फलाभावो भवेदिति ॥४०॥

अब संहितामत को अवलम्बन कर वराहमिहिरादि मत का खण्डन करते हैं।

हि. भा.—यदि वराहमिहिर आदि आचार्यों के इस तरह मत हैं तब संहिताओं में राहुवश से जो ग्रहण फल कहा गया है वह व्यर्थ है। राहुकृत ग्रहण के अभाव (राहु के द्वारा ग्रहण नहीं होने) में होम जप स्नान आदि का भी फलाभाव होता है इति ॥४०॥

इदानीं लोकप्रथामाह ।

राहुकृतं ग्रहणद्वयमागोपालाङ्गनादिसिद्धमिदम् ।
बहुफलमिदमपि सिद्धं जपहोमस्नानफलमत्र ॥४१॥

सु. भा.—स्पष्टार्थम् ॥४१॥

वि. भा.—राहुद्वारा सूर्यग्रहणं चन्द्रग्रहणं च भवतीति गोपस्त्रीष्वपि प्रसिद्धमस्त्यर्थाद्गोपस्त्रियोऽपि जानन्ति यद्राहुकृतं ग्रहणद्वयं भवति, अत्र ग्रहणे जप करणे होम करणे स्नाने च बहुफलं भवतीत्यपि प्रसिद्धमस्तीति ॥४१॥

अब लोक प्रथा को कहते हैं ।

हि. भा.—राहुद्वारा सूर्यग्रहण और चन्द्र ग्रहण होता है यह विषय गोपालों(ग्वालों) की स्त्रियों में भी प्रसिद्ध है अर्थात् ग्वालों की स्त्रियां तक भी इस बात को जानती हैं कि दोनों ग्रहण राहु से ही होते हैं, और इस ग्रहण समय में जप करने से, हवन करने से, और स्नान करने से बहुत फल होता है यह भी उन लोगों (ग्वालों की स्त्रियों) में प्रसिद्ध है इति ॥४१॥

इदानीं राहुकृतं ग्रहणं भवतीत्यत्र स्मृतिवाक्यं प्रदर्शयति ।

स्मृतिषूक्तं न स्नानं राहोरन्यत्र दर्शनाद्रात्रौ ।
राहुग्रस्ते सूर्ये सर्वं गङ्गासमं तोयम् ॥४२॥

सु. भा.—स्पष्टार्थम् ॥४२॥

वि. भा.—सूर्ये राहुग्रस्ते चन्द्रे वा राहुग्रस्ते सर्वं जलं गङ्गासमं भवति । राहुदर्शनाद् भिन्न समये रात्रौ स्नानं न कुर्यात् । एवं स्मृतिषु (धर्मशास्त्रेषु) उक्तम् (कथितम्) । सिद्धान्तशेखरे "सर्वं च गङ्गासममम्बु राहुग्रस्ते दिनेशे यदि वा शशाङ्के । राहूपलब्धेरपरत्र कुर्यात् । स्नानं न रात्रौ स्मृतिषूक्तमेवम् ।" श्रीपतिनैवमुच्यते । "अप्रशस्तं निशि स्नानं राहोरन्यत्रदर्शनात् । राहुदर्शनसंक्रान्तिविवाहात्ययवृद्धिषु । स्नानदानादिकं कुर्यान्निशि काम्यव्रतेषु च । सर्वं गङ्गासमं तोयं सर्वे ब्रह्मसमा द्विजाः । सर्वं भूमिसमं दानं राहुग्रस्ते दिवाकरे ।" इत्यादि स्मृति पुराणवचनानुकूलं श्रीपत्युक्तमिति स्फुटमेवेति ॥४२॥

अब राहुकृत ग्रहण होता है इस में स्मृति वाक्य को दिखलाते हैं ।

हि. भा.—राहु द्वारा सूर्य के ग्रस्त होने में वा चन्द्र के ग्रस्त होने में सब जल गङ्गाजल के बराबर होता हैं । राहुदर्शन से भिन्न समय में रात्रि में स्नान नहीं करना

चाहिये, इस तरह धर्मशास्त्र में कहा गया है। सिद्धान्तशेखर में 'सर्वं च गङ्गासममम्बुराहुग्रस्ते' इत्यादि विज्ञान भाष्य में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है। तथा "अप्रशस्तं निशि स्नानं राहोरन्यत्रदर्शनात्" इत्यादि विज्ञानभाष्य में लिखित स्मृति पुराण बचनों के अनुकूल ही कहा है इति ॥४२॥

इदानीं राहुकृतग्रहणे वेदवाक्यं प्रदर्शयति ।

स्वर्भानुरासुरिनं तमसा विव्याध वेदवाक्यमिदम् ।
श्रुति संहितास्मृतीनां भवति यथैक्यं तदुक्तिरतः ॥४३॥

सु. भा.—'स्वर्भानुर्ह वा आसुरिः सूर्यं तमसा विव्याध'—इति माध्यन्दिनी श्रुतिः । अथ यथा श्रुतिसंहितास्मृतीनामैक्यं भवति तथा कथनमुचितमत एकवाक्यता प्रतिपादनार्थं तदुक्तिरत्रोचिता ॥४३॥

वि. भा.—स्वर्भानुरासुरिरित्यादिवेदवचनम् यथा स्वर्भानुर्हवा आसुरिः सूर्यं तमसा विव्याध । इति माध्यन्दिनी श्रुतिस्तत्र आसुरिरसुरकुलोत्पन्नः स्वर्भानुः (सिंहिकासूनुः राहुः) तमसा (अन्धकारेण) इनं (सूर्यबिम्बं) विव्याध (भेदितवान्) इदं वेदवाक्यमस्ति, यथा श्रुतिसंहितास्मृतीनामैक्यं (समता) भवति तथा कथनमुचितमत एकताप्रतिपादनार्थं तदुक्तिरत्रोचितास्तीति । सिद्धान्तशेखरे 'स्वर्भानुरासुरिरिनं तमसा घनेन विव्याध वेदवचने तदपि प्रसिद्धम् । प्रोक्तानि भानुशशिनोरसुरेश्वरेण सञ्छन्नयोरपि च सांहितिकैः फलानि ।:' श्रीपतिनैवं कथितम् । असुरेश्वरेण (राहुणा) आच्छादितयोः सूर्यचन्द्रमसोः सांहितिकैः (संहितावेत्तृभिः) शुभाशुभानि च फलानि प्रोक्तानि । यदाह गर्गसंहितायां भटोत्पलः "यन्नक्षत्रगतो राहुर्ग्रसते शशिभास्करौ । तज्जातानां भवेत्पीड़ा ये नराः शान्तिवर्जिताः ।" इत्यादिना सर्वत्रैव ग्रहणकारणं राहुरिति प्रसिद्धम् ॥४३॥

अब राहुकृत ग्रहण में वेदवाक्य को कहते हैं ।

हि. भा.— 'स्वर्भानुर्हवा आसुरिः सूर्यं तमसा विव्याध' यह माध्यन्दिनी श्रुति है इसका अर्थ यह है आसुरि (राक्षस कुलोत्पन्न) स्वर्भानु (सिंहिका पुत्र राहु) ने अन्धकार से सूर्य बिम्ब को भेदित किया, । श्रुति (वेद) संहिता और स्मृति (धर्मशास्त्र) में जैसे ऐक्य (समता-एकवाक्यता) हो वैसे कहना उचित है अतः एकता प्रतिपादन के लिये उस की उक्ति यहां उचित है । सिद्धान्तशेखर में 'स्वर्भानुरासुरिरिनं तमसा घनेन' इत्यादि से श्रीपति ने आचार्योक्त के सदृश ही कहा है इति ॥४३॥

इदानीं स्वोक्तिमाह ।

राहुस्तच्छादयति प्रविशति यच्छुक्लपञ्चदश्यन्ते ।
भूछाया तमसीन्दोर्वरप्रदानात् कमलयोनेः ॥४४॥

चन्द्रोऽम्बुमयोऽधः स्थो यदग्निमयभास्करस्य मासान्ते ।
छादयति शमिततापो राहुश्छादयति तत् सवितुः ॥४५॥

सु. भा.—इन्दोर्यद्‌बिम्बं शुक्लपञ्चदश्यन्ते पूर्णान्ते भूछायातमसि भूमान्धकारे प्रविशति तदेव बिम्बं कमलयोनेर्ब्रह्मणो वरप्रदानाद् भूछायामाश्रित्य राहुश्छादयति । एवं मासान्ते दर्शान्तेऽग्निमयस्य भास्करस्य महद्‌बिम्बं जलमयः शमिततापोऽधः स्थश्च चन्द्रश्छादयति सवितुः सूर्यस्य तदेव बिम्बं छायामाश्रित्य राहुश्छादयतीति । भास्करोक्तिरप्येतादृशी ॥४५॥

वि भा.—इन्दोः (चन्द्रस्य) यद्बिम्बं शुक्लपक्षपञ्चदश्यन्ते (पूर्णान्ते) भूछायातमसि (भूभान्धकारे) प्रविशति, तदेव बिम्बं ब्रह्मणो वरप्रदानात् भूछायामाश्रित्य राहुश्छादयति । एवं मासान्ते (अमान्तकाले) ऽग्निमयस्य भास्करस्य (सूर्यस्य) महद्बिम्बं जलमयः शमिततापोऽधः स्थश्चन्द्रश्छादयति, सूर्यस्य तदेव बिम्बं भूछायामाश्रित्य राहुश्छादयतीति । सिद्धान्तशेखरे "विष्णुलूनशिरसः किल पङ्गोर्दत्तवान् वरमिमं परमेष्ठी । हेमदानविधिना तव तृप्तिस्तिग्मशीतमहसोरुपरागे । भूमेश्छायां प्रविष्टः स्थगयति शशिनं शुक्लपक्षावसाने राहुर्ब्रह्मप्रसादात् समधिगतवरस्तत्तमो व्यासतुल्यः । ऊर्ध्वस्थं भानुबिम्बं सलिलमयतनोरप्यधोर्वत्तिबिम्बं संसृत्यैवं च मासव्युपरति समये स्वस्य साहित्यहेतोः ।" इत्यनेन श्रीपतिनाऽऽचार्योक्तानुरूपमेव कथितम् । श्रीपत्युक्तश्लोकार्थः विष्णुना (नारायणेन) लूनं (छिन्नं) शिरो (मस्तकं) यस्य स विष्णुलूनशिरास्तस्य पङ्गोः (गतिविकलस्य राहोरित्यर्थः) परमेष्ठी (ब्रह्मा) इमं वरं दत्तवान् । किं वरमित्याह्-तिग्मशीतमहसोः (सूर्याचन्द्रमसोः) उपरागे (ग्रहणे) होमदानविधिना ग्रहणकाले यद्दानं दीयते यच्चाग्नौ हूयते तेन तव तृप्तिः (तर्पणमाप्यायनमित्यर्थः) भविष्यति ब्रह्मप्रसादात् समधिगतवरोराहुः तत्तमो व्यासतुल्यः (तस्या भूच्छायाया अन्धकाररूपेण व्यासेन समानः) शुक्लपक्षावसाने (पौर्णमास्यन्ते) भूभां प्रविष्टः सन् चन्द्रं ग्रसते । एवममूना प्रकारेण मासव्युपरति समये (अमावास्यायां) स्वस्य साहित्यहेतोः । सूर्यचन्द्राभ्यां मिलनकामनया पीयूषपिण्डस्य चन्द्रस्य अधोर्वत्ति बिम्बं सूर्यबिम्बापेक्षयेतिभावः । संसृत्य (आश्रित्य) ऊर्ध्वस्थं सूर्यबिम्बं स्थगयति स्वस्य साहित्यहेतोरिति । अत्र लल्लोक्तम्—"ग्रहणे कमलासनानुभावाद्धुतदत्तांशभुजोऽस्य सन्निधानम् । यदतः स्मृतिवेदसंहितासु ग्रहणं राहुकृतं गतं प्रसिद्धिम् ।" इति, श्रीपत्युक्तं च "भूमेश्छायां प्रविष्टः स्थगयति शशिन" मित्यादि दृष्ट्वा भास्कराचार्येण गोलाध्यायस्य ग्रहणवासनाधिकारे—

दिग्देशकालावरणादिभेदान्नच्छादको राहुरिति ब्रुवन्ति ।
यन्मानिनः केवल गोलविद्यास्तत्संहिता वेदपुराणबाह्यम् ॥

राहुः कुभामण्डलगः शशाङ्कं शशाङ्कगश्छादयतीनबिम्बम् ।
तमोमयः शम्भुवरप्रदानात् सर्वागमानामविरुद्धमेतत् ॥

एवमुक्तमिति ।

अथात्र संहितायां गणितागतसमयात् पूर्वं परतो वा ग्रहणदर्शने तदुत्पातरूपमिति तत्फलं च गर्गोक्तम् ।

"वेलाहीने शस्त्रभयं गर्भाणां श्रावणं तथा ।
अतिवेले फलानां तु सस्यानां क्षयमादिशेत् ॥
दृक्समे पर्वणि नृपा निर्वैरा विगतज्वराः ।
प्रजाश्च सुखिताः सर्वभयरोगविवर्जिताः ॥"
इति लक्ष्यीकृत्य वराहमिहिरेण
"वेलाहीने पर्वणि गर्भविपत्तिश्च शस्त्रकोपश्च ।
अतिवेले कुसुमफलक्षयो भयं सस्यनाशश्च ॥
हीनातिरिक्तकाले फलमुक्तं पूर्वशास्त्रदृष्टत्वात् ।
स्फुटगणितविदः कालः कथञ्चिदपि नान्यथा भवति ॥"
एवं दृग्गणितैक्यं विधाने स्वपाटवं प्रदर्शितमिति ॥४४-४५॥

अब अपना मन्तव्य कहते हैं ।

हि. भा.—पूर्णान्तकाल में चन्द्र बिम्ब भूभा के अन्धकार में प्रवेश करता है ब्रह्मा के वरप्रदान से भूछाया (भूभा) को आश्रयण कर अर्थात् भूभा बिम्ब में प्रविष्ट हो कर राहु उसी चन्द्र बिम्ब को आच्छादित करता है । एवं अमान्त काल में सूर्य बिम्ब से अधः स्थित चन्द्रबिम्ब सूर्यबिम्ब को आच्छादित करता है, ब्रह्मवरप्रदान से राहु चन्द्रबिम्ब में प्रविष्ट हो कर उसी सूर्य बिम्ब को आच्छादित करता है । अर्थात् पूर्णान्त काल में भूभामण्डलगत राहु चन्द्र बिम्ब को आच्छादित करता हैं तथा अमान्त में चन्द्रमण्डलगत राहु सूर्यबिम्व को आच्छादित करता है । सिद्धान्तशेखर में "विष्णुलूनशिरसः किल पङ्गोर्दत्तवान् वरमिमं परमेष्ठी" इत्यादि विज्ञान भाष्य में लिखित श्लोकों से श्रीपति ने भी आचार्योक्त के अनुरूप ही कहा है । 'ग्रहणे कमलासनानुभावाद्धुतदत्तांशभुजोऽस्य सन्निधानम्' इत्यादि विज्ञान भाष्य में लिखित लल्लोक्त श्लोक को देख कर तथा 'भूमेश्छायां प्रविष्टः स्थगयति शशिनं' इत्यादि विज्ञानभाष्य में लिखित श्रीपत्युक्त को देख कर सिद्धान्तशिरोमणि के गोलाध्याय ग्रहणवासनाधिकार में "दिग्देश कालावरणादिभेदान्नच्छादको राहुरिति ब्रुवन्ति" इत्यादि से भास्कराचार्य ने आचार्योक्त के अनुरूप ही संहिता-वेद-स्मृति-पुराणों के मतों के साथ ज्यौतिष सिद्धान्त का समन्वय किया है । संहिता में गणितागत समय से पहले वा पीछे ग्रहणदर्शन होने से उत्पातरूप फल गर्ग ने कहा है जैसे "बेलाहीने शस्त्रभयं गर्भाणां श्रावणं तथा" इत्यादि विज्ञान भाष्य में लिखित श्लोकों को देखना चाहिये । इसी को लक्ष्य कर

वराह मिहिराचार्य ने "वेलाहीने पर्वणि गर्भविपत्तिश्च शस्त्रकोपश्च" इत्यादि विज्ञान भाष्य में लिखित श्लोकों से दृग्गणितैक्य विधान में अपनी पटुता को दिखलाया है इति ॥४४-४५॥

इदानीं राहुबिम्बमाह ।

भूछायाव्याससमः शशिकक्षायां स्थितः शशिग्रहणे ।
राहुश्छादयतीन्दुं सूर्यग्रहणेऽर्कमिन्दुसमः ॥४६॥

सु. भा.—शशिग्रहणे शशिकक्षायां स्थितो भूछायाव्याससमो राहुरिन्दुं सूर्यग्रहणे चेन्दुसमोऽर्कं सूर्यं च छादयति ॥४६॥

वि. भा.—शशिग्रहणे (चन्द्रग्रहणे) चन्द्रकक्षायां स्थितो भूभाव्याससमो राहुश्चन्द्रं छादयति । सूर्यग्रहणे च चन्द्रसमो राहुः सूर्यं छादयतीति ॥४६॥

अब राहुबिम्ब को कहते हैं ।

हि. भा.—चन्द्रग्रहण में चन्द्रकक्षा में स्थित भूभाव्यास के बराबर राहु चन्द्र बिम्ब को ग्रस्त करता है । तथा सूर्यग्रहण में चन्द्र व्यास के बराबर राहु सूर्य को ग्रसित करता है इति ॥४६॥

इदानीं ग्रहणे राहुदर्शनं कथं न भवतीत्याह ।

यत् तदधिकं तमोमयराहुव्यासस्य सूर्यदृष्टत्वात् ।
नश्यति भूछायेन्द्वोर्व्याससमोऽस्माद् भवति राहुः ॥४७॥

सु. भा.—तमोमयराहुव्यासस्य यन्मानं तदधिकं ताभ्यां भूभाचन्द्रव्यासाभ्यामधिकं तत् सूर्यदृष्टत्वात् तत्तेजसा नश्यति तस्माद्राहुर्भूछायासमश्चन्द्रमसो व्याससमश्चैव भवति । स चान्धकारमध्ये स्थितत्वान्न दृश्यो भवतीति स्फुटम् ॥४७॥

वि. भा.—तमोमयराहुव्यासस्य यन्मानं तदधिकं ताभ्यां भूभाचन्द्राभ्यामधिकं तत् सूर्यदृष्टत्वात्तत्तेजसा नश्यति, अस्मात् कारणाद्राहुर्भूछायेन्द्वोः (भूभाचन्द्रमसोः) व्याससमश्चैव भवति । स चान्धकारमध्ये स्थितत्वान्न दृश्यो भवतीति ॥४७॥

अब ग्रहण में राहु दर्शन क्यों नहीं होता है कहते हैं ।

हि. भा.—भूभा और चन्द्र से सूर्य बिम्ब के अधिक होने के कारण सूर्य बिम्ब के तेज से अन्धकार मय राहु का अन्धकार नष्ट होता है अतः भूभाबिम्ब व्यास के बराबर तथा चन्द्रबिम्ब के व्यास के बराबर ही तमोमय राहु व्यास होता है, वह अन्धकार के बीच में रहने के कारण दृश्य नहीं होता है इति ॥४७॥

इदानीं निर्गलितार्थमाह ।

भूछायेन्दुमतो हि ग्रहणे छादयति नार्कमिन्दुर्वा ।
तत्स्थस्तद्व्याससमो राहुश्छादयति शशिसूर्यौ ॥४८॥

सु. भा.—अतो ग्रहणे भूछाया चन्द्रं वा चन्द्रः सूर्यं न छादयति । किन्तु तद्व्याससमस्तत्स्थो राहुरेव शशिसूर्यौ छादयतीति सिद्धान्तः ॥४८॥

वि. भा.—अतोऽस्मात् कारणात् ग्रहणे भूछाया (भूभा) चन्द्रं न छादयति वा चन्द्रः सूर्यं न छादयति किन्तु तद्व्याससमस्तत्स्थो राहुरेव चन्द्रसूर्यौ छादयतीति ॥४८॥

इति ग्रहण वासना

अब निर्गलितार्थ (निचोड़) को कहते हैं ।

हि. भा.—इस कारण से ग्रहण में भूभा चन्द्र को आच्छादित नहीं करती है, वा चन्द्र सूर्य को आच्छादित नहीं करते है किन्तु उनके व्यास के बराबर तत्स्थित राहु ही चन्द्र और सूर्य को आच्छादित करता है इति ॥४८॥

इति ग्रहण वासना

अथ गोलबन्धाधिकारः प्रारम्यते ।

तत्रादौ पूर्वापरयाम्योत्तरक्षितिजवृत्तान्याह ।

प्राच्यपरं सममण्डलमन्यद्याम्योत्तरं क्षितिजमन्यत् ।
परिकरवत् तन्मध्ये भूगोलस्तत्स्थितद्रष्टुः ॥४६॥

सु. भा.—पूर्वापरमेव वृत्तं सममण्डलम् । अन्यद् याम्योत्तरवृत्तम् । परिकर-वत् कटिबन्धनवत् तदर्धेऽन्यत् क्षितिजम् । तन्मध्ये तेषां वृत्तानां गर्भीयकेन्द्रे तत्स्थित द्रष्टुस्तस्य भूगोलस्योपरि स्थितो यो द्रष्टा तस्य भूगोलः कल्प्य इति ॥४९॥

वि. भा.—प्रथमं पूर्वापरं सममण्डलसंज्ञकं वृत्तं विधायान्यत् (द्वितीयं) याम्योत्तरवृत्तं च विधाय पूर्वापरयाम्योत्तरवृत्तयोः सर्वतोऽप्यर्धभागे लम्बाकारेण संश्लिष्टमन्यत् (तृतीयं) क्षितिजवृत्तंसंज्ञकं विधेयम् । तेषां वृत्तानां गर्भीयकेन्द्रे तस्य भूगोलस्योपरि स्थितो यो द्रष्टा तस्य भूगोलः कल्प्यः । सिद्धान्तशेखरे "श्रीपरार्यादिससारदारुघटितैः श्लक्ष्णैः समैर्मंडलैर्गोलज्ञो दृढसन्धिबन्धरुचिरं गोलं विनिर्मापयेत् । तत्र प्रागपरं विधाय वलयं याम्योत्तरं चापरं तिर्यक् तद्द्वित-यार्धसक्तमभितः कुर्यात्तृतीयं पुनः ।" इति श्रीपत्युक्तवृत्तरचनाक्रम आचार्योक्तानु-रूप एव, एवमेव गोलबन्धविधिर्लल्लोक्तशिष्यधीवृद्धिदतन्त्रे, भास्करसिद्धान्त-शिरोमणौ चास्ति, भास्करेण "सुसरलवंशशलाकावलयैः श्लक्ष्णैः सचक्रभा-गाङ्कैः । रचयेद् गोलं गोले शिल्पे चानल्पनैपुणो गणकः ।" इति श्रीपत्युक्तिरेव विशदीकृतेत्यवगम्यत इति ॥४९॥

अब गोलबन्धाधिकार प्रारम्भ किया जाता है ।

उस में पहले पूर्वापरवृत्त, याम्योत्तरवृत्त और क्षितिजवृत्त को कहते हैं ।

हि. भा.—प्रथम सममण्डल संज्ञक पूर्वापर वृत्त बनाकर द्वितीय याम्योत्तर वृत्त को बनाकर इन दोनों (पूर्वापर वृत्त और याम्योत्तर वृत्त) के चारों तरफ अर्धभाग में लम्बाकार सटा हुआ तृतीय क्षितिजवृत्त बनाना चाहिये उन वृत्तों के गर्भीय केन्द्र में उस भूगोल के ऊपर स्थित द्रष्टा (दर्शक) के भूगोल की कल्पना करनी चाहिये । सिद्धान्तशेखर में 'श्रीपर्ण्यादि ससार दारुघटितैः' इत्यादि विज्ञान भाष्य में लिखित श्लोक से श्रीपति आचार्योक्त वृत्त रचनानुरूप ही वृत्त रचना क्रम को कहा है । इसी तरह गोलबन्ध विधि लल्लोक्त शिष्यवृद्धिदतन्त्र में और भास्कर सिद्धान्तशिरोमणि में भी है । भास्कराचार्य 'सुसरलवंशशलाकावलयैः,' इत्यादि से श्रीपत्युक्ति ही को विशदरूप में कहा है इति ॥ ४९॥

इदानीमुन्मण्डलसंस्थानमाह ।

पूर्वापरयोर्लग्नं याम्योत्तरयोर्नतोन्नतं क्षितिजात् ।
स्वाक्षांशैरुन्मण्डलमहर्निशोर्हानि वृद्धिकरम् ॥५०॥

सु. भा.—स्पष्टार्थम् । पूर्वापरक्षितिजसङ्गमयोर्विलग्नम्'—इत्यादि भास्करोक्तमेतदनुरूपम् ॥५०॥

वि. भा.—पूर्वापरवृत्तक्षितिजवृत्तयोः पूर्वदिशि यत्र योगः पश्चिमदिशि च यत्र योगस्तद्बिन्दुद्वयगतं क्षितिजात् स्वाक्षांशैर्याम्योत्तरयोर्नतोन्नतमर्थात् दक्षिण-समस्थानात् स्वाक्षांशैरधोगतमुत्तरसमस्थानाच्च स्वाक्षांशैरुपरिगतमुन्मण्डलं भवति तच्च दिनरात्र्योरपचयोपचयकारकं भवत्यर्थादेतदुन्मण्डलं निरक्षदेशीयं क्षितिजं भवति उन्मण्डलवति देशे दिनरात्री-उपचयापचयवत्यौ भवतः । उन्मण्डल-हीने निरक्षदेशे च दिनरात्री सर्वदैव समाने भवत इति । सिद्धान्तशेखरे "संसक्तं समवृत्तभूजवलयप्राक्पश्चिमासङ्गयोर्याम्योदक् क्षितिजाधरोत्तरगतं स्वाक्षांश-तुल्यान्तरे । स्यादुन्मण्डलमेतदप्यवनिजं देशे निरक्षे स्मृतं जायेते तमस्विनी दिवस-योर्वृद्धिक्षयौ तद्वशात् ।" इति श्रीपत्युक्तोन्मण्डलरचनाक्रम आचार्योक्तानुरूप एव । सिद्धान्तशिरोमणौ 'पूर्वापरक्षितिजसङ्गमयोर्विलग्नं याम्ये ध्रुवे पललवैः क्षितिजादधः स्थे । सौम्ये कुजादुपरिचाक्षलवैर्ध्रुवे तदुन्मण्डलं दिननिशोः क्षयवृद्धि-कारि ।" भास्करोक्तमिदमाचार्योक्तानुरूपमेवेति ॥५०॥

अब उन्मण्डल संस्थान को कहते हैं ।

हि. भा.—पूर्वापरवृत्त और क्षितिजवृत्त की पूर्वदिशा में जहां योग (पूर्वस्वस्तिक) है और पश्चिम दिशा में योग (पश्चिम स्वस्तिक) है, एतद्बिन्दुद्वय गत तथा दक्षिण समस्थान से अपने अक्षांशान्तर पर अधोगत उत्तर समस्थान से अपने अक्षांशान्तर पर ऊपर गया हुआ वृत्त उन्मण्डल है, यह दिन और रात्रि का हानि (अपचय) और वृद्धि (उपचय) कारक है । यह उन्मण्डल ही निरक्ष देशीय क्षितिज है इसलिये निरक्ष देश में दिन और रात्रि सर्वदा बराबर होती है, निरक्ष देश से भिन्न देश (जहां उन्मण्डल है) में दिन और रात्रि के न्यूनाधिकत्व के कारण उन्मण्डल ही है । सिद्धान्त शेखर में श्रीपति और भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है इति ॥५०॥

इदानीं विषुवन्मण्डलसंस्थानमाह ।

विषुवन्मण्डलमूर्ध्वं सममण्डलतः स्थितं स्वकाक्षांशैः ।
याम्येनोत्तरतोऽधः क्षितिजे प्राच्यपरयोर्लग्नम् ॥५१॥

सु. भा.—ऊर्ध्वं खस्वस्तिकम् । अधोऽधः स्वस्तिकम् । शेषं स्पष्टम् । 'पूर्वापरस्वस्तिकयोर्विलग्नम्'—इत्यादि भास्करोक्तं चिन्त्यम् ।।५१।।

वि. भा.—सममण्डलतः (पूर्वापरवृत्तात्) स्वकीयाक्षांशैर्दक्षिणेनोर्ध्वभागे (ऊर्ध्वखस्वस्तिके) स्वकीलाक्षांशैरुत्तरतोऽधः खस्वस्तिके स्थितं क्षितिजवृत्ते पूर्वस्वस्तिके पश्चिमस्वस्तिके च लग्नं विषुवन्मण्डलं विषुवन्नाम (समरात्रिन्दिवकालः) उपचारात् समरात्रिन्दिवकालो यत्र तिष्ठति रवौ भवति तत्रासक्तमिति। पूर्वापर विन्द्वोरेव विषुवचिन्हे गोलवन्धे प्राचीनैः स्वीकृते इति पूर्वापर चिन्ह्योः संसक्तमित्यर्थः) स्यात्-एतस्य नाम नाड़ीवृत्तमप्यस्ति यतो वृत्तमिदं षष्टया ६० नाड़िकाभिश्चिन्हितमस्तीति । सिद्धान्तशेखरे "नतमथ समवृत्ताद्दक्षिणेनाक्षभागैं विषुवदुपपतन्तं मण्डलं नाड़िकाख्यम् । उदगपि पलभागैः स्यादधस्तात्तदेतद् गगन रसमिताभिर्लाञ्छितं नाड़िकाभिः ।" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवास्ति-सिद्धान्तशिरोमणौ "पूर्वापरस्वस्तिकयोर्विलग्नं खस्वस्तिकाद् दक्षिणतोऽक्षभागैः। अधश्च तैरुत्तरतोऽङ्कितं च षष्टयाऽत्र नाड़ीवलयं विदध्यात् ।" भास्करोक्तश्चायं श्रीपत्यादर्शरूपो द्रष्टव्य इति ।।५१।।

अब विषुवन्मण्डल की संस्थिति को कहते हैं ।

हि. भा.—पूर्वापर वृत्त से दक्षिण तरफ अक्षांशान्तर (ऊर्ध्वखस्वस्तिक) में, उत्तर तरफ अधः खस्वस्तिक (अक्षांशान्तर) में स्थित, क्षितिज वृत्त में पूर्वस्वस्तिक और पश्चिम स्वस्तिक में लगा हुआ विषुवद्वृत है, इसका नाम नाड़ी वृत्त भी है क्यों कि इस वृत्त में साठ नाड़ी (घटी) अङ्कित रहती हैं, विषुवद्वृत्त इसका नाम इसलिये है कि विषुवत् उसको कहते हैं जहां पर रवि के रहने से दिनमान और रात्रिमान बराबर होता है सायनमेषादि और सायन तुलादि में रवि के रहने से यह स्थिति होती है अर्थात् पूर्वस्वस्तिक और पश्चिम स्वस्तिक में संसक्त रहने से इसका नाम विषुदद्वृत्त है इति । सिद्धान्तशेखर में 'नतमथसमवृत्ताद्दक्षिणेनाक्षभागैः' इत्यादि विज्ञान भाष्य में लिखित श्लोक से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है सिद्धान्तशिरोमणि में 'पूर्वापर स्वस्तिकयोर्विलग्नं' इत्यादि से भास्कराचार्य श्रीपत्युक्त को आदर्श रूप मानते हैं इति ।।५१।।

इदानीं क्रान्तिमण्डलसंस्थानमाह ।

विषुवन्मण्डललग्नं मेषतुलादावुदक् कुलीरादौ ।
जिनभागैर्याम्येन मृगादावपममण्डलमिहार्कः ।।५२।।

पाताश्चन्द्रादीनां भ्रमन्ति भार्धे रवेश्च भूछाया ।
पातादपमण्डलवद् विमण्डलानि स्वविक्षेपैः ।।५३।।

सु. भा.—स्पष्टार्थम्। 'क्रान्तिवृत्तं विधेयं'—इत्यादि तथा 'क्रान्तिपाते च पाताद्भषट्कान्तरे' इत्यादि भास्करोक्तं चिन्त्यं। आचार्यमतेऽयनाभावो ज्ञेयः। पातादपमण्डलवदित्यनेन ग्रहाणां विमण्डलानि न्यस्तानीत्यग्रे सम्बन्धः ॥५२-५३॥

वि. भा.—पूर्वापरवृत्त नाड़ीवृत्त क्षितिजवृत्तोन्मण्डलानां पूर्वदिशि सम्पातबिन्दुः पूर्वस्वस्तिकं, पश्चिमदिशि सम्पातबिन्दुश्च पश्चिमस्वस्तिकम्। अनयोः पूर्वापरस्वस्तिकयोः मेषादितुलादिबिन्दू अपि तिष्ठत इत्ययनांशाभावकालिकीस्थितिः। तेन मेषादिबिन्दौ तुलादिबिन्दौ च (पूर्वस्वस्तिके पश्चिम स्वस्तिके च) नाड़ीवृत्तेन सह सक्तवृत्तं क्रान्तिवृत्तं बध्नीयात्, कुलीरादौ (कर्कटादौ) मिथुनान्तबिन्द्वात्मके नवत्यंशचापे नाड़ीवृत्ताच्चतुर्विंशत्यंशैरुत्तरतः-मृगादौ (धनुरन्तबिन्द्वात्मके तुलादिबिन्दोर्नवत्यंशचापे) चतुर्विंशत्यंशैर्दक्षिणतः। बध्नीयात् अस्मिन् (क्रान्तिवृत्ते) वृत्ते रविर्भ्रमति, चन्द्रादीनां ग्रहाणां पाताश्च भ्रमन्ति। रवेः षड्भान्तरे भूछाया (भूभा) भ्रमति। पातात् (क्रान्ति विमण्डल सम्पातात्) क्रान्तिवृत्तवत् स्वस्वशरांशान्तरे तेषां ग्रहाणां (चन्द्रादीनां) विमण्डलानि भवन्ति। सिद्धान्तशेखरे "पूर्वापरस्वस्तिकसक्तवृत्तं क्रान्त्याख्यमत्राजतुलाधराद्योः। उदग् जिनांशैः खलु कर्कटादौ नाड्याह्वयाद् दक्षिणतो मृगादौ। भ्रमत्यमुष्मिन् वलये दिनेशः शशाङ्कपूर्वद्युसदां च पाताः। सहस्रगोः षड्भवनान्तरे हि छाया मही गोल समुत्थिता च।" श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव। शिष्यधीवृद्धिदे तन्त्रे लल्लोक्तं च "मेषतुलादौ लग्नं नाड़ीवृत्तेऽपमण्डलं तदुदक्। जिनभागैः कर्क्यादौ याम्यैस्तैरेव मकरादौ। भ्रमति रविरत्र वलये ग्रहाश्च चन्द्रादयः स्वपातयुताः। भूभाभार्धभानोः स्वशीघ्रवृत्ते ज्ञसितपातौ।" इत्यनुपदमेव गृहीतं श्रीपतिना। भास्कराचार्येण च "क्रान्तिवृत्तं विधेयं गृहाङ्कं भ्रमत्यत्र भानुश्चभार्धेकुभा भानुतः। क्रान्तिपातः प्रतीपं तथा प्रस्फुटाः क्षेपपाताश्च तत्स्थानकान्यङ्कयेत्। क्रान्तिपाते च पाताद् भषट्कान्तरे नाड़िकावृत्तलग्नं विदध्यादिदम्। पाततः प्राक्त्रिभे सिद्धभागैरुदक् दक्षिणे तैश्च भागैर्विभागे ऽपरे।" इति प्राचीनोक्तरीत्यैव तथैव क्रान्तिवृत्तसंस्थानमुक्तम्। रवित एव छायोत्पद्यते। रविकेन्द्राद् भूकेन्द्रगामिसूत्रं यत्र क्रान्तिवृत्ते लगति तदेव भूभामध्यस्थानम्। रविः क्रान्तिवृत्ते—क्रान्तिवृत्तस्य केन्द्रं च भूकेन्द्रम्। अतो रवेर्भूकेन्द्रगामिसूत्रं क्रान्तिवृत्तस्य व्यासत्वाद्रवितः षड्भान्तरे क्रान्तिवृत्ते लगति तेन 'भार्धे रवेश्च भूछाये' ति युक्तियुक्तमाचार्योक्तमिति ॥५२–५३॥

अब क्रान्तिवृत्त संस्थान को कहते हैं।

हि. भा.—पूर्वापरवृत्त नाड़ीवृत्त क्षितिजवृत्त उन्मण्डल इन वृत्तों के पूर्वतरफ सम्पात बिन्दु पूर्वस्वस्तिक है, और पश्चिम तरफ सम्पात बिन्दु पश्चिम स्वस्तिक है। अयनांशाभाव काल में पूर्वस्वस्तिक ही मेषादि बिन्दु तथा पश्चिम स्वस्तिक तुलादि बिन्दु रहता है। अतः

मेषादि विन्दु (पूर्वस्वस्तिक) और तुलादि विन्दु (पश्चिम स्वस्तिक) में नाड़ीवृत्त के साथ संसक्त क्रान्तिवृत्त को बांधना चाहिये। कर्क्यादि (मिथुनान्त विन्द्वात्मकनवत्यंशचाप) में नाड़ीवृत्त से चौबीस अंश उत्तर, मकरादि (धनुरन्तविन्द्वात्मक नवत्यंशचाप) में चौबीस अंश दक्षिण क्रान्तिवृत्त को बांधना चाहिये, इस क्रान्तिवृत्त में रवि भ्रमण करते हैं चन्द्र आदि ग्रहों के पात भ्रमण करते हैं। रवि से छः राशि पर भूभा भ्रमण करती हैं। पात (क्रान्तिवृत्त और विमण्डल के सम्पात) से क्रान्तिवृत्त के सदृश अपने अपने शरांशान्तर पर उन ग्रहों का विमण्डल होता है। रवि से छाया की उत्पत्ति होती है। रविकेन्द्र से भूकेन्द्र-गामी सूत्र क्रान्तिवृत्त में जहां लगता है वही भूभा मध्यस्थान (केन्द्र) है। रवि क्रान्तिवृत्त में है, क्रान्तिवृत्त का केन्द्र भूकेन्द्र है इसलिये रवि से भूकेन्द्रगामी सूत्र क्रान्तिवृत्त में छः राशि पर लगता है क्यों कि वह सूत्र (रवि से भूकेन्द्रगामी सूत्र) क्रान्तिवृत्त का व्यास है, व्यास रेखा वृत्त के दो समान खण्ड करती है अतः रवि से छः राशि पर भूभाकेन्द्र होना है यह आचार्योक्त युक्तियुक्त है। सिद्धान्तशेखर में 'पूर्वापर स्वस्तिक सक्तवृत्तं इत्यादि' विज्ञान भाष्य में लिखित श्लोकों से श्रीपतिआचार्योक्त के अनुरूप ही कहा है। शिष्यवृद्धिद तन्त्र में 'मेषतुलादौ लग्नं नाड़ीवृत्तेऽपमण्डलं' इत्यादि लल्लाचार्योक्त विषय को अक्षरशः श्रीपति ने ग्रहण किया है इति ॥५२-५३॥

इदानीं विमण्डलान्याह।

सौम्यं विमण्डलार्धं प्रथमं याम्यं द्वितीयमेतेषु।
चन्द्रकुजजीवमन्दा भ्रमन्ति शीघ्रेण बुधशुक्रौ ॥५४॥

सु. भा.—प्रथम विमण्डलार्धं मेषादिराशिषट्कं विक्षेपांशैः सौम्यं द्वितीय-मर्धं तुलादिषट्कञ्च याम्यं विक्षेपांशैर्बध्नीयात्। बुधशुक्रौ शीघ्रेण शीघ्रोच्चेन स्वस्वविमण्डले भ्रमतः। तयोः शीघ्रोच्चे विमण्डले भ्रमत इति शेषं स्पष्टा-र्थम् ॥५४॥

वि. भा.—क्रान्तिविमण्डलयोः सम्पातः पात इति ततः प्रथमं विमण्डलार्धं मेषादिराशिषट्करूपं शरांशैः सौम्यं (उत्तरदिशि) द्वितीयमर्धं (तुलादिराशिषट्कं च) शरांशैर्याम्यं (दक्षिणदिशि) बध्नीयात्। एतेषु स्वस्वविमण्डलेषु चन्द्रभौमगुरु-शनयो भ्रमन्ति बुधशुक्रौ शीघ्रोच्चेन स्वस्वविमण्डले भ्रमतोऽर्थात्तयोः शीघ्रोच्चे विमण्डले भ्रमत इति। सिद्धान्तशेखरे "विमण्डलार्धं प्रथमं निजेषुभागैरुदक् चोत्तर-पातचिन्हात्। सषड्गृहाद् दक्षिणतो द्वितीयमर्धं तथाऽपक्रमवृत्तवच्च। एतेषु च स्वस्वविमण्डलेषु चन्द्रार जीवार्कसुता भ्रमन्ति। निजोच्चवृत्तेन चलाभिधेन किलोश-नश्चान्द्रमसायिनी च।" इत्यनेन श्रीपतिः, लल्लः "भूभा भार्धभानोः स्वशीघ्रवृत्ते ज्ञसितपातौ। विक्षेपमण्डलदलं पूर्वं क्षेपांशकैरुदक् पातात्। षड्भयुताद्दक्षिणतो

विमण्डलार्धं द्वितीयं स्यात् ।" भास्करश्च—नाड़िकामण्डले क्रान्तिवृत्तं यथा क्रान्तिवृत्ते तथा क्षेपवृत्तं न्यसेत् । क्षेपवृत्तं तु राश्यङ्कितं तत्र च क्षेपपातेषु चिन्हानि कृत्वोक्तवत् । क्रान्तिवृत्तस्य विक्षेपवृत्तस्य च क्षेपपाते सषड्भे च कृत्वा युतिम् । क्षेपपातागृतः पृष्ठतश्च त्रिभे क्षेपभागैः स्फुटैः सौम्ययाम्ये न्यसेत् ।" इत्यनेन सर्वं तथैव कथितवान् । केवलं "क्षेपभागैः स्फुटै" रित्युक्त्या ग्रहाणां स्फुटशरा अपेक्षितास्ते च

शीघ्रकर्णेन भक्तास्त्रिभज्यागुणाः स्युः परक्षेपभागाग्रहाणां स्फुटाः ।
क्षेपवृत्तानि षण्णां विदध्यात्पृथक् स्वस्ववृत्ते भ्रमन्तीन्दु पूर्वाग्रहाः ।।

इत्यनेनानीता भगोलविमण्डल रचनां भास्करेण गृहीताः । प्राचीनैस्त एव पूर्वपठिताः शरा अत्र विमण्डलरचनायामपि गृहीता ।। इति ।।५४।।

अब विमण्डलों को कहते हैं ।

हि. भा.—क्रान्तिवृत्त और विमण्डल के सम्पात पात है, वहां से प्रथम विमण्डलार्धं (मेषादि छः राशिरूप) को शरांशान्तर पर उत्तर तरफ तथा द्वितीय विमण्डलार्ध (तुलादि छः राशिरूप) को शरांशान्तर पर दक्षिण तरफ बांधना चाहिये । इन अपने अपने विमण्डलों में चन्द्र, भौम, गुरु, शनि भ्रमण करते हैं । बुध और शुक्र शीघ्रोच्च से अपने अपने विमण्डल में भ्रमण करते हैं । सिद्धान्तशेखर में 'विमण्डलार्धं प्रथमं निजेषु भागैः' इत्यादि से श्रीपति, 'भूभा भार्धभानोः स्वशीघ्रवृत्ते ग्रसित पातौ' इत्यादि से लल्लाचार्य, 'नाड़िका मण्डले क्रान्तिवृत्तं यथा क्रान्तिवृत्ते' इत्यादि से भास्कराचार्य ने सब एक ही तरह कहा है । केवल भास्कराचार्य ने 'शीघ्रकर्णेन भक्तास्त्रिभज्यागुणाः' इत्यादि से साधित भगोलीय परमस्फुटशरवश से भगोलीय विमण्डल रचना की हैं प्राचीनाचार्यो ने पूर्व पठितशर ही को इस विमण्डल रचना में ग्रहण किया है इति ।।५४।।

इदानीं दृग्मण्डलाभिनिवेशमाह ।

दृग्मण्डलार्धमूर्ध्वं यत् तत् परिधिस्थितं द्रष्टा ।
पश्यति यतः क्षितिस्थस्तद्भ्रमति ततो ग्रहाभिमुखम् ।।५५।।

सु. भा.—यतः क्षितिस्थः क्षितिगर्भस्थो द्रष्टा यदूर्ध्वं दृग्मण्डलार्धं तत्परिधिस्थितं ग्रहं पश्यन्ति ततस्तस्मात् कारणात् तद् दृग्मण्डलं ग्रहाभिमुखं भ्रमति । 'ऊर्ध्वाधर स्वस्तिककीलयुग्मे' इत्यादि भास्करोक्तं विचिन्त्यम् ।।५५।।

वि. भा.—यतः (यस्मात् कारणात्) भूगर्भस्थो द्रष्टा ऊर्ध्वं दृग्मण्डलार्धं यत् तत्परिधिस्थितं ग्रहं पश्यति तस्मात् कारणात् तद् दृग्मण्डलं ग्रहाभिमुखं भ्रमतीति । सिद्धान्तशेखरे "द्रष्टुर्ग्रहाभिमुखमभ्रमवृत्तसक्तं दृग्मण्डलं प्रतिपलं भ्रमति ग्रहाणाम्"

श्रीपत्युक्तमेवास्ति। भास्करश्च–"ऊर्ध्वाधरस्वस्तिक कीलयुग्मे प्रोतं श्लथं दृग्वलयं तदन्तः। कृत्वा परिभ्राम्य च तत्र तत्र नेयं ग्रहो गच्छति यत्र यत्र। ज्ञेयं तदेवाखिल खेचराणां पृथक् पृथग्वा रचयेत्तथाष्टौ।" यथा दृग्मण्डलबन्धनमुपपादयति तदेव श्रीपत्युक्त्याऽपि पर्यवस्यतीति स्फुटमेव ॥५५॥

अब दृग्मण्डल को कहते हैं।

हि. भा.—भूगर्भस्थित द्रष्टा (दर्शक) दृग्मण्डल के ऊर्ध्व परिध्यर्ध स्थित ग्रह को देखता है इसलिये वह दृग्मण्डल ग्रहाभिमुख भ्रमण करता है। सिद्धान्तशेखर में 'द्रष्टुर्ग्रहाभिमुखम-भ्रमवृत्तसक्तं दृग्मण्डलं प्रतिपलं भ्रमति ग्रहाणाम्।' श्रीपति इस तरह कहते हैं। भास्कराचार्य 'ऊर्ध्वाधरस्वस्तिक कीलयुग्मे प्रोतं श्लथं दृग्वलयं तदन्तः।' इत्यादि से दृग्मण्डल बन्धन को जैसे कहते हैं श्रीपत्युक्ति से भी वही होता है इति ॥५५॥

इदानीं दृक्क्षेपवृत्तमाह।

क्षितिजापमण्डलयुतिर्लग्नं लग्नाग्रया दिशा लग्नम्।
दृक्क्षेपमण्डलं दक्षिणोत्तरं वित्रिभविलग्ने ॥५६॥

सु. भा.—क्षितिजक्रान्तिमण्डलयोर्यत्र युतिस्तदेव लग्नम्। दृक्क्षेपमण्डलं लग्नाग्रया दिशा लग्नं वित्रिभलग्ने वित्रिभलग्नस्थाने क्रान्तिमण्डले दक्षिणोत्तरं तिर्यग् भवति। लग्नाग्रा यद्युत्तरा तदा लग्नाग्रांशै र्दक्षिणसमस्थानात् पूर्वस्वस्तिक-दिशि दक्षिणाग्रायां च लग्नाग्रांशैर्दक्षिणसमस्थानात् पश्चिमस्वस्तिकदिशि क्षितिजे लग्नं वित्रिभखस्वस्तिकगतं दृक्क्षेपमण्डलं भवतीत्यर्थः। 'ज्ञेयं तदेवाखिल-खे चराणाम्'—इत्यादि भास्करोक्तं विचिन्त्यम् ॥५६॥

वि. भा.—क्षितिजवृत्तक्रान्तिवृत्तयोर्यत्र योगस्तदेव लग्नम्। लग्नोत्पन्नं नवत्यंशवृत्तं दृक्क्षेपवृत्तं भवति तच्च वित्रिभ लग्नस्थाने क्रान्तिवृत्ते तिर्यक् (लम्ब-रूपं) भवति, लग्नाग्रया दिशा लग्नमर्थाल्लग्नाग्रा यद्युत्तरा तदा दक्षिणसमस्था-नाल्लग्नाग्रांशैः पूर्वस्वस्तिकदिशि यदि च लग्नाग्रा दक्षिणा तदा दक्षिणसमस्था-नाल्लग्नाग्रांशैः पश्चिमस्वस्तिकदिशि क्षितिजे लग्नं वित्रिभलग्नखस्वस्तिकगतं तत् (दृक्क्षेपवृत्तं) भवतीत्यर्थः। सिद्धान्तशेखरे 'प्राग्लग्नमत्र भवनत्रितयेन हीनं दृक्क्षेपमण्डलमुशन्ति कुशाग्रधीराः' इत्यनेन श्रीपतिः, सिद्धान्तशिरोमणौ 'दृग्मण्डलं वित्रिभलग्नकस्य दृक्क्षेपवृत्ताख्यमिदं वदन्ती' त्यनेन भास्करोऽप्याचार्यो क्तानुरूपमेव कथयतीति ॥५६॥

अब दृक्क्षेपवृत्त को कहते हैं।

हि. भा.—क्षितिजवृत्त और क्रान्तिवृत्त की पूर्व दिशा में जहां योग है वही लग्न है।

लग्नोत्पन्न नवत्यंश वृत्त दृक्क्षेपवृत्त होता है। वह (दृक्क्षेपवृत्त) वित्रिभ लग्नस्थान में क्रान्तिवृत्त के ऊपर तिर्यक् (लम्ब रूप) होता है, तथा लग्नाग्रा यदि उत्तर दिशा की है तब दक्षिण समस्थान से लग्नाग्रांशान्तर पर पूर्वस्वस्तिक की तरफ यदि लग्नाग्रा दक्षिण दिशा की है तब दक्षिण समस्थान से लग्नाग्रांशान्तर पर पश्चिम स्वस्तिक की तरफ क्षितिजवृत्त में लगता है। अर्थात् वह दृक्क्षेपवृत्त त्रित्रिभलग्न और खस्वस्तिक में गया हुआ होता है। सिद्धान्तशेखर में "प्राग्लग्नमत्र भवनत्रितयेन हीनं' इत्यादि से श्रीपति तथा सिद्धान्तशिरोमणि में 'दृग्मण्डलं वित्रिभ लग्नकस्य' इत्यादि से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है इति ।।५६।।

इदानीं मेषादि द्वादशराशीनामहोरात्रवृत्तान्यमाह ।

विषुवदुदग् बध्नीयात् क्रान्त्यंश समान्तरेष्वजादीनाम् ।
वृत्तत्रितयं व्यस्तं कर्क्यादीनां तुलादीनाम् ।।५७।।

विषुवद्दक्षिणतोऽन्यन्मकरादीनां तदेव विपरीतम् ।
स्वाहोरात्राण्येषां व्यासाः पृथगेवमिष्टमपि ।।५८।।

सु. भा.—स्वाहोरात्राणि द्युज्या एषामहोरात्रवृत्तानां व्यासा ज्ञेयाः। एवमिष्टमहोरात्रवृत्तमपि पृथग्गोलोपरि निवेश्यम्। शेषं स्पष्टम्। ईप्सितक्रान्तितुल्येऽन्तरे' इत्यादि तथा 'अथ कल्प्या मेषाद्याः' इत्यादि च भास्करोक्तं विचिन्त्यम् ।।५७-५८।।

वि. भा.—अजादीनां (मेषादीनां) त्रयाणां राशीनां (मेषवृषमिथुनानां) क्रान्त्यंशतुल्यान्तरेषु नाड़ीवृत्तादुत्तरदिशि वृत्तत्रितयं स्वाहोरात्रवृत्ताह्वयं बध्नीयादर्थान्मेषान्तक्रान्त्यंशैर्नाड़ीवृत्तादुत्तरे यद्वृत्तं तन्मेषान्ताहोरात्रवृत्तम्। वृषान्तक्रान्त्यंशान्तरे नाड़ीवृत्तादुत्तरे यद्वृत्तं तद्वृषान्ताहोरात्रवृत्तम्। मिथुनान्तक्रान्त्यंशान्तरे नाड़ीवृत्तादुत्तरे मिथुनान्ताहोरात्रवृत्तमिति। इति वृत्त त्रितयं (मेष वृषमिथुनानामहोरात्रवृत्तत्रितयं) व्यस्तं विपरीतक्रमेण कर्क्यादीनामहोरात्रवृत्तानि भवंत्यर्थाद्वृषान्ताहोरात्रवृत्तमेव कर्कान्ताहोरात्रवृत्तम्। मेषान्ताहोरात्रवृत्तमेव सिंहान्ताहोरात्रवृत्तम्। कन्यान्ताहोरात्रवृत्तं तु मीनान्ताहोरात्रवृत्तरूपं नाड़ीवृत्तमेवास्ति। तुलादीनां षण्णां राशीनां नाड़ीवृत्ताद्दक्षिणदिशि—अहोरात्र वृत्तं भवति। यथा तुलान्तक्रान्त्यशान्तरे नाड़ीवृत्ताद्दक्षिणदिशि यद्वृत्तं तत्तुलान्ताहोरात्रवृत्तम्। नाड़ीवृत्ताद्दक्षिणदिशि वृश्चिकान्तक्रान्त्यंशान्तरे वृश्चिकान्ताहोरात्रवृत्तम्। नाड़ीवृत्ताद्दक्षिणदिशि धनुरन्तक्रान्त्यंशान्तरे धनुरान्ताहोरात्रवृत्तम्। तदेव विपरीतं मकरादीनामहोरात्रवृत्तानि भवन्त्यर्थाद्वृश्चिकान्ताहोरात्रवृत्तमेव मकरान्ताहोरात्रवृत्तम्। तुलान्ताहोरात्रवृत्तमेव कुम्भान्ताहोरात्रवृत्तम्। कन्यान्ता-

होरात्रवृत्तमेव नाड़ीवृत्तरूपं मीनान्ताहोरात्रवृत्तम् । एषामहोरात्रवृत्तानां व्यासाः पृथक् पृथक् द्युज्या भवंति । एवमिष्टमप्यहोरात्रवृत्तगोलोपरि पृथक् निवेश्यम् । सिद्धान्तशेखरे "मेषाद् वृत्तत्रितयमपमांशैर्ग्रहाणां त्रयाणां नाड़ीवृत्तादिदमुदगपि व्यत्ययात् कर्कटाच्च । षण्णां जूकात् कथितमनुदक् चैवमिष्टापमांशैः स्वाहोरात्राह्वयमभिहितं मण्डलं गोलविद्भिः ।"श्रीपतिः । लल्लश्च-वृत्तत्रयमपमांशैर्नाड़ीवृत्ताद् भवत्यजादीनाम् । व्यस्तं कर्क्यादीनामेवं षण्णां तुलादीनाम् । इष्टक्रान्तेरग्रे तद् द्युज्यामण्डलं च बध्नीयात् । मध्येऽस्य ग्रहगोला भवन्ति वृत्तैर्भगोलस्य ।" आचार्यस्याऽऽदर्शभूताविति । भास्कराचार्योऽपि "ईप्सितक्रान्तितुल्येऽन्तरे सर्वतो नाड़िकाख्यादहोरात्रवृत्ताह्वयम् । तत्र बध्वा घटीनां च षष्टयाऽङ्कयेदस्य विष्कम्भखण्डं द्युजीवा मता ।" एषां प्राचीनानां सदृशमेवाहोरात्रवृत्तं कथयति । केवलमयनांशलब्धिकारणात् 'विषुवत्क्रान्तिवलयोः सम्पातः क्रान्तिपातः स्यादि' ति प्रथमं कथयित्वा "अथ कल्प्या मेषाद्या अनुलोमं क्रान्तिपाताङ्कात् ।" इत्याह ॥५७-५८॥

अब मेषादिद्वादश (बारह) राशियों के अहोरात्रवृत्त को कहते हैं ।

हि. भा—मेषादि तीन राशि (मेष–वृष-मिथुन) यों के क्रान्त्यंशतुल्य अन्तर पर नाड़ीवृत्त से उत्तर तरफ अहोरात्र वृत्त संज्ञक तीन वृत्तों को बांधना चाहिये-अर्थात् नाड़ीवृत्त से उत्तर तरफ मेषान्त क्रान्त्यंशान्तर पर जो वृत्त होता है वह मेषान्ताहोरात्रवृत्त है, वृषान्त क्रान्त्यंशान्तर पर नाड़ीवृत्त से उत्तर जो वृत्त होता है वह वृषान्ताहोरात्रवृत्त है । एवं नाड़ीवृत्त से उत्तर मिथुनान्त क्रान्त्यंशान्तर पर मिथुनान्ताहोरात्र वृत्त होता है । यह मेष- वृत्त-मिथुन के अहोरात्र वृत्त विपरीत क्रम से कर्क्यादि तीन राशियों का अहोरात्रवृत्त होता है अर्थात् वृषान्ताहोरात्र वृत्त ही कर्कान्ताहोरात्र वृत्त होता है, मेषान्ताहोरात्रवृत्त ही सिंहान्ताहोरात्रवृत्त होता है । कन्यान्ताहोरात्रवृत्त मीनान्ताहोरात्रवृत्तरूप नाड़ीवृत्त ही हैं । तुलादि छः राशियों के नाड़ीवृत्त से दक्षिण तरफ अहोरात्रवृत्त होता है । जैसे नाड़ीवृत्त से दक्षिण तुलान्त क्रान्त्यंशान्तर पर तुलान्ताहोरात्रवृत्त होता है । नाड़ीवृत्त से दक्षिण वृश्चिकान्त क्रान्त्यंशान्तर पर वृश्चिकान्ताहोरात्रवृत्त होता है । एवं नाड़ीवृत्त से दक्षिण धनुरन्त क्रान्त्यंशान्तर पर धनुरन्ताहोरात्र वृत्त होता है । ये ही विपरीत क्रम से मकरादि राशियों का अहोरात्र वृत्त होते हैं अर्थात् वृश्चिकान्ताहोरात्रवृत्त ही मकरान्ताहोरात्रवृत्त होता हैं । तुलान्ताहोरात्रवृत्त ही कुम्भान्ताहोरात्रवृत्त होता है । कन्यान्ताहोरात्रवृत्त ही नाड़ीवृत्तरूप मीनान्ताहोरात्रवृत्त होता है । इन अहोरात्रवृत्तों की व्यास द्युज्या होती है । एवं इष्ट अहोरात्रवृत्त को भी पृथक् गोल के ऊपर निवेश करना चाहिये । सिद्धान्तशेखर में 'मेषाद्वृत्तत्रितयमपमांशैर्ग्रहाणां त्रयाणां' इत्यादि विज्ञान भाष्य में लिखित श्रीपत्युक्त के तथा 'वृत्तत्रयमपमांशैर्नाड़ीवृत्तात्' इत्यादि विज्ञान भाष्य में लिखित लल्लोक्त का आदर्शरूप आचार्योक्त ही है । भास्कराचार्य भी 'ईप्सितक्रान्तितुल्येऽन्तरे सर्वतो नाड़िकाख्यादहोरात्रवृत्ताह्वयम्'

इत्यादि से प्राचीनोक्त अहोरात्रवृत्तों के सदृश ही अहोरात्रवृत्त कहते हैं । केवल अयनांश की उपलब्धि के हेतु से 'विषुवत्क्रान्तिवलयोः सम्पातः क्रान्तिपातः स्यात्' पहले यह कह कर 'अथ कल्प्या मेषाद्या अनुलोमं क्रान्तिपाताङ्कात् ।' यह कहते हैं इति ॥५७-५८॥

इदानीं राश्युदयाः कथं समानेत्याशङ्क्याह ।

लङ्का समपश्चिमगं प्राणेन कलां भमण्डलं भ्रमति ।
अपमण्डलस्य राशिर्द्वादशभागः क्षितिजलग्नाः ॥५९॥

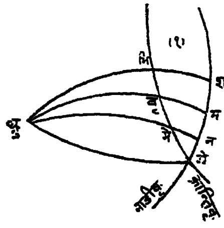
यान्त्युदयं मेषाद्या यतस्तदुदया न कालसमाः ।
क्रान्तिवशाल्लङ्कायां तदूनताधिक्यमक्षवशात् ॥६०॥

सु. भा.—लङ्कासमपश्चिमगं भमण्डलं भचक्रमध्यप्रदेशरूपं नाडीमंडलं प्राणेनैकेनासुना कलामेकं कलां भ्रमति । नाडीमण्डलस्यैका कलैकेनासुनोदेति । क्रान्तिमण्डलस्य द्वादशभागो द्वादशसमानभागो राशिरुच्यते । ते मेषाद्याः क्षिति-जलग्ना यत उदयं यान्त्यतो लङ्कायां क्रान्तिवशात् तिरश्चीनत्वात् तदुदयाः कालसमाः कालेन समा न सन्ति । एवं स्वदेशेऽपि क्रान्तिवशादक्षवशाच्च तेषां राशीनामुदयेषु ऊनताधिक्यं भवति । 'यो हि प्रदेशो ऽपमण्डलस्य तिर्यक्स्थितो यात्युदयं तथाऽस्तम्'—इत्यादि भास्करोक्तं चिन्त्यम् ॥६०॥

वि. भा.—लङ्कापश्चिमपश्चिमगं भमण्डलं भचक्रमध्यप्रवेशरूपं नाड़ीवृत्तं प्राणेन (एकेनासुना) कलां (एकां कलां) भ्रमत्यर्थान्नाड़ीवृत्तस्यैका कलैकेनासुनो-देति । क्रान्तिवृत्तस्य द्वादशतुल्यभागो राशिः कथ्यते, ते मेषाद्या यतः क्षितिजलग्ना उदयं यान्त्यतो लङ्कायां क्रान्तिवशात् तदुदयाः कालेन समा न सन्ति । एवं स्वदेशेऽपि क्रान्तिवशादक्षवशाच्च तेषां राशींनामुदयेषु न्यूनाधिक्यं भवतीति ।

अत्रोपपत्तिः ।

क्रान्तिवृत्तस्य त्रिंशदंशात्मक एको राशिः । राश्याद्युपरि राश्यन्तोपरि च ध्रुवप्रोतवृत्तकरणेन तयोरन्तर्गतं नाडीवृत्तीयचापं तद्राशेर्निरक्षोदयमानम् । यथा मेषाद्युपरिध्रुवप्रोतवृत्तं नाड़ीवृत्ते मेषादिविन्दा (नाड़ीवृत्त क्रान्तिवृत्तयोः सम्पात-बिन्दौ) वेव लगति तस्मान् मेषान्तोपरि ध्रुवप्रोतवृत्तनाड़ीवृत्तयोः सम्पातं यावन्मेषो-दयमानं निरक्षदेशीयम् । एवं मेषान्तो (वृषादि) परि ध्रुवप्रोतवृत्तवृषान्तोपरि ध्रुवप्रोतवृत्तयोरन्तर्गतं नाड़ीवृतीयचापं निरक्षदेशीयं वृषोदयमानम् । वृषान्तो (मिथुनादि) परिध्रुवप्रोतवृत्तमिथुनान्तोपरि ध्रुवप्रोत (आयनप्रोतवृत्त) वृत्तयोर-न्तर्गतं नाड़ीवृत्तीयचापं निरक्षदेशीयं मिथुनोदयमानमेतेषु न्यूनाधिक्यं कथं भवतीति प्रदर्श्यते ।



गो = गोलसन्धिः = मेषादिः । मे = मेषान्तविन्दुः । वृ = वृषान्तबिन्दुः । मि = मिथुनान्त विन्दुः । गोमे = मेवृ = ३०°, गोन = मेषोदयमानम् । नम = वृषोदयमानम् । मश = मिथुनोदयमानम् । ध्रु = ध्रुवः । ध्रुमि = परमाल्पद्युज्याचापम् = < ध्रुगोमि ध्रुमे = मेषान्त द्युज्याचापम् । ध्रुवृ = वृषान्त द्युज्याचापम् । < मेवृध्रु = वृषान्तजयष्टयंशाः = ९० – वृषान्तजायनवलनम् । गोलसन्धावायनवलनं परमं जिनांशसमम् । अयनसन्धावर्थान्मिथुनान्ते आयनवलनम् = ०, अत एतयोर्मध्ये वृषान्ते आयनवलनम् < २४ परमाल्पद्युज्याचापम् = ९० — जिनांश = ९० — २४ = ६६,

वृषान्ते यष्टयंशाः = ९० — वृषान्तजायनवलनं = ९० — जिनांशाल्पाऽऽयनवलनम् । अतो वृषान्ते यष्टयंशाः > परमाल्पद्युज्याचापम्, ध्रुगोमे चापीय त्रिभुजेऽनुपातः क्रियते ज्या < गोध्रुमे = $\frac{\text{परमाल्पद्युज्या} \times \text{ज्या } ३०}{\text{मेषान्तद्युज्या}}$ = मेषोदयज्या = ज्यागोन

ध्रुमेवृ चापीय त्रिभुजेऽनुपातेन $\frac{\text{वृषान्तजयष्टि} \times \text{ज्या } ३०}{\text{मेषान्तद्युज्या}}$ = ज्या < मेध्रुवृ = ज्या नम = वृषोदयज्या, परन्तु वृषान्तय > परमाल्पद्यु । अतः $\frac{\text{वृषान्तयष्टि} \times \text{ज्या } ३०}{\text{मेषान्तद्युज्या}}$ > $\frac{\text{परमाल्पद्युज्या} \times \text{ज्या } ३०}{\text{मेषान्तद्युज्या}}$ अर्थात् वृषोदयज्या > मेषोदयज्या वा मेषोदयमान < वृषोदयमानं, एवमेव मिष्टध्रुचापीय त्रिभुजेऽनुपातेन $\frac{\text{वृषान्तयष्टि} \times \text{ज्या } ३०}{\text{परमाल्पद्युज्या}}$ = ज्या < मिध्रुवृ = ज्यामश = मिथुनोदयज्या, परन्तु वृषान्तयष्टि > परमाल्पद्यु तथा मेषान्तद्यु > परमाल्पद्यु अतः $\frac{\text{वृषान्तयष्टि} \times \text{ज्या } ३०}{\text{परमाल्पद्यु}}$ > $\frac{\text{वृषान्तयष्टि} \times \text{ज्या } ३०}{\text{मेषान्तद्यु}}$ अर्थात् मिथुनोदयज्या > वृषोदयज्या

∴ मिथुनोदयज्या < वृषोदयज्या < मेषोदयज्या वा मिथुनोदयमा < वृषोदयमान < मेषोदयमान ∴ सिद्धम् ।

एतदुपपत्तिर्वस्तुतो यथैव शिष्यधीवृद्धिदतन्त्रे लल्लाचार्येणोक्ता तथैव श्लोकान्तरेण श्रीपतिना भास्कराचार्येण चोक्ता स्वस्वग्रन्थे ।

यथा लल्लः—

लङ्कावृत्ते मध्यस्थितें भुवो यत्कुजं तदुद्वृत्तम् ।
तेन न तत्र चरदलं सदा समत्व च दिवसनिशोः ॥

इत्यादि से प्राचीनोक्त अहोरात्रवृत्तों के सदृश ही अहोरात्रवृत्त कहते हैं । केवल अयनांश की उपलब्धि के हेतु से 'विषुवत्क्रान्तिवलयोः सम्पातः क्रान्तिपातः स्यात्' पहले यह कह कर 'अथ कल्प्या मेषाद्या अनुलोमं क्रान्तिपाताङ्कात् ।' यह कहते हैं इति ॥५७-५८॥

इदानीं राश्युदयाः कथं समानेत्याशङ्कयाह ।

लङ्का समपश्चिमगं प्राणेन कलां भमण्डलं भ्रमति ।
अपमण्डलस्य राशिर्द्वादशभागः क्षितिजलग्नाः ॥५९॥

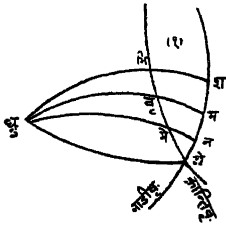
यान्त्युदयं मेषाद्या यतस्तदुदया न कालसमाः ।
क्रान्तिवशाल्लङ्कायां तदूनताधिक्यमक्षवशात् ॥६०॥

सु. भा.—लङ्कासमपश्चिमगं भमण्डलं भचक्रमध्यप्रदेशरूपं नाडीमंडलं प्राणेनैकेनासुना कलामेकं कलां भ्रमति । नाडीमण्डलस्यैका कलैकेनासुनोदेति । क्रान्तिमण्डलस्य द्वादशभागो द्वादशसमानभागो राशिरुच्यते । ते मेषाद्याः क्षितिजलग्ना यत उदयं यान्त्यतो लङ्कायां क्रान्तिवशात् तिरश्चीनत्वात् तदुदयाः कालसमाः कालेन समा न सन्ति । एवं स्वदेशेऽपि क्रान्तिवशादक्षवशाच्च तेषां राशीनामुदयेषु ऊनताधिक्यं भवति । 'यो हि प्रदेशो ऽपमण्डलस्य तिर्यक्स्थितो यात्युदयं तथाऽस्तम्'—इत्यादि भास्करोक्तं चिन्त्यम् ॥६०॥

वि. भा.—लङ्कापश्चिमपश्चिमगं भमण्डलं भचक्रमध्यप्रवेशरूपं नाड़ीवृत्तं प्राणेन (एकेनासुना) कलां (एकां कलां) भ्रमत्यर्थान्नाड़ीवृत्तस्यैका कलैकेनासुनोदेति । क्रान्तिवृत्तस्य द्वादशतुल्यभागो राशिः कथ्यते, ते मेषाद्या यतः क्षितिजलग्ना उदयं यान्त्यतो लङ्कायां क्रान्तिवशात् तदुदयाः कालेन समा न सन्ति । एवं स्वदेशेऽपि क्रान्तिवशादक्षवशाच्च तेषां राशींनामुदयेषु न्यूनाधिक्यं भवतीति ।

अत्रोपपत्तिः ।

क्रान्तिवृत्तस्य त्रिंशदंशात्मक एको राशिः । राश्याद्युपरि राश्यन्तोपरि च ध्रुवप्रोतवृत्तकरणेन तयोरन्तर्गतं नाडीवृत्तीयचापं तद्राशेर्निरक्षोदयमानम् । यथा मेषाद्युपरिध्रुवप्रोतवृत्तं नाड़ीवृत्ते मेषादिविन्दा (नाड़ीवृत्त क्रान्तिवृत्तयोः सम्पातबिन्दौ) वेव लगति तस्मान् मेषान्तोपरि ध्रुवप्रोतवृत्तनाड़ीवृत्तयोः सम्पातं यावन्मेषोदयमानं निरक्षदेशीयम् । एवं मेषान्तो (वृषादि) परि ध्रुवप्रोतवृत्तवृषान्तोपरि ध्रुवप्रोतवृत्तयोरन्तर्गतं नाड़ीवृतीयचापं निरक्षदेशीयं वृषोदयमानम् । वृषान्तो (मिथुनादि) परिध्रुवप्रोतवृत्तमिथुनान्तोपरि ध्रुवप्रोत (आयनप्रोतवृत्त) वृत्तयोरन्तर्गतं नाड़ीवृत्तीयचापं निरक्षदेशीयं मिथुनोदयमानमेतेषु न्यूनाधिक्यं कथं भवतीति प्रदर्श्यते ।



गो= गोलसन्धिः = मेषादिः । मे=मेषान्तबिन्दुः । वृ=वृषान्तबिन्दुः । मि=मिथुनान्त विन्दुः । गोमे=मेवृ =३०°, गोन=मेषोदयमानम् । नम=वृषोदयमानम् । मश=मिथुनोदयमानम् । ध्रु=ध्रुवः । ध्रुमि=परमाल्पद्युज्याचापम्=<ध्रुगोमि ध्रुमे=मेषान्त द्युज्याचापम् । ध्रुवृ=वृषान्त द्युज्याचापम् । <मेवृध्रु=वृषान्तजयष्ट्यंशाः=९०–वृषान्तजायनवलनम् । गोलसन्धावायनवलनं परमं जिनांशसमम् । अयनसन्धावर्थान्मिथुनान्ते आयनवलनम्=०, अत एतयोर्मध्ये वृषान्ते आयनवलनम्<२४ परमाल्पद्युज्याचापम्=९०—जिनांश=९०—२४=६६,

वृषान्ते यष्ट्यंशाः=९०—वृषान्तजायनवलनं=९०—जिनांशाल्पाऽऽयनवलनम् । अतो वृषान्ते यष्ट्यंशाः>परमाल्पद्युज्याचापम्, ध्रुगोमे चापीय त्रिभुजेऽनुपातः क्रियते ज्या<गोध्रुमे=$\frac{\text{परमाल्पद्युज्या} \times \text{ज्या } ३०}{\text{मेषान्तद्युज्या}}$=मेषोदयज्या=ज्यागोन

ध्रुमेवृ चापीय त्रिभुजेऽनुपातेन $\frac{\text{वृषान्तजयष्टि} \times \text{ज्या } ३०}{\text{मेषान्तद्युज्या}}$ =ज्या<मेध्रुवृ=ज्या

नम=वृषोदयज्या, परन्तु वृषान्तय>परमाल्पद्यु । अतः $\frac{\text{वृषान्तयष्टि} \times \text{ज्या } ३०}{\text{मेषान्तद्युज्या}}$

> $\frac{\text{परमाल्पद्युज्या} \times \text{ज्या } ३०}{\text{मेषान्तद्युज्या}}$ अर्थात् वृषोदयज्या>मेषोदयज्या वा मेषोदयमान

<वृषोदयमानं, एवमेव मिष्टध्रुचापीय त्रिभुजेऽनुपातेन $\frac{\text{वृषान्तयष्टि} \times \text{ज्या } ३०}{\text{परमाल्पद्युज्या}}$

=ज्या<मिध्रुवृ=ज्यामश = मिथुनोदयज्या, परन्तु वृषान्तयष्टि>परमाल्पद्यु तथा मेषान्तद्यु>परमाल्पद्यु अतः $\frac{\text{वृषान्तयष्टि} \times \text{ज्या } ३०}{\text{परमाल्पद्यु}}$

> $\frac{\text{वृषान्तयष्टि} \times \text{ज्या } ३०}{\text{मेषान्तद्यु}}$ अर्थात् मिथुनोदयज्या>वृषोदयज्या

∴ मिथुनोदयज्या<वृषोदयज्या<मेषोदयज्या वा मिथुनोदयमा<वृषोदयमान<मेषोदयमान ∴ सिद्धम् ।

एतदुपपत्तिर्वस्तुतो यथैव शिष्यधीवृद्धिदतन्त्रे लल्लाचार्येणोक्ता तथैव श्लोकान्तरेण श्रीपतिना भास्कराचार्येण चोक्ता स्वस्वग्रन्थे ।

यथा लल्लः—

लङ्कावृत्ते मध्यस्थिते भुवो यत्कुजं तदुद्वृत्तम् ।
तेन न तत्र चरदलं सदा समत्व च दिवसनिशोः ॥

तत्राक्षाभावेऽपि स्वस्वक्रान्त्या स्थितौ तिरश्चीनौ ।
ज्यायस्या मेषवृषौ यतोऽल्पकालोदयौ तेन ॥
मिथुनान्तोऽल्पक्रान्त्या पदान्तगत्वादृजुः स्थितो यस्मात् ।
तस्माच्चिरोदयोऽसावक्षवशाच्चान्यविषयेषु ॥
प्रागायतं कुलीरान्मकारादुदगायतं यतः षट्कम् ।
अक्ष भूमवशगत्वादधिकन्यूनोदयं तस्मात् ॥ इति

सिद्धान्तशेखरे श्रीपतिः—

यो द्वादशांशोऽपममण्डलस्य राशिः स ते द्वादश मेषपूर्वाः ।
तिर्यक्तया क्रान्तिवशान्निरक्षेऽप्युशन्ति कालेन समेन नैव ॥
निरक्षतायामपि हन्त यस्मात् तिर्यक् स्थितौ मेषवृषौ महत्या ।
क्रान्त्या भवेतामत एव चाल्पकालोदयौ तौ पुरि रावणस्य ॥
मिथुनोऽल्पतयाऽपमस्य तेषामृजुरास्ते नियतं पदान्तगत्वात् ।
अतएव चिरोदयोऽन्यदेशेष्वपि वा ऽक्षस्य वशेन तद्वदेवम् ॥
याम्यायतं कर्कटकाद् भषट्कं यतो मृगादेरुदगायतं हि ।
भवेत्ततस्तच्चिरतुच्छकालसमुद्गमि स्वाक्षवशभूमेण ॥ इति

सिद्धान्तशिरोमणेर्गोलाध्याये भास्कराचार्यश्च ।

"यो हि प्रदेशोऽपममण्डलस्य तिर्यक् स्थितो यात्युदयं तथाऽस्तम् ।
सोऽल्पेन कालेन य ऊर्ध्वसंस्थोऽनल्पेन सोऽस्मादुदया न तुल्याः ॥
य उद्गमे याम्यनता मृगाद्याः स्वस्वापमेनापि निरक्षदेशे ।
याम्याक्षतस्तेऽति नतत्वमाप्ता उद्यन्ति कालेन ततोऽल्पकेन ॥
कर्क्यादयः सौम्यनता हि येऽत्र ते यान्ति याम्याक्षवशादृजुत्वम् ।
कालेन तस्माद्बहुनोदयन्ते तदन्तरे स्वं चरखण्डमेव ॥" इति ५९-६०॥

अब राशियों का उदयमान बराबर क्यों नहीं होता है सो कहते हैं ।

हि. भा.—भचक्रमध्यप्रदेशरूप नाड़ीवृत्त एक असु में एक कला भ्रमण करता है अर्थात् नाड़ीवृत्त की एक कला एक असु में उदित होती है । क्रान्तिवृत्त का समान द्वादश भाग राशि कहलाता है । वे मेषादिराशि क्षितिज संलग्न होने से उदित होता है इसलिये क्रान्तिवश से लङ्का में वह उदय काल बराबर नहीं होता है एवं अपने देश में भी क्रान्तिवश से और अक्षांश वश से उन राशियों के उदय में न्यूनाधिक्य होता है इति ॥५९-६०॥

उपपत्ति ।

राश्यादि के ऊपर ध्रुवप्रोतवृत्त तथा राश्यन्त के ऊपर ध्रुवप्रोतवृत्त नाड़ीवृत्त में जहां

लगता है तदन्तर्गत नाड़ीवृत्तीय चाप उस राशि का निरक्षदेशीय उदयमान होता है। जैसे मेषादिगत ध्रुवप्रोत्तवृत्त में नाडीवृत्त मेषादि (गोलसन्धि) ही में लगता है वहां (मेषादि) से मेषान्तोपरिगत ध्रुव प्रोतवृत्त नाड़ीवृत्त के सम्पात पर्यन्त निरक्षदेशीय मेषोदयमान है। एवं मेषान्तो (वृषादि) परिगत ध्रुव प्रोतवृत्त तथा वृषान्तोपरिगत ध्रुव प्रोतवृत्त के अन्तर्गत नाड़ीवृत्तीय चाप निरक्ष देशीय वृषोदयमान है एवं वृषान्तो (मिथुनादि) परिगत ध्रुवप्रोतवृत्त तथा मिथुनान्तोपरिगत ध्रुवप्रोतवृत्त के अन्तर्गत नाड़ीवृत्तीय चाप निरक्ष देशीय मिथुनोदय मान हैं, इन उदयमानों में न्यूनाधिक्य क्यों होता है तदर्थ निम्नलिखित युक्ति है यहां संस्कृतोपपत्ति में लिखित (१) क्षेत्र को देखिये।

गो=गोलसन्धि=मेषादि, मे=मेषान्त बिन्दु। वृ=वृषान्तबिन्दु। मि=मिथुनान्त बिन्दु। गोमे=मेवृ=वृमि=३०° गोन=मेषोदयमान। नम=वृषोदयमान। मश=मिथुनोदयमान। ध्रु=ध्रुव। ध्रुमि=परमाल्पद्युज्याचाप ध्रुमे=मेषान्तद्युज्याचाप। ध्रुवृ=वृषान्त द्युज्याचाप। <ध्रुगोमि=परमाल्पद्युज्यांश, <मेवृध्रु=वृषान्तयष्ट्यंश=९०–वृषान्तायनवल। गोल सन्धि में आयनवलन परमं जिनांश (२४) के बराबर होता है अयन सन्धि (मिथुनान्त) में आयनवलनाभाव होता है अतः इन दोनों के बीच (वृषान्त) में आयनवलन <२४, परमाल्पद्युज्याचाप=९० – जिनांश=९०–२४=६६, वृषान्त में यष्ट्यंश=९० —वृषान्तायनवलन=९०—जिनांशाल्पायनवलन। अतः वृषान्त में यष्ट्यंश<परमाल्पद्युज्याचाप। ध्रुगोमे चापीय त्रिभुज में अनुपात करते है $\frac{\text{परमाल्पद्यु} \times \text{ज्या ३०}}{\text{मेषान्तद्यु}}$ = ज्या < गोध्रुमे = मेषोदयज्या = ज्यागोन। ध्रुमेवृ चापीय त्रिभुज में अनुपात से $\frac{\text{वृषान्तयष्टि} \times \text{ज्या ३०}}{\text{मेषान्तद्यु}}$ =ज्या<मेध्रुवृ=ज्यानम=वृषोदयज्या परन्तु वृषान्तयष्टि> परमाल्पद्यु ∴ $\frac{\text{वृषान्तय} \times \text{ज्या ३०}}{\text{मेषान्तद्यु}} > \frac{\text{परमाल्पद्यु} \times \text{ज्या ३०}}{\text{मेषान्तद्यु}}$ अर्थात् वृषोदयज्या> मेषोदयज्या वा मेषोदयमान<वृषोदयमान। इसी तरह मिवृध्रु चापीय त्रिभुज में अनुपात से $\frac{\text{वृषान्तयष्टि} \times \text{ज्या ३०}}{\text{परमाल्पद्यु}}$ =ज्या<मिध्रुवृ= ज्यामश= मिथुनोदयज्या। परन्तु वृषान्तयष्टि >परमाल्पद्यु, तथा मेषान्तद्यु>परमाल्पद्यु

अतः $\frac{\text{वृषान्तय} \times \text{ज्या ३०}}{\text{परमाल्पद्यु}} > \frac{\text{वृषान्तय} \times \text{ज्या ३०}}{\text{मेषान्तद्यु}}$ अर्थात् मिथुनोदयज्या>वृषोदयज्या, अतः मिथुनोदयज्या>वृषोदयज्या>मेषोदयज्या, वा मिथुनोदयमान>वृषोदयमान >मेषोदयमा। अतः आचार्योक्त उपपन्न हुआ। यह उपपत्ति यथार्थतः शिष्यधीवृद्धिदतन्त्र में जिस तरह लल्लाचार्य ने कहा है उसी तरह श्लोकान्तर से श्रीपति और भास्कराचार्य ने अपने ग्रन्थ में कहा है।

जैसे लल्लाचार्योक्त शिष्यवृद्धिदतन्त्र में

'लङ्कावृत्ते मध्यस्थिते भुवो यत्कुजं तदुद्वृत्तम्' इत्यादि संस्कृतोपपत्ति में श्लोकों को देखना चाहिये ।

सिद्धान्तशेखर में श्रीपति

'यो द्वादशांशोऽपममण्डलस्य राशिः स ते द्वादश मेष पूर्वाः' इत्यादि संस्कृतोपपत्ति में लिखित श्लोकों को देखना चाहिये ।

सिद्धान्तशिरोमणि गोलाध्याय में भास्कराचार्य

'यो हि प्रदेशोऽपममण्डलस्य तिर्यक् स्थितो यात्युदयं' इत्यादि संस्कृतोपपत्ति में देखना चाहिये ॥५९-६०॥

इदानीं चराग्रयोः संस्थानमाह ।

क्षितिजोन्मण्डलयोर्यत्स्वाहोरात्रान्तरं चरदलं तत् ।
क्षितिजेऽग्रा प्राच्यपरस्वाहोरात्रान्तरांशज्या ॥६१॥

सु. भा.—स्पष्टार्थम् । 'उन्मण्डलक्ष्मावलयान्तराले'—इत्यादि तथा 'क्ष्माजे द्युरात्रसमण्डलमध्यभाग'—इत्यादि भास्करोक्तमेतदनुरूपं विचिन्त्यम् ॥६१॥

वि. भा.—स्वक्षितिजवृत्तोन्मण्डलयोरन्तरेऽहोरात्रवृत्तीयं चापं चरखण्डकालः कथ्यते । क्षितिजाहोरात्रवृत्तयोः सम्पातात्पूर्वस्वस्तिकं यावत् क्षितिजवृत्तेऽग्रांशाः । एतज्ज्याऽग्रा कथ्यत इति । सिद्धान्तशिरोमणेर्गोलाध्याये 'उन्मण्डलक्ष्मावलयान्तराले द्युरात्रवृत्ते चरखण्डकाल' इत्यनेन भास्कराचार्येणाप्याचार्योक्तानुरूपमेव कथितम् । तथे' क्ष्माजे द्युरात्र सममण्डलमध्यभागजीवाऽग्रका भवति पूर्वपराशयोः सा' त्यनेनाचार्योक्तानुरूपमेवाग्रा स्वरूपं कथितमिति ॥६१॥

अब चर और अग्रा की स्थिति को कहते हैं ।

हि. भा.—स्वक्षितिजवृत्त और उन्मण्डल के अन्तर्गत अहोरात्र वृत्तीय चाप चरखण्ड काल कहलाता है । क्षितिजाहोरात्र वृत्त के सम्पात से पूर्वस्वस्तिकपर्यन्त क्षितिज वृत्तीय चाप अग्रांश है इसकी ज्या अग्रा कहलाती है । सिद्धान्तशिरोमणि गोलाध्याय में उन्मण्डल-क्ष्मावलयान्तराले' इत्यादि से भास्कराचार्य आचार्योक्त चर खण्डकाल के सदृश ही चरखण्ड काल कहा है । तथा 'क्ष्माजे द्युरात्र सममण्डल मध्यभाग' इत्यादि से आचार्योक्त अग्रा के अनुरूप ही अग्रा को भी कहा है इति ॥६१॥

इदानीं शङ्कुदृग्ज्ययोः संस्थानमाह ।

स्वाहोरात्रे क्षितिजाद्दिनगतशेषोच्चता रवेः शङ्कुः ।
तस्माद्दिनगतशेषं शङ्कुकुमध्यान्तरं दृग्ज्या ॥६२॥

सु. भा.—क्षितिजात् सकाशात् स्वाहोरात्रवृत्ते दिनगते वा पश्चिमकपाले दिनशेषे या रवेरुच्चता लम्बरूपा स शङ्कुर्भवति । तस्माच्छंकोश्च त्रिप्रश्नाधिकारविधिना दिनगतशेषं च भवति । शङ्कुकुमध्यान्तरं शङ्कुमूलस्य कुमध्यस्य भूगर्भस्य चान्तरं दृग्ज्येत्युच्यते । रविकेन्द्रात् क्षितिजोपरि लम्बः शङ्कुः । शङ्कुमूलं भूगर्भान्तरं च दृग्ज्या भवतीत्यर्थः ॥६२॥

वि. भा.—क्षितिजात् स्वाहोरात्रवृत्ते दिनगते वा पश्चिमकपाले दिनशेषे या रवेरुच्चता लम्बरूपा स शङ्कुर्भवति । तस्मात् (शङ्कोः) त्रिप्रश्नाधिकारोक्तविधिना दिनगतशेषं च भवति । शङ्कुमूलस्य भूगर्भस्य चान्तरं दृग्ज्येति कथ्यते । रविबिम्बकेन्द्रात् क्षितिजधरातलोपरि लम्बः शङ्कुः कथ्यते । सिद्धान्तशेखरे "पूर्वापरक्षितिजवृत्तत उन्नतांशज्याशङ्कुरत्र कथितः स्फुटमिष्टभायाम् । तस्याग्रतो दिनकरोऽम्बररत्नबिम्बमध्यावलम्बकमुत प्रवदन्ति शङ्कुम् ।" इत्यनेन श्रीपतिनापि भूगर्भभूपृष्ठयोरभेदस्वीकारात् सूर्यबिम्ब केन्द्रात् क्षितिजधरातलोपरि लम्बसूत्रं शङ्कुः कथ्यते । शिष्यधीवृद्धिदतन्त्रे लल्लः "पूर्वापरकुजवृत्तादुन्नतलवशिञ्जिनीष्टभाशङ्कुः । तस्याग्रे दिवसकरो नरोऽर्कबिम्बावलम्बो वा ।" भास्कराचार्यश्च "दृष्टिमण्डलभवा लवाः कुजादुन्नता गगनमध्यतो नताः । शङ्कुरुन्नतलवज्यका भवेद् दृग्गुणश्च नतभाग शिञ्जिनी ।" तथैव सदृशोत्तयैव शङ्कुं प्रतिपादयन्तीति ॥६२॥

अब शंङ्कु और दृग्ज्या की स्थिति को कहते हैं ।

हि. भा.—क्षितिजवृत्त से स्वाहोरात्रवृत्त जो दिनगत है उसमें वा पश्चिमकपाल में दिनशेष में रवि की जो उच्चता है वह शङ्कु है अर्थात् रवि बिम्बकेन्द्र से क्षितिज धरातल के ऊपर लम्ब रेखा शङ्कु है। उस शङ्कु से त्रिप्रश्नाधिकारोक्त विधि से दिनगत और दिनशेष होता है, शङ्कु मूल से भूगर्भपर्यन्त रेखा दृग्ज्या कहलाती है तथा रविबिम्ब केन्द्र से क्षितिज धरातल के ऊपर लम्ब रेखा शङ्कु है अर्थात् रविबिम्ब केन्द्र से खस्वस्तिक गतवृत्त दृग्वृत्त है, रवि केन्द्र से खस्वस्तिक पर्यन्त चाप नतांश चाप है इसकी ज्या दृग्ज्या है, तथा रविबिम्ब केन्द्र से दृग्वृत्त और क्षितिजवृत्त के सम्पात पर्यन्त दृग्वृत्तीय चाप उन्नतांश है, इसकी ज्या शङ्कु है । सिद्धान्तशेखर में श्रीपति, शिष्यधीवृद्धिदतन्त्र में लल्लाचार्य, गोलाध्याय में भास्कराचार्य सब एक ही तरह शङ्कु को कहते है इति ॥६२॥

इदानी प्रकारान्तरेण तयोः संस्थानं शङ्कुतलंचाह ।

दृग्मण्डले नतांशज्या दृग्ज्या शङ्कुरुन्नतांशज्या ।
अर्कोदयास्तसूत्राद्दिनशङ्कोर्दक्षिणेन तलम् ॥६३॥

सु. भा.—दिनशङ्कोर्दिवाशङ्कोस्तलं मूलमर्कोदयास्तसूत्राद्दक्षिणेन भवति ।

अर्कग्रहणमुपलक्षणार्थम् ।

शेषं स्पष्टार्थम् । 'दृष्टिमण्डलभवा लवाः कुजात्'—इत्यादिभास्करोक्तमेतदनुरूपं विचिन्त्यम् ।।६३।।

वि. भा.—दृग्वृत्ते यो हि नतांशस्तज्ज्या दृग्ज्या कथ्यते, उन्नतांशचापस्य ज्या शङ्कुः । दिवाशङ्कुमूलं रवेरुदयास्तसूत्राद्दक्षिणेन भवति । अत्रार्कग्रहणमुपलक्षणार्थम् । रव्युपरि दृग्वृत्ते निवेशिते दृग्वृत्तक्षितिजवृत्तयोः सम्पातद्वयगतं सूत्रं दृक्कुज सूत्रम् । रवि विम्बकेन्द्रादूर्ध्वाधर सूत्रोपरि लम्बरेखा दृग्ज्या । रविबिम्बकेन्द्रादेव दृक्कुज सूत्रोपरिलम्बरेखा शङ्कुः । शङ्कुमूलाद् भूकेन्द्रपर्यन्तं दृक्कुजसूत्रखण्डं तथा नतांशज्यामूलाद् भूकेन्द्रपर्यन्तमूर्ध्वाधरसूत्रखण्डं चेति भुजचतुष्टयैरेकं चतुर्भुजं जातम् । अत्र शङ्कूर्ध्वाधररेखयोः समानान्तरत्वात् नतांशज्या-दृक्कुजसूत्र खण्डं च समानान्तरमत इत्यायतं चतुर्भुजम् । तेन दृक्कुजसूत्रखण्डं दृग्ज्यासंज्ञकं रविबिम्बकेन्द्रादूर्ध्वाधरसूत्रोपरिलम्बेन नतांशज्या प्रमाणेन समानम् । तथैव शङ्कुरेखा नतांशज्यामूलाद् भूकेन्द्रपर्यन्तं-ऊर्ध्वाधर सूत्र खण्डेन समानेति । अत्र लल्लोक्तम्- "अम्बरमध्यांशुमतोर्मध्यांशज्या भवेन्नतज्या रवे । शङ्कोर्मूलाद्दिङ्मध्यगामिनी भूतले दृग्ज्या ।" इति "दृष्टिमण्डलभवा लवाः कुजादुन्नता गगनमध्यतो नताः" इत्यादि भास्करोक्तं च सदृशमेवेति ।।६३।।

अब प्रकारान्तर से उन दोनों (दृग्ज्या और शङ्कु) की संस्थिति और शङ्कुतल को कहते हैं ।

हि. भा.—दृग्वृत्त में जो नतांश चाप है उसकी ज्या दृग्ज्या कहलाती है । तथा उन्नतांश चाप की ज्या शङ्कु कहलाती है । दिवाशङ्कुमूल रवि के उदयास्त सूत्र से दक्षिण होता है । यहां रविग्रहण उपलक्षण के लिये है । रविबिम्ब केन्द्र के ऊपर दृग्वृत्त करने से दृग्वृत्त और क्षितिज वृत्त के दो स्थानों में जो योग है तद्गत् सूत्र दृक्कुज सूत्र है । रवि बिम्बकेन्द्र से ऊर्ध्वाधर सूत्र के ऊपर लम्बरेखा दृग्ज्या है रवि बिम्ब केन्द्र ही से दृक्कुज सूत्र के ऊपर लम्ब रेखा शङ्कु । शङ्कुमूल से भूकेन्द्रपर्यन्त दृक्कुज सूत्रखण्ड तथा नतांशज्या मूल से भूकेन्द्रपर्यन्त ऊर्ध्वाधर सूत्रखण्ड इन चारों भुजों से एक चतुर्भुज उपपन्न हुआ । यहां शङ्कु और ऊर्ध्वाधर सूत्र के समानान्तर होने के कारण नतांशज्या और दृक्कुज सूत्रखण्ड समानान्तर हुआ अतः यह आयत चतुर्भुज है । इसलिये दृक्कुज सूत्र खण्ड दृग्ज्या संज्ञक रवि बिम्ब केन्द्र से ऊर्ध्वावर सूत्र के ऊपर लम्बनतांशज्या के बराबर हुआ । उसी तरह शङ्कुसूत्र और नतांशज्यामूल से भूकेन्द्रपर्यन्त ऊर्ध्वाधर सूत्र खण्ड के बराबर हुआ । यहां "अम्बरमध्यांशुमतोः" इत्यादि लल्लोक्त तथा 'दृष्टिमण्डलभवा लवाः' इत्यादि भास्करोक्त समान ही है इति ।।६३।।

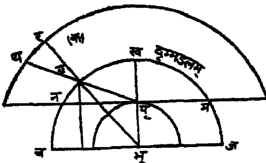
इदानीं दृग्गोलस्य दृश्यादृश्यत्वं लम्बनावनत्युत्पत्तौ कारणं चाह।

दृश्यादृश्यं दृग्गोलार्धं भूव्यासदलविहीनयुतम्।
द्रष्टा भूगोलोपरि यतस्ततो लम्बनावनती ॥६४॥

सु. भा.—दृग्गोलार्धं दृग्मण्डलार्धं भूव्यासदलेन विहीनं कुपृष्ठगानां दृश्यं खण्डं भूव्यासदलेन युतं चादृश्यखण्डं भवति। यतो द्रष्टा भूगोलोपरि भूपृष्ठे तिष्ठति ततस्तस्माल्लम्बनावनती भवतः। कुपृष्ठगानां कुदलेन हीनं'—इत्यादि तथा 'यतः क्वर्धोच्छ्रितो द्रष्टा'—इत्यादि भास्करोक्तमेतदनुरूपं विचिन्त्यम् ॥६४॥

वि. भा.—दृग्मण्डलार्धं भूव्यासार्धेन विहीनं तदा भूपृष्ठवासिनां दृश्यं खण्डं भवति। दृग्मण्डलार्धं भूव्यासार्धेन युतं तदाऽदृश्य खण्डं भवति। यतो द्रष्टा भूपृष्टोपरि तिष्ठति तस्मात् कारणाल्लम्बनावनती भवेताम्।

यथोपपत्तिः।



भू=भूकेन्द्रम्। पृ=भूपृष्ठ स्थानम्, चभूज=गर्भक्षितिज धरातलम्, नपृम = पृष्ठक्षितिजधरातलम्। भूपृ=भूव्यासार्धम्। ग्र=दृग्मण्डलेग्रहः। नखम= क्षितिजादुपरि दृग्मण्डलार्धम्=दृश्यखण्डम्। भूख=दृग्मण्डलव्यासार्धम्। दृग्मण्डलव्या $\frac{1}{2}$—भूपृ= दृग्मण्डलव्या $\frac{1}{2}$—भूव्या $\frac{1}{2}$=पृख, पृ (भूपृष्ठ) स्थितो द्रष्टा दृग्मण्डलार्ध (दृश्यखण्ड) स्थितं ग्र ग्रहं पश्यन्ति। क्षितिजाधो दृग्मण्डलार्धम्=अदृश्य खण्डम्। = दृग्मण्डलव्या $\frac{1}{2}$+भूव्या $\frac{1}{2}$। भू, पृ बिन्दुभ्यां (ग्र) ग्रहगते रेखे नीलाम्बरगोलीय दृग्मण्डले यत्र लग्ने तयोरन्तरं दृग्मण्डलीयचापं दृग्लम्बनं कथ्यते। यर= दृग्लम्बनम्। ग्रख=पृष्ठीयनतांशाः= $<$ग्र पृख, कोणज्या कोणोन भार्धांशज्ययोस्तुल्यत्वात् ज्या$<$ग्रपृख=ज्या (१८०—$<$ग्रपृख)=पृष्ठीयदृग्ज्या=ज्या$<$ग्रपृभू। भूग्र=ग्रहकर्णः। तदाऽनुपातेन $\frac{\text{पृदृग्ज्या.भूव्या } \frac{1}{2}}{\text{ग्रक.र्ण}}$ =ज्या$<$भूग्रपृ = दृग्लम्बनज्या, यतः$<$भूग्रपृ=$<$यग्र र नीलाम्बरगोलस्य केन्द्रं यत्र कुत्रापि कल्पयितुं शक्यते तेन ग्र बिन्दावपि तत्केन्द्रं भवितुमर्हति। अतः $<$यग्रर=यर चापम्। परं यरचापम्=दृग्लम्बनम्। अतः$<$भूग्रपृ कोणोऽपि दृग्लम्बनम्। नतिश्च दृग्लम्बनाधीना। लम्बननत्योरुत्पत्तेः कारणं भूपृष्ठबिन्दुरेव सिद्धान्तशेखरे दृग्मण्डलार्धं यदि होर्ध्ववर्त्तिग्रहं यतस्तत्परिणाहसंस्थम्। द्रष्टा प्रपश्यत्यवनीतलस्थो भ्रमत्यतः खेचरसंमुखं तत्।" लल्लश्च-दृग्मण्डलमुपरिष्टाद् दृष्टः स्यात्तद्वृत्तौ खचरः। श्रीपतेः प्रमाणम्। भास्कराचार्यः-कुपृष्ठगानां कुदलेन हीनं दृग्मण्डलार्धं खचरस्य दृश्यम्।

कुच्छन्नलिप्तानुरतो विशोध्याः स्वभुक्तितिथ्यंशमिताः प्रभार्थम् ।" इति विशेषमाहेति ॥६४॥

अब दृग्गोल के दृश्यत्व और अदृश्यत्व को तथा लम्बन और नति की उत्पत्ति के कारण को कहते है ।

हि. भा.—दृग्मण्डलार्ध में भूव्यासार्ध घटाने से भूपृष्ठस्थ लोगों का दृश्यखण्ड होता है । दृग्मण्डलार्ध में भूव्यासार्ध जोड़ने से अदृश्य खण्ड होता है । क्योंकि द्रष्टा भूपृष्ठ के ऊपर रहता है इसलिये लम्बन और नति होती है (अर्थात् लम्बन और नति की उत्पत्ति होती है) ।

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये । भू = भूकेन्द्र, पृ = भूपृष्ठस्थान चभूज = गर्भक्षितिजधरातल । नपृम = पृष्ठक्षितिजध, भूपृ = भूव्यासार्ध = भूव्या$\frac{१}{२}$, ग्र = दृग्मण्डले ग्रहः । नखम = क्षितिज से ऊपर दृग्मण्डलार्ध = दृश्यखण्ड । भूख = दृग्मण्डलव्यासार्ध । दृग्मण्डलव्या$\frac{१}{२}$ — भूव्या$\frac{१}{२}$ = पृख । पृ (भूपृष्ठ) स्थित द्रष्टा दृग्मण्डलार्ध (दृश्यखण्ड) स्थित (ग्र) ग्रह को देखता है । क्षितिज अधोभाग में दृग्मण्डलार्ध = अदृश्यखण्ड = दृग्मण्डलाव्या$\frac{१}{२}$ + भूव्या$\frac{१}{२}$ । भू और पृ बिन्दुओं से ग्र—ग्रहगत भूग्र, पृग्र रेखाद्वय को बढ़ाने से नीलाम्बर गोलीय दृग्मण्डल में जहां लगता है तदन्तर्गत दृग्मण्डलीय चाप दृग्लम्बन कहलाता है । यर = दृग्लम्बन ग्रख = पृष्ठीयनतांश = $<$ ग्रपृख, कोणज्या और कोणोन भार्धांशज्या बराबर होती है अतः ज्या $<$ ग्रपृख = ज्या (१८० — $<$ ग्रपृख) = पृष्ठीयदृग्ज्या = ज्या $<$ ग्रपृभू । भूग्र = ग्रहकर्ण । तब अनुपात से $\frac{\text{पृदृज्या. भूव्या}\frac{१}{२}}{\text{ग्रकर्ण}}$ = ज्या $<$ भूग्रपृ = दृग्लम्बनज्या । क्योंकि $<$ भूग्रपृ = $<$ यग्रर । नीलाम्बर गोल के केन्द्र जहां तहां मान सकते हैं, अतः ग्र बिन्दु में भी उसका केन्द्र हो सकता है, अतः $<$ यग्रर = यरचाप, लेकिन यरचाप = दृग्लम्बन ।

∴ $<$ भूग्रपृ = दृग्लम्बन । नति दृग्लम्बन के अधीन है । लम्बन और नति की उत्पति के कारण भूपृष्ठ बिन्दु ही है । सिद्धान्तशेखर में 'दृग्मण्डलार्धं यदिहोर्ध्ववर्त्ति' इत्यादि संस्कृतोपपत्ति में लिखित श्लोक से श्रीपति ने कहा है । भास्कराचार्य सिद्धान्तशिरोमणि में "कुपृष्ठगानां कुदलेन हीनं" इत्यादि विशेष कहते हैं इति ॥६४॥

इदानीं परमलम्बनावनती आह ।

क्षितिजे भूदललिप्ताः कक्षायां दृङ्नतिर्नभो मध्यात् ।
अवनतिलिप्ता याम्योत्तरा रविग्रहवदन्यत्र ॥६५॥

सु. भा.—नभोमध्यात् खस्वस्तिकात् कक्षायां ग्रहगोले दृग्मण्डले क्षितिजे

या भूदललिप्ताः कुच्छन्नलिप्ताः सा दृङ्नतिर्दृग्लम्बनं परममुच्यते । अवनतिलिप्ता तत्र दृग्मण्डले याम्योत्तरा लम्बरूपा भवति अन्यत्र ग्रहयोर्वा भग्रहयोर्युतावेवं दृग्लम्बननतिसंस्थानं विज्ञाय स्पष्टलम्बनादिकं रविग्रहवत् कार्यमिति । दिग्मात्रमिहाचार्येण प्रदर्शितं ग्रहयुत्यादौ च विशेषतः प्रतिपादितमिति ॥६५॥

वि. भा.—नभोमध्यात् (खस्वस्तिकात्) कक्षायां (ग्रहगोलीयदृग्मण्डले) क्षितिजे या भूदललिप्ताः (भूव्यासार्धकलाः-कुच्छन्नकला वा) सा दृङ्नतिः (परमं दृग्लम्बनं) कथ्यते, तत्र दृग्मण्डलेऽवनतिकला याम्योत्तरा (लम्बरूपा) भवति । अन्यत्र (ग्रहयुतौ-भग्रहयुतौ च) वं नतिदृग्लम्बनयोः संस्थानं ज्ञात्वा सूर्यग्रहणवत् स्पष्टलम्बनादिकं सर्वं कार्यमिति ॥६५॥

अत्रोपपत्तिः ।

पूर्वश्लोकोपपत्तौ प्रदर्शितं दृग्लम्बनज्या स्वरूपम् $= \frac{\text{पृदृग्ज्या. भूव्या } \frac{1}{2}}{\text{ग्रकर्ण}}$

एतत्स्वरूपा वलोकनेन स्फुटमवसोयते यत्पृष्ठीयदृग्ज्याया यत्र परमत्वं भवेत्तत्रैव दृग्लम्बनज्यायाः परमत्वं भवेद्यदि कर्णमानं स्थिरं भवेत् । पृष्ठक्षितिजदृग्मण्डलयोः सम्पातबिन्दौ स्थिते ग्रहे पृष्ठीयदृग्ज्या = त्रि, तदा तत्र परमा दृग्लम्बनज्या $= \frac{\text{त्रि. भूव्या} \frac{1}{2}}{\text{ग्रकर्ण}}$ अस्याश्चापं गर्भक्षितिजपृष्ठक्षितिजयोरन्तर्गतं दृग्मण्डलीयचापं कुच्छन्नकलामानम् = परम दृग्लम्बनम् । नतेः परमत्वं वित्रिभे ग्रहे भवति दृग्लम्बननत्योर्ज्ञानेन स्पष्टलम्बनज्ञानं भवेत्तद्वशतो ग्रहयुत्यादेर्ज्ञानं भवतीति ग्रहयुत्यधिकारावलोकनेन स्फुटं भवतीति ॥६५॥

अब परमलम्बन और नति को कहते हैं ।

हि. भा.—खस्वस्तिक से ग्रहगोलीय दृग्मण्डल और पृष्ठक्षितिज के योग बिन्दु में जो भूव्यासार्धकला (कुच्छन्नकला) होती है वह परम दृग्लम्बन कला है । उस दृग्मण्डल में नतिकला याम्योत्तर (लम्बरूप) होती है । अन्यत्र (ग्रहयुति–भग्रहयुति में) इस तरह नति और दृग्लम्बन की संस्थिति जानकर सूर्यग्रहणवत् स्पष्टलम्बनादिक सब कुछ साधन करना चाहिये । यहां आचार्य ने केवल संकेत मात्र दिखलाया हैं, ग्रहयुत्यादि में विशेषरूप से कहते हैं इति ॥६१॥

उपपत्ति ।

पूर्वश्लोक की उपपत्ति में दृग्लम्बनज्या का स्वरूप $= \frac{\text{पृदृज्या.भूव्या } \frac{1}{2}}{\text{ग्रहकर्ण}}$ इसको देखने से मालूम होता है कि यदि ग्रहकर्ण को स्थिर माना जाय तब पृष्ठीय दृग्ज्या का परमत्व

जहां होगा वहीं दृग्लम्बन का भी परमत्व होगा। परन्तु ज्या परम त्रिज्या के बराबर होती है, पृष्ठीय दृग्ज्या त्रिज्या के बराबर पृष्ठक्षितिज और दृग्मण्डल के सम्पात बिन्दु में ग्रह के रहने से होती हैं अतः वहीं (पृष्ठक्षितिज दृग्मण्डल के सम्पात बिन्दु) पर परम दृग्लम्बन (गर्भक्षितिजधरातल और पृष्ठक्षितिज धरातज के अन्तर्गत दृग्मण्डलीय चाप (कुच्छन्नकला) होता है। नति का परमत्व वित्रिभ स्थान में ग्रह के रहने से होता है। दृग्लम्बन और नति के ज्ञान से स्पष्ट लम्बन ज्ञान होता है उसके वश से ग्रह युत्यादि ज्ञान होता है यह ग्रहयुत्यधिकार देखने से स्पष्ट है इति ॥६५॥

इदानीं दृक्कर्माह।

सत्रिगृहक्रान्तिरुदग्दक्षिणयोस्त्रिज्यया हृतं वलनम्।
विक्षेपगुणमृणधनं ग्रहेऽन्यदृक्कर्मचरदलवत् ॥६६॥

सु. भा.—उदग्दक्षिणयोरुत्तरदक्षिणानयनयोः सत्रिग्रहक्रान्तिः सत्रिभग्रहक्रान्तिज्या वलनमायनं वलनं भवति। तद्विक्षेपेण गुणं त्रिज्यया हृतं ग्रहे ऋणं वा धनमायनं दृक्कर्म भवति। अन्यद्दृक्कर्माक्षजं दृक्कर्म चरदलवत् चरसाधनवज्ज्ञेयम्।

अत्रोपपत्त्यर्थमुदयास्ताधिकारे ३–४ श्लोकयोरुपपत्तिर्विलोक्या। अत्रैव चतुर्वेदाचार्येण 'सत्रिग्रहोत्क्रमज्यया क्रान्तिः साध्ये' त्यन्यथा व्याख्यातमत एव भास्करः 'ब्रह्मगुप्तकृतिरत्र सुन्दरी सान्यथा तदनुगैर्विचार्यते'—इत्याद्युक्तवान् ॥६६॥

वि. भा.—उत्तरदक्षिणायनयोः सत्रिभग्रहक्रान्तिज्याऽऽयनं वलनं भवति। तन्मध्यमशरेण गुणं त्रिज्यया भक्तं फलमृणं वा धनमायनं दृक्कर्म भवति। अन्यदृक्कर्म (अक्षजं दृक्कर्म) चरदलवत् (चरसाधनवत्) बोध्यम् ॥६६॥

अत्रोपपत्तिः।

ग्रहबिम्बकेन्द्रोपरिगतं कदम्बप्रोतवृत्तं क्रान्तिवृत्ते यत्र लगति तदेव ग्रहस्थानम्। स्थानोपरि ध्रुवप्रोतवृत्तं कार्यं बिम्बकेन्द्रोपर्यहोरात्रवृत्तं कार्यं तदा बिम्बकेन्द्रात्स्थानावधि मध्यमशर एको भुजः। बिम्बकेन्द्रात्स्थानोपरि ध्रुवप्रोतवृत्तोपरिलम्बो द्वितीयो भुजः। स्थानोपरि ध्रुवप्रोतवृत्ते तृतीयो भुजः। त्रिभुजेऽस्मिन् स्थानगतकदम्बप्रोतवृत्तध्रुवप्रोतवृत्तयोरुत्पन्नः कोण आयनवलनम्। लम्बवृत्तस्थानगतध्रुवप्रोतवृत्तयोरुत्पन्नः कोणः=९०। तेनानुपातेन

$$\frac{\text{मध्यशरज्या} \times \text{आयनवलनज्या}}{\text{त्रि}} = \text{लम्बवृत्तीयचापज्या} = \text{बिम्बीयाहोरात्रवृत्तीय-}$$

चापज्या परन्तु सत्रिभग्रहक्रांज्या = द्युज्याग्रीयायनवज्या।

$$\frac{\text{मध्यशज्या.सत्रिभक्रांज्या}}{\text{त्रि}} = \frac{\text{मध्यशर. सत्रिभग्रक्रांज्या}}{\text{त्रि}} = \text{बिम्बीयाहोरा-}$$

त्रवृचापज्या=बिम्बीयाहोरात्रवृत्तीयचापासवः, इति स्वल्पान्तरात् कलात्वेन स्वीकृता आचार्येण, एतस्य कलात्वेन ग्रहे संस्कारो नोचित इति मत्वापि स्वल्पान्तरमवगत्याऽऽचार्येण लल्लेन च तदेव फलं ग्रहे संस्कृतम् । भास्कराचार्येण

$\frac{\text{मध्यश. सत्रिभग्रक्रांज्या}}{\text{त्रि}}$ तन्त्रिज्याग्रे परिणतं कृतं यथा

$$\frac{\text{मध्यश. सत्रिभग्रक्रांज्या} \times \text{त्रि}}{\text{त्रि} \times \text{बिम्बीयद्यु}} = \text{नाडीवृत्तीयायन दृक्कर्मासवः}$$

$$= \frac{\text{मध्यश. सत्रिभग्रक्रांज्या}}{\text{बिम्बीयद्यु}} = \frac{\text{मध्यश. सत्रिभग्रक्रांज्या}}{\text{द्यु.}}, \quad \text{स्वल्पान्तरात्}$$

बिम्बीय द्यु=स्थानीयद्यु । स्थानीयद्यु=द्यु । तत एतस्य फलस्य ग्रहसंस्कारयोग्यत्वं 'यदि निरक्षोदयासुभी राशिकला १८०० लभ्यन्ते तदैभिरसुभिः किमिति' जाता

आयन दृक्कर्मकलाः= $\frac{\text{मशर. सत्रिभक्रांज्या} \times १८००}{\text{द्यु. निरक्षोदयासु}}$ कृतम् । यद्यपि भास्कराचार्येण साधितमायनदृक्कर्मकला प्रमाणं समीचीनं नास्ति, किन्तु आचार्योक्तापेक्षया किञ्चित् समीचीनमस्ति । भास्कराचार्येण आयनवलनज्यास्थाने सत्रिभग्रहक्रांन्तिज्या न स्वीकृता तदा तदुक्ताऽऽयनदृक्कर्मकला= $\frac{\text{मशर. आयनवलन } १८००}{\text{द्यु. निरक्षोदयासु}}$ एतेन

"आयनं वलनमस्फुटेषुणा सङ्गुणं द्युगुणा भाजितं हृतम् । पूर्णपूर्णधृतिभिर्ग्रहाश्रित व्यक्षभोदयहृदायनाः कलाः ।" भास्करोक्तमिदमुपपद्यते । सिद्धान्तशेखरे "विक्षेप सत्रिभखगोत्क्रमजाऽपमज्याघाते गृहत्रयगुणेन हृते कलास्ताः । शोध्यास्तयोः समदिशोः खचरेषु देया भिन्नांशयोर्भवति दृग्विधिरेष पूर्वः ।" श्रीपतिनैवं कथ्यते । लल्लाचार्येण सत्रिभग्रहक्रान्तिज्या स्थाने सत्रिभग्रहक्रान्त्युत्क्रमज्या स्वीकृता, श्रीपतिरपि बहुधाऽऽचार्य (ब्रह्मगुप्त) मतानुसरणं कुर्वन्नपि कुत्रचित् स्थले लल्लोक्तमपि मतान्तरं स्वीचकार, तदत्रापि लल्लोक्तवत् सत्रिभग्रहक्रान्तिज्यास्थाने तदुत्क्रमज्यां स्वीकृतवान् । क्रान्तेर्वलनस्य च यद्येकैव दिक् यथा क्रान्तिः शरश्च यद्युत्तरदिक्कौ दक्षिणदिक्कौ वा भवतस्तदा शरेणोन्नामितो यावत् क्षितिजे नीयते तावत् क्रान्तिवृत्तग्रहस्थानात् पृष्ठतः क्रान्तिवृत्तं क्षितिजे लगति तत्तत्र फलमृणम् । भिन्नदिक्कयोर्वलनशरयोश्चैतद्विपरीतमतस्तत्र धनमिति ॥६६॥

अब दृक्कर्म को कहते हैं ।

हि॰ भा.—उत्तरायण और दक्षिणायन में सत्रिभग्रह क्रान्तिज्या आयनवलन होती है । उसको मध्यमशर से गुणाकर त्रिज्या से भाग देने से फल ऋण वा धन आयनदृक्कर्म होता है । अन्य दृक्कर्म (आक्षदृक्कर्म) चरखण्ड साधन की तरह समझना चाहिये इति ॥६६॥

उपपत्ति ।

ग्रहबिम्बकेन्द्रोपरिगत कदम्बप्रोतवृत्त क्रान्तिवृत्त में जहां लगता है वह ग्रह स्थान है । स्थानोपरिगत ध्रुवप्रोतवृत्त कर देना । बिम्ब केन्द्र के ऊपर अहोरात्र वृत्त कर देना तब बिम्बकेन्द्र से स्थानपर्यन्त मध्यमशर एक भुज बिम्बकेन्द्र से स्थानोपरिगत ध्रुवप्रोतवृत्त के ऊपर लम्बवृत्त करने से लम्बवृत्तीय चाप द्वितीय भुज । लम्बन से स्थान पर्यन्त तृतीय भुज इन तीनों भुजों से उत्पन्न त्रिभुज में स्थानगत कदम्बप्रोतवृत्त और ध्रुवप्रोतवृत्त से उत्पन्न कोण आयनवलन है । स्थानगतध्रुवप्रोतवृत्त और लम्बवृत्त से उत्पन्न कोण = ९०, तब अनुपात से $\frac{\text{मध्यमशरज्या. आयनवलनज्या}}{\text{त्रि}} = \frac{\text{मध्यमशर. सत्रिभग्रहक्रान्ति}}{\text{त्रि}}$ = लम्बवृत्तीयचापज्या = बिम्बीयाहोरात्रवृत्तीय चापज्या = बिम्बीयाहोरात्रवृत्तीयचापासु = बिम्बीयाहोरात्रवृत्तीय चापकला स्वल्पान्तर से आचार्य स्वीकार करते हैं । इसकी कलात्व से ग्रह में संस्कार करना उचित नहीं है इस बात को मान करके भी स्वल्पान्तर समझ कर आचार्य और लल्लाचार्य उसी फल का ग्रह में संस्कार किया है । भास्कराचार्य $\frac{\text{मध्यमशर.आयनवलन}}{\text{त्रि}}$ इसको त्रिज्याग्र में परिणत किया है जैसे $\frac{\text{मध्यशर. आयनवलन. त्रि}}{\text{त्रि. बिम्बीयद्यु}}$ = नाड़ीवृत्तीयायनदृक्कर्मासु = $\frac{\text{मध्यमशर. आयनवलन}}{\text{बिम्बीयद्यु}}$, यहां स्वल्पान्तर से बिम्बीयद्यु = स्थानीयद्यु = द्यु इस फल को ग्रह संस्कार योग्यत्व 'यदि गृहाश्रित राशि के निरक्षोदयासु में राशिकला १८०० पाते हैं तो इन असुओं में क्या इससे आयनदृक्कर्म कला आती है उसका स्वरूप $= \frac{\text{मध्यशर. आयनवलन} \times १८००}{\text{द्यु, निरक्षोदयासु}}$, किया है इससे भास्करोक्त 'आयनं वलनमस्फुटेषुणा सङ्गुणं' इत्यादि संस्कृतोपपत्ति में लिखित पद्य उपपन्न होता है । सिद्धान्तशेखर में 'विक्षेप सत्रिभ खगोत्क्रमज्याऽपमज्या' इत्यादि से श्रीपति प्रकार आचार्योक्त प्रकार से भिन्न है । लल्लाचार्य ने सत्रिभग्रह क्रान्तिज्या स्थान में उसकी उत्क्रमज्या ली है श्रीपति ने भी लल्लोक्तवत् सत्रिभग्रह क्रान्तिज्या स्थान में उसकी उत्क्रमज्या को स्वीकार किया है । बहुत स्थानों में आचार्यमत को अनुसरण करते हुए कहीं कहीं लल्लोक्त को भी श्रीपति ने स्वीकार किया है यहां भी लल्लोक्तवत् सत्रिभग्रहक्रान्तिज्यास्थान उसकी उत्क्रमज्या को स्वीकार किया है । यदि क्रान्ति और वलन की एक दिशा हो यथा क्रान्ति और शर यदि उत्तर दिशा का है वा दक्षिण दिशा का तब शर से उन्नामित ग्रह जब क्षितिज में आते हैं तावत् क्रान्तिवृत्त ग्रह स्थान से पृष्ठ ही क्रान्तिवृत्त क्षितिज में लगता है वहां फल ऋण होता है । शर और वलन की दिशा भिन्न रहने से विपरीत होता है अतः वहां फल धन होता है इति ।।६६।।

इदानीं ग्रहर्क्षगोलयोः स्थिरवृत्तान्याह ।

कक्षा मण्डलतुल्यं प्राच्यपरं दक्षिणोत्तरं क्षितिजम् ।
उन्मण्डलविषुवन्मण्डले स्थिराणि ग्रहर्क्षाणाम् ॥६७॥

सु. भा.—पूर्वापरम् । दक्षिणोत्तरम् । क्षितिजम् । उन्मण्डलम् । विषुवन्मण्डलम् । सर्वं कक्षामण्डलतुल्यं समानं महद्वृत्तं च ज्ञेयम् । ग्रहर्क्षाणां गोलयोरेतानि स्थिराणि वृत्तानि सन्तीति ॥६७॥

वि. भा.—प्राच्यपरं (पूर्वापरम्), दक्षिणोत्तरं (याम्योत्तरम्), क्षितिजम्, उन्मण्डलम्, विषुवन्मण्डलम् (नाड़ीवृत्तम्) सर्वं कक्षामण्डल (क्रान्तिवृत्त) तुल्यं महद्वृत्तं चेति, ग्रहाणां—नक्षत्राणां चैतानि पञ्चवृत्तानि स्थिराणि कथितानि ॥६७॥

अब ग्रहगोल और नक्षत्र गोल में स्थिर वृत्तों को कहते हैं।

हि. भा.—पूर्वापरवृत्त, याम्योत्तरवृत्त, क्षितिजवृत्त, उन्मण्डल, नाड़ीवृत्त ये सब (पांच) वृत्त कक्षावृत्त (क्रान्तिवृत्त के बराबर महद्वृत्त हैं) ग्रहों के और नक्षत्रों के ये पांच स्थिरवृत्त कथित हैं इति ॥६७॥

इदानीं ग्रहाणां चलवृत्तान्याह ।

मन्दोच्चानां सप्तोच्चनीचवृत्तानि पञ्चशीघ्राणाम् ।
प्रतिमण्डलानि चैवं प्रत्येकं भास्करादीनाम् ॥६८॥

दृग्मण्डलविक्षेपापममण्डलानि क्षपाकरादीनाम् ।
षट्कं विमण्डलानां चलवृत्तान्येकपञ्चाशत् ॥६९॥

सु. भा.—मन्दनीचोच्चवृत्तानि =७
भौमादीनां शीघ्रनीचोच्चवृत्तानि=५
मन्दप्रतिवृत्तानि =७
शीघ्रप्रतिवृत्तानि =५
दृग्मण्डलं दृक्क्षेपमण्डलं कक्षामण्डलं
चेति सप्तानां ग्रहाणाम् =२१
चन्द्रादीनां षड्विमण्डलानि =६
५१

एवं चलवृत्तान्येकपञ्चाशत् सन्तीति ॥६८-६९॥

वि. भा.—रव्यादिग्रहाणां मन्दोच्चनीचवृत्तानि = ७, भौमादिपञ्चकानामेव ग्रहाणां शीघ्रोच्चत्वात् शीघ्रनीचोच्चवृत्तानि पञ्च=५, ग्रहाणां मन्दप्रति-

वृत्तानि=७, शीघ्रप्रतिवृत्तानि=५, दृग्वृत्तं, दृक्क्षेपवृत्तं कक्षावृत्तं चेति रव्यादि-ग्रहाणामेकविंशतिः=२१, रविं विनैव चन्द्रादिग्रहाणां विमण्डलानि=६, सर्वेषां योग एकपञ्चाशत् ५१ संख्यकानि चलवृत्तानि सन्तीति। सिद्धान्तशेखरे "मन्दोच्च-नीचवलयानि भवन्ति सप्त शैघ्र्याणि पञ्च च तथा प्रतिमण्डलानि। दृक्क्षेप दृष्टच-पमजानि च खेचराणामर्कं विनैव खलु षट् च विमण्डलानि। पञ्चादशैकसहितानि च मण्डलानि पूर्वापरं वलयमुत्तरदक्षिणं च। क्ष्माजं तथा विषुवदुद्वलयाभिधाने पञ्चस्थिराणि कथितान्युडु खेचराणाम्।" इत्यनेन श्रीपतिनाऽऽचार्योक्तानुरूपमेव कथितम् ॥६९॥

अब ग्रहों के चलवृत्तों को कहते हैं।

हि. भा.—रव्यादि ग्रहों के मन्दोच्चनीच वृत्त सात ७ हैं, भौमादि पांच ग्रहों के शीघ्रनीचोच्चवृत्त=५, रव्यादि ग्रहों के मन्दप्रतिवृत्त=७, भौमादिग्रहों के शीघ्रप्रतिवृत्त=५, दृग्वृत्त, दृक्षेपवृत्त, और कक्षावृत्त ये सात ग्रहों के=२१, चन्द्रादिग्रहों के विमण्डल=६, सबों के योग=५१, एतत् संख्यक चलवृत्त है सिद्धान्तशेखर में 'मन्दोच्च नीचवलयानि भवन्ति सप्त' इत्यादि विज्ञान भाष्य में लिखित श्लोकों से श्रीपति ने आचार्योक्त के अनुरूप ही कहा है इति ॥६८-६९॥

इदानीमध्यायोपसंहारमाह।

यत् स्पष्टीकरणाद्यं गोलादुत्प्रेक्ष्य तत् कृतं सर्वम्।
गोलाध्यायः सप्तत्यार्याणामेकविंशोऽयम् ॥७०॥

सु. भा.—इह मया यत्स्पष्टीकरणाद्यं सर्वं कृतं तद्गोलादुत्प्रेक्ष्यावगम्य कृतमतः सर्वं सयुक्तिकं ज्ञेयमिति। शेषं स्पष्टार्थम्।

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते।
हृदि तं विनिधाय नूतनोऽयं रचितो गोलविधौ सुधाकरेण।

इति श्रीकृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्तनूतनतिलके गोलाध्यायो नामैकविंशोऽध्यायः ॥२१॥

वि. भा.—मया स्पष्टीकरणाद्यं यत् सर्वं कृतं तद्गोलादवगम्य कृतम्। अयमार्याणां सप्तत्यैकविंशो गोलाध्यायोऽस्तीति ॥७०॥

इति ब्राह्मस्फुटसिद्धान्ते गोलाध्यायो नामैकविंशतितमोऽध्यायः ॥२१॥

अब अध्याय के उपसंहार को कहते हैं।

हि. भा.—स्पष्टीकरण आदि जो कुछ हमने किया है वह सब गोल से समझ कर किया है, इसलिये इन सबों को युक्ति युक्त समझना चाहिये। सत्तर आर्याओं का यह इक्कीसवां गोलाध्याय है इति ॥७०॥

इति ब्राह्मस्फुटसिद्धांत में गोलाध्याय नामक इक्कीसवां अध्याय समाप्त।

ब्राह्मस्फुटसिद्धान्तः

यन्त्राध्यायः

ब्राह्मस्फुटसिद्धान्तः

७

अथ यन्त्राध्यायः प्रारभ्यते ।

तत्र प्रथमं गोल प्रशंसामाह ।

मध्याद्यमिह यदुक्तं तत् प्रत्यक्षमिव दर्शयति यस्मात् ।
तस्मादाचार्यत्वं गोलविदो भवति नान्यस्य ॥ १ ॥

सु. भा.—यस्मादिह सिद्धान्ते यन्मध्याद्यं गणितमुक्तमस्ति तत् सर्वं गोल-वित् प्रत्यक्षमिव दर्शयति तस्माद्गोलविद एवाचार्यत्वं भवति नान्यस्येति ॥१॥

वि. भा.—यस्मात् कारणादिह सिद्धान्तग्रन्थे ग्रहाणां मध्याद्यं गणितं यदुक्त (कथित) मस्ति तत्सर्वं गोलवित् प्रत्यक्षमिव दर्शयति, तस्मात्कारणाद् गोलविद आचार्यत्वं भवति, अन्यस्य नेति ॥ १ ॥

अब यन्त्राध्याय प्रारम्भ किया जाता है ।

उसमें पहले गोल प्रशंसा कहते हैं ।

हि. भा.—जिस कारण से इस सिद्धान्त ग्रन्थ में ग्रहों के मध्यादि गणित जो कथित है उन सबों को गोलवेता (गोल को जानने वाले) प्रत्यक्ष के तरह दिखलाते हैं, इस कारण से गोलवेत्ता ही को आचार्यत्व होता है, अन्य किसी को आचार्यत्व नहीं होता है अर्थात् गोल को जानने वाले ही आचार्य होते हैं दूसरे नहीं ॥ १ ॥

इदानीं स्वगोलग्रथने कारणं कथयति ।

आचार्येर्न ज्ञातः श्रीषेणार्यभटविष्णुचन्द्राद्यैः ।
गोलो यस्मात् तस्मात् ब्राह्मो गोलः कृतः स्पष्टः ॥ २ ॥

सु० भा०—यस्मात् श्रीषेणार्यभटविष्णुचन्द्राद्यैर्गोलो न ज्ञातस्तस्मान्मयाऽयं ब्राह्मो गोलः स्पष्ट कृत इति ॥ २ ॥

वि. भा.—यस्माद्धेतोः श्रीषेणार्यभटविष्णुचन्द्राद्यैराचार्यैर्गोलो न ज्ञातस्तस्मान्मयाऽयं ब्राह्मो गोलः स्पष्टः कृत इति ॥ २ ॥

अब अपनी गोल रचना के कारण कहते हैं ।

हि. भा.—क्योंकि श्रीषेण-आर्यभट-विष्णु-चन्द्र आदि आचार्य गोल को नहीं समझे इसलिये हमने इस ब्राह्म गोल को स्पष्ट किया है इति ॥ २ ॥

इदानीं गणित गोलयोः प्रशंसामाह ।

गणितज्ञो गोलज्ञो गोलज्ञो ग्रहगतिं विजानाति ।
यो गणितगोलबाह्यो जानाति ग्रहगतिं स कथम् ॥ ३ ॥

सु. भा.—यो गणितज्ञः स गोलज्ञो भवति (गोलस्य गणितक्षेत्रान्तर्गतत्वात्)। यो गोलज्ञः स एव ग्रहगतिं विशेषेण जानाति । तस्माद्यो गणितगोलबाह्योऽस्ति स कथं ग्रहगतिं जानाति । न जानातीत्यर्थः ॥ ३ ॥

वि. भा.—यो गणितज्ञः स गोलज्ञो भवति (गोलस्य गणितान्तर्गतत्वात्), यो गोलज्ञः स ग्रहगतिं विजानाति । सिद्धान्तशिरोमणेर्गोलाध्याये "दृष्टान्त एवावनिभग्रहाणां संस्थानमानं प्रतिपादनार्थम् । गोलः स्मृतः क्षेत्रविशेष एषः प्राज्ञैरतः स्याद् गणितेन गम्यः ॥" भास्कराचार्येणाप्येवमेव कथ्यते । यो गणितगोलबाह्योऽर्थाद् गणितं गोलं च न जानाति स ग्रहगतिं कथं जानाति । कथमपि न जानातीति ॥ ३ ॥

अब गणित और गोल की प्रशंसा करते हैं ।

हि. भा.—जो गणित जानते हैं वे गोल को भी जानते हैं क्योंकि गोल-गणितक्षेत्र परिधि के अन्तर्गत है; जो गोल जानते हैं वे ग्रहगति को जानते हैं; सिद्धान्त-शिरोमणि के गोलाध्याय में 'दृष्टान्त एवावनिभग्रहाणां'' इत्यादि विज्ञान भाष्य में लिखित श्लोक से भास्कराचार्य ने भी आचार्योक्त के अनुरूप ही कहा है, जो गणित और गोल नहीं जानते हैं वे ग्रहगति को कैसे जानेंगे अर्थात् किसी तरह भी नहीं जान सकते हैं इति ॥ ३ ॥

इदानीं यन्त्राध्यायारम्भप्रयोजनमाह ।

गोलस्य परिच्छेदः कर्तुं यन्त्रैर्विना यतोऽशक्यः ।
संक्षिप्तं स्पष्टार्थं यन्त्राध्यायं ततो वक्ष्ये ॥ ४ ॥

सु. भा.—यतो यन्त्रैर्विना गोलस्य परिच्छेदः सम्यग्विचारः कर्तुं गणकोऽ-

शक्यो भवति ततो गोलस्य स्पष्टार्थं संक्षिप्तं यन्त्राध्यायमहं वक्ष्य इत्याचार्योक्तिः ॥ ४ ॥

वि. भा.—यतो यन्त्रैर्विना ज्यौतिषिको गोलस्य परिच्छेदः (यथार्थरूपेण विचारः) कर्त्तुमसमर्थो भवति, तस्माद्धेतोर्गोलस्य स्पष्टार्थं संक्षिप्तं यन्त्राध्यायमहं वक्ष्ये ॥ सिद्धान्तशेखरे "शक्यः परिच्छेदविधिर्विधातुं यन्त्रैर्विना नो समयस्य तज्ज्ञैः । तेषां स्वयंवाहक पूर्वकाणामतः प्रवक्ष्ये खलु लक्षणानि ॥" श्रीपतिनैवं यन्त्राध्यायारम्भप्रयोजनं कथ्यते । सिद्धान्त शिरोमणेर्गोलाध्याये भास्कराचार्योऽपि श्रीपत्युक्तसदृशमेव कथयति—

"दिनगतकालावयवा ज्ञातुमशक्या यतो विना यन्त्रैः ।
वक्ष्ये यन्त्राणि ततः स्फुटानि संक्षेपतः कतिचित् ॥"
सर्वस्मिन् ज्यौतिषसिद्धान्तग्रन्थे यन्त्राध्यायो भवत्येवेति ॥ ४ ॥

अब यन्त्राध्याय आरम्भ करने के कारण कहते हैं ।

हि. भा.—यन्त्रों के बिना ज्यौतिषिक लोग गोल का विचार अच्छी तरह करने में असमर्थ होते हैं । इसलिए गोल की स्पष्टता के लिए संक्षेरूप से यन्त्राध्याय को मैं कहता हूं । सिद्धान्त शेखर में "शक्यः परिच्छेदविधिर्विधातु यन्त्रैर्विना नो समयस्य तज्ज्ञैः" इत्यादि विज्ञानभाष्य में लिखित श्लोकोक्त अनुसार यन्त्राध्याय आरम्भ करने के कारण कहते हैं । सिद्धान्त शिरोमणि के गोलाध्याय में भास्कराचार्य भी श्रीपत्युक्त के सदृश ही कहते हैं । 'दिनगत कालावयवा ज्ञातुमशक्या यतो विना यन्त्रैः' इत्यादि । सब ज्यौतिष सिद्धान्त ग्रन्थों में यन्त्राध्याय होता ही है इति ॥ ४ ॥

इदानीं तन्त्राणि यन्त्रोपकरणानि चाह ।

**सप्तदश कालयन्त्राण्यतो धनुस्तुर्यंगोलकं चक्रम् ।
यष्टिः शङ्कुर्घटिका कपालकं कर्त्तरी पीठम् ॥५॥
सलिलं भ्रमोऽवलम्बः कर्णश्छाया दिनार्धमर्कोऽक्षः ।
नतकालज्ञानार्थं तेषां संसाधानान्यष्टौ ॥६॥**

सु. भा.—यतो धनुर्यन्त्रम् । तुर्यगोलं तुरीयम् । चक्रयन्त्रम् । यष्टिः । शङ्कुः । घटिका घटीयन्त्रम् । कपालयन्त्रम् । कर्त्तरी । पीठसंज्ञं यन्त्रम् । सलिलं जलम् । भ्रमः शाणः । अवलम्बोऽवलम्बसूत्रम् । कर्णश्छायाकर्णः । छाया शङ्कुच्छाया । दिनार्धं दिनार्धमानम् । अर्कः सूर्यः । अक्षः पलांशाः । अतो नतकालज्ञानार्थं सप्तदश कालयन्त्राणि सन्ति । तेषां यन्त्राणां मध्ये सलिलादीन्यष्टौ यन्त्रसंसाधनानि यन्त्ररचनामूलभूतानि सन्ति ॥५-६॥

वि. भा.—यतोधनुर्यन्त्रम्, तुर्यगोलकं (तुरीययन्त्रम्), चक्रं (चक्रयन्त्रम्), यष्टिः, शङ्कुः, घटिका (घटीयन्त्रम्), कपालकं (कपालयन्त्रम्), कर्त्तरी यन्त्रम्। पीठ संज्ञकं यन्त्रम्। सलिलं (जलम्), भ्रमः (शाणः), अवलम्बः (अवलम्बसूत्रम्), कर्णः (छायाकर्णः), छाया (शङ्कुछाया), दिनार्धं (दिनार्धमानम्), अर्कः (सूर्यः), अक्षः (अक्षांशाः), नतकालज्ञानार्थं सप्तदशकाल यन्त्राणि सन्ति, तेषां यन्त्राणां मध्ये सलिलं भ्रम इत्यादीनि-अष्टौ यन्त्रसंसाधनानि (यन्त्र निर्माणोपकरणानि) सन्तीति ॥५-६॥

अब यन्त्र और यन्त्रोपकरण कहते हैं।

हि. भा.—धनुर्यन्त्र, तुर्यगोलक (तुरीय) यन्त्र, चक्र (चक्र) संज्ञक यन्त्र, यष्टि, शङ्कु, घटिका (घटी) यन्त्र, कपाल यन्त्र, कर्त्तरीयन्त्र, पीठसंज्ञकयन्त्र, सलिल (जल), भ्रम (शाण), अवलम्ब (अवलम्ब सूत्र), छायाकर्ण, शङ्कुच्छाया, दिनार्धमान, सूर्य, अक्षांश, नतकालज्ञान के लिये सत्रह काल यन्त्र हैं, उन यन्त्रों में जल, भ्रम आदि आठ यन्त्ररचना–मूल भूत हैं इति ॥५-६॥

इदानीं सलिलादीनां किं प्रयोजनमित्याह।

सलिलेन समं साध्यं भ्रमेण वृत्तमवलम्बकेनोर्ध्वम्।
तिर्यक् कर्णेनान्यैः कथितैश्च नव प्रवक्ष्यामि ॥७॥

सु० भा०—सलिलेन समं साम्यं साध्यम्। भ्रमेण शाणेन वृत्तं साध्यम्। अवलम्बकेनोर्ध्वमूर्ध्वाधरत्वं साध्यम्। कर्णेनान्यैः कथितैश्छायादिभिश्च यन्त्रस्य तिर्यक् तिर्यक्त्वं साध्यम्। एवमवशिष्टानि नव यन्त्राणि प्रवक्ष्याम्यहमित्याचार्योक्तिः ॥७॥

वि. भा.—सलिलेन (जलेन), समं (भुवः साम्यं) साध्यम्। भ्रमेण (शाणेन), वृत्तं साध्यम्। अवलम्बकेन यन्त्रे उर्ध्वाधरत्वं साध्यम्। कर्णेन, अन्यैः कथितैश्छायादिभिश्च यन्त्रस्य तिर्यक्त्वं साध्यम्। एवमवशिष्टानि नव यन्त्राण्यहं प्रवक्ष्यामि। सिद्धान्तशेखरे—

"अद्भिः समाभूर्वलयं भ्रमात्तु त्र्यस्त्रं च कर्णाच्चितुरस्रयुक्तम्।
लम्बोऽध ऊर्ध्वार्जवसिद्धये स्यात् बीजानि तैलाम्बुरसाः ससूत्राः ॥"

श्रीपतिनैवं कथ्यते । ससूत्राः तैलाम्बुरसा बीजानि भवन्ति, तत्र सूत्रं मुखविवराद्वालुकादिनिःसरणार्थं लोहतन्तुरूपम् । तैलं तथा अम्बु (जलं), रसाः (पारदाः), एतानि बीजानि आदि कारणानि सन्तीति । शिष्य धीवृद्धिद तन्त्रे लल्लश्च—

"इष्टं सुवृत्तवलयं लघुशुष्कदारु निर्मापितं विविध शिल्पवदाततक्ष्णा ।
गोलं समं सलिल तैलवृषाङ्कबीजैः कालानुसारिणममुं भ्रमयेत् स्वबुद्धया
त्रिशत्पलं तरति यद्रसतैलकेषु तत्सार्यते त्रिभिरिदं स्ववहस्य बीजम् ।
वृत्ते भ्रमात् त्रिचतुरस्रमुपैतिकर्णालम्बाच्च सिद्धिमधऊर्ध्वमिला समाद्भिः

यान्युपकरणानि तद्वशेन यथैव स्वयंवहयन्त्रनिर्माणं च प्रतिपादयतस्तान्येवोपकरणानि तथैव स्वयंवहयन्त्रनिर्मणं च श्रीपतेरभिप्रेतमिति स्फुटं प्रतीयमानेऽपि तदुक्त्या न सर्वं स्फुटीभवतीति विवेचकैर्विवेचनीयम् ॥ ७ ॥

अब सलिला (जल) दि से क्या किया जाता है कहते हैं ।

हि. भा.—जल से पृथ्वी को बराबर करना चाहिये । शाण से वृत्त साधन करना चाहिए । अवलम्ब सूत्र से यन्त्र में ऊर्ध्वाधो भाव विदित होता है । कर्ण से और कथित छायादियों से यन्त्र का तिर्यक्त्व (तिरछापन) साधन करना चाहिये । एवं अवशिष्ट नौ यन्त्रों को मैं कहता हूं ॥

सिद्धान्त शेखर में 'अद्भिः समा भूर्वलयं भ्रमात्तु' इत्यादि विज्ञान भाष्य में लिखित श्लोकोक्त के अनुसार श्रीपति ने कहा है । शिष्य धीवृद्धिदतन्त्र में लल्लाचार्य—'इष्टं सुवृत्तवलयं लघुशुष्कदारु निर्मापितं' इत्यादि विज्ञान भाष्य में लिखित श्लोकों के अनुसार कहा है इति ॥ ७ ॥

इदानीं धनुर्यन्त्रमाह ।

धार्यं धनुस्तथाऽन्यत् छाया साम्यं यथोन्नता भागाः ।
दिनगतशेषाः घटिकाः स्वलम्बभुक्ता धनुर्मध्या ॥ ८ ॥

सु. भा.—धनुर्यन्त्रं तथा धार्यं यथाऽन्यत् छायासाम्यं भवेत् । अत्रैतदुक्तं भवति । यस्मिन् दिने धनुर्यन्त्रेण कालज्ञानमभीष्टं तद्दिनसम्बन्धिक्रान्तिचरादिना प्रतिघटिकोन्नत कालवशेन धनुर्यन्त्रकेन्द्रस्थापितेष्टप्रमाणकीलस्य छायाः प्रसाध्य स्वस्वोन्नतकालसम्मुखेऽङ्कयाः । इष्टदिने तथा धनुर्धार्यं यथा कीलच्छायाधनुरग्रयोरन्तरे परिधौ कीलच्छायासंबंधि गणितागतशङ्कुभागसमा भागाः स्युस्तथा धृते वाऽवलम्बोऽपि दृक्सूत्राकारो लगति । अतो धनुर्मध्यात् स्वलम्बभुक्ता भागा रवे-

रुन्नता भागास्तथा तत्राङ्कित उन्नतकालश्च पूर्वापरकपालयोर्दिनगतशेषा घटिका: स्युः।

अत्रोपपत्तिः। गोलयुक्त्यैव स्फुटा ॥८॥

वि. भा.—धनुर्यन्त्रं तथा धार्यं यथाऽन्यत् छायासाम्यं भवेदर्थात् क्रान्तिवशेन 'अक्षप्रभासंगुणितापमज्या तद्द्वादशांशो भवति क्षितिज्येत्यादिना चरज्या साध्या, तथेष्टशङ्कोरिष्टहृतेर्ज्ञानम्, इष्टहृतेरिष्टान्त्या, ततश्चरज्या संस्कारेण सूत्रज्ञानं तत उन्नतकालावबोधः सम्यग्भवत्येवं प्रतिघटिकोन्नतकालवशेन धनुर्यन्त्रकेन्द्रे स्थापितस्येष्टप्रमाणकीलस्य छायाः प्रसाध्य स्वस्वोन्नतकालसंमुखेऽङ्कनीयाः। धनुर्यन्त्रमभीष्टदिने तथा धार्यं यथा कीलच्छाया धनुरग्रयोरन्तरे परिधौ कीलच्छायासम्बन्धिगणितागतशङ्कुभागसमा भागाः स्युस्तथा धृते सति—अवलम्बोऽपि दृक्सूत्राकारो लगति, धनुर्मध्यात् स्वलम्बभुक्ता भागा रवेरुन्नतभागास्तत्राङ्कित उन्नतकालश्च पूर्वापरकपालयोर्दिनगतशेषघटिकाः स्युरिति ॥

सिद्धान्तशेखरे गोलयन्त्रेण दिनगतघटिका दिनशेषघटिकाश्च निम्नलिखित प्रकारेण श्रीपतिना आनीताः—

चक्रांशाङ्कं क्रान्तिवृत्तं विधेयं उर्वीवृत्तं याम्यवृत्तं च तद्वत्।
नाड़ीवृत्तं षष्टिभागाङ्कितं हि याम्योदक्स्था यष्टिरुर्वीजमध्ये ॥

कार्यं खगोलस्य दृढ़स्य मध्ये भगोलमेतत् परितस्तथा च।
यन्त्रांशके तिग्मकरो ऽपवृत्ते क्षिपेच्छलाकामिह तत्र भागे ॥

तान्नाड़िकावृत्तगतां विधाय समुद्गमात् सूर्यवशेन भूजात्।
तदीयभा केन्द्रगता यथा स्यात् स खम्बुनाड्या भ्रमयेत्तथैव ॥

पातङ्गचिह्नक्षितिजान्तरस्थाः समुद्गतांशा गणकैर्निरुक्ताः।
नाड्यः शलाका कुजयोस्तु मध्ये समुन्नतास्ता नियतं भवन्तीति ॥

व्याख्या—षष्ट्यधिकशतत्रयांशैः समानैश्चिह्नितं क्रान्तिवृत्तं विधेयम्। तद्वत् समषष्ट्यधिकशतत्रयांशैश्चिह्नितमेव क्षितिजवृत्तं याम्योत्तरवृत्तं च विधेयम्। नाड़ीवृत्तं षष्टिभागाङ्कितं विधेयम्। क्षितिजवृत्तस्य केन्द्रे दक्षिणोत्तरबिन्द्वोर्गता यष्टि (सुसरलससारदारुनिर्मिता यष्टिका) धार्या, गोलकेन्द्ररूपे क्षितिजवृत्तकेन्द्रे दक्षिणोत्तरसमस्थानरूपयोर्गता च यष्टिः कार्येत्यर्थः। दृढ़स्य (कठिनमाबद्धस्य) खगोलस्य (सममण्डल-याम्योत्तर मण्डलादिनिर्मितस्य गोलस्य) केन्द्रे तथा समन्ततः एतत् अनन्तरोक्त क्रान्तिवृत्त–क्षितिजवृत्त–याम्योत्तरवृत्त, नाड़ीवृत्तात्मकं भगोलं कार्यम्। इह भगोले क्रान्तिवृत्ते यत्रांशके (यस्मिन्नंशे) सूर्य-

स्तस्मिन्नंशे शलाकां (दारवीं लोहसंभवां वा) क्षिपेत् (दद्यात्)। तां शलाकां नाड़ीवृत्तसंलग्नां कृत्वा कथमित्याह। उदयक्षितिजात् सूर्यवशेन। तस्याः शलाकायाश्छाया यथा केन्द्रगतास्यात् तथा यन्त्रं भ्रमयेत्। पातङ्गं चिह्नं (शलाकयाक्षिप्तं रविचिह्नमिति तथा क्षितिजं च तयोरन्तरस्था अंशा गणकैः क्षितिजादुन्नतांशाः कथिताः। शलाकाक्षितिजयोर्मध्ये शलाकासंसक्तनाड़ीवृत्तस्य क्षितिजवृत्तस्य च मध्ये नाड्यो घटिकायास्ता समुन्नता नाड्यो भवन्ति। दिनगतघटिका दिनशेषा वा घटिका भवन्तीत्यर्थः।

श्रीपत्युक्तं गोलयन्त्रद्वारेण रवेरुन्नतांशज्ञानं-उन्नतघटिकाज्ञानं च लल्लोक्तस्य—

अथ लग्नकाल सिद्धयै पूर्वापर परिकरोत्तरैर्नवभिः।
निर्मापयेद् भगोलं प्राग्विधिना क्रान्तिवृत्तमिह॥

तस्य बहिश्च खगोलं समवृत्तक्षितिजदक्षिणोत्तरगैः।
उन्मण्डलेन च तथा ध्रुवयष्ट्या पूर्ववत् सभुवा॥

षष्ट्याङ्कयेद् भगोलं प्रागपराणीतराणि चक्रांशैः।
कुर्याद् दृढं खगोलं श्लथं भगोलं च नलिकाभ्याम्॥

यस्मिन्नंशे सविता तत्र शलाकां क्षिपेदपमवृत्ते।
नाड़ीवृत्तस्थां तामुदयक्षितिजाद्रविवशेन॥

भ्रमयेच्छश्वत्तद्वत् यथा न केन्द्रं त्यजेच्छलाकाभा।
रविचिन्हक्षितिजान्तरमुदितांशास्तृणकुजान्तरं घटिकाः॥

अस्य सर्वथैव समानार्थकमिति॥

गोलाध्याययन्त्राध्याये भास्कराचार्येणाऽप्येवमेवेदं गोलयन्त्रमभिहितम्।

"अपवृत्तगरविचिन्हं क्षितिजे धृत्वा कुजेन संसक्ते।
नाड़ीवृत्ते बिन्दुं कृत्वा धृत्वाऽथ जलसमं क्षितिजम्॥

रविचिन्हस्य च्छाया पतति कुमध्ये यथा तथा विधृते।
उडुगोले कुजबिन्द्वोर्मध्ये नाड्यो द्युयाताः स्युः॥

यथोक्तविधिना खगोलान्तर्भगोलं बद्ध्वा तत्र क्रान्तिवृत्ते मेषादेरारभ्य रविभुक्तराशिभागाद्यं दत्त्वा तदग्रे यच्चिन्हं तदपवृत्तगरविचिन्हमुच्यते। भगोलं चालयित्वा रविचिन्हं क्षितिजे धार्यम्। तथा धृते सति क्षितिज प्राच्यां विषुवन्मण्डले यत्र लग्नं तत्र खटिकया बिन्दुः कार्यः। ततः क्षितिजवृत्तं जलसमं यथा भवति तथा गोलयन्त्रं स्थिरं कृत्वा भगोलस्तथा चाल्यो यथा रविचिन्हस्य छाया भूगर्भे पतति तथा कृते सति विषुवद्वृत्ते क्षितिजविन्द्वोर्मध्ये यावत्यो घटिकास्तावत्यस्तस्मिन् काले दिनगता ज्ञेयाः इति॥८॥

अब धनुर्यन्त्र को कहते हैं ।

हि. भा—धनुर्यन्त्र को इस तरह धारण करना चाहिये जिससे अन्य छाया साम्य हो अर्थात् क्रान्तिवश से 'अक्षप्रभा सङ्गुणितापमज्या तद्द्वादशांशो भवति क्षितिज्या' इत्यादि से चरज्या साधन करना तथा इष्टशङ्कु से इष्टहृति का ज्ञान, उससे इष्टान्त्या का ज्ञान कर उसमें चरज्या संस्कार से सूत्रज्ञान कर उस से उन्नत काल का ज्ञान होता है । एवं प्रत्येक घटिकोन्नत काल वश से धनुर्यन्त्र केन्द्र में स्थापित इष्ट प्रमाण कील की छाया साधन कर अपने अपने उन्नत काल के संमुख अङ्कित करना । धनुर्यन्त्र को इष्ट दिन में ऐसे धारण करना जिससे कील की छाया धनुष के दोनों अग्र के अन्तर में कीलच्छाया सम्बन्धी गणितागतशङ्कुभाग के बराबर भाग (अंश) हो, ऐसे धरने से अवलम्ब भी दृक् सूत्राकार लगता है । धनुष के मध्य से अपने लम्बभुक्त भाग रवि के उन्नत भाग (उन्नतांश) होते हैं, वहां अङ्कित उन्नतकाल पूर्व कपाल और पश्चिम कपाल में दिनगत घटी-दिन शेष घटी होतीं है । सिद्धान्तशेखर में 'गोलयन्त्र से दिनघत घटी और दिन शेष घटी का ज्ञान अधोलिखित प्रकार से श्रीपति ने किया है जैसे 'चक्रांशाङ्कं क्रान्तिवृत्तं विधेयं विदध्याद्दुर्वीवृत्तं याम्यवृत्तं च तद्वत्' इत्यादि विज्ञान भाष्य में लिखित पद्यों से, श्रीपत्युक्त पद्यों का अर्थ यह है क्रान्तिवृत्त क्षितिजवृत्त और याम्योत्तरवृत्त में तीन सौ साठ अंश अङ्कित करना चाहिये । नाड़ीवृत्त को साठ अंशों से अङ्कित करना । क्षितिजवृत्त के केन्द्र में गोलकेन्द्र में दक्षिण सम स्थान और उत्तर समस्थानगत यष्टि स्थापन करना; दृढ़ (मजबूती से बन्धा हुआ) खगोल (पूर्वापरवृत्त याम्योत्तर वृत्तादि से निर्मित गोल) के केन्द्र में तथा चारों तरफ क्रान्तिवृत्त-क्षितिजवृत्त याम्योत्तरवृत्त नाड़ीवृत्तात्मक भगोल को करना, इस भगोल में क्रान्तिवृत्त में जिस अंश में सूर्य है उस अंश में लकड़ी की वा लोहे की शलाका देनी चाहिये । उस शलाका को उदय क्षितिज से सूर्यवश से नाड़ीवृत्त से संलग्न कर शलाका की छाया जैसे केन्द्रगत हो वैसे यन्त्र को भ्रमण कराना चाहिये । शलाका से क्षिप्त रवि चिन्ह तथा क्षितिज के अन्तर में जो अंश है वह उन्नतांश कथित हैं । शलाका और क्षितिज के मध्य में शलाका संसक्त नाड़ीवृत्त और क्षितिजवृत्त के मध्य में उन्नत घटी होती है अर्थात् दिनगत घटी और दिनशेष घटी होती है । श्रीपति कथित गोलयन्त्र द्वारा रवि का उन्नतांश ज्ञान और उन्नत घटिका ज्ञान लल्लोक्त "अथ लग्नकाल सिद्धयै पूर्वापरपरिकरोत्तरैर्नवभिः" इत्यादि विज्ञान भाष्य में लिखित प्रकार के सर्वथा समानार्थक है, गोलाध्याय के यन्त्राध्याय में भास्कराचार्य ने भी 'अपवृत्तग रविचिन्हं क्षितिजे धृत्वा कुजेन संसक्ते' इत्यादि से इसी तरह कहा है इति ॥८॥

इदानीं प्रकारान्तरेण यन्त्रं सूर्याभिमुखे कथं समं धार्यमित्येतदर्थमाह ।

धार्यं समं तथा वा ज्या छाया मध्यगा यथा भवति ।
अग्रादिष्टा घटिका ज्यामध्यच्छायया भुक्ताः ॥९॥

सु. भा.—यथा ज्याछाया धनुषो ज्यायाः पूर्णज्यायाश्छाया मध्यगा धनुषो

मध्यगा भवति तथा वा यन्त्रं समं धार्यम् । दृग्मण्डलाकारं धार्यं यथा तत्पार्श्वयो रवेस्तुल्यं तेजो लगतीत्यर्थः । एवं ज्यामध्यच्छायया ज्याया धनुः पूर्णज्याया मध्येऽर्थात् केन्द्रे स्थापितो यः कीलस्तस्य छायया भुक्ता या अग्राद्धनुः कोटचग्रादङ्किता घटिकास्ता इष्टा घटिकाः स्युः ॥

गोलयुक्तिरेव वासनाऽत्र ज्ञेया ॥९॥

वि. भा.—यथा ज्याछाया (धनुषो ज्यायाः पूर्णज्यायाश्छायाः) धनुषो मध्यगा भवति तथा वा यन्त्रं समं धार्यम् । दृग्मण्डलाकारं धार्यं यथा तत्पार्श्वयो रवेस्तेजो तुल्यं लगतींत्यर्थः । एवं ज्यामध्यच्छायया (ज्याया धनुः पूर्णज्याया मध्ये ऽर्थात् केन्द्रे स्थापितो यः कींलस्तस्य छायया) भुक्ता अग्रात् (धनुः कोटचग्रा-दङ्किता) या घटिकास्ता इष्टा घटिकाः स्युः ॥९॥

अब प्रकारान्तर से सूर्याभिमुख यन्त्र को कैसे रखा जाता है इस के लिये कहते हैं ।

हि. भा.—जैसे धनुष की पूर्णज्या की छाया धनुष के मध्यगत होती है वैसे यन्त्र को समरूप से धारण करना । दृग्मण्डलाकार धारण करना जिससे उसकी दोनों बगल में रवि का तेज बराबर (तुल्य) लगता है । एवं धनुष की पूर्णज्या के मध्य में अर्थात् केन्द्र में स्थापित जो कील उसकी छाया से भुक्त जो धनुष के कोटचग्र से अङ्कित घटी है वह इष्टघटी है इति ॥९॥

इदानीं प्रकारान्तरेणेष्टघटिकां धनुः स्वरूपं चाह ।

घटिका स्वशङ्कुभागैः पृथग्गतैर्लम्बभूसमज्यार्धात् ।
साशीतिशतांशाङ्कं चक्रस्यार्धं धनुर्यन्त्रम् ॥१०॥

सु. भा.—पृथग्गतैः स्वशङ्कुभागैर्लम्बभूसमज्यार्धाद्वा घटिकाः साध्याः । अत्रैतदुक्तं भवति । यदि स्वाभीष्टदिनेष्टकाले शङ्कुभागा एव विदितास्तदा धनुः-कोटचग्रात् तान् भागान् दत्त्वा तदग्राद्धनुर्ज्या या भूमिस्तस्या उपरि लम्ब एव यो ज्यार्धात् ज्याखण्डतो भवति स शङ्कुस्तस्मात् त्रिप्रश्नविधिनेष्टक्रान्तिचरादिनेष्टा-न्त्यामवगम्य घटिका ज्ञेया इति । चक्रस्य वृत्तस्यार्धं साशीतिशताङ्कं चक्रार्धांशाङ्कं धनुर्यन्त्रं भवति ॥ १० ॥

वि. भा.—पृथग्गतैः स्वशङ्कुभागैर्लम्बभूसमज्यार्धाद्वा घटिकाः साध्याः । अर्थाद्यदीष्टदिनेष्टकाले शङ्कुभागा एव विदितास्तदा धनुःकोटचग्रात् तान् भागान् दत्वा तदग्राद्धनुर्ज्या या भूमिस्तदुपरि लम्ब एव यो ज्याखण्डतो भवति स शङ्कुस्तस्मात् त्रिप्रश्नाधिकार विधिनेष्टान्त्यां ज्ञात्वा घटिका ज्ञेयाः । चक्र-

स्यार्धे (वृत्तार्धे) अशीत्यधिकशतांशैरङ्कितं धनुर्यन्त्रं भवतीति । पूर्वश्लोकोक्त-विषयस्यैतच्छोकोक्तविषयस्य चानुरूप एव सिद्धान्तशिरोमणौ भास्कराचार्येणा-भिहितो यथा चक्रं चक्रांशाङ्कं परिधावित्यादि, फलकयन्त्रेणापि साहाय्यं नेयम् ।

"धार्यं तथा फलकयन्त्रमिदं यथैव तत्पार्श्वयोर्लगति तुल्यमिनस्य तेजः ।
छायाक्षजा स्पृशति तत्परिधौ यमंशं तत्रांशके मतिमता तरणिः प्रकल्प्यः ।

अक्षप्रोतां रविलवगतां पट्टिकां न्यस्य तस्मात्,
यष्टेरग्रादुपरि फलकेऽधश्च गोलक्रमेण ।

यत्नाद्देयश्चरदलगुणस्तत्र या ज्या तयात्र,
छिन्ने वृत्ते तलगघटिकाः स्युर्नता लम्बकान्ताः ।"

अस्यार्थः—यन्त्रमाधारेऽवलम्बमानं तथा धार्य यथा यन्त्रोभयपार्श्वयोस्तुल्यकालमे-वार्कतेजो लगति । अर्काभिमुख नेमिकं दृग्मण्डलाकारमित्यर्थः । तथा धृते सुषिरे प्रोतस्याक्षस्य छाया वृत्तपरिधौ यस्मिन्नंशे लगति तत्रांशेऽर्कः कल्प्यः । अक्षप्रोतैव पट्टिका रविचिन्हे स्थाप्या तथा धृतायां पट्टिकायां यत्पूर्वं कृतं यष्टिचिन्हं तस्मादुपर्युत्तरगोले । दक्षिण गोले तु तदधश्चरज्यामितान्यङ्गुलानि फलके गणयित्वा तत्र चिन्हं कार्यम् । चिन्हस्थाने या ज्यारेखा सा वृत्ते यत्र लग्ना तस्मादधोवृत्ते लम्बरेखावधेर्यावत्यो घटिकास्तावत्यस्तत्काले नता ज्ञेयाः । एतद्वशे-नेष्टघटिकाज्ञानं सुलभमिति ॥१०॥

अब प्रकारान्तर से इष्टघटी तथा धनुः स्वरूप को कहते हैं ।

हि. भा.—यदि इष्टदिन में इष्टकाल में शङ्कुभाग ही विदित हो तब धनुःकोटचग्र से उन भागों (अंशों) को दान देकर उस के अग्र से धनुष की ज्या रूप भूमि के ऊपर लम्ब हीं शङ्कु हैं, उससे त्रिप्रश्नाधिकारोक्त विधि से इष्टान्त्या जानकर इष्टघटी का ज्ञान करना चाहिये, वृत्तार्ध में एक सौ अस्सी अंशों को अङ्कित करने से धनुर्यन्त्र होता हैं । पूर्वश्लोकोक्त विषय और इस श्लोकोक्त विषय के अनुरूप ही भास्कराचार्य ने 'चक्रं चक्रांशाङ्कं परिधौ' इत्यादि से कहा है, फलक यन्त्र से भीं काम लेना चाहिये इति ॥१०॥

इदानीं परोक्तघटचानयनं खण्डयति ।

मध्यदिवसोन्नतांशैर्दिनार्धनाड़ीर्वदन्ति तुल्या ये ।
ते मूर्खास्तच्छाया इष्टच्छाया समा न यतः ॥११॥

सु. भा.—ये मध्यदिवसोन्नतांशैर्दिनार्धनाडीस्तुल्या इष्टघटिकाः प्रकल्प्या-भीष्टोन्नतांशैरनुपातेनेष्टा घटिका वदन्ति ते मूर्खाः सन्ति । यत इष्टघटीतो यदि

दिनार्धे घटिकाभिर्मध्योन्नतांशास्तदेष्टघटिकाभिः किमित्यनुपातेन य इष्टोन्नतांशा आयान्ति तच्छाया वेधोपलब्धेष्टकालिकच्छाया समा न भवन्तीति तेषामानयनमसत् ॥ ११ ॥

वि. भा. — ये मध्यान्हकालिकोन्नतांशैर्दिनार्धनाड़ीतुल्या इष्टघटिकाः प्रकल्प्याभीष्टोन्नतांशैरनुपातेनेष्टा घटिका वदन्ति ते मूर्खाः सन्ति । यतो यदि दिनार्धघटीभिर्मध्योन्नतांशास्तदेष्टघटीभिः किमित्यनुपातेन य इष्टोन्नतांशा आयान्ति तच्छाया वेधोपलब्धेष्टकालिकच्छाया समा न भवत्यतस्तदानयनं न समीचीनमिति ॥ सिद्धान्तशिरोमणौ ।

चक्रं चक्रांशाङ्कं परिधौ श्लथश्टङ्खलादिकाधारम् ।
धात्री त्रिभ आधारात् कल्प्या भार्धेऽत्र खार्धं च ॥
तन्मध्ये सूक्ष्माक्षं क्षिप्त्वार्काभिमुखनेमिकं धार्यम् ।
भूमेरुन्नतभागास्तत्राक्षच्छायया भुक्ताः ।
तत्खार्धान्तिश्च नता उन्नतलवसंगुणीकृतं द्युदलम् ।
द्युदलोन्नतांशभक्तं नाड्यः स्थूलाः परैः प्रोक्ताः ॥

व्याख्या-धातुमयं दारुमयं वा समं चक्रं कृत्वा तन्नेम्यां शृङ्खलादिराधारः शिथिलः कार्यः । चक्रमध्ये सूक्ष्मं सुषिरमाधारात् सुषिरोपरिगामिनी लम्बवदूर्ध्वरेखा कार्या । तन्मत्स्यतोऽन्या तिर्यग्रेखा च कार्या । तच्चक्रं परिधौ भगणांशैरङ्कयित्वाधारात् त्रिभ इति नवतिभागान्तरे तिर्यग्रेखा तत्परिधिसम्पाते धात्री क्षितिः कल्प्या । भार्धेऽन्तर ऊर्ध्वरेखा नेमिसम्पाते खार्धं कल्प्यम् । सुषिरे सूक्ष्मा शलाका प्रदातव्या । सा चाक्षसंज्ञा तच्चक्रमर्काभिमुखनेमिकं च यथा भवति तथाधारे धार्यम् । तथा धृतेऽक्षस्य छाया परिधौ यत्र लगति तत्कुजचिन्हयोरन्तरे येंऽशास्तेरवेरुन्नतांशाः । ये छायाखार्धयोरन्तरे ते नतांशा ज्ञेयाः । एवमत्र नतोन्नतांशज्ञानं भवति । अतोऽन्यैर्घटिका अप्यानीताः । तस्मिन् दिने गणितेन मध्यदिनोन्नतांशान् दिनार्धमानं च ज्ञात्वानुपातः कृतः । यदि मध्यदिनोन्नतांशैर्दिनार्धनाड्यो लभ्यन्ते तदैभिः किमित्येवं स्थूला घटिकाः स्युः ॥ अत्र परवाक्यम् ।

इष्टोन्नतांशा द्युदलेन निघ्ना मध्योन्नतांशैर्विहृताश्च नाड्यः ।
दिनस्य पूर्वापरभागयोश्च याताश्च शेषाः क्रमशो भवन्ति ॥

वस्तुत एतस्य खण्डनमाचार्येण भास्कराचार्येण च यत् क्रियते तत्समीचीनमेवेत्याचार्योक्तश्लोकव्याख्यायां द्रष्टव्यमिति ॥११॥

अब दूसरों के घट्यानयन का खण्डन करते हैं ।

हि. भा.—जो लोग मध्याह्नकालिक उन्नतांश से दिनार्ध घटी तुल्य इष्ट घटी

कल्पना कर अभीष्ट उन्नतांश से अनुपात द्वारा इष्ट घटी कहते हैं वे मूर्ख हैं। क्योंकि यदि दिनार्ध घटी में मध्योन्नतांश पाते हैं तो इष्ट घटी में क्या इस अनुपात से जो इष्ट उन्नतांश आते हैं उसकी छाया वेधोपलब्ध इष्ट कालिक छाया के बराबर नहीं होती है इस लिये उनका आनयन ठीक नहीं है इति ।। सिद्धान्त शिरोमणि में 'उन्नतलवसंगुणीकृतं द्युदलम् द्युदलोन्नताशभक्तं नाड्यः स्थूलाः परैः प्रोक्ताः' इससे भास्कराचार्य ने भी अन्यों के घटिकानयन का खण्डन किया है। अन्य के वाक्य इष्टोन्नतांशा द्युदलेन निघ्ना मध्योन्नतांशैर्विहृताश्च नाड्यः' इत्यादि विज्ञान भाष्य में लिखित के अनुसार है। वस्तुतः इसका खण्डन आचार्य और भास्कराचार्य भी जो करते है समीचीन है यह आचार्योक्त श्लोक के उपरिलिखित भाष्य से स्पष्ट है इति ।।११।।

इदानीं यन्त्रेण नतोन्नतकालज्ञानमाह।

जीवां स्वाहोरात्रे परिकल्प्याग्रान्नतोन्नतत्रिज्याः।
अनुपातात् कार्यास्तुर्यगोलके चक्रके चैवम् ।।१२।।

सु. भा.—स्वाहोरात्रे द्युज्यावृत्तेऽनुपाताद् द्वादश कोटचा पलकर्णस्तदा शङ्कुकोटचा किमित्यनुपातात् जीवामिष्टहृतिं प्रकल्प्य ततोऽग्राद्धनुः कोटचग्रान्नतत्रिज्याः कार्यास्त्रिज्यावशेन नतोन्नतकालौ कार्यौ। अत्रैतदुक्तं भवति। इष्टहृतिवशेन त्रिज्यानुपातेनेष्टान्त्याः कार्याः। तत्र चरसंस्कारेण सूत्रमुत्पाद्य तत्समां ज्यां धनुषि दत्त्वा धनुरग्राद्या घटिकास्ताश्चरसंस्कृतोन्नतकालघटिकाः। ज्याया धनुर्यन्त्राधरभागपर्यंतं या घटिकास्ता नतकालघटिकाः। एवं गोलयुक्तिवशान्नतोन्नतकालौ तुर्यगोलके तुरीये चक्रे च भवत इति ।। १२ ।।

वि. भा—स्वाहोरात्रे (द्युज्यावृत्ते) अनुपातात् "द्वादशाङ्गुलशङ्कुना पलकर्णस्तदेष्टशंकुना कि" मित्यनुपातेन समागतां हृतिं जीवां परिकल्प्य ततोऽग्रात् (धनुःकोटचग्रात्)नतोन्नतत्रिज्याः कार्याः। त्रिज्यावशेन नतोन्नतकालौ कार्यौ, अर्थादिष्टहृतिवशेन त्रिज्यानुपातेने$\left(\frac{\text{इहृति.त्रि}}{\text{द्यु}} = \text{इष्टान्त्या}\right)$ष्टान्त्याः कार्याः, तत्र चरज्या संस्कारेण सूत्रं 'इष्टाष्टा + चरज्या = सूत्रम्' भवति। तत्तुल्यां जीवां धनुषि दत्वा धनुरग्राद्या घटिकास्ताश्चर संस्कृतोन्नतकाल घटिका भवंति। जीवाया धनुः (चापं) यन्त्राधोभागपर्यन्तं या घटिकास्ता नतकालघटिकाः। एवं नतोन्नतकालौ तुर्यगोलके (तुरीय यन्त्रे) चक्रे (चक्रयन्त्रे) च भवत इति ।।१२।।

अब यन्त्र से नतकालज्ञान और उन्नतकालज्ञान को कहते हैं।

हि. भा.—द्युज्यावृत्त में अनुपात से 'द्वादश कोटि में यदि पलकर्ण-कर्ण पाते हैं तो

इष्टशङ्कुकोटि में क्या इससे इष्टहृति आती है, इष्टहृति को जीवा कल्पना कर तब धनुष के कोटचग्र से त्रिज्यावश से नतकाल और उन्नत काल साधन करना अर्थात् इष्टहृतिवश से त्रिज्यानुपात से $\frac{\text{इहृति.त्रि}}{\text{द्यु}}$ = इष्टान्त्या' इष्टान्त्या लानी चाहिये, उसमें चरज्या संस्कार से इष्टान्त्या ± चरज्या = सूत्र, सूत्र होता है, एतत्तुल्यज्या को धनुष (चाप) में देकर धनुष के अग्र से जो घटी होगी वह चर संस्कृत उन्नतकाल घटी होती है, इससे उन्नत काल घटी का ज्ञान स्पष्ट ही है। ज्या के चाप यन्त्र के अधोभाग पर्यन्त जो घटी है वह नतकाल घटी है। इस तरह तुरीय यन्त्र में और चक्र यन्त्र में भी नतकाल और उन्नत काल विदित होते हैं इति ॥१२॥

इदानीं यन्त्रादेव नतोन्नतकालज्ञानमाह।

दिनघटिकाङ्कितयष्टेर्व्यस्त नतज्याग्रमुन्नतज्यां च।
दिङ्मध्ये च शलाका तच्छायाग्रान्नता नाडचः ॥१३॥

सु. भा.—दिनघटिकाङ्कितयष्टिर्द्युज्या तस्याः सकाशात् प्रतिघटिकं दिङ्मध्यस्थापितशलाकाछाया प्रसाध्या सा रवितो व्यस्तदिक्का भवति। तत्र प्रतिघटिकोन्नतकालसम्बंधिच्छायाग्रे तात्कालिकं नतज्याग्रं नतज्यामुन्नतज्यां नतकालमुन्नतकालं चाङ्कयेत्। एवमेकस्मिन् फलके प्रतिद्युज्यासम्वन्धिनीं नतकालाद्यङ्कितां भाभ्रमरेखामुत्पादयेत्। इष्टदिनेष्टकाले समधरातले यथा दिक्के स्थापिते फलके दिङ्मध्यशलाकाछायाग्रं तद्दिनसम्बन्धि भाभ्रमरेखायां यत्र लग्नं तत्राङ्किता नाडचो नता नाडचः स्युः। एवं तत्राङ्कितोन्नत कालादित उन्नतकालादिज्ञानं भवतीति गोलयुक्तितः स्फुटम् ॥ १३ ॥

वि. भा.—दिनघटिकाङ्कितयष्टिः (द्युज्या) तस्याः सकाशात् प्रत्येकघटिकायां दिङ्मध्यस्थापित शलाकायाश्छायाः साध्यास्ता रवितो व्यस्ता (विपरीतदिक्काः) भवन्ति। तत्र प्रतिघटिकोन्नतकालसम्बन्धिछायाग्रे न तज्याग्रं नतज्यामुन्नतज्यां नतकालमुन्नतकालं चाङ्कयेत्। एव मेकस्मिन् फलके प्रतिद्युज्यासम्बन्धिनीं नतकालाङ्कितां भाभ्रमरेखां रचयेत्। इष्टदिने इष्टकाले समधरातले यथादिक्के स्थापिते फलके दिङ्मध्यशलाका छायाग्रं तद्दिनसम्बन्धि भाभ्रमरेखायां यत्र लगति तत्राङ्किता नाडचो (घटिकाः) नता नाडचः (नतघटिका) भवन्ति एवमेव तत्राङ्कितोन्नतकालादित उन्नतकालादिज्ञानं भवतीति ॥१३॥

अब यन्त्र ही से नतकालज्ञान और उन्नत कालज्ञान को कहते हैं।

हि. भा.—दिन घटी से अङ्कित यष्टि (द्युज्या) से प्रत्येक घटी में दिङ्मध्य (वृत्त-

केन्द्र) स्थापित शलाका की छायाएँ साधन करनी चाहिये। वे रवि से विरुद्ध दिशा की होती हैं। वहां प्रत्येक घटी के उन्नतकाल सम्बन्धी छायाग्र में नतकाल और उन्नतकाल को अङ्कित करना। एवं एक फलक में प्रति द्युज्या सम्बन्धी नतकाल से अङ्कित (चिन्हित) भाभ्रम रेखा बनानी चाहिये। इष्टदिन में इष्टकाल में समधरातल में यथादिशा में स्थापित फलक में दिङ्मध्यशलाका का छायाग्र उस दिन सम्बन्धी भाभ्रमरेखा में जहां लगता है वहां अङ्कित नाड़ी (घटीं) नतनाड़ी (नतघटीं) होती है। इसी तरह उसमें अङ्कित उन्नतकालादि से उन्नत कालादि ज्ञान होता है इति ॥१३॥

इदानीं धनुर्यन्त्रे विशेषमाह।

धनुषः पृष्ठे द्रष्ट्रा वेध्या ज्यामध्य संस्थया दृष्टचा।
इष्टान्तरं नतज्या धनुषि चच्छायोन्नतज्यायाः ॥१४॥
ज्यार्धं दृष्टेर्दृग्ज्यां नतजीवांशं कुमुन्नतज्यां च।
धनुषि प्रकल्प्य योज्यं यद्युक्तं नाडिकाद्यं च ॥१५॥

सु. भा.—द्रष्ट्रा पुरुषेण धनुषः पृष्ठे ज्यामध्यसंस्थया पूर्णज्यो परिस्थापित-नलकरन्ध्रगतया दृष्टचा इष्टग्रहयोरन्तरम्। उन्नतज्यायाः सकाशात् धनुषि यन्त्रे नतज्या छाया चेत्यादि सर्वे पदार्था वेध्याः। एवं धनुषि धनुर्यन्त्रे दृष्टेज्यार्धमेव दृग्ज्यां नतजीवांशं नतभागान्। कुं भूमिपर्यन्तमर्थात् यन्त्रे कल्पितक्षितिज पर्यन्त-मुन्नतज्यां च प्रकल्प्य यन्नाडिकाद्यमुपयुक्तमस्ति तत् सर्वं योज्यं गोलयुक्तितः। तथैव यन्त्रचिन्तामण्यादौ तुरीययन्त्रेऽङ्किताश्चोन्नतांशादयः प्रसिद्धाः सिद्धान्त-विदाम् ॥ १४–१५ ॥

वि. भा.—द्रष्ट्रा (दर्शकेन पुरुषेण) धनुषः पृष्ठे, ज्यामध्यसंस्थया (पूर्ण-ज्योपरिस्थापितनलकरन्ध्रगतया) दृष्टचा, इष्टान्तरम् (इष्टग्रयोरन्तरम्), उन्नतज्यायाः सकाशात् धनुषि (धनुर्यन्त्रे) नतज्या, छाया चेत्यादयः सर्वे पदार्था ज्ञातव्याः। एवं धनुर्यन्त्रे दृष्टेज्यार्धमेव दृग्ज्यां-नतजीवांशं नतांशान् कुं (भूमिपर्यन्त-मर्थात् यन्त्रे कल्पितक्षितिजपर्यन्तं) उन्नतज्यां च प्रकल्प्य यन्नाड़िकाद्यमुपयुक्तं तत्सर्वं गोलयुत्तचा योज्यम्। तुरीययन्त्रे तथैवोन्नतांशादयोऽङ्किता यन्त्रचिन्ता-मण्यादि ग्रन्थे सन्तीति ॥ १४-१५ ॥

अब धनुर्यन्त्र में विशेष कहते हैं।

हि. भा.—दर्शक पुरुष को धनुष के पृष्ठ में पूर्णज्या के ऊपर स्थापित नलकरन्ध्रगत दृष्टि से इष्ट दो ग्रहों का अन्तर तथा धनुर्यन्त्र में उन्नतज्या से नतज्या-छाया इत्यादि सब पदार्थ जानने चाहियें। एवं धनुर्यन्त्र में दृष्टि से ज्यार्ध को दृग्ज्या नतांश को यन्त्र में

कल्पित क्षितिज पर्यन्त उन्नतज्या मानकर जो नाड़िकादि उपयुक्त हैं उन सबों को काम में लाना चाहिये। तुरीय यन्त्र में उसी तरह उन्नतांशादि अङ्कित है यन्त्र चिन्तामणि आदि ग्रन्थों में स्फुट है इति ॥१४-१५॥

इदानीमन्यं विशेषमाह।

अवलम्बनं शलाकाज्यार्धं यष्टिं प्रकल्प्य वा धनुषि।
भूम्युच्छ्रायाल्लम्बो यष्ट्युक्तैरानयेत् करणैः ॥१६॥

सु. भा.—वा धनुषि धनुर्यन्त्रे केन्द्रगां शलाकामवलम्वनमवलम्वसूत्रं ज्यार्धं चापानां ज्यार्धानि शलाकाप्रोतां यष्टिं च प्रकल्प्य यष्ट्युक्तैर्यष्ट्यादिभिरुदितैः करणैः साधनैर्भूम्युच्छ्रायात् क्षितिजोच्छ्रायाल्लम्बः शङ्कुभागादीन् गणक आनयेत्। आचार्योक्तित एव तथैव भास्करेण फलकयन्त्रे सर्वं रचितमिति ॥ १६ ॥

वि. भा.—वा धनुर्यन्त्रे केन्द्रगतां शलाकामवलम्वसूत्रचापानां ज्यार्धानि शलाकां प्रोतां यष्टिं च प्रकल्प्य यष्ट्यादिभिः कथितैः साधनैः क्षितिजोच्छ्रायाल्लम्बः शङ्कुभागादीन् गणक आनयेत्। सिद्धान्तशिरोमणौ 'कर्त्तव्यं चतुरस्रकं सुफलक' मित्यादि फलकयन्त्ररचनावैशद्यमाचार्योक्तमिदं संक्षिप्तमादर्शमादाय भास्कराचार्येण प्रतिपादितमिति ॥१६॥

अब अन्य विशेष कहते हैं।

हि. भा.—अथवा धनुर्यन्त्र में केन्द्रगतशलाका को अवलम्बसूत्र, चाप के ज्यार्ध शलाका प्रोत (पहराई हुई) यष्टि मान कर यष्ट्यादि से कथित साधनों से क्षितिज के उच्छ्राय से उन्नतांशादि को गणक लावे, सिद्धान्तशिरोमणि में 'कर्त्तव्यं चतुरस्रकं सुफलकं' मित्यादि फलकयन्त्र रचना का स्पष्टीकरण भास्कराचार्य ने आचार्योक्त इस संक्षिप्त आदर्श को लेकर किया है इति ॥१६॥

इदानीं तुर्यगोलमाह।

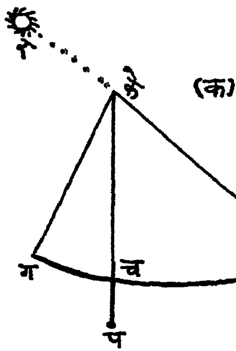
अङ्कितमंशनवत्या धनुषोऽर्धं तुर्यगोलकं यन्त्रम्।
घटिकानतोन्नतांश ग्रहान्तराद्यं धनुर्वदिह ॥१७॥

सु. भा.—धनुषोऽर्धं कोदण्डखण्डमंशनवत्याङ्कितं तुर्यगोलकं यन्त्रं भवति। इहात्रापि धनुर्यन्त्रवद्घटिकानतोन्नतांशग्रहान्तराद्यं सिध्यति ॥ १७ ॥

वि. भा.—धनुषोऽर्धं (कोदण्डखण्डं) अंशनवत्याऽङ्कितं कार्यं तत्तुर्यगोलकं यन्त्रं भवति, अत्रापि धनुर्यन्त्रवत् घटिकानतोन्नतांशग्रहान्तराद्यं सिध्यतीति।

कथमेतेन यन्त्रेण नतोन्नतांश ज्ञानं भवतीति प्रतिपाद्यते ।।

नतोन्नतांशज्ञानार्थमुपपत्तिः ।।



केन्द्ररन्ध्रद्वारा कुजरन्ध्रं रविकिरणो यथा विशेत्तथा यन्त्रं धार्यम् ।

र=रविबिम्बम् । तत्तेजः 'के' बिन्दु द्वारा 'कु' दृष्टिबिन्दौ निर्गच्छति । तथा यन्त्रे स्थिरीकृते ग्रहें क्षितिजस्थे सति, यदि कु दृष्टिस्थानमपि क्षितिजस्थं भवेत्तदा केग ऊर्ध्वाधरसूत्रमवलम्बसूत्रम् । कुजादूर्ध्वस्थे ग्रहे तथोक्तवद्यन्त्रे स्थिरीकृते केग ऊर्ध्वाधररूपं न भवेदपि-ऊर्ध्वाधररूपं=केप, तत्समानान्तरम्=कुऊ सूत्रमप्यूर्ध्वाधररूपम् । ततः $<$उकुके$=<$कुकेच, परं$<$ऊकुके= नतांशाः, अतः $<$पकेग=उन्नतांशाः । सिद्धान्ततत्त्वविवेके—

"धातुजं दारुजं वा यत् यन्त्रं बुद्धिमता कृतम् ।
तस्य केन्द्रकुजोर्ध्वस्थे रन्ध्रे कार्ये समान्तरे ।।
कुजरन्ध्रस्थदृष्टयवै केन्द्ररन्ध्रगतं ग्रहम् ।
खस्थं विध्वाऽथ तद्यन्त्रं कार्यं दृग्वृत्तवद्बुधैः ।।"

व्याख्या—तस्य यन्त्रस्य केन्द्रकुजबिन्द्वोरुर्ध्वस्थे समान्तरे रन्ध्रे (छिद्रे) कार्ये, अर्थात् कुजरेखा तु नलिकारूपा कार्या, तथा कृते कुजरन्ध्रे दृष्टिं निवेश्य दृग्वृत्तधरातले तथैतद्यन्त्रं धार्यं, यथा सा नलिकारूपा कुजरेखा, ग्रहगर्भदृष्टिसूत्रं भवेत्तदैव आकाशस्थं ग्रहं केन्द्ररन्ध्रगतं पश्येदिति । अत्र यन्त्रमधोमुखं परिवर्त्य निवेशितम् ।।

अथवा केन्द्ररन्ध्रेण क्ष्माजरन्ध्रं विशेद्यथा ।
अर्कतेजस्तथा यन्त्रं धार्यमर्कमुखं सदा ।।
अर्कोदये भवेत् खस्थं लम्बसूत्रं यथा यथा ।।
वियत्यर्कः कुजस्थानादुन्नतश्च तथा तथा ।
यन्त्रे खतश्च तत्सूत्रं नेम्यंशैश्चलितं भवेत् ।।
अतः खादुन्नतांशाश्च ज्ञेया भूजान्नतांशकाः ।
तज्ज्यके शङ्कुदृग्ज्ये च यन्त्रे दृग्वृत्तवत् स्थिते ।।"

कमलाकरेणैवं यन्त्रद्वारोन्नतांशनतांशयोर्ज्ञानं प्रतिपादितम् ।

तथा यन्त्रचिन्तामणौ—

"केन्द्रोर्ध्वरन्ध्रेण यथाऽर्कतेजः क्ष्माजोर्ध्वरन्ध्रं प्रविशेत्तथैव ।
धार्यं तु केन्द्रादवलम्बभागज्या दृग्ज्यका स्यान्नतशिञ्जिनी वा ।"

कमलाकरोक्तसदृशमेवोक्तमस्तीति ।।१७।।

अब तुर्यगोल को कहते हैं।

हि. भा.—धनुष (चक्रार्ध) के आधे भाग (कोदण्डखण्ड) को नव्वे अंश से अङ्कित करने से वह तुर्यगोलक नाम का यन्त्र होता है यहां भी धनुर्यन्त्र की तरह घटी, नतांश, उन्नतांश' ग्रहान्तरादि सिद्ध होता है। इस यन्त्र से नतांश और उन्नतांश ज्ञान कैसे होता है उसके लिये उपपत्ति।

यहां संस्कृतोपपत्ति में लिखित (क) क्षेत्र को देखिये। केन्द्र छिद्र द्वारा क्षितिजस्थ रन्ध्र (छिद्र) में रविकिरण जिस तरह प्रवेश करे उस तरह यन्त्र को धारण करना चाहिये। र=रवि बिम्ब। उनके तेज 'के' बिन्दु द्वारा 'कु' दृष्टि बिन्दु में निकलता है। यन्त्र को स्थिर करने से ग्रह के क्षितिजस्थ रहने पर यदि 'कु' दृष्टिस्थान भी क्षितिजस्थ हो तब केग ऊर्ध्वाधर सूत्र अवलम्ब सूत्र होगा। क्षितिज से ग्रह के ऊपर रहने से पूर्ववत् यन्त्र को स्थिर करने से केग ऊर्ध्वाधर रूप न हो तथापि ऊर्ध्वाधररूप=केप, उसके समानान्तर=कुऊ सूत्र भी ऊर्ध्वाधर रूप है तब $<$ऊकुके$=<$कुकेच, लेकिन ऊकुके=नतांश, अतः $<$पकेग$=$उन्नतांश। सिद्धान्त तत्त्व विवेक में "धातुजं दारुजं वा यत् यन्त्रं बुद्धिमता कृतम्" इत्यादि तथा "अथवा केन्द्ररन्ध्रेण क्ष्माजरन्ध्रं विशेद्यथा। अर्कतेजस्तथा यन्त्रं धार्यमर्कमुखं सदा" इत्यादि श्लोकों से कमलाकर ने उपर्युक्त उपपत्ति से यन्त्र द्वारा नतांश और उन्नतांश का ज्ञान कहा हैं। तथा यन्त्र चिन्तामणि में 'केन्द्रोर्ध्वरन्ध्रेण यथाऽर्कतेजः क्ष्माजोर्ध्वरन्त्रं प्रविशेत्तथैव' इत्यादि से कमलाकरोक्त के सदृश ही कहा गया है इति ॥१७॥

इदानीं चक्रयन्त्रमाह।

परिधौ भगणांशाङ्कं मीनान्तं चक्रतो विद्ध्वा।
चक्रकयन्त्रं मध्याल्लम्बोऽत्र फलं धनुस्तुल्यम् ॥१८॥

सु. भा.—चक्रकयन्त्रं परिधौ मीनान्तं द्वादशराश्यकं भगणांशाङ्कं च कार्यम्। अत्र परिधौ कल्पिताधारमध्याल्लम्बः कार्यः। अस्माच्चक्रतश्चक्रयन्त्राद्ग्रहादीन् विद्ध्वा फलं धनुस्तुल्यं धनुर्यन्त्रसमं भवति। विशेषार्थं भास्करचक्रयन्त्रं तदीयगोलयन्त्राध्याये चिन्त्यम् ॥ १८ ॥

वि. भा.—चक्रकयन्त्रपरिधौ भगणांशाङ्कं मीनान्तं (द्वादशराश्यङ्कं) च कार्यम्। अत्र (चक्रकयन्त्र) परिधौ कल्पिताऽधारमध्याल्लम्बः कार्यः। अस्माच्चक्रतः (चक्रयन्त्रात्) ग्रहादीन् विद्ध्वा फलं धनुस्तुल्यं (धनुर्यन्त्र समं) भवतीति। सिद्धान्तशेखरे—

"कृत्वा सुवृत्तं फलकं हि षष्ट्या चक्रांशकैश्चाङ्कितमत्र मध्ये।
लम्बस्तदग्रात् सुषिरेण यद्वत् केन्द्रेऽर्करश्मिः पततीति दध्यात् ॥

लम्बेन मुक्ता रविभागतोंऽशास्तत्रोदितास्ते घटिकास्तु याताः।
चक्राख्यमेतद्दलमस्य चापं ज्यामध्यरन्ध्र स्थित लम्बमेतत् ॥"

श्रीपतिनैवमुक्तम् । सुवृत्तं फलकं षष्ट्या चक्रांशैश्चाङ्कितं कृत्वा । अयमर्थः—सुसरलससारदारुजातं वर्त्तुलं पीठाकारं यन्त्रं निर्माय तत्र (यन्त्रे) घटिकाज्ञानार्थं षष्टिर्विभागाः । अंशादिज्ञानार्थं च षष्टयधिकशतत्रयं ३६०विभागाः कार्याः । अस्मिन् यन्त्रे मध्ये (केन्द्रबिन्दौ) अवलम्बयष्टिः—देयः । यद्वत् अवलम्ब-यष्टिमूलगतयन्त्रच्छिद्रेण, अर्करश्मिः (सूर्यबिम्बकेन्द्रतेजः) यन्त्रकेन्द्रे पतति इत्यनेन विधिना यन्त्रं स्थापयेत् । लम्बेन (अवलम्बयष्ट्या) मुक्ताः (त्यक्ता) ये भागास्ते सूर्याधिष्ठितांशात् उदिता भागाः स्युः । घटिकास्तु अवलम्बभुक्ता व्यतीता घटिकाः स्युः । अनेन प्रकारेण निर्मितं यन्त्रं चक्रयन्त्रं स्यात् अस्य चक्र-यन्त्रस्यार्धं चापसंज्ञकं यन्त्रं भवति । एतच्चापयंत्रं ज्यामध्यरन्ध्रस्थितलम्बं कार्यं चक्रयन्त्ररूप वृत्तस्यार्धभागकारिण्या व्यासरेखाया मध्ये रन्ध्रं तत्र लम्बश्च देयः।

अत्रोपपत्तिः।

वृत्ताकारकाष्ठयन्त्रं षष्टिघटीभिः षष्टयधिकशतत्रयां ३६० शैश्चाङ्कितं कृत्वा मध्ये स्वल्परन्ध्रं तद्गतावलम्बयष्टिकं च सूर्याभिमुखं तथा स्थापितं यथैतद्यन्त्रं वर्धितं सत् सूर्यबिम्बकेन्द्रगतं भवेत् । तत इदं दृग्वृत्तानुरूपं जातम् । एतत्केन्द्रे लम्बरूपाया यष्टेश्छाया तत्परिधौ यत्र लगति स बिन्दुः सूर्यकेन्द्रविन्दोः षड्भान्तरे भवेत् । अत्र सूर्योदयकाले सूर्याधिष्ठितांशात् षड्भान्तरे पश्चिम बिन्दावेवावलम्बच्छाया यन्त्रपरिधौ लगति । ततोऽनन्तरं सूर्यो यथा यथोपरि गच्छति तथा तथा लम्बच्छाया पश्चिमबिन्दोरधो गच्छति, त एव लम्बमुक्ता अंशास्ते सूर्याधिष्ठितांशात् आरभ्योन्नतांशा एव । घटिकाभिश्चाङ्कितं यन्त्रमिति यन्त्रमुक्ता घटिकाः सूर्योदयाद् गतघटिका इति । एतच्चक्रयन्त्रस्यार्धं वृत्तार्धरूपं चापयन्त्रमिति । तत्रापि वृत्तार्धकारिण्या व्यासरेखाया मध्ये सूक्ष्मं छिद्रं चक्रयन्त्र-वल्लम्बश्च देयः । चक्रयन्त्रवदेवेहोन्नतांशानामुन्नतघटिकानां च ज्ञानं वृत्तार्धादेव क्रियते । अत्र लल्लोक्तम्—

"वृत्तं कृत्वा फलकं षड्वर्गाङ्कं तथा च षष्टयङ्कम् ।
मध्यस्थितावलम्बं मध्यस्थित्या प्रविष्टोष्णम् ॥

तदधो लम्बविमुक्तं गृहादि यत्तदुदितं दिनकरांशात् ।
नाड्यः पूर्वकपाले द्युगतास्ताः पश्चिमे द्युदलात् ॥

चक्राख्यं यन्त्रमिदं दलं धनुर्यन्त्रमाहुरस्यैव ।
ज्याकार्मुकभृच्छिद्रप्रविष्टदिनकरकरं धार्यम् ॥

मध्यस्थ लम्बमुक्ताः कोटेरारभ्य नाड़िका द्युगताः ।
उदिताश्च दिनकरांशादारभ्य भवन्ति गृहभागाः ॥"

इति श्रीपतिना छन्दोऽन्तरेणोक्तमिति स्फुटमेव गणकानाम् । भास्कराचार्येणापि—

"चक्रं चक्रांशाङ्कं परिधौ श्लथशृङ्खलादिकाधारम् ।
धात्रीत्रिभ आधारात् कल्प्या भार्धेऽत्र खार्धं च ॥
तन्मध्ये सूक्ष्माक्षं क्षिप्ताऽर्काभिमुखनेमिकं धार्यम् ।
भूमेरुन्नतभागास्तत्राक्षच्छायया भुक्ताः ॥
तत्खार्धान्तिश्च नता उन्नतलवसंगुणीकृतं द्युदलम् ।
द्युदलोन्नतांशभक्तं नाड्यः स्थूलाः परैः प्रोक्ताः ॥"

इत्युक्त्या चक्रयन्त्रं तथैव कथितं सिद्धान्तशिरोमणेर्वासनाभाष्यान्मिताक्षराच्छ्रीपतेराशयोऽपि विविच्य विज्ञैर्निरूपणीय इति ॥१८॥

अब चक्र यन्त्र को कहते हैं ।

हि. भा.—चक्रयन्त्र परिधि में भगणांश को अङ्कित करना चाहिये, और द्वादश राशि (बारहों राशि) को भी अङ्कित करना चहिये । इस चक्रयन्त्र परिधि में कल्पित आधार मध्य से लम्ब करना चाहिये । इस चक्रयन्त्र से ग्रहादियों को वेध कर फल धनुर्यन्त्र के बराबर होता है । सिद्धान्तशेखर में "कृत्वा सुवृत्तं फलकं हि पञ्चा चक्रांशकैश्चाङ्कित-मत्र मध्ये" इत्यादि विज्ञान भाष्य में लिखित श्लोकों के अनुसार कहा है, श्लोकों का अर्थ यह है—सरल सार वाली लकड़ी के वर्त्तुलाकार यन्त्र बनाकर उस यन्त्र में घटी ज्ञान के लिये साठ विभाग और अंश ज्ञान के लिये तीन सौ साठ विभाग करना चाहिये । इस यन्त्र के केन्द्रबिन्दु में अवलम्ब यष्टि देनी चाहिये जैसे अवलम्बयष्टिमूलगत यन्त्रछिद्र से सूर्य बिम्ब के तेज यन्त्र केन्द्र में पतित हो इस तरह से यन्त्र को स्थापन करना चाहिये। अवलम्बयष्टि से त्यक्त जो भाग वे सूर्याधिष्ठित अंश (जिस अंश में सूर्य है) से उदित भाग होते हैं । और घटी व्यतीत (गत) घटी होती है । इस चक्रयन्त्र का आधा चाप संज्ञक यन्त्र होता है । चक्रयन्त्ररूप वृत्त को आधा करने वाली व्यास रेखा के मध्य में रन्ध्र (छिद्र) करना और उसमें लम्ब देना ।

उपपत्ति ।

वृत्ताकार काष्ठ के यन्त्र में साठ घटी को और तीन सौ साठ अंश को अङ्कित कर मध्य में छोटा छिद्र कर तद् गत अवलम्बयष्टि को सूर्याभिमुख इस तरह रखना चाहिये जिससे यन्त्र को बढ़ाने से सूर्यबिम्ब के केन्द्र में चला जाय । इसलिये वह दृग्मण्डलाकार

हुआ। इसके केन्द्र में लम्बरूपयष्टि की छाया उसकी परिधि में जहां लगती है वह बिन्दु सूर्यकेन्द्र बिन्दु से षड्भान्तर (छः राशि अन्तर) पर होता है। सूर्योदयकाल में सूर्याधिष्ठित अंश (जिस अंश में सूर्य है) से षड्भान्तर (छः राशि अन्तर) पर पश्चिम बिन्दु ही में अवलम्ब की छाया यन्त्र परिधि में लगती है, उसके बाद ज्यों-ज्यों सूर्य ऊपर जाते हैं त्यों त्यों लम्ब की छाया पश्चिम बिन्दु से नीचे जाती है। वही लम्ब से त्यक्त अंश है, वह सूर्याधिष्ठित अंश से लेकर (आरम्भकर) उन्नतांश ही है। यह यन्त्र घटिकाओं से अङ्कित है इसलिये यन्त्रमुक्त (यन्त्र से त्यक्त) घटी सूर्योदय से गत घटी है। इस चक्रयन्त्र का आधा वृत्तार्ध रूप चाप यन्त्र होता है। उस चाप यन्त्र में भी वृत्त की अर्धकारिणी व्यास रेखा के मध्य में सूक्ष्म छिद्र और तद्गत लम्ब चक्र यन्त्र ही की तरह देना चाहिये। चक्र यन्त्र के अनुसार ही इस चाप यन्त्र में भी वृत्तार्ध ही से उन्नतांश और उन्नतांश और उन्नत घटी का ज्ञान करते हैं। शिष्यधीवृद्धिद तन्त्र में वृत्तं कृत्वा फलकं षड्वर्गाङ्कं तथा च षष्ट्यङ्कम्' इत्यादि विज्ञान भाष्य में लिखित, लल्लाचार्योक्त श्लोकों के आशय को श्रीपति ने श्लोकान्तर से कहा है। सिद्धान्तशिरोमणि के गोलाध्याय में 'चक्रं चक्रांशाङ्कं परिधौ श्लथशृङ्खला धिकाधारम्' इत्यादि श्लोकों से भास्कराचार्य ने भी चक्रयन्त्र उसी तरह कहा है इति ॥१८॥

इदानीं यष्टयाशङ्क्वाद्याह।

यष्टिस्तिर्यग्धार्या नष्टच्छायावलम्बकः शङ्कुः।
दृग्ज्यान्तरमनुपातात् स्वाहोरात्रार्धमग्रा च ॥१९॥

सु. भा.—क्षितिजवृत्तकेन्द्रगता यष्टिस्तथा धार्या यथा सा नष्टच्छाया स्यात्। एवं यष्टिव्यासार्धभवगोले यष्टयग्रे रविकेन्द्रं भवति तस्मात् क्षितिजोपरि योऽवलम्बकः स शङ्कुर्भवति। यष्टिमूलाच्छङ्कुमूलपर्यन्तमन्तरं दृग्ज्या भवति। अनुपातात् यष्टेरनुपातात् स्वाहोरव्यासार्धं द्युज्या तथाऽग्रा च साध्या। उदयकाले रविकेन्द्रोपरि यष्टयनुपातेनार्थाद्यष्टयग्रप्रपातेन क्षितिजे तत्प्राग् बिन्द्वन्तरमग्रांशाः ततः पलकर्णेन द्वादशकोटिस्तदाऽग्रया किं जाता क्रान्तिज्या। तत्कोटिज्या द्युज्या प्रसिद्धैव। 'यष्टयग्राल्लम्बोना ज्ञेया दृग्ज्या नृकेन्द्रयोर्मध्ये' इति तथा उदयेऽस्ते यष्टयग्रप्राच्यपरा मध्यमग्रा स्यात्—इति च भास्करोक्तं चिन्त्यम् ॥ १९ ॥

वि.भा.—क्षितिजवृत्तकेन्द्रगता यष्टिस्तथा धार्या यथा सा नष्टद्युतिर्भवेत्। एवं यष्टिव्यासार्धोत्पन्नगोले यष्टयग्रे रविर्भवति, रविकेन्द्रात् क्षितिज धरातलोपरि योऽवलम्बकः सशङ्कुर्भवति। यष्टिमूलाच्छङ्कुमूल पर्यन्तं दृग्ज्या भवति। यष्टेरनुपातात् स्वाहोरात्रार्धं (द्युज्या) अग्रा च साध्या। यष्टयग्रपूर्वापर रेखयोरन्तरं त्रिज्यावृत्ते ज्यार्धवत् स्थितम्। साग्रा ज्ञेया। ततः पलकर्णेन द्वादशकोटिस्तदाऽग्रया किं जाता क्रान्तिज्या, ततः $\sqrt{\text{त्रि}^2 - \text{क्रांज्या}^2}$ = द्युज्या, "यष्टयाग्राल्ल-

म्बोना ज्ञेया दृग्ज्या नृकेंन्द्रयोर्मध्ये" तथा ,उदयेऽस्ते यष्टयग्रप्राच्यपरामध्यमग्रा स्यात्' इति भास्करोक्तं विविच्य ज्ञेयमिति ॥१९॥

अब यष्टि से शङ्कु आदि को कहते हैं।

हि. भा.—क्षितिजवृत्तकेन्द्रगत यष्टि को इस तरह रखना चाहिये जिससे छायारहित यष्टि हो। एवं यष्टिव्यासार्धोत्पन्न गोल में यष्टि के अग्र में रवि होते हैं। रवि केन्द्र से क्षितिज धरातल के ऊपर लम्ब शंकु है। यष्टि के मूल से शङ्कु मूलपर्यन्त अन्तर दृग्ज्या होती है। यष्टि के प्रपात (पतन) से स्वाहोरात्रार्ध (द्युज्या) तथा अग्रा साधन करना चाहिये अर्थात् उदयकाल में रविकेन्द्र के ऊपर यष्टयग्र के प्रपात से क्षितिज में उसका और पूर्व बिन्दु का अन्तर अग्रा है, तब पलकर्ण में यदि द्वादश कोटि पाते हैं तो अग्रा में क्या इस अनुपात से क्रान्तिज्या आती है, इसकी कोटिज्या $\sqrt{(\text{त्रि}^2 - \text{क्रांज्या})^2}$ = द्युज्या, सिद्धान्त-शिरोमणि के गोलाध्याय में 'यष्टयग्राल्लम्बो ना ज्ञेया दृग्ज्या नृकेन्द्रयोर्मध्ये' तथा 'उदयेऽस्ते यष्टयग्रप्राच्यपरामध्यमग्रा स्यात्' यह भास्करोक्त के विचार करने से स्फुट है इति ॥१९॥

इदानीं यष्टियन्त्रमाह।

परिलिख्य वृत्तमवनौ यष्टिव्यासार्धमन्यदस्यान्तः।
स्वाहोरात्रार्धार्धं घटिका षष्टयङ्कितं परिधौ ॥२०॥
यष्टिव्यासार्धेऽग्रा यष्टयग्रान्तरसमज्ययया धनुषि ।
घटिका द्वितीयवृत्ते याताः प्रागपरतः शेषाः ॥२१॥

सु. भा.—अवनौ समावनौ यष्टिव्यासार्धं वृत्तं परिलिख्यस्यान्तरेककेन्द्र-कमन्यद् द्युज्यावृत्तं च स्वाहोरात्रार्धार्धं स्वाहोरात्रार्धं द्युज्या सैवार्धं व्यासदलं यस्य तच्च परिलिख्यास्य परिधौ घटिकाषष्टयङ्कितं कार्यम्। ततो यष्टिव्यासार्धे गोले यत्र यष्टिर्नष्टद्युतिर्जाता तत्र यष्टिः स्थिरा कार्या। क्षितिजेऽग्रायास्तद्यष्टयग्रस्य च यदन्तरं तत्समा या ज्या पूर्णज्या तया द्वितीयवृत्ते द्युज्यावृत्ते यद्धनुर्भवेत् तस्मिन् धनुषि या घटिकास्ताः प्राक् कपाले याता अपरतः पश्चिमकपाले शेषा दिनशेषा घटिकाः स्युः। 'त्रिज्याविष्कम्भार्धं वृत्तं कृत्वा दिगङ्कितं तत्र' इत्यादिभास्करोक्त-मेतदनुरूपमेव। एकस्मिन् दिने यदि द्युज्या स्थिरा स्यात् तदैवानेन विधिना कालज्ञानमिति स्फुटं सिद्धान्तविदाम् ॥ २०-२१ ॥

वि. भा.—अवनौ (समपृथिव्यां) यष्टिव्यासार्धेन वृत्तं परिलिख्यास्यान्तः (मध्ये) स्वाहोरात्रार्धार्धं (स्वाहोरात्रार्ध) द्युज्या सैवार्धं व्यासार्धं यस्य तच्चैक-केन्द्रकमन्यद् द्युज्यावृत्तं परिलिख्यास्य परिधौ घटिका षष्टयङ्कितं कार्यम्। ततो

यष्टिव्यासार्धगोले यत्र यष्टिर्नष्टद्युतिर्जाता तत्र यष्टिः स्थिरा कार्या। क्षितिजेऽग्रायास्त-द्यष्ट्यग्रस्य च यदन्तरं तत्समा या पूर्णज्या तया द्वितीयवृत्ते (द्युज्यावृत्ते) यद्धनु-(चापं) र्भवेत्तस्मिन् धनुषि (चापे) या घटिकास्ताः पूर्वकपाले गताः, अपरतः पश्चिमकपाले) शेषाः (दिनशेषाः) घटिकाः स्युः। यद्येकस्मिन् दिने द्युज्या स्थिरा भवेत्तदैवानेन विधिना कालज्ञानं भवितुमर्हतीति। सिद्धान्तशेखरे—

"संसाधिताशं कृतचक्रभागं विधाय वृत्तं समभूप्रदेशे।
त्रिज्याङ्गुलाङ्कां सुसमां च यष्टिं नष्टद्युतिं तज्जठरे निदध्यात्॥
तदग्रलम्बः खलु शङ्कुरुक्तस्तन्मूलकेन्द्रान्तरमत्र दृग्ज्या।
पूर्वापरात्तद्विवरं भुजः स्याच्छङ्क्वग्रमस्तोदयसूत्रमध्यात्॥
शङ्क्वग्रमर्कैर्गुणितं विभक्तं तल्लम्बकेन स्फुटमक्षभा स्यात्।
अग्राग्रभागान्नतकालमौर्वी कार्येह खल्वङ्गुलवृत्तजाता॥"

श्रीपतिनैवं कथ्यते; एतेषामयमर्थः—समपृथिव्यां पूर्वादिदिशां ज्ञापकैश्चिन्हैः सहितं षष्ट्यधिकशतत्रयमिताः समाना भागाः कृता यस्मिन् तत्—एतादृशं वृत्तं विधाय तज्जठरे (मध्ये—केन्द्रे वा) स्वेच्छानुसारं यावदङ्गुलतुल्या त्रिज्या कल्पिता भवेत्तावद्भिरङ्गुलचिन्हैश्चिन्हितां सर्वतोऽपि निम्नोन्नतभावरहितां छायाहीनाम-र्थात् सूर्याभिमुखं यष्टिस्तथा स्थापिता भवेद्यथा स्वमार्गे वर्धिता सती सूर्यबिम्ब-केन्द्रं गच्छेत्तादृशीं यष्टिं धारयेत्। यष्ट्यग्रात् भूपरि पात्यमानोलम्बः शङ्कुः। अस्मिन् वृत्ते शङ्कुमूलकेन्द्रान्तरं दृग्ज्या (नतांशज्या) भवति। पूर्वापरसूत्राच्छ-ङ्कुमूलस्यान्तरं भुजसंज्ञको भवति। उदयास्तसूत्राच्छङ्कुमूलं यावच्छङ्क्वग्र-संज्ञकम्। अस्य नाम भास्करेण शङ्कुतलं कथ्यते। शङ्क्वग्रं (शङ्कुतलं) द्वादशभिर्गुणितं पूर्वकथितलम्बेन (शङ्कुना) विभक्तं तदा स्फुटा पलभा स्यात्। स्वदेशसम्बन्धिनी पलभा भवतीति। अग्राग्रबिन्दोरत्र अङ्गुलवृत्तजाता नतांशज्या कार्या। प्रथमं त्रिज्यारूपा यष्टिर्यावन्मिताङ्गुला रचिता तदङ्गुलव्यासार्धवृत्त-सम्बन्धिनी दृग्ज्या कर्त्तव्येति।

अत्रोपपत्तिः।

समायां भुवि कृतदिक्चिन्हं भगणांशाङ्कितं च यद्वृत्तं तत् क्षितिजवृत्तम्। त्रिज्याङ्गुला यष्टिस्त्रिज्यास्वरूपा। सा नष्टद्युतिर्यथा भवेत्तथा धार्या, येन यष्ट्यग्रं वर्धितं सद्रविबिम्बकेन्द्रं गच्छेत्। नष्टद्युतेर्यष्टेरग्रादधो यावान् लम्बस्तावांस्तस्मिन् समये शङ्कुः। त्रिज्यारूपाया यष्टेः शङ्कुरूपलम्बस्य च वर्गान्तरमूलं नतांशज्ये (दृग्ज्या) ति शङ्कुमूवृलत्तकेन्द्रयोरन्तररूपेति। शङ्कुमूलपूर्वापररेखयोरन्तरं भुजः। अग्राग्रयोः (पूर्वापर दिग्गतयोरुपरिगता रेखोदयास्तसूत्रम्) उदयास्तसूत्रस्य शङ्कुमूलस्य चान्तरं शङ्क्वग्रं शङ्कुतलनाम्ना प्रसिद्धम्। तदा शंङ्कुना

यदिशङ्कुतलं भुजो लभ्यते तदा द्वादश शङ्कुना किमित्यनुपातेन समागच्छति पलभा । अग्राग्रबिन्दोरङ्गुलवृत्तजाता नतज्या उन्नतज्या वा कार्येत्यस्यायमाशयः । शङ्कुमूलयष्टिमूलयोरन्तरं दृग्ज्या तत्स्वरूपं प्रथममुक्तम् । अत्र तु नतांशज्या, अग्राग्रबिन्दोः यष्टयङ्गुलमानानुसारेणाङ्गुलात्मकप्रमाणवती आनेया । शङ्कुमूलयष्टिमूलयोरन्तरे एकां सरलशलाकां धृत्वा तामङ्गुलेन मापयित्वा तन्मानं ज्ञेयमिति ।

अत्र लल्लोक्तम्—

दिङ्मध्यस्थितमूला यष्टिर्नष्टप्रभा त्रिगुणतुल्या ।
धार्या तदीयलम्बककाष्ठांशा वोदिता भागाः ।।

यष्टिस्त्रिज्याकर्णो लम्बोना कृतिविशेषपदमनयोः ।
दृग्ज्या छाया प्राक्पर लम्बनिपातान्तरं बाहुः ।।

प्रागपराग्रासक्तं सूत्रं शङ्क्वन्तरं हृतं सूर्यैः ।
यष्टयवलम्बविभक्तं यष्टयवलम्बेन विषुवद् भा ।।"

इति । भास्करोक्तं च—

"त्रिज्याविष्कम्भार्धं वृत्तं कृत्वा दिगङ्कितं तत्र ।
दत्वाऽग्रां प्राक् पश्चाद् द्युज्यावृत्तं च तन्मध्ये ।।

तत्परिधौ षष्टयङ्कं यष्टिर्नष्टद्युतिस्ततः केन्द्रे ।
त्रिज्याङ्गुला निधेया यष्ठयग्राग्रान्तरं यावत् ।

तावत्या मौर्व्या यद् द्वितीयवृत्ते धनुर्भवेत्तत्र ।
दिनगतशेषा नाडयः प्राक् पश्चात् स्युः क्रमेणैवम् ।।"

इति सर्वथा श्रीपत्युक्तसममेवेति ।।२०-२१।।

अब यष्टियन्त्र को कहते हैं।

हि· भा·—समान पृथ्वी में यष्टि व्यासार्ध से वृत्त लिखकर इसके मध्य में द्युज्या व्यासार्ध से एक कैन्द्रिक अन्यद्युज्या वृत्त लिखकर इसकी परिधि में साठ घटी अङ्कित करनी चाहिये। अनन्तर यष्टिव्यासार्धगोले जहां यष्टि नष्टद्युति (छाया रहित) हुई है वहां यष्टी को स्थिर करना। क्षितिज में उस यष्टयग्र का और अग्रा का जो अन्तर है तत्तुल्य पूर्णज्या से द्वितीयवृत्त (द्युज्यावृत्त) में जो चाप हो उस चाप में जो घटी है वह पूर्वकपाल में दिनगत घटी होती है और पश्चिमकपाल में दिनशेषघटी होती है । यदि एक दिन में द्युज्या स्थिर मानीजाय अर्थात् एक दिन में रवि की क्रान्ति स्थिर हो तब ही इस विधि से कालज्ञान हो सकता है। सिद्धान्तशेखर में 'संसाधितायां कुलचक्रभागं विधायवृत्तं समभूप्रदेशे। त्रिज्याङ्कुलाङ्कां' इत्यादि श्लोकोक्त के अनुसार कहते हैं। इन श्लोकों का अर्थ यह है कि समान

पृथिवी प्रदेश में वृत्त लिखकर उसमें पूर्वादि दिशाओं के सूचक चिन्ह अङ्कित करना तथा तीन सौ साठ समान भाग कर देना, उसके मध्य (केन्द्र) में अपनी इच्छा के अनुसार जितने अङ्गुल की त्रिज्या हो उतनी अङ्गुल संख्या से चिन्हित और सब तरह से समान छायाहीन अर्थात् सूर्याभिमुख यष्टि इस तरह रखी जाय जिससे स्वमार्ग में यष्टि को बढ़ाने से सूर्यबिम्ब केन्द्र में चली जाय। यष्ट्यग्र से भू (क्षितिज) के ऊपर लम्बशङ्कु होता है। इस वृत्त (पूर्व लिखितवृत्त) में शङ्कुमूल और केन्द्र के अन्तर दृग्ज्या (नतांशज्या) होती है शङ्कुमूल से उदयास्त सूत्रपर्यन्त लम्बरूप अन्तर भुज है। शंकुमूल से उदयास्त सूत्रपर्यन्त लम्बरूपरेखा शङ्क्वग्र संज्ञक है यही शङ्कुतल हैं। शङ्क्वग्र (शङ्कुतल) को बारह से गुणाकर पूर्वकथित लम्ब (शङ्कु) से भाग देने से स्फुट पलभा होती है। पहले त्रिज्यारूप यष्टि जितनी अङ्गुल की बनाई गई तदङ्गुल व्यासार्धवृत्त सम्बन्धिनी दृग्ज्या करनी चाहिये इति ।।

उपपत्ति।

समान पृथिवी में इष्ट त्रिज्या से वृत्त बनाकर उसमें दिशाओं के चिन्ह अङ्कित कर देना तथा भगणांश अङ्कित कर देना चाहिये वह क्षितिज वृत्त है। त्रिज्याङ्गुल यष्टि को इस तरह रखना चाहिये जिससे उसकी छाया नष्ट हो तथा उसको बढ़ाने से यष्ट्यग्र रवि बिम्बकेन्द्र में चला जाय। नष्टद्युति (छाया रहित) यष्ट्यग्र से नीचे जितना लम्ब है उतना उस समय में शङ्कु है । त्रिज्यारूप यष्टि और शङ्कुरूप लम्ब का वर्गान्तरमूल नतांशज्या (दृग्ज्या) शङ्कुमूल और वृत्तकेन्द्र का अन्तर रूप होता है। शङ्कुमूल से पूर्वापर रेखा के ऊपर लम्ब भुज है । अग्राग्रगत (पूर्व पश्चिम दिग्गत अग्राद्वयगत) रेखा उदयास्तसूत्र है। उदयास्तसूत्र और शङ्कुमूल का लम्बरूप अन्तर शङ्क्वग्र (शङ्कुतल) है। तब अनुपात करते हैं यदि शङ्कु में शङ्कुतल भुज पाते हैं तो द्वादशाङ्गुल शङ्कु में क्या इस अनुपात से स्फुट पलभा आती है। शङ्कुमूल और यष्टिमूल का अन्तर दृग्ज्या है इसका स्वरूप पहले कहा गया है। यहां नतज्या—अग्राग्र बिन्दु से यष्ट्यङ्गुल मान के अनुसार अङ्गुलात्मक प्रमाण वाली लानी है। शङ्कुमूल और यष्टिमूल के अन्तर में एक सरल शलाका रख कर उसको अङ्गुल से मापन कर उसका मान समझना चाहिये। यहां लल्लाचार्य "दिङ्मध्य-स्थित मूला यष्टिर्नष्टप्रभा त्रिगुणतुल्या" इत्यादि विज्ञान भाष्य में लिखित श्लोकों के अनुसार कहते हैं सिद्धान्तशिरोमणि के गोलाध्याय में" त्रिज्या विष्कम्भार्धं वृत्तं कृत्वा दिगङ्कितं तत्र" इत्यादि विज्ञानभाष्य में लिखित श्लोकों से भास्कराचार्य सर्वथा श्रीपत्युक्त के समान ही कहा है इति ।।२०-२१।।

इदानीं प्रकारान्तरेण घटिकानयनमाह।

यष्टेः स्वाहोरात्रार्धभाजिताऽन्तरदलाहता त्रिज्या।
फलचापांशा द्विगुणाः षड्भिर्वा भाजिता घटिकाः ।।२२।।

सु. भा.—पूर्वमग्रा यष्ट्यग्रयोरन्तरं मित्वा यद्गृहीतं तस्य दलं कार्यम्। तेनान्तरदलेन त्रिज्याऽऽहता यष्टेः स्वाहोरात्रार्धेन यष्टिव्यासार्धभवद्युज्यया भाजिता फलचापांशा द्विगुणाः षड्भिर्भाजिता वा घटिकाः स्युरिति।

अत्रोपपत्तिः।

अन्तरं घटयंशपूर्णज्याऽतस्तदर्धं तदर्धज्या द्युज्याव्यासार्धे ततोऽनुपातेन त्रिज्यावृत्ते परिणता कृता तस्याश्चापं द्विगुणमंशात्मकं तत् षड्भिर्विभज्य घटिकाः कृता इति स्फुटम्॥ २२॥

वि. भा.—पूर्वमग्राग्रयष्ट्योरन्तरं मित्वा यद् गृहीतं तस्यार्धं कार्यम्। त्रिज्या तेनान्तरार्धेन गुणिता यष्टेः स्वाहोरात्रार्धेन (यष्टिव्यासार्धोत्पन्नद्युज्यया) भक्ता फलचापांशा द्विगुणाः षड्भिर्भक्ता वा घटिकाः स्युरिति॥

अत्रोपपत्तिः।

अन्तरं घटयंशपूर्णज्या, एतस्या अर्धं घटयंशार्धज्या द्युज्याव्यासार्धे, ततोऽनुपातेन 'द्युज्याव्यासार्धे यदीयं घटयंशार्धज्या लभ्यते तदा त्रिज्याव्यासार्धे किं समागच्छति त्रिज्याव्यासार्धे घटयंशार्धज्या तत्स्वरूपम् $= \frac{\text{ज्या } \frac{1}{2} \text{ घटयंश. त्रि}}{\text{द्यु}}$

अस्याश्चापं द्विगुणमंशात्मकं तत् षड्भिर्भक्तं तदा घटिकाः स्युरिति॥

सिद्धान्तशेखरे

"न्यस्येदग्रां प्राक् प्रतीच्यग्रतोऽत्र याम्योदक्स्था मध्यदेशान्नतज्या।
साध्यः शङ्कुस्तन्मितिभ्यां भ्रमस्तु देयस्तस्मिन् स्वोदयात् स्वाग्रकाग्रात्॥
विरचित समयांशस्तन्मितंशङ्कुमस्मिन् तदुदरगतभाग्रं स्थापयेदग्रकाग्रात्।
तदवधि विगतास्ते कालभागा भवेयुर्दिनगतघटिकाः स्युः कालभागारसाप्ताः॥'

श्रीपतिनैवं कथ्यते। अस्यार्थः—अत्रास्मिन् पूर्वलिखितवृत्ते प्राक् प्रतीच्यग्रतः (पूर्वापरबिन्दुभ्यां) अग्रां न्यस्येत्। मध्यदेशात् (वृत्तकेन्द्रबिन्दोः) याम्योदक्स्था (दक्षिणदिक्स्था, उत्तर दिक्स्था वा) नतज्या देया। तन्मितिभ्यां (अग्रान्तज्ययोर्मानाभ्यां) शङ्कुः साध्यः। तस्मिन् वृत्ते भ्रमः—अहोरात्रवृत्तं—विरचितसमयांशः (विरचिताश्चिन्हिताः समयांशा यस्मिन्) षष्टिघटीभिरहोरात्रवृत्तं चिन्हितं (अङ्कित) भवति, अत्राहोरात्रवृत्तमंशात्मकमर्थात् षष्ट्यधिकशतत्रय भागात्मकं कार्यम्। तच्च स्वोदयात् (स्वोदयबिन्दोः) स्वाग्रकात् (अग्राग्रबिन्दोः) दातव्यः। अस्मिन् षष्ट्यधिकशतत्रयभागाङ्कितेऽहोरात्रवृत्ते तन्मितंशङ्कु (अग्रानत

ज्ययोर्मानानुसारेण मापितमङ्गुलात्मकं शङ्कुं तदुदरगतभाग्रं यथा स्यात्तथा स्थापयेत् । अग्रकाग्रात् तदवधि (अग्राग्रबिन्दोः) शङ्कुमूलपर्यन्तमहोरात्रवृत्ते येंऽशास्ते गता कालभागाः स्युः । ते कालभागाः षड्भिर्भक्ता सन्तो दिनगत घटिका भवेयुरिति ॥

अस्योपपत्तिः ।

समभूमौ वृत्तकरणं यष्टेः शङ्कोश्च स्वरूपादिकं कथितमेव । अत्र पूर्वापर-बिन्दुभ्यामङ्गुलात्मिकाऽग्रा वृत्तकेन्द्रबिन्दोश्च नतज्या दत्ता, यष्ट्यग्रबिन्दोर्लम्बरू-पोऽङ्गुलात्मकः शङ्कुस्तदनुसारिमानेन मापितश्चक्रभागाङ्कितेऽहोरात्रवृत्ते यष्टि-संलग्नस्तथा स्थापितो यथा छायाग्रं वृत्तकेन्द्रे पतेत् । एवमग्राग्रबिन्दोः शङ्कुमूल-पर्यन्तमहोरात्रवृत्तीयमंशादिमानं कालभागाः स्युरिति । अत्र श्री भास्कराचार्येण "अग्राग्रउदितो रविर्यथा यथाऽहोरात्रवृत्त गत्योपरि गच्छति तथा तथा केन्द्रे निवेशितमूलाया यष्टेरग्रे भ्राम्यमाणे यष्टिनष्टद्युतिः स्यात् । यतो यष्ट्यग्रे रविः । अग्राग्रादर्कं यावदहोरात्रवृत्ते यावत्यो घटिकास्तावत्यो दिनगता भवन्ति । तत्राकाशे द्युज्यावृत्तं लेखितुं नायाति ।

अतोऽग्राग्र यष्ट्यग्रयोरन्तरं शलाकया मित्वा गृहीतम् । ततो भुवि लिखिते द्युज्यावृत्ते तया शलाकया ज्यारूपया धनुषि घटिकाज्ञानं युक्तियुक्तम् ॥"

इत्युच्यते, अनयोर्भावनया श्रीपत्युक्तं भास्करोक्तं च सर्वमुपपद्यते । अत्र कलांशाः षड्भक्ता घटिका भवन्त्यहोरात्रवृत्ते शष्ट्यधिकशतत्रयमंशा अङ्किताः सन्ति तेन षष्टिघटिकानुसारेण षड्भिरंशैरेका घटिका भवतीति । श्रीपत्युक्तमिदं यष्टियन्त्रेण समयज्ञानं भास्करोक्तं च लल्लोक्तस्य—

"अग्राग्राच्छङ्कुभ्रमवृत्ते कालांशकैर्लिखेद्राशिम् ।
दिङ्मध्यच्छायाग्रं कृत्वाऽत्र स्थापयेच्छङ्कुम् ॥
अग्राग्राच्छङ्कुतलान्तरस्थिता वा समुद्गता भागाः ।
कालांशाः षट्कहृता भवन्ति घटिका दिनस्य गताः ॥
इत्यस्यैवानुरूपमिति विज्ञैर्विवेच्यम् ॥२२॥

अब प्रकारान्तर से घटिकानयन को कहते हैं ।

हि॰ भा॰—पहले अग्राग्र और यष्ट्यग्र के अन्तर को मापन कर जो लिया गया है । उसके आधे को त्रिज्या से गुणाकर यष्टि व्यासार्धोत्पन्न द्युज्या से भाग देने से जो फल हो उसके चापांश को दो से गुणा कर छः से भागदेने से वा (प्रकारान्तर से) घटी होती है इति ॥

उपपत्ति ।

अग्राग्र और यष्टयग्र के अन्तर घटयंश की पूर्णज्या है। इसका आधा द्युज्याव्यासार्ध में घटयंशार्धज्या होती है। तब अनुपात करते हैं यदि द्युज्याव्यासार्ध में यह घटयंशार्धज्या पाते हैं तो त्रिज्या व्यासार्ध में क्या इस अनुपात से त्रिज्याव्यासार्ध में घटयंशार्धज्या आती है उसका स्वरूप = $\frac{\text{ज्या } \frac{१}{२} \text{ घटयंश.त्रि}}{\text{द्यु}}$ इसके चाप को दो से गुणा करने से अंशात्मक होता है उसको छः से भाग देने से घटी होती है इति। सिद्धान्तशेखर में "न्यसेदग्रां प्राक् प्रतीच्यग्रतोऽत्र याम्योदकस्था मध्यदेशान्नतज्या" यहां संस्कृतोपपत्ति में लिखित श्लोकों के अनुसार श्रीपति कहते हैं। इन श्लोकों का अर्थ यह है—इस पूर्वलिखित वृत्त में पूर्वबिन्दु और पश्चिम बिन्दु से अग्रा का न्यास करना चाहिये। वृत्त के केन्द्र बिन्दु से दक्षिण दिशा में वा उत्तर दिशा में नतज्या दान देना चाहिये अग्रा और नतज्या के मानों से शङ्कु स.धन करना। उस वृत्त में अहोरात्रवृत्त साठ घटी से अङ्कित होता है यहां अहोरात्रवृत्त को अंशात्मक अर्थात् तीन सौ साठ अंशात्मक करना चाहिये। वह अग्राग्र बिन्दु से देना चाहिये अर्थात् अहोरात्रवृत्त में अंश बिभाग स्वोदयबिन्दु (अग्राग्रबिन्दु) से करना चाहिये। इस तीन सौ साठ अंश से अङ्कित अहोरात्रवृत्त में अग्रा और नतज्या के मानानुसार मापित शङ्कु को उसके मध्यगत छायाग्र में जैसे हो वैसे स्थापन करना चाहिये। अग्राग्र बिन्दु से शङ्कुमूल पर्यन्त अहोरात्रवृत्त में जो अंश है वे गतकलांश है, उन गतकलांश को छः से भाग देने से दिनगत घटी होती है इति ॥

इसकी उपपत्ति ।

समान पृथिवी में वृत्त रचना और यष्टि-शङ्कु के स्वरूपादि पूर्व में कथित ही है। इस वृत्त में पूर्व बिन्दु और पश्चिम बिन्दु से अग्रा दान देना तथा वृत्त केन्द्र बिन्दु से नतज्या देनी चाहिये। यष्टयग्र बिन्दु से लम्बरूप अङ्गुलात्मकशङ्कु को चक्रभाग (३६० अंश) से अङ्कित अहोरात्रवृत्त में यष्टि से संलग्न उस तरह स्थापना करना चाहिये जिससे छायाग्र वृत्तकेन्द्र में पतित हो। इस तरह अग्राग्र बिन्दु से शङ्कुमूल पर्यन्त अहोरात्रवृत्तीय अंशादिमान कालभाग होते हैं। यहां भास्कराचार्य संस्कृतोपपत्ति में लिखित 'अग्रागउदितो-रविः' यहां से लेकर घटिकाज्ञानं युक्ति युक्तं पर्यन्त' कहते हैं, इन दोनों का विचार करने से श्रीपत्युक्त और भास्करोक्त भी उपपन्न होता है। यहां कालांश को छः से भाग देने से घटी होती है। अहोरात्रवृत्त में तीन सौ साठ अंश अङ्कित है इसलिये साठ घटी के अनुसार छः अंश में एक घटी होती है। यह श्रीपत्युक्त यष्टियन्त्र से समय ज्ञान भास्करोक्त भी शिष्यधी-वृद्धिद तन्त्र में लल्लोक्त 'अग्राग्राच्छङ्कुभ्रमवृत्ते कालांशकैर्लिखेद्राशिम्' इत्यादि संस्कृतोपपत्ति में लिखित इन श्लोकों के अनुरूप ही इसको विवेचक लोग विचार कर देखें इति ॥२२॥

अथवा घटिकानयनमाह ।

यष्टिव्यासार्धे वा घटिका शङ्क्वङ्गुलादितो मूलात् ।
अवलम्ब सूत्र युक्त्या घटिका दिवसस्य गतशेषाः ॥२३॥

सु. भा.—वा यष्टिव्यासार्धे गोले शङ्क्वङ्गुलादितो मूलात् शङ्कुतलाच्च घटिकाः साध्याः । शङ्कुतलात् शङ्कोश्चेष्टहृतिमानीय ततो द्युज्यानुपातेनेष्टान्त्यां सूत्रं चानीय त्रिप्रश्नोक्त्या घटिका साध्या इत्यर्थः । अर्थाद् गोलरचनां विनैव नष्टद्युतेर्यष्टेरग्रादवलम्बकं कृत्वा शङ्कुं विज्ञाय १९ सूत्र युक्त्या द्युज्येष्टान्त्यादिना त्रिप्रश्नोक्त्या गतशेषा घटिका ज्ञेयाः ॥ २३ ॥

वि. भा.—वा यष्टिव्यासार्धे गोले शङ्क्वङ्गुलादितो मूलात् (शङ्कुतलाच्च) घटिकाः साध्याः । अर्थात् $\sqrt{\text{शङ्कु}^2 + \text{शंतल}^2}$=इहृति ततो द्युज्ययेष्टहृतिर्लभ्यते तदा त्रिज्यया किं समागतीष्टान्त्या= $\frac{\text{इहृति.त्रि}}{\text{द्यु}}$ ततश्चरज्या संस्कारेण सूत्रज्ञानं ततः 'अथोन्नताद्रूनयुताच्चरेणेत्यादि' भास्करोक्तविधिनोन्नतकालाववोधः सम्यग्भवतीति । वा ऽवलम्वसूत्रयुक्त्या दिवसस्य गतशेषा घटिकाः साध्या अर्थाद्गोलरचनां विनैव नष्टद्युतेर्यष्टेरग्रादवलम्बकं कृत्वा शङ्कुं ज्ञात्वा १९ सूत्रयुक्त्या द्युज्यां तत इष्टान्त्यां ज्ञात्वोपर्युक्तरीत्या दिनस्य गतघटिकाः शेषघटिकाश्च विज्ञातव्या इति ॥२३॥

अब पुनः घटिकानयन को कहते हैं ।

हि. भा.—वा यष्टिव्यासार्धगोल में शङ्क्वङ्गुल और शङ्कुतल से घटी साधन करना चाहिये अर्थात् $\sqrt{\text{शङ्कु}^2 + \text{शंतल}^2}$ = इहृति । तब अनुपात 'द्युज्या में इष्टहृति पाते हैं तो त्रिज्या में क्या' से इष्टान्त्या का ज्ञान होता है इसमें चरज्या संस्कार करने से सूत्र का ज्ञान होता हैं तब 'अथोन्नताद्रूनयुताच्चरेणेत्यादि' भास्करोक्त सूत्र से उन्नतकाल ज्ञान होता हैं । अथवा अवलम्बसूत्र युक्ति से दिनगतघटी और दिनशेष घटी साधन करना चाहिये अर्थात् बिना गोल रचना के नष्ट द्युति यष्टि के अग्र से अवलम्बसूत्र कर शङ्कु को जानकर १६ सूत्र युक्ति से द्युज्या ज्ञान से इष्टान्त्या जानकर त्रिप्रश्नोक्त विधि से दिनगतघटी और दिनशेष घटी का ज्ञान सुलभ ही है इति ॥२३॥

इदानीं यष्टियन्त्रेण वेधेन रविचन्द्रान्तरांशानाह ।

यष्टिव्यासार्धाद् भुवि वृत्तं भगणांशकं कृत्वा ।
यष्टिकीलप्रोते मूले पृथगग्रयोर्बद्धे ॥२४॥

ताभ्यां सूर्यशशाङ्कौ वेध्यावग्रस्थितेन सूत्रेण ।
सूत्रज्ययाऽन्तरांशा ये तेऽर्कविभाजिता स्तिथयः ।।२५।।

सु० भा०—यष्टिव्यासार्धात् समभुवि भगणांशकं चक्रांशाङ्कितं वृत्तं कृत्वा केन्द्रगतः कीलः कार्यः । कीलप्रोते द्वे यष्टी वृत्तव्यासार्धं प्रमाणे कार्ये । किंविशिष्टे यष्टी मूले पृथगग्रयोर्बद्धे । यत्र कीले यष्टिमूलाग्रे ते एकत्र मिलिते कार्ये इत्यर्थः । ताभ्यां मूलमिलिताभ्यां यष्टिभ्यां मूलस्थदृष्टचा युगपदेकैकयष्टचग्रगतौ सूर्यशशाङ्कौ गणकेन यष्टचग्रयोर्गतं यत् सूत्रं तेन सूत्रेण वेध्यौ । तत् सूत्रं च रविचन्द्रान्तरांशपूर्णज्या गोलयुक्तचा भवति । अतस्तत्सूत्रज्यया पूर्णज्यया क्षितिजवृत्तं यद्धनुस्ते रविचन्द्रयोरन्तरांशा भवन्ति । एवं येऽन्तरांशास्तेऽर्कविभाजिता द्वादशभक्तास्तिथयः स्युरिति ।। २४-२५ ।।

वि. भा.—समपृथिव्यां यष्टिव्यासार्धात् वृत्तं कार्यं तच्च चक्राशाङ्कितं कृत्वा तत्केन्द्रगतः कीलः कार्यः । कीलप्रोते वृत्तव्यासार्धं प्रमाणे द्वेयष्टी कार्ये । मूले पृथगग्रयोर्वद्धे (कीले यष्टिमूलाग्रे एकत्र मिलिते कार्ये) ताभ्यां मूलमिलिताभ्यां यष्टिभ्यां मूलस्य दृष्टचा युगपदेकैक यष्टचग्रगतौ सूर्य चन्द्रौ यष्टचग्रयोर्गतेन सूत्रेण वेध्यौ । तद्यष्टचग्रगतं सूत्रं रविचन्द्रान्तरांश पूर्णज्या भवति अतस्तत् सूत्रज्यया (पूर्णज्यया) क्षितिजवृत्ते यच्चापं ते रवि चन्द्रान्तरांशा भवति । तेऽन्तरांशा द्वादश भक्ता स्तदा तिथयो भवन्तीति । सिद्धान्तशेखरे

"वृत्ते चक्रकलाङ्किते‌ऽक्ष शकटाकारं शलाकाद्वयं कृत्वा तेन विवेधयेद्रविविधू लम्बस्य पातस्तयोः ।
यावन्तः परिधौ तदन्तरलवाः सूर्यैर्विभक्ता गताः शुक्ले स्युस्तिथयो भवन्ति बहुले पक्षे च भोग्याः स्फुटम् ।।

श्रीपतिनोक्तमाचार्योक्तानुरूपमेव । अस्य सूत्रस्यायमर्थः—भगणांशाङ्कितेऽत्रवृत्ते शकटाकारं शलाकाद्वयं मूले दृढ़विद्धं यष्टिद्वयं विधाय तेन शलाकाद्वयेन सूर्यचन्द्रौ वेधयेदर्थात् यष्टचोर्मूले एकत्र कृत्वा मूलमिलिताभ्यां तभ्यां यष्टिभ्यां मूलस्थ दृष्टचा यष्टचग्रगतौ सूर्यचन्द्रौ वेधयेत् (तयोर्यष्टग्रगतयो रविचन्द्रयो र्लम्बस्य पातः कार्योर्थाद्रविवेधकारि यष्टचग्रादेको लम्बश्चन्द्रवेधकारि यष्टचग्राच्चान्योलम्बः कार्यः । यावन्तः परिधौ तदन्तरलवा । अयमर्थः लम्बयोरन्तरं यत् तत्परिधौ तस्य येऽन्तरांशा अर्थाज्ज्यावत्सम्पादितस्य लम्बान्तरस्य परिधौ यावन्मिता अंशाः स्युस्ते द्वादशभिर्भाजिताः सन्तः शुक्लपक्षे गतास्तिथयः स्युः । बहुले पक्षे (कृष्णपक्षे) भोग्या अवशेषास्तिथयो भवन्तीति ।

अत्रोपपत्तिः ।

तत्र लम्बनिपाताभ्यां तयोरन्तरं ज्यावद्यद् भवति शकटाकारेण धृतं शला–

काद्वयं तथैव तस्मिन् वृत्ते स्थापितं सद्वा येंऽशास्ते रविचन्द्रयोरन्तरांशा एव भवन्ति। सूर्यचन्द्रयोरन्तरांशा द्वादशभक्तास्तिथयो भवन्तीति स्फुटमेव। केवलं गणितेन तिथ्यानयने सूर्योनचन्द्रांशाः क्रियन्ते ते द्वादशभक्तास्तदा शुक्लप्रतिपदादिकास्तिथयो भवन्ति। अत्र तु अन्तरांशा आयान्तीति चन्द्रोनसूर्यांशस्थले तदन्तरांशा द्वादशभक्ता इति चन्द्रतो रविपर्यन्तमर्थाद्रविचन्द्रयोः पुनर्योगात्मकामावास्यापर्यन्तं तिथयो भवन्ति ता एव भोग्यास्तिथय इति। अत्र लल्लश्च--

"शकटाकृतियष्टिभ्यां विद्ध्वा रविशीतगू तदवलम्बे।
भगणांशाङ्के वृत्ते मुक्त्वा संलक्षयेत् स्थाने॥
अन्तरमनयोर्भागा हि सूर्यशशिनोर्दिवाकरविभक्ताः।
तिथयः शुक्ले याताः कृष्णे शेषाः फलं भवति॥"

इत्येतदनुरूपमेव श्रीपत्युक्तमिति॥२४-२५॥

अब यष्टि यन्त्र द्वारा वेध से रवि और चन्द्र के अन्तरांशानयन को कहते हैं।

हि. भा.— समान पृथिवी में यष्टि व्यासार्ध से वृत्त बनाकर चक्रांश से अङ्कित कर उसको केन्द्रगत कील करना चाहिये। कीलगत वृत्त के व्यासार्ध तुल्य दो यष्टि करना, कील में दोनों यष्टियों के मूल को मिलाकर रखना चाहिये। उन मूल मिलित यष्टिद्वय से मूलस्थ दृष्टि द्वारा एक ही समय में एक एक यष्ट्यग्रगत सूर्य और चन्द्र को यष्ट्यग्रगत सूत्र से वेध करना चाहिये। वह यष्ट्यग्रगत सूत्र रवि और चन्द्र की अन्तरांश पूर्णज्या होती है। अतएव उस पूर्णज्या से क्षितिज वृत्त में जो चाप होता है वह रवि और चन्द्र का अन्तरांश होता है। उस अन्तरांश को बारह से भाग देने से तिथि होती है। सिद्धान्तशेखर में "वृत्ते चक्रलवांङ्कितेऽत्र शकटाकारं शलाकाद्वयं" इत्यादि विज्ञान भाष्य में लिखित श्लोक के अनुसार श्रीपति कहते हैं। इस श्लोक का अर्थ यह है भगणाङ्कित वृत्त में शकटाकार मूल में मिली हुई दो यष्टियों से सूर्य और चन्द्र को वेध करना अर्थात् दोनों यष्टियों के मूल मिलाकर मूलस्थ दृष्टि से यष्टिद्वय द्वारा यष्ट्यग्रगत सूर्य और चन्द्र को वेध करना चाहिये। यष्ट्यग्रगत रवि और चन्द्र से लम्ब गिराना चाहिये। परिधि में लम्बान्तर के जितने अंश हैं उनको बारह से भाग देने से शुक्लपक्ष में गत तिथि होती है। कृष्णपक्ष में भोग्य (अवशिष्ट) तिथि होती है इति।

उपपत्ति।

मूल में मिली हुई दो यष्टियों से सूर्य और चन्द्र को वेध करना चाहिये, वेध करने से यष्ट्यग्रगत सूर्य और चन्द्र से लम्ब गिराने से लिखित वृत्त में लम्बान्तर के जितने अंश हैं वे सूर्य और चन्द्र के अन्तरांश होते हैं। उनको बारह से भाग देने से तिथि होती हैं। केवल गणित से तिथि साधन में चन्द्र में सूर्य को घटाने से जो अन्तरांश होता है उस को बारह से

भाग देने से शुक्ल प्रतिपदादिक तिथि होती है। यहां तो अन्तरांश आते हैं इसलिये चन्द्र-रहित सूर्य (अन्तरांश) को बारह से भाग देने सेच न्द्र से रवि पर्यन्त अर्थात् रवि और चन्द्र की पुनः योगात्मक अमावास्या पर्यन्त तिथि होती है वे ही भोग्य तिथियां हैं। यहां लल्लाचार्य ने—"शकटाकृति यष्टिभ्यां विद्ध्वा रविशीत गूतदवलम्बे" इत्यादि संस्कृतोपपत्ति में लिखित श्लोकों के अनुसार कहा है। लल्लोक्त के अनुरूप ही श्रीपत्युक्त है इति ।।२४-२५।।

इदानीं प्रकारान्तरेणान्तरांशानयनमाह ।

सूत्रार्धगुणा त्रिज्या यष्टिहृता फलधनुर्द्विगुणितं वा ।
रविचन्द्रान्तरमिष्टव्यासार्धोल्लिखितवृत्तस्य ।।२६।।

सु. भा.—पूर्वं यत् पूर्णज्यासमं सूत्रमागतं तस्यार्धेन त्रिज्या गुणा यष्टिहृता फलधनुर्द्विगुणितं वा रविचन्द्रान्तरं भवति । इष्टव्यासार्धोल्लिखितवृत्तस्याग्रे सम्बन्धः ।

अत्रोपपत्तिः ।

सूत्रार्धं यष्टिव्यासार्धे रविचन्द्रान्तरार्धज्या सा त्रिज्या व्यासाध परिणता । तद्धनुर्द्विगुणमन्तरांशा भवन्ति ।।२६।।

वि. भा.—पूर्वश्लोकोपपत्तौ रविचन्द्रान्तरपूर्णज्यासमं यत्सूत्रं समागत तेन त्रिज्या गुणिता यष्ट्या भक्ता लब्धस्य चापं द्विगुणितं वा रविचन्द्रान्तरांशा भवन्तीति । इष्टव्यासार्धोल्लिखितवृत्तस्याग्रे सम्बन्धः ।

अत्रोपपत्तिः ।

अथ सूत्रम्=रविचन्द्रान्तरांश पूर्णज्या, अतः $\frac{\text{सूत्र}}{२}$=ज्या$\frac{१}{२}$ रविचन्द्रान्तरांश, इयं यष्टिव्यासार्धेऽस्ति, ततो ऽनुपातेनेष्ट त्रिज्या व्यासार्धे समानीयते, यदि यष्टिव्यासार्धे इयं रविचन्द्रान्तरार्धज्या लभ्यते तदा त्रिज्या व्यासार्धे किं समागच्छति त्रिज्या व्यासार्धे रविचन्द्रान्तरार्धज्या तत्स्वरूपम् $\frac{\frac{\text{सूत्र}}{२}\times\text{त्रि}}{\text{यष्टि}}$ अस्याश्चापं रविचन्द्रान्तरार्धम् । द्विगुणितं तदा रविचन्द्रान्तरांशा भवन्तीति ।।२६।।

अब प्रकारान्तर से अन्तरांशानयन कहते हैं।

हि. भा.—पूर्वश्लोक में रविचन्द्रान्तरांश की पूर्णज्या तुल्य जो सूत्र आया है उससे त्रिज्या को गुणा कर यष्टि से भाग देने से जो लब्ध हो उसके चाप को द्विगुणित करने से रविचन्द्रान्तरांश होता है इति।

उपपत्ति।

सूत्र = रविचन्द्रान्तरांश पूर्णज्या, अतः $\frac{\text{सूत्र}}{२}$ = ज्या $\frac{१}{२}$ रविचन्द्रान्तरांश, यह यष्टि-व्यासार्धगोलीय है। इसको त्रिज्याव्यासार्ध में परिणत करते है। यदि यष्टि व्यासार्ध में यह रवि चन्द्रान्तरार्धज्या पाते हैं तो त्रिज्या व्यासार्ध में क्या इससे त्रिज्या व्यासार्ध में रवि चन्द्रान्तरार्धज्या आती है। इसके चाप को द्विगुणित करने से रविचन्द्रान्तरांश होता है इति ॥२६॥

इदानीं यष्टियन्त्रेण दिक्साधनमाह।

मध्यघृताया यष्टेर्लम्बकशङ्कू प्रवेशनिर्गमने।
क्रान्तिवशात् प्राच्यपरे मत्स्याद्याम्योत्तरे साध्ये ॥२७॥

सु. भा.—समावनाविष्टव्यासार्धेन लिखितस्य वृत्तस्य मध्ये स्थापित-कीलस्य छाया पूर्वकपालस्थे रवौ यत्र प्रतीच्यां परिधौ लगति स प्रवेशबिन्दुः। यत्र च पश्चिमकपालस्थे रवौ प्राचि लगति स निर्गमनबिन्दुः। तत्र प्रवेशनिर्गमने समये मध्यघृताया यष्टेर्नष्टद्युतेरग्राल्लम्बं विधाय द्वौ समौ शंकू साध्यौ। ताभ्यां तत्तत्कालक्रान्तिवशात् त्रिप्रश्नोक्तया भुजान्तरं विधाय प्राच्यपरे साध्ये ताभ्यां मत्स्याद्याम्योत्तरे च साध्ये इति सर्वं त्रिप्रश्नाधिकारतः स्फुटम् ॥२७॥

वि. भा.—समपृथिव्यामिष्टव्यासार्धेन लिखितवृत्तस्य केन्द्रे स्थापितस्य कीलस्य छाया पूर्वकपालस्थे रवौ यत्र पश्चिमदिशि वृत्तपरिधौ लगति स छाया-प्रवेशबिन्दुः। पश्चिमकपालस्थे रवौ कीलच्छाया पूर्वदिशि वृत्तपरिधौ यत्र लगति स छायानिर्गमनबिन्दुः। तत्र प्रवेशनिर्गमनसमये केन्द्रस्थयष्टे (कीलस्य) र्नष्टद्युतेरग्राल्लम्बं विधाय द्वौ समौ शङ्कू साध्यौ, ताभ्यां (शङ्कुभ्यां) तत्तत्काल-क्रान्तिवशाद् भुजान्तरं कृत्वा पूर्वापरे साध्ये ताभ्यां मत्स्योत्पादनेन याम्योत्तरे साध्ये इति।

अत्रोपपत्तिः ।

छायाप्रवेशनिर्गमनसमये केन्द्रस्थयष्टेरग्राल्लम्बं विधाय द्वौ समौ शंकू साध्यौ, तदा $\frac{\text{शङ्कुतल}\times १२}{\text{शङ्कु}}$ =पलभा । ततः $\sqrt{\text{पलभा}^{२}+१२^{२}}$ =पलकर्णः । क्रान्तिज्ञानं तु वर्त्तत एवातः- $\frac{\text{पलक.क्रांज्या}}{१२}$ =प्रवेश कालिकाग्रा=अग्रा । $\frac{\text{पक}\times\text{क्रांज्या}'}{१२}$ =निर्गमनकालिकाग्रा=अग्रा' । क्रांज्या=छायाप्रवेशकालिक क्रान्तिज्या । क्रांज्या' =छायानिर्गमनकालिक क्रान्तिज्या । शङ्क्वोस्तुल्यत्वाच्छंतकुलमपि तुल्यमस्ति । अग्रा ± शंतल=भुजः प्रवेशकालिकः । अग्रा' ± शंतल=भुजः' = निर्गमनकालिकः । अनयोरन्तरम् । अग्रान्तरम्=भुजान्तरम् । एतद्भुजान्तर वशेन वास्तवपूर्वापर रेखायाः समानान्तररेखाया ज्ञानं भवेत् । वृत्तकेन्द्रबिन्दुतस्तत्समानान्तरा रेखा वास्तव पूर्वापररेखा भवेत् । केन्द्रबिन्दुतस्तदुपरिलम्बरेखा दक्षिणोत्तरा रेखा भवेत् । प्राचीनै रेखोपरिलम्बकरणार्थं मत्स्योत्पादनं क्रियते स्म । एतावता दिग्ज्ञानं जातमिति ॥२७॥

अब यष्टियन्त्र से दिक्साधन को कहते हैं।

हि. भा.—समान पृथिवी में इष्टव्यासार्ध से लिखित वृत्त के केन्द्र में स्थापित कील की छाया पूर्वकपाल में रवि के रहने से पश्चिम दिशा में वृत्त परिधि में जहां लगती है वह बिन्दु छायाप्रवेश बिन्दु है । पश्चिम कपाल में रवि के रहने से कील की छाया पूर्वदिशा में वृत्तपरिधि में जहां लगती है वह छाया निर्गमबिन्दु है । छायाप्रवेश समय में और निर्गमन समय में नष्टद्युति यष्टि के अग्र से लम्ब करके दो समानशङ्कु का साधन करना । उन दोनों शङ्कुओं से तत्तत्कालिक (प्रवेशकालिक और निर्गमनकालिक) क्रान्तिवश से भुजान्तर लाकर पूर्वापर दिशा साधन करना, उन दोनों से मत्स्योत्पादन से दक्षिणदिशा और उत्तर दिशा साधन करना चाहिये इति ॥२७॥

उपपत्ति ।

छाया प्रवेश समय में और निर्गमन समय में केन्द्रस्थ यष्टि के अग्र से लम्ब करके दो समान शङ्कु का साधन करना चाहिये । तब $\frac{\text{शंतल}\times १२}{\text{शङ्कु}}$ =पलभा । $\sqrt{\text{पलभा}^{२}+१२^{२}}$

=पलकर्ण । क्रान्ति के ज्ञान से $\frac{\text{पलक.क्रांज्या}}{१२}$ =प्रवेशकालिक अग्रा = अग्रा । $\frac{\text{पलक.क्रांज्या}^{1}}{१२}$ =निर्गमनकालिक अग्रा = अग्रा^{1} । क्रांज्या = छायाप्रवेशकालिक क्रान्तिज्या । क्रांज्या^{1} =छाया निर्गमन कालिक क्रान्तिज्या । दोनों शङ्कुओं के बराबर रहने से शङ्कुतल भी बराबर है ।

∴ अग्रा ± शंतल = प्रवेशकालिक भुज । अग्रा^{1} ± शंतल = भुज^{1} = निर्गमनकालिक भुज दोनों के अन्तर करने से अग्रान्तर=भुजान्तर, इस भुजान्तर वश से वास्तव पूर्वापर रेखा की समानान्तर रेखा का ज्ञान होता है । वृत्त के केन्द्रबिन्दु से उसकी समानान्तरा रेखा वास्तव पूर्वापर रेखा होती है । केन्द्र बिन्दु से उसके ऊपर लम्बरेखा दक्षिणोत्तरा रेखा होती है । प्राचीनाचार्य रेखा के ऊपर लम्ब करने के लिये मत्स्योत्पादन करते थे । इससे दिक् साधन हो गया इति ॥२७॥

इदानीं भुजकोटिसाधनमाह ।

शङ्कुतलाग्रान्तरयुतिरन्यैकदिशोर्भुजो भुजस्य कृतिम् ।
दृग्ज्याकर्णकृतेः प्रोह्य पदं पूर्वापरा कोटिः ॥ २८॥

सु. *भा.*—स्पष्टार्थम् । त्रिप्रश्नाधिकारे सर्वं स्फुटमेव प्रतिपादितम् ॥२८॥

वि. भा.—अन्यदिशि शङ्कुतलस्याग्रायाश्चान्तरमेकदिशि तयोर्योगो भुजो भवति । दृग्ज्यारूपकर्णवर्गाद् भुजस्य कृतिं (वर्गं) प्रोह्य (हित्वा) पूर्वापरानुकारा कोटिर्भवेदिति ॥

अत्रोपपत्तिः ।

यष्ट्यग्रादवलम्बसूत्रं शङ्कुः । शङ्कुमूलात्पूर्वापरसूत्रोपरिलम्बो भुजसंज्ञकः । स्वोदयास्तसूत्रपूर्वापरसूत्रयोरन्तरमग्रा । शङ्कुमूलात्स्वोदयास्तसूत्रोपरिलम्बः शङ्कुतलम् । एतेषां भुजाग्राशङ्कुतलानां स्वरूपदर्शनेन स्फुटमस्ति यदग्राशङ्कुतलयोर्भिन्नदिक्कयोरन्तरमेकदिक्कयोर्योगो भुजो भवति । शङ्कुमूलाद्वृत्तकेन्द्रपर्यन्तं दृग्ज्याकर्णः । भुजाग्राद्वृत्तकेन्द्रपर्यन्तं पूर्वापरसूत्रखण्डं कोटिः । भुजसंज्ञको भुजः । एतैः कर्णकोटिभुजैरुत्पन्नत्रिभुजे $\sqrt{\text{दृग्ज्या}^{2} - \text{भुज}^{2}}$ = कोटिः । एतेनाचार्योक्तमुपपन्नम् ॥२८॥

अब भुज और कोटि के साधन को कहते हैं।

हि. भा.—अग्रा और शङ्कुतल की भिन्न दिशा रहने से दोनों का अन्तर भुज होता है। तथा दोनों की दिशा एक रहने से योग करने से भुज होता है। दृग्ज्यारूप कर्ण वर्ग में भुज वर्ग को घटाकर मूल लेने से पूर्वापरानुकार कोटिसंज्ञक होता है। इति ॥२८॥

उपपत्ति।

यष्टयग्र से अवलम्ब सूत्र शङ्कु है। शङ्कुमूल से पूर्वापर सूत्र के ऊपर लम्ब भुज संज्ञक है स्वोदयास्त सूत्र और पूर्वापर सूत्र का अन्तर अग्रा है। शङ्कुमूल से स्वोदयास्त सूत्र के ऊपर लम्ब शङ्कुतल है। इन भुज, अग्रा शङ्कुतल का स्वरूप देखने से स्पष्ट है कि भिन्न दिशा का शंकुतल और अग्रा का अन्तरभुज होता है, तथा एक दिशा का शंकुतल और अग्रा का योग करने से भुज होता हैं। शङ्कुमूल से वृत्तकेन्द्रपर्यन्त दृग्ज्याकर्ण, भुजसंज्ञक भुज, भुजाग्र से वृत्त केन्द्रपर्यन्त कोटि, इन कर्णभुज और कोटि से उत्पन्न जात्यत्रिभुज में $\sqrt{\text{दृग्ज्या}^2 - \text{भुज}^2}$ = कोटि। इससे आचार्योक्त उपपन्न हुआ इति ॥२८॥

इदानीं यष्टियन्त्रेण पलभाज्ञानमाह।

उदयास्तसूत्रशङ्क्वन्तरं हृतं शङ्कुनाऽर्कसङ्गुणितम्।
विषुवच्छायैवं वा विनोदयास्तमयसूत्रेण ॥२९॥

सु. भा.—उदयास्तसूत्रशंक्वन्तरं शंकुतलं तदर्कसंगुणितं शंकुना हृतं फलं विषुवच्छाया पलभा भवति। उदयास्तसूत्रेण विनाऽपि वा पलभाज्ञानमेवं वक्ष्यमाणेन विधिना भवतीत्यस्याग्रे सम्बन्धः।

अत्रोपपत्तिः। अक्षक्षेत्रानुपातेन स्फुटा ॥२९॥

वि. भा.—उदयास्तसूत्रशंक्वन्तरं (शंकुतलं) तद्द्वादशभिर्गुणितं शंकुना भक्तं लब्धं बिषुवच्छाया (पलभा) भवति उदयास्तसूत्रेण विनाऽपि वा पलभाज्ञान मेवमग्रिमश्लोकेन भवतीति।

अत्रोपपत्तिः।

पूर्वं समभुवि लिखितं वृत्तं क्षितिजवृत्तम्। त्रिज्याङ्गुला यष्टिः स्वत एव त्रिज्यारूपा। सा नष्टद्युतिर्यथा भवति तथा धार्या, येन यष्टयग्रं वर्धितं सद्रविबिम्ब-केन्द्रं गच्छेत्। यष्टयग्रादधो यावान् लम्बस्तावान् तस्मिन् काले शंकुः। अथ त्रिज्यारूपाया यष्टेः शङ्कुरूपलम्बस्य वर्गान्तरमूलं नतांशज्या (दृग्ज्या) शंकुमूल-वृत्तकेन्द्रयोरन्तररूपेति। शंकमूलपूर्वापररेखयोरन्तरं भुजः। पूर्वापरदिग्गतयोर-

अग्रयोरुपरि गता रेखोदयास्तसूत्रम् । उदयास्तसूत्रस्य शंकुमूलस्यान्तरं शंकुतलम् । तदाऽक्षक्षेत्रानुपातेन यदि शंकुना शंकुतलं लभ्यते तदा द्वादशशंकुना किमिति समागच्छति पलभा तत्स्वरूपम् $= \frac{\text{शंतल} \times १२}{\text{शंकु}}$ एतावताऽऽचार्योक्तमुपपन्नम् ॥२९॥

अब यष्टियन्त्र से पलभाज्ञान कहते हैं ।

हि. भा.—उदयास्तसूत्र और शङ्कुमूल के अन्तर (शङ्कुतल) को बारह से गुणा कर शङ्कु से भाग देने से पलभा होती है। बिना उदयास्तसूत्र के भी पलभा ज्ञान आगे कहते हैं इति ॥२९॥

उपपत्ति ।

पूर्व में समान पृथिवी में लिखित वृत्त क्षितिजवृत्त है। यष्टि त्रिज्या के बराबर है। यष्टि को इस तरह धारण करना चाहिये जिससे यष्ट्यग्र को बढ़ाने से रवि बिम्बकेन्द्र में जाय, यष्टयग्र से नीचे जो लम्ब होगा वह शङ्कु है। त्रिज्यारूपयष्टि और शङ्कुरूप लम्ब का वर्गान्तरमूल नतांशज्या (दृग्ज्या) शङ्कुमूल और वृत्तकेन्द्र का अन्तररूप है। शङ्कुमूल से पूर्वापरसूत्र पर्यन्त लम्बरूपभुज है । शङ्कुमूल से उदयास्तसूत्रपर्यन्त लम्बरूप शङ्कुतल है। तब अनुपात करते है यदि शङ्कु में शङ्कुतल पाते हैं तो द्वादशा (बारह अङ्गुल) ङ्गुल शङ्कु में क्या इस अनुपात से पलभा आती है, इसका स्वरूप $= \frac{\text{शंतल} \times १२}{\text{शङ्कु}}$ = पलभा । इससे आचार्योक्त उपपन्न हुआ इति ॥२९॥

इदानीं भुजद्वयतः पलभाज्ञानमाह ।

प्राच्यपराशङ्कुतलान्तरद्वयान्तरयुतिः समान्यदिशोः ।
द्वादशगुणिता विषुवच्छाया शङ्क्वन्तर विभक्ता ॥३०॥

सु. भा.—शंकुमूलप्राच्यपरान्तरं भुजः । एवमेकस्मिन् दिने भुजद्वयं ज्ञेयम् तयोः समान्यदिशोरन्तरयुतिः कार्या सा द्वादशगुणिता शंक्वन्तरविभक्ता विषुवच्छाया भवति । 'भुजयोरेकान्यदिशोरन्तरमैक्यं रविक्षुण्णमि—त्यादिभास्करोक्तमेतदनुरूपमेव ।

अत्रोपपत्तिः ।

भास्करविधिना स्फुटा सजातीयक्षेत्रयोर्भुजयोः कोट्योः कर्णयोरन्तरतो योगाद्वा तथैव सजातीयक्षेत्रोत्पन्नत्वात् ॥३०॥

वि. भा.—शङ्कुतलम् (शङ्कुमूलम्), प्राच्यपरा (पूर्वापररेखा)। शङ्कुमूल पूर्वापररेखयोरन्तरं भुजः। एकस्मिन् दिने भुजद्वयं ज्ञेयम्। तयोर्भुजयोरेकदिशायां वियुतिः (अन्तरं) भिन्न दिशायां युतिः कार्या, सा द्वादशगुणिता शंक्वन्तरेण विभक्ता तदा विषुवच्छाया (पलभा) भवतीति ॥

अत्रोपपत्तिः।

अग्राशङ्कुतलयोः संस्कारेण भुजः = अग्रा ± शंतल। तथा अग्रा ± शंतल' = भुजः', अनयोरन्तरम् = शङ्कुतलान्तरम् = भुजान्तरम्। तदा शङ्कुतलान्तरं भुजः। शङ्क्वन्तरं कोटिः। हृत्यन्तरं कर्णः, इति भुजत्रयैरुत्पन्नत्रिभुजमप्यक्षेत्रसजातीयमतोऽनुपातः $\frac{\text{शङ्कुतलान्तर} \times १२}{\text{शंक्वन्तर}} = \frac{\text{भुजान्तर} \times १२}{\text{शंक्वन्तर}}$ = पलभा। सिद्धान्तशिरोमणेर्गोलाध्याये भास्करोक्त 'भुजयोरेकान्यदिशोरन्तरमैक्यं रविक्षुण्ण' मित्याचार्योक्तानुरूपमेवास्तीति ॥३०॥

अब भुजद्वय से पलभाज्ञान को कहते हैं।

हि. भा.—शङ्कुमूल और पूर्वापररेखा का अन्तरभुज है। एक दिन में दो भुजों को जानना चाहिये। एक दिशा में दोनों भुजों के अन्तर को और भिन्न दिशा में दोनों भुजों के योग को बारह से गुणाकर शंक्वन्तर से भाग देने से पलभा होती है इति ॥३०॥

उपपत्ति।

अग्रा और शङ्कुतल के संस्कार से भुज होता है। अग्रा ± शंतल = भुज। तथा अग्रा ± शंतल' = भुज' दोनों का अन्तर करने से शंकुतलान्तर = भुजान्तर। शंकुतलान्तरभुज, शंक्वन्तरकोटि, हृत्यन्तर कर्ण इन तीनों अवयवों से उत्पन्न त्रिभुज अक्ष क्षेत्र के सजातीय हैं, इसलिये अनुपात करते हैं। $\frac{\text{शंतलान्तर} \times १२}{\text{शंक्वन्तर}} = \frac{\text{भुजान्तर} \times १२}{\text{शङ्कुवन्तर}}$ पलभा, इससे आचार्योक्त उपपन्न होता है। सिद्धान्तशिरोमणि के गोलाध्याय में 'भुजयोरेकान्यदिशोरन्तरमैक्यम्' इत्यादि भास्करोक्त आचार्योक्त के अनुरूप ही है इति ॥३०॥

इदानीं रविज्ञानमाह।

शङ्कुप्राच्यपरान्तर शङ्क्वग्रैक्यमुदगन्तरं याम्ये।
लम्बगुणं यष्टिहृतं क्रान्तिज्याऽतो रविः साध्यः ॥३१॥

सु. भा.—शंकुप्राच्यपरान्तरंभुजः। शंक्वग्रं शंकुतलम्। उदग्भुजेऽनयोरैक्यं याम्ये भुजेऽन्तरमग्रा भवति। एवमैक्यान्तरं लम्बगुणं लम्बज्यया गुणं यष्टिहृतं त्रिज्याहृतं फलं क्रान्तिज्या भवति। अतः प्राग्वत् त्रिप्रश्नोक्तिवद्रविः साध्यः।

अत्रोपपत्तिः।

त्रिज्याकर्णेन लम्बज्या कोटिस्तदाऽग्राकर्णेन किं जाता क्रान्तिज्या। शेष वासना स्फुटा ॥३१॥

वि. भा.—शङ्कुप्राच्यपरान्तरं भुजः। शंक्वग्रं शङ्कुतलम्। उत्तरे भुजेऽनयो (शङ्कुतल भुजयोः) र्योगः, दक्षिणे भुजेऽन्तरं कार्यं तदाऽग्रा भवति। तद्योगान्तरं लम्ब (लम्बज्यया) गुणं यष्टि (त्रिज्या) भक्तं तदा क्रान्तिज्या भवति। अतः पूर्ववत् (त्रिप्रश्नोक्तवत्) रविः साध्य इति ॥

अत्रोपपत्तिः।

अग्राशङ्कुतलयोः संस्कारेण भुजो भवत्यत एतद्विलोमेन शङ्कुतलभुजयोः संस्कारेणाग्रा भवेत्। ततोऽनुपातो यदि त्रिज्यया लम्बज्या लभ्यते तदाऽग्रया किं समागच्छति क्रान्तिज्या तत्स्वरूपम् $=\frac{\text{लंज्या.अग्रा}}{\text{त्रि}}=$ क्रांज्या, ततः $\frac{\text{त्रि.क्रांज्या}}{\text{त्रिज्या}}$ $=$ रविभुजज्या अस्याश्चापं रविभुजांशाः स्युरिति ॥३१॥

अब यष्टियन्त्र से रविज्ञान कहते हैं।

हि. भा.—शङ्कुमूल और पूर्वापर सूत्र का अन्तरभुज है। शङ्क्वग्र (शङ्कुतल), उत्तरभुज में शङ्कुतल और भुज का योग अग्रा होती है। दक्षिणभुज में शङ्कुतल और भुज का योग अग्रा होती है। उस योगान्तर (अग्रा) को लम्बज्या से गुणाकर यष्टि (त्रिज्या) से भाग देने से क्रान्तिज्या होती है। इससे पूर्ववत् (त्रिप्रश्नाधिकारोक्त विधि से) रवि का साधन करना चाहिये ॥३१॥

उपपत्ति।

अग्रा और शङ्कुतल के संस्कार से भुज होता है, इसके विलोम से शङ्कुतल और भुज के संस्कार से अग्रा होती है। तब अनुपात करते हैं, यदि त्रिज्या में लम्बज्या पाते हैं तो अग्रा में क्या इस अनुपात से क्रान्तिज्या आती है उसका स्वरूप $=\frac{\text{लंज्या.अग्रा}}{\text{त्रि}}=$ क्रांज्या।

अतः $\frac{\text{त्रि.क्रांज्या}}{\text{जिज्या}}=$ भुजज्या इसके चाप करने से भुजांश होता है इति ॥३१॥

इदानीं यष्ट्या गृहाद्यौच्च्यानयनमाह ।

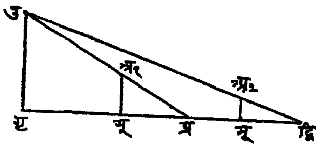
अपसृतिरन्यशलाका गुणा शलाकान्तरेण भक्ता भूः ।
भूः स्वशलाकागुणिता यष्टि विभक्ता गृहाद्यौच्च्यम् ॥३२॥

सु. भा.—इष्टप्रमाणैका यष्टिर्धार्या । तस्या एकस्मिन्नग्रे लम्बरूपाऽङ्गुलादिभिरङ्किता विपुलैका शलाका बद्ध्वा दृढीकार्या यथा यष्टिशलाकाभ्यां कोणः समकोणो भवेत् । यष्टयन्याग्रसंस्थदृष्ट्या समधरातलस्थगृहादौच्च्यमन्यया चलयष्ट्या विध्येत् । इयमन्या यष्टिर्यत्र शलाकायां लग्ना तस्माच्छलाकामूलपर्यन्तं सङ्ख्या वेधसम्बन्धिनी शलाका ज्ञेया । एवं प्रथमस्थानतो वेधं कृत्वा शलाकाप्रमाणं विज्ञाय प्रथमस्थानतस्तस्यामेव सरलरेखायामपसृत्य द्वितीयस्थानतो गृहादौच्च्यं विध्वा तत्रापि शलाकाप्रमाणं जानीयात् । वेधस्थानयोरन्तरं चापसृतिरुच्यते । अपसृतिरन्यशलाकागुणा शलाकान्तरेण भक्ता तदा भूः स्वभूर्वेधस्थानगृहान्तरं भवति । भूश्च स्वशलाकागुणा यष्टिविभक्ता गृहादौच्च्यं स्यात् ।

अत्रोपपत्तिः ।

गृउ=गृहौच्च्यम् । प्रमू=यष्टिः=द्विमू । प्र=प्रथमवेधस्थानम् । द्वि=द्वितीयवेधस्थानम् । मूअ$_{१}$—प्रथमवेधे शलाका=श$_{१}$ मू अ$_{१}$ द्वितीयवेधे शलाका =श$_{२}$ प्रद्वि=अपसृतिः=आगृप्र=भू$_{१}$ । गृद्वि=भू$_{२}$=भू$_{१}$+अ ।

सजातीयक्षेत्रतः



$$\text{गृउ} \frac{\text{भू}.\text{श}_{१}}{\text{य}} = \frac{(\text{भू}_{१}+\text{अ})\ \text{श}_{२}}{\text{य}}$$

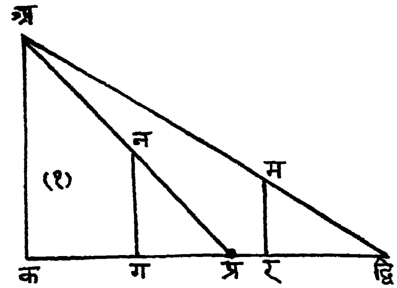
$\therefore$ भू.श$_{१}$=भू$_{१}$.श$_{२}$+अ.श$_{२}$ । ततः भू$_{१}$ (श$_{१}$-—श$_{२}$)=अ.श$_{२}$ ।

$$\therefore \frac{\text{अ}.\text{श}_{२}}{\text{श}_{१}-\text{श}_{२}} = \text{भू}_{१} \text{ । एवं } \text{भू}_{२} = \frac{\text{अ}.\text{श}_{१}}{\text{श}_{१}-\text{श}_{२}}$$ । शेषोपपत्तिः स्फुटा ॥३२॥

वि. भा.—एकेष्टा यष्टिर्ग्रहीतव्या तस्या एकस्मिन्नग्रे तदुपरि लम्बरूपाऽङ्गुलादिभिश्चिन्हिता विपुलैका शलाका तथा वन्धनीया यथा दृढ़ा भवेत् । यष्ट्यन्याग्रस्थितदृष्ट्या समपृथिव्यां स्थितं गृहाद्यौच्च्यं विध्येत् । शलाकाप्रमाणं च ज्ञात्वा प्रथमवेधस्थानात्तस्यामेव सरलरेखायामपसृत्य (किञ्चिद्गत्वा) द्वितीयस्थानतोऽपि गृहाद्यौच्च्यं विध्येत् । तत्रापि शलाकाप्रमाणं ज्ञेयम् । वेधस्थान योरन्तरमपसृतिः कथ्यते । अपसृतिरन्यशलाकया गुणा शलाकान्तरेण भक्ता तदा भूः (वेधस्थानस्य गृहस्य चान्तरं) भवति । भूः स्वशलाकया गुणिता यष्ट्या भक्ता तदा गृहाद्यौच्च्यं भवेदिति ॥

अत्रोपपत्तिः ।

प्रग = यष्टिः = द्विर ।
प्र = प्रथमवेधस्थानम् ।
द्वि = द्वितीयवेधस्थानम् प्रथमवेधस्थानेशलाका = गन = श ।
द्वितीयवेध स्थाने शलाका
= रम = श' प्रद्वि = अपसृतिः ।
कप्र = भूः । कद्वि = भू' = भू + अपसृति ।



तदा अकप्र, नगप्र त्रिभुजयो सजातीयत्वादनुपातः $\frac{\text{श.भू}}{\text{यष्टि}}$ = अक = गृहाद्यौच्च्यम् । तथा अकद्वि, मरद्वि त्रिभुजयोः साजात्यादनुपातेन $\frac{\text{श}'\text{.भू}'}{\text{यष्टि}}$ =

$$= \frac{\text{श}'\ (\text{भू} + \text{अपसृति})}{\text{यष्टि}} = \text{गृहाद्यौच्च्यम्। अतः} \frac{\text{श.भू}}{\text{यष्टि}} = \frac{\text{श}'\ (\text{भू} + \text{अपसृति})}{\text{यष्टि}}$$

पक्षौ 'यष्टि' गुणितौ तदा श.भू = श' (भू + अपसृति) = श'.भू + श'.अपसृति, समशोधनेन श.भू — श'.भू = भू (श — श') = श' अपसृति पक्षौ श — श' भक्तौ तदा

$\frac{\text{श}'\text{.अपसृति}}{\text{श} - \text{श}'}$ = भू । एवं $\frac{\text{श.अपसृति}}{\text{श} - \text{श}'}$ = भू', एतेनोपपन्नमाचार्योक्तमिति ।।३२।।

अब यष्टि से गृहादि की ऊंचाई का आनयन कहते हैं ।

हि. भा.—एक इष्ट प्रमाण की यष्टि ग्रहण कर उसके एक अग्र में उस के ऊपर लम्बरूप अङ्गुलादि से अङ्कित एक विपुल (मोटी) शलाका खूब दृढ़ता से बाँधनी चाहिये । यष्टि के अन्य अग्र स्थित दृष्टि से समधरातलस्थित गृहादि की ऊँचाई को वेध करना शलाका प्रमाण को भी जान कर प्रथमवेधस्थान से उसी सरल रेखा में कुछ दूर जाकर द्वितीय स्थान से भी गृहादि की ऊँचाई को वेध करना चाहिये । वहां भी शलाका प्रमाण जान लेना चाहिये । दोनों वेध स्थानों का अन्तर अपसृति कहलाती है । अपसृति को अन्यशलाका से गुणाकर शलाकान्तर से भाग देने से भू (वेध स्थान और गृहादि का अन्तर) प्रमाण होता है । भू को अपनी शलाका से गुणाकर यष्टि से भाग देने से गृहादि की ऊँचाई होती है इति ।।३२।।

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित (१) क्षेत्र को देखिये । प्रग = यष्टि = द्विर । प्र = प्रथम वेधस्थान । द्वि = द्वितीय वेधस्थान । प्रथम वेधस्थान में शलाका = गन = श । द्वितीय वेध स्थान में शलाका = रम = श′ । प्रद्वि = अपसृति । कप्र = भू । कद्वि = भू′ = भू + अपसृति, तब अकप्र, नगप्र दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं $\frac{\text{श.भू}}{\text{यष्टि}}$ = अक = गृहादि की ऊंचाई, तथा अकद्वि, मरद्वि दोनों त्रिभुजों के सजातीयत्व के द्वारा अनुपात करने से $\frac{\text{श}'\text{.भू}'}{\text{यष्टि}}$ = $\frac{\text{श}'\text{ (भू + अपसृति)}}{\text{यष्टि}}$ = गृहादि की ऊंचाई, अतः समीकरण से $\frac{\text{श.भू}}{\text{यष्टि}}$ = $\frac{\text{श}'\text{ (भू + अपसृति)}}{\text{यष्टि}}$ दोनों पक्षों को 'यष्टि' से गुणा करने से श.भू = श′ (भू + अपसृति), = श′.भू + श′.अपसृति, समशोधन करने से श.भू — श′.भू = भू(श — श′) = श′ अपसृति, दोनों पक्षों को श — श′ इससे भाग देने से $\frac{\text{श}'\text{.अपसृति}}{\text{श — श}'}$ = भू । एवं $\frac{\text{श.अपसृति}}{\text{श — श}'}$ = भू′, इससे आचार्योक्त उपपन्न हुआ ।।३२।।

इदानीं प्रकारान्तरेण गृहाद्यौच्च्यानयनमाह ।

दृष्टचा गुणिताऽपसृतिर्दृष्टि विशेषेण भाजिता भूमिः ।
भूमिः स्वदृष्टिभक्ता शलाकया सङ्गुणोच्छ्रायः ।।३३।।

सु. भा.—समधरातले यष्टिरूर्ध्वा धरा लम्बरूपा धार्या । धरातले दृष्टिस्तथा चालनीया यथा दृष्टिर्यष्टेरग्रं गृहाद्यग्रं चैकसरलरेखायां स्युः । एवं कृते दृष्टियष्टिमूलयोरन्तरं यत् तदेवेह दृष्टिरित्युच्यते । अथ पुनः सैव यष्टिस्तस्यामेव सरलरेखायां तयैवोर्ध्वाधरा स्थाप्या । तद्वशतो द्वितीयवेधेऽपि दृष्टिस्थानं निश्चेयं तथा दृष्टियष्टिमूलान्तरं द्वितीयदृष्टिश्च ज्ञातव्या । द्वयोर्दृष्टिस्थानयोरन्तरं चात्रापसृतिरुच्यते । अपसृतिर्दृष्टचा स्वदृष्टचा गुणिता दृष्टयोर्विशेषेणान्तरेण भाजिता स्वभूमिः स्यात् । सा भूमिशलाकया यष्टया संगुणा स्वदृष्टिभक्ता गृहाद्युच्छ्रायः स्यादिति ।

अत्रोपपत्तिः ।

{ क्षेत्रं १४५७ तमे पृष्ठे द्रष्टव्यम् । }

गृउ=गृहौच्च्यम् । मूअ$_{१}$=मूअ$_{२}$=यष्टिः । मूप्र=प्रथमदृष्टिः=दृ$_{१}$ । मूद्वि=द्वितीय दृष्टिः =दृ$_{२}$ । प्रद्वि=अपसृतिः=अ । प्रगृ=प्रथमभूमिः =भू$_{१}$ । द्विगृ=द्वितीयभूमिः=भू$_{२}$=भू$_{१}$+अ ।

ततः सजातीयक्षेत्रतः ।

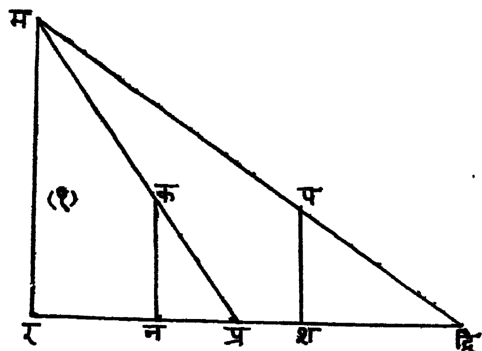
$$गृउ = \frac{य.भू_{१}}{दृ_{१}} = \frac{(भू_{१}+अ).य}{दृ_{२}}$$ ततः $भू_{१}.दृ_{२} = भू_{१}.दृ_{१} + दृ.अ$

$$\therefore भू_{१} = \frac{दृ.अ}{दृ_{२} - दृ_{१}}$$ । एवं $भू_{२} = \frac{दृ_{२}.अ}{दृ_{२} - दृ_{१}}$ । ततोऽनुपातेनोच्छ्रित्यानयनं सुगममिति ॥३३॥

वि. भा.—समधरातले ऊर्ध्वाधरा लम्बरूपा च यष्टिः स्थाप्या, समधरातले दृष्टिस्तथा स्थाप्या यथा दृष्टिर्यष्टेरग्रं गृहाद्यग्रं चैकस्यां सरलरेखायां भवेयुः । एवं करणेन दृष्टियष्टिमूलयोरन्तरं यत्तद्दृष्टिः कथ्यते । पुनः सैव यष्टिस्तस्यामेव सरलरेखायां पूर्ववदेवोर्ध्वाधरा-लम्बरूपा च स्थाप्या, तद्वशेन द्वितीय वेधेऽपि पूर्ववदेव दृष्टिस्थानस्य निश्चयः कार्यः । तथा दृष्टियष्टिमूलान्तरं ज्ञातव्यं द्वितीयदृष्टिश्च ज्ञेया । दृष्टिस्थानयोरन्तरमपसृतिः कथ्यते । अपसृति स्वदृष्टचा गुणिता दृष्टचोरन्तरेण भक्ता तदा स्वभूमिर्भवेत् । सा भूमिः शलाकया (यष्टचा) संगुणितां स्वदृष्टिभक्ता तदोच्छ्रायः (गृहादेरुच्छ्रायः) भवतीति ॥

अत्रोपपत्तिः ।

कन = पश = यष्टिः ।
नप्र =प्रथमदृष्टिः=दृ$_{१}$ ।
शद्वि=द्वितीय दृष्टिः=दृ$_{२}$ ।
मर=गृहाद्यौच्च्यम् ।
प्रद्वि=अपसृतिः ।
प्रर=प्रथम भूमिः=भू$_{१}$ ।
द्विर=द्वितीयभूमिः=भू$_{२}$
=भू$_{१}$+अपसृतिः ।



तदा कनप्र, मरप त्रिभुजयोः साजात्यादनुपातेन $\frac{\text{य}\times\text{भू}}{\text{दृ}}$ = गृहाद्यौच्च्यम्

तथा पशद्वि, मरद्वि त्रिभुजयोः सजातीयत्वादनुपातः $\frac{\text{य}\times\text{भू}'}{\text{दृ}'}$

$= \frac{\text{य (भू+अपसृति)}}{\text{दृ}'}$ = गृहाद्यौच्च्यम् । अतः $\frac{\text{य}\times\text{भू}}{\text{दृ}} = \frac{\text{य (भू+अपसृति)}}{\text{दृ}'}$

पक्षौ (य) भक्तौ तदा $\frac{\text{भू}}{\text{दृ}} = \frac{\text{भू+अपसृति}}{\text{दृ}'}$ छेदगमेन $\text{भू}\times\text{दृ}' = \text{दृ(भू+अपसृति)}$

$= \text{दृ.भू} + \text{दृ.अपसृति}$, समशोधनेन $\text{भू.दृ}' - \text{दृ.भू} = \text{भू} (\text{दृ}' - \text{दृ}) = \text{दृ.अपसृति}$ पक्षौ

$\text{दृ}' - \text{दृ}$ भक्तौ तदा $\frac{\text{दृ.अपसृति}}{\text{दृ}' - \text{दृ}}$ = भू एवमेव $\frac{\text{दृ}'\text{.अपसृति}}{\text{दृ}' - \text{दृ}} = \text{भू}'$, एतेनोपपन्नं सूत्रमिति ॥३३॥

अब प्रकारान्तर से गृहादि की ऊंचाई का आनयन कहते हैं ।

हि. भा.—सम धरातल में ऊर्ध्वाधर लम्बरूप यष्टि स्थापन पर करना, समधरातल में दृष्टि को उस तरह रखना चाहिये जिस से दृष्टि, यष्टि का अग्र और गृहादि का अग्र एक ही सरल रेखा में हो । इस तरह करने से दृष्टि और यष्टि के मूल का अन्तर यहां दृष्टि कहलाती है । पुनः उसी यष्टि को उसी सरल रेखा में पूर्ववत् ऊर्ध्वाधर–लम्बरूप स्थापन करना । उसके वश से द्वितीय वेध में भी पूर्ववत् ही दृष्टिस्थान निश्चित करना चाहिये । तथा दृष्टि और यष्टि मूल का अन्तर जानना चाहिये । द्वितीय दृष्टि भी ज्ञातव्य है, दोनों दृष्टि स्थानों का अन्तर यहां अपसृति कथित है अपसृति को अपनी दृष्टि से गुणाकर दोनों दृष्टि के अन्तर से भाग देने से अपनी भू (भूमि) होती है । भूमि को शलाका (यष्टि) से गुणाकर अपनी दृष्टि से भाग देने से गृहादि की ऊंचाई होती है इति ॥३३॥

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित (१) क्षेत्र को देखिये । कन = पश = यष्टि । नप्र = प्रथमदृष्टि = दृ । शद्वि = द्वितीयदृष्टि = $\text{दृ}'$ । मर = गृहादि की ऊंचाई । प्रद्वि = अपसृति । प्रर = प्रथम भूमि = भू । द्विर = द्वितीयभूमि = $\text{भू}'$ = भू + अपसृति । तब कनप्र, मरप दोनों

त्रिभुजों के सजातीयत्व से अनुपात करने से $\frac{\text{य.भू}}{\text{ह}}$ = गृहादि की ऊंचाई । एवं पशद्वि, मरद्वि दोनों त्रिभुजों के सजातीयत्व से अनुपात करने से $\frac{\text{य.भू}'}{\text{ह}'} = \frac{\text{य (भू + अपसृति)}}{\text{ह}'}$ = गृहादि की ऊंचाई, अतः समीकरण करने से $\frac{\text{य.भू}}{\text{ह}} = \frac{\text{य (भू + अपसृति)}}{\text{ह}'}$ दोनों पक्षों को (य) भाग देने से $\frac{\text{भू}}{\text{ह}} = \frac{\text{भू + अपसृति}}{\text{ह}'}$ छेदगम से $\text{भू.ह}' = \text{ह (भू + अपसृति)}$ $= \text{ह.भू} + \text{ह.अपसृति}$, समशोधन करने से $\text{भू.ह}' - \text{ह.भू} = \text{भू} (\text{ह}' - \text{ह}) = \text{ह.अपसृति}$ दोनों पक्षों को $\text{ह}' - \text{ह}$ इससे भाग देने से $\text{भू} = \frac{\text{ह.अपसृति}}{\text{ह}' - \text{ह}}$; एवं $\frac{\text{ह}'\text{.अपसृति}}{\text{ह}' - \text{ह}} = \text{भू}'$, इस से आचार्योक्त सूत्र उपपन्न हुआ ।।३३।।

इदानीं गृहादिमूलवेधेन भूमिज्ञानमाह ।

लम्बनिपातान्तरकं लम्बौच्च्यान्तरविभक्तमधिकगुणम् ।
भूर्लम्बान्तरगुणिता लम्बनिपातान्तरविभक्ता ।।३४।।

सु.भा.—इष्टप्रमाणा या यष्टेर्मूलस्थ दृष्टचा यष्टचग्रं गृहादिमूलं विध्येत् । यष्टिमूलाग्राभ्यां द्वौ लम्बौ कार्यौ तयोर्लम्बनिपातयोरन्तरकं लम्बौच्च्ययोरन्तरेण विभक्तमधिकेन लम्बमानेन गुणभूः स्यात् । लम्बान्तरगुणितेत्यादेरग्रे सम्बन्धः ।

अत्रोपपत्तिः ।

यष्टिमूलाद्गृहादिमूलपर्यन्तं रेखाकर्णः । यष्टिमूलादधिको लम्बः कोटिः । अधिकलम्बगृहादिमूलयोरन्तरभूमिर्भुजः । इदमेकं त्रिभुजम् । लम्बौच्च्यान्तरं कोटिः । यष्टिः कर्णः । लम्बनिपातान्तरभूमिर्भुजः । इदं द्वितीयं त्रिभुजं प्रथमसजातीयमतोऽनुपातेन भूम्यानयनं सुगममिति ।।३४।।

वि. भा.—इष्टयष्टेर्मूलस्थदृष्टचा यष्टचग्रं गृहादिमूलं विध्येत् । यष्टिमूलाग्राभ्यां लम्बौ कार्यौ, तयोर्लम्बयोर्मूलान्तरं अधिकेन लम्बेन गुणं लम्बौच्च्ययोरन्तरेण विभक्तं तदा भूर्भवेत् । लम्बान्तर गुणितेत्यादेरग्रे सम्बन्ध इति ।।

अत्रोपपत्तिः ।

यष्टिमूलादधिको लम्बः कोटिः । अधिकलम्बगृहादिमूलयोरन्तरं भुजः । यष्टिमूलाद्गृहादिमूलपर्यन्तं कर्णः । एतैः कोटिभुजकर्णैरुत्पन्नमेकं त्रिभुजम् । लम्बौच्च्यान्तरं कोटिः । लम्बमूलयोरन्तरं भुजः । यष्टिः कर्णः । एतैः कोटिभुजकर्णैरुत्पन्नं द्वितीयं त्रिभुजम । त्रिभुजयोः साजात्यादनुपातो यदि लम्बौच्च्यान्तरकोटौ लम्बमूलान्तरं भुजो लभ्यते तदा ऽधिकलम्बकोटौ किं समागच्छति, अधिकलम्बगृहादिमूलयोरन्तरभूमिस्तत्स्वरूपम् $= \frac{\text{लम्बमूलान्तर} \times \text{अधिकलम्ब}}{\text{लम्बौच्च्यान्तर}}$ एतेनोपपन्नमाचार्योक्तमिति ।।३४।।

अब गृहादि मूलवेध से भूमिज्ञान कहते हैं ।

हि॰ भा॰—इष्टयष्टि की मूलस्थ दृष्टि से यष्ट्यग्रगत गृहादि के मूल को वेध करना । यष्टि के मूल और अग्र से लम्ब करना, इन दोनों लम्बमूलान्तर को अधिक लम्ब से गुणाकर लम्बौच्च्यान्तर से भाग देने से भूमि होती है ।।३४।।

उपपत्ति ।

यष्टि के मूल से अधिक लम्बकोटि । अधिकलम्ब गृहादि मूल के अन्तरभुज । यष्टि के मूल से गृहादिमूलपर्यन्त कर्ण इन कोटि भुज कर्णों से उत्पन्न एक त्रिभुज । तथा लम्बौच्च्यान्तर कोटि, लम्बमूलान्तरभुज । यष्टि कर्ण इन कोटिभुज कर्णों से उत्पन्न द्वितीय त्रिभुज इन दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं यदि लम्बौच्च्यान्तर कोटि में लम्बमूलान्तर भुज पाते हैं तो अधिक लम्बकोटि में क्या इस अनुपात से अधिकलम्ब गृहादि मूल का अन्तर भूमि प्रमाण आता है उसका स्वरूप $= \frac{\text{लम्बमूलान्तर. अधिकलम्ब}}{\text{लम्बौच्यान्तर}}$ इससे आचार्योक्त उपपन्न हुआ इति ।।३४।।

इदानीं भूमिज्ञाने वंशौच्च्यज्ञानमाह ।

लब्धोनो दृग्लम्बो दृग्लम्बादग्रलम्बके हीने ।
अधिकेऽधिको गृहौच्च्यं तलाग्रके विद्धया दृष्ट्या ।।३५।।

सु॰ भा॰—इष्टप्रमाणयष्टेर्मूलस्थदृष्ट्या गृहाद्यग्रं विध्येत् । यष्टिमूलाग्राभ्यां भुवि लम्बौ कार्यो । मूलाल्लम्बो दृग्लम्ब इत्युच्यते । भूर्लम्बौच्च्ययोरन्तरेण गुणिता लम्बनिपातयोरन्तरेण भक्ता लब्धेन दृग्लम्बो हीनः कार्यो दृग्लम्बादग्र-

लम्बके हीने सति। अधिके चाधिक: कार्यस्तदा गृहाद्यौच्च्यं भवेत्। एवं तलाग्रके ये तयोर्विद्धया दृष्टया भूम्यौच्च्ये भवतः। भूमिज्ञानं तलवेधेनौच्च्यज्ञानं चाग्रवेधेन भवतीत्यर्थः।

अत्रोपपत्तिः।

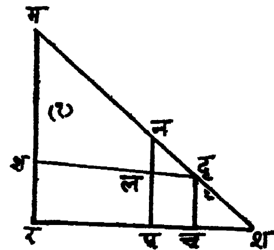
लम्बनिपातान्तरेण लम्बौच्च्ययोरन्तरं तदा ऽऽत्मगृहाद्यन्तरभूम्यां किं लब्धेन हीनो युतश्च दृग्लम्बो दृग्लम्बादग्रलम्बे हीनाधिके गृहाद्यौच्च्यं भवतीत्यत्र स्थितिद्वये क्षेत्रे विरचय्य सर्वं स्फुटं निरीक्षणीयम् ॥३५॥

वि. भा.—इष्टयष्टेर्मूलस्थदृष्ट्या गृहाद्यग्रं विध्येत्। यष्टिमूलाग्राभ्यां भुवि लम्बौ कार्यौ, मूलाल्लम्बो दृग्लम्बः कथ्यते। भूर्लम्बौच्च्ययोरन्तरेण गुणिता लम्बनिपातयोरन्तरे भक्ता लब्धेन दृग्लम्बो हीनः कार्यो यदि दृग्लम्बादग्रलम्बो हीनो भवेत्। अग्रलम्बाद् दृग्लम्बो हीनश्चेत्तदाऽधिकः (युक्तः) कार्यस्तदा गृहाद्यौच्च्यं भवेत्। एवं तलाग्रके ये तयोर्विद्धया दृष्ट्या भूम्यौच्च्ये भवतोऽर्थात्तलवेधेन भूमिज्ञानमग्रवेधेन चौच्च्यज्ञानं भवतीति॥

अत्रोपपत्तिः।

दृन=यष्टिः। दृ = दृष्टिस्थानम्। रम = गृहाद्यौच्च्यम्। दृच = दृष्टच्छायः = दृग्लम्बः। नप = यष्ट्यग्राल्लम्बः। नल= लम्बान्तरम्। पच = लम्बनिपातान्तरम्=दृल। ततः मशदृ, नलदृ त्रिभुजयोः साजात्यात्

$$\frac{\text{लम्बान्तर} \times \text{भू}}{\text{लम्बनिपातान्तर}} = \text{मश}$$ ।



∴ मश+शर=मश+दृग्लम्ब=मर=गृहाद्यौच्च्यम्। दृश=आत्मगृहान्तरभूमिः=भू। अत्र दृग्लम्बादग्रलम्बो ऽधिकोस्ति। दृग्लम्बादग्रलम्बेहीनेऽप्येवमेवोपपत्तिरिति ॥३५॥

अब भूमिज्ञान से वंशौच्च्यज्ञान को कहते हैं।

हि. भा.—इष्ट यष्टि की मूलस्थ दृष्टि से गृहादि के अग्र को वेध करना। यष्टि के मूल और अग्र से भूमि के ऊपर लम्ब करना। यष्टि के मूल से जो लम्ब होता है वह

दृग्लम्ब कहलाता है। भू को लम्बौच्च्य के अन्तर से गुणा कर लम्ब निपातान्तर से भाग देने से जो लब्ध हो उसको दृग्लम्ब में से हीन करना यदि दृग्लम्ब से अग्रलम्ब हीन हो तब। अग्रलम्ब से दृग्लम्ब हीन हो तब जोड़ने से गृहादि का औच्च (ऊंचाई) प्रमाण होता है। एवं तल वेध से भूमिज्ञान और अग्रवेध से औच्च्यज्ञान होता है ॥३५॥

उपपत्ति ।

यहां संस्कृतोपपत्ति में लिखित(१)क्षेत्र को देखिये। दृन=यष्टि। दृ=दृष्टिस्थान। रम=गृहाद्यौच्च्य। दृच=दृष्टयुच्छ्राय=दृग्लम्ब। नप=यष्टयग्र से लम्ब। नल =लम्ब-मूलान्तर। पच=लम्बनिपातान्तरभू=दृल तव मशदृ, नलदृ दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं $\frac{\text{लम्बान्त} \times \text{भूर}}{\text{लम्बनिपातान्तर}}$ =मश। अतः श+शर=मश +दृग्लम्ब=मर=गृहाद्यौच्च्य। दृश=आत्मगृहान्तर भूमि=भू। यहां दृग्लम्ब से अग्र लम्ब अधिक है। दृग्लम्ब से अग्रलम्ब के हीन रहने पर भी इसी तरह उपपत्ति समझनी चाहिये इति ॥३५॥

इदानीं प्रकारान्तरेण भूम्यौच्च्यानयनमाह।

दृष्टिर्दृग्लम्बगुणा विभाजिताऽधः शलाकया भूमिः।
सकलशलाका गुणिता भूमिर्दृष्टया हृतोच्छ्रायः ॥३६॥

सु. भा.—यस्मिन् धरातले गृहाद्यौच्च्यं वस्तु वर्त्तते तस्मिन् धरातले ऊर्ध्वाधरा लम्बरूपैकेष्टप्रमाणा शलाका स्थाप्या। ततो दृष्टिस्तथा चाल्या यथा दृष्टि शलाकाग्रं गृहादिमूलं चैकरेखायां स्युः। एवं तत्र दृगौच्च्यं दृग्लम्बः। दृगौच्च्य-शलाकामूलयोरन्तरं भूमिदृष्टिरित्युच्यते। सा शलाका चाधः शलाका ज्ञेया। दृष्टिर्दृग्लम्बगुणाऽधः शलाकया विभाजिता भूमिः स्यात्। एवं तस्मिन्नेव धरातले तथा दृष्टिर्नियोज्या यथा दृष्टिः शलाकाग्रं गृहाद्यग्रं चैकरेखायां स्युः। अत्र शलाका सकलशलाका। दृष्टिशलाकामूलयोरन्तरं दृष्टिरित्युच्यते। भूमिः सकलशलाकागुणा दृष्टया हृतोच्छ्रायो भवति।

अत्रोपपत्तिः। सजातीयक्षेत्रानुपातेन स्फुटा ॥३६॥

वि. भा.—यत्र भूमौ गृहाद्यौच्च्यं वस्तु वर्त्तते तत्रैव धरातले ऊर्ध्वाधरा लम्बरूपैका शलाका स्थाप्या। ततो दृष्टिस्तथा चालनीया यथा दृष्टिः शलाकाग्रं गृहादिमूलं चैकस्यां रेखायां भवेयुः। तत्र दृगौच्च्यं दृग्लम्बः दृगौच्च्यशलाका-मूलयोरन्तरं भूमिदृष्टिः कथ्यते। सा शलाकाऽधः शलाका बोध्या। दृष्टिर्दृग्लम्ब-

गुणाऽधःशलाकया विभाजिता तदा भूमिः स्यात्। एवं तत्रैव धरातले तथा दृष्टिः स्थाप्या यथा दृष्टिः शलाकाग्रं गृहाद्यग्रं चैकस्यां रेखायां भवेयुः। अत्र शलाका सकल शलाका ज्ञेया। दृष्टिशलाकामूलयोरन्तरं दृष्टिः कथ्यते। भूमिः सकलशलाका गुणा दृष्ट्या भक्तोच्छ्रायो भवतीति ॥

अत्रोपपत्तिः।

क्षेत्ररचनयाऽनुपातेन च स्फुटेति ॥३६॥

अब प्रकारान्तर से भूमि और औच्च्य (ऊंचाई) के आनयन को कहते हैं।

हि. भा.—जिस धरातल में गृहादि उच्च वस्तु है उसी धरातल में ऊर्ध्वाधर लम्बरूप एक यष्टि स्थापन करना। दृष्टि को उस तरह चलाना जिससे दृष्टि, शलाका का अग्र, और गृहादि का मूल एक ही रेखा में हो। वहां दृगौच्च्य दृग्लम्ब है। दृगौच्च्यमूल और शलाका मूल का अन्तर भूमि दृष्टि संज्ञक है। उस शलाका को अधः शलाका समझना चाहिये। दृष्टि को दृग्लम्ब से गुणा कर अधः शलाका से भाग देने से भूमि होती है। एवं उसी धरातल में दृष्टि को उस तरह चलाना जिससे दृष्टि, शलाका का अग्र और गृहादि का अग्र एक ही रेखा में हो। यहां शलाका सकल (सम्पूर्ण) शलाका समझनी चाहिये। दृष्टि शलाका मूल की अन्तर दृष्टि संज्ञक है। भूमि को सकल शलाका से गुणा कर दृष्टि से भाग देने से गृहादि का उच्छ्राय होता है।

उपपत्ति।

क्षेत्ररचना से अनुपात द्वारा स्फुट है इति ॥३६॥

इदानीं प्रकारान्तरेण गृहौच्च्यानयनमाह।

मित्वा गृहैकदेशं विद्ध्वेष्टशलाकया गृहं सर्वम्।
प्रथमशलाकाभक्तं मितं द्वितीयागुणितमौच्च्यम् ॥३७॥

सु. भा.—यस्मिन् धरातले लम्बरूपं गृहादि वर्तते तस्मिन् धरातले लम्बरूपोर्ध्वाधरांगुलादिभिरङ्कितैका शलाका स्थाप्या। ततो दृष्टि तस्मिन्नेव धरातले कुत्रापि संस्थाप्य नलिकया वा ऽन्ययष्ट्या ज्ञातौच्च्यं गृहैकदेशं विध्येत्। नलिका वाऽन्ययष्टिर्यत्र शलाकायां लग्ना तस्मात् शलाकामूलपर्यन्तं प्रथमा शलाका शलाकामूलदृष्टिस्थानान्तरं च दृष्टिर्ज्ञातव्या। पुनस्तत्रस्थयैव दृष्ट्या गृहाग्रं चैकयष्ट्या विध्येत्। इयं यष्टिर्यत्र पूर्वशलाकायां लग्ना तस्मात् शलाकामूलपर्यन्तं द्वितीया शलाका ज्ञेया। अथ व्याख्या। गृहैकदेशं प्रथमशलाकावशेन मित्वा गणयित्वा धार्यम्। इष्टशलाकया च सर्वं गृहौच्च्यं विद्ध्वा द्वितीया शलाका

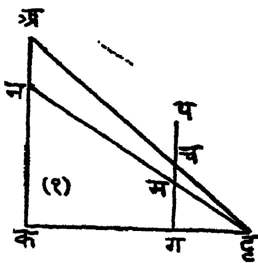
ज्ञातव्या । ततो गृहैकदेशौच्च्यं मितं गणितं द्वितीयशलाकया गुणितं प्रथमशला-कया भक्तं गृहौच्च्यं स्यात् ।

अत्रोपपत्तिः ।

प्रथमशलाकया दृष्टितुल्यो भुजस्तदा ज्ञातौच्च्येन किं जाता भूमिः $= \frac{\text{ज्ञाऔ.दृ}}{\text{प्रश}}$ । ततो दृष्टया द्वितीयशलाका तदा भूम्या किं जातं गृहौच्च्यं $= \frac{\text{द्विश.ज्ञाऔ.दृ}}{\text{प्रश.दृ}} = \frac{\text{द्विश.गृऔ}}{\text{प्रश}}$ । अत उपपन्नम् ॥३७॥

वि. भा.—यस्मिन् धरातले लम्बरूपं गृहादि वर्त्तते तस्मिन् धरातले लम्बरूपोर्ध्वाधराङ्कलादिभिरङ्कितैका शलाका स्थाप्या । ततो दृष्टिं तस्मिन्नेव धरातले कुत्रापि संस्थाप्य नलिकयाऽन्ययष्टया वा ज्ञातौच्च्यं गृहैकदेशं विध्येत् । नलिकाऽन्ययष्टिर्वा शलाकायां यत्र लग्ना तस्माच्छलाकामूलपर्यन्तं प्रथमा शलाका, शलाकामूलदृष्टिस्थानान्तरं च दृष्टिर्ज्ञातव्या । पुनस्तत्रस्थयैव दृष्टया गृहाग्रं चैकयष्टया विध्येत् । इयं यष्टिर्यत्र पूर्वशलाकायां लग्ना तस्माच्छ-लाकामूलपर्यन्तं द्वितीया शलाका ज्ञेया ।

गृहैकदेशं प्रथमशलाकावशेन गणयित्वा धार्यम् । इष्टशलाकया च सर्वं गृहौच्च्यं विद्ध्वा द्वितीया शलाका ज्ञेया, ततो गृहैकदेशौच्च्यं द्वितीयशलाकया गुणितं प्रथमशलाकया भक्तं गृहौच्च्यं भवेत् ।



अत्रोपपत्तिः ।

अक=गृहाद्यौच्च्यम् । गप=शलाका । दृ-=दृष्टिस्थानम् । कन=ज्ञातौच्च्यम् । कदृ=भूमिः । मग=प्रथम शलाका । चग=द्वितीय शलाका । गदृ=दृष्टि संज्ञकः=दृ तदा कनदृ, गमदृ त्रिभुजयोः सजातीयत्वादनुपातेन

$\frac{\text{ज्ञातौच्च्य} \times \text{दृ}}{\text{प्रथमशलाका}}$ =भूमिः । ततः अकदृ, चगदृ त्रिभुजयोः साजात्यादनुपातः

$\frac{\text{द्वितीयशलाका. भूमि}}{\text{दृ}}$ =गृहाद्यौच्च्म्= $\frac{\text{द्विशलाका.ज्ञातौच्च्य.दृ}}{\text{प्रथमशलाका.दृ}}$

$= \frac{\text{द्वितीयशलाका.ज्ञातौच्च्य}}{\text{प्रथमशलाका}}$ एतेनोपपन्नमाचार्योक्तमिति ॥३७॥

अब प्रकारान्तर से गृहौच्च्यानयन को कहते है।

हि. भा.—जिस धरातल में लम्बरूप गृहादि है उस धरातल में ऊर्ध्वाधराकार अंगुलादि से अङ्कित एक शलाका स्थापन करना। दृष्टि को उसी धरातल में कहीं पर रखकर नलिका से या अन्य यष्टि से गृहादि का एक प्रदेश (जिसकी ऊंचाई विदित है) को वेध करना। नलिका वा अन्ययष्टि शलाका में जहां लगती है वहां से शलाका मूलपर्यन्त प्रथम शलाका संज्ञक है। शलाका मूल दृष्टि स्थान का अन्तर दृष्टि समझनी चाहिये। पुनः उसी स्थान स्थित दृष्टि से गृहाग्र को एक यष्टि से वेध करना। यह यष्टि पूर्व शलाका में जहां लगती है वहां से शलाकामूल पर्यन्त द्वितीय शलाका संज्ञक है। गृहादि के एक प्रदेश को प्रथम शलाकावश से गणना कर धारण करना। इष्टशलाका से गृहौच्च्य को वेध कर द्वितीयशलाका समझनी चाहिये। तब गृह के प्रदेश के औच्च्यको द्वितीय शलाका से गुणा कर प्रथम शलाका से भाग देने से गृहौच्च्य होता है इति ॥३७॥

उपपत्ति।

यहां संस्कृतोपपत्ति में लिखित (१) क्षेत्र को देखिये। अक = गृहादि का औच्च्य (ऊंचाई), गप = शलाका। दृ = दृष्टिस्थान। कन = ज्ञातौच्च्य = (विदित ऊंचाई)। कदृ = भूमि = भू। मग = प्रथमशलाका। चग = द्वितीयशलाका। गदृ = दृष्टि संज्ञक = दृ।

तब कनदृ, गमदृ दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं। $\frac{\text{ज्ञातौच्च्य.दृ}}{\text{प्रथमशलाका}}$ = भूमि = भू। ∴ अकदृ, चगदृ दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं। $\frac{\text{द्वितीयशलाका.दृ}}{\text{भूम}}$ = गृहाद्यौच्च्य = $\frac{\text{द्वितीयशलाका. ज्ञातौच्च्य.दृ}}{\text{प्रथमशलाका.दृ}} = \frac{\text{द्वितीयशलाका.ज्ञातौच्च्य}}{\text{प्रथमशलाका.दृ}}$ इससे आचार्योक्त उपपन्न हुआ इति ॥३७॥

इदानीं परमतं खण्डयति

यष्टया हृताच्छलाका त्रिज्याघाताद्धनुर्गृहान्तरकम् ।
यैरुक्तं मूर्खास्ते यतो न दृष्टान्तरं दृग्ज्या ॥३८॥

सु. भा.—पूर्वश्लोकोक्तविधिना गृहाग्रवेधे ऽन्ययष्टिर्यत्र शलाकायां लग्ना तस्माद् दृष्टिस्थानपर्यन्तं कर्ण एव यष्टिः। द्वितीयशलाका कोटिः। दृष्टिर्भुजः। शलाका त्रिज्यागुणा यष्टिहृता फलस्य धनुर्दृष्टिस्थानाद्गृह मूलाग्ररेखयोरन्तरगः कोणो गृहान्तरांशाभिधस्त्रिकोणमित्या वास्तव एव सिध्यति। गृहाग्ररूपग्रह-

स्य दृष्टान्तरं दृष्टिसंज्ञसमं दृग्ज्या भवेद्वा न। अतो 'यैराचार्यैः पूर्वफलचापसमं गृहान्तरकमुक्तं ते मूर्खाः सन्ति यतो दृष्टान्तरं दृग्ज्या नास्तीति वाग्बलमेतद्दूषण-मिति सुधीभिश्चिन्त्यम् ॥३८॥

वि. भा.—शलाका त्रिज्यागुणा यष्टिहृता फलस्य धनुः (चापं) गृहान्तरकं यैराचार्यैरुक्तं ते मूर्खाः सन्ति। यतो दृष्टान्तरं दृग्ज्या नास्तीति ॥

अत्रोपपत्तिः।

पूर्वश्लोकोक्तविधिना गृहाग्रवेधेऽन्ययष्टिर्यत्रशलाकायां लग्ना तस्माद्दृष्टि-स्थानपर्यन्तं यष्टिः कर्णः। द्वितीयशलाका कोटिः। दृष्टिर्भुजः। पूर्वोक्तश्लोको-पपत्तौ लिखितं क्षेत्रं द्रष्टव्यम्। दृच=यष्टिः कर्णः। चग=शलाका कोटिः। गदृ=दृष्टिर्भुजः। अत्र त्रिभुजे कोणानुपातः क्रियते यदि यष्ट्या तत्संमुख-कोणज्या त्रिज्या लभ्यते तदा शलाकया किं समागच्छति दृष्टिस्थानाद्गृहाग्रमूलयो र्गतरेखयोरुत्पन्नकोणज्या तत्स्वरूपम्= $\frac{\text{त्रि} \times \text{शलाका}}{\text{यष्टि}}$ =ज्या$<$गदृच, अस्या-श्चापम्=$<$गदृच=गृहान्तरांशा वास्तवाः। गृहाग्ररूपग्रहस्य दृष्टान्तरं दृष्टिसंज्ञ-समं दृग्ज्या भवेदेव। आचार्येण व्यर्थमेव खण्डनं क्रियते इति ॥३८॥

अब अन्यों के मत का खण्डन करते हैं।

हि. भा—शलाका को त्रिज्या से गुणाकर यष्टि से भाग देने से जो फल प्राप्त हो उसके चाप को जो आचार्य गृहान्तर कहते हैं वे मूर्ख हैं, क्योंकि दृष्टान्तर दृग्ज्या नहीं है इति ॥३८॥

उपपति।

पूर्वश्लोकोक्त विधि से गृहाग्रवेध करने से अन्य यष्टि शलाका में जहां लगती है, वहां से दृष्टि स्थान पर्यन्त यष्टिकर्ण, द्वितीयशलाका कोटि, दृष्टिभुज, पूर्वोक्तश्लोकोपपत्ति में लिखित क्षेत्र को देखना चाहिये। दृच=यष्टिकर्ण, चग=शलाका कोटि, गदृ=दृष्टिभुज, इस त्रिभुज में कोणानुपात करते हैं, यदि यष्टि में तत्संमुख कोणज्या त्रिज्या पाते हैं तो शलाका में क्या इस अनुपात से दृष्टि स्थान से गृह के अग्र और मूलगत रेखाद्वय से उत्पन्न कोणज्या आती है उसका स्वरूप=$\frac{\text{त्रि.शलाका}}{\text{यष्टि}}$ =ज्या$>$गदृच, इसका चाप=$<$गदृच

=वास्तव गृहान्तरांश, गृहाग्ररूपग्रह का दृष्टान्तर (दृष्टि संज्ञतुल्य) दृग्ज्या होती है, आचार्य का यह खण्डन ठीक नहीं है इति ।३८।।

इदानीं शंकुमाह ।

मूले द्वयङ्गुल विपुलः सूच्यग्रो द्वादशाङ्गुलोच्छ्रायः ।
शंकुस्तलाग्रविद्धोऽग्रवेधलम्बादृजुर्ज्ञेयः ।।३९।।

सु. भा — (शंकुस्तलाग्रविद्धोऽग्रवेधलम्बादृजुर्ज्ञेयः ।।३९।।
अग्रवेधलम्बादग्ररन्ध्रगतावलम्बादृजुर्लम्बाकारो ज्ञेयः ।
तलादाधारवृत्तकेन्द्रादग्रपर्यन्तं विद्धः सरन्ध्र इत्यर्थः ।
शेषं स्पष्टार्थम् ।।३९।।

वि. भा.—मूले (तले) द्वयङ्गुलपिण्डः, अग्रे सूच्याकारः । द्वादशाङ्गुलमुच्छ्रितिः । अग्रवेधलम्बात् (अग्ररन्ध्रगतावलम्बात्) ऋजुः (सरलाकारो लम्बाकारो वा), तलाग्रविद्धः (आधारवृत्तकेन्द्रादग्रपर्यन्तं विद्धः सरन्ध्र इतिः) शंकुर्ज्ञेयः । सिद्धान्त शेखरे । "भ्रमविरचितवृत्तस्तुल्यमूलाग्रभागो द्विरदरदनजन्मा सारदारूद्भवो वा । गुरु ऋजुरवलम्बादव्रणः षट्कवृत्तः समतल इह शस्तः शंकुरर्काङ्गुलः स्यात् ।।" अस्यार्थ :—भ्रमेण (शाणेन) विरचितं कृतं वृत्तं यस्मिन् सः । अत एव तुल्यमूलाग्रभागः (समानो मूलभागोऽग्रभागश्च यस्य सः) घर्षण शिलया तथा धृष्टो यथा सर्वत्रैव कृतानां वृत्तानां परिधयस्तुल्या भवेयुः । गजदन्तसम्भवः । वा सारवत्काष्ठेन निर्मितः । गुरुः (अलघुतौल्यः) । अवलम्बसूत्रतः सरलाकारः । व्रणरहितः । षड्वृत्तसहितः । समतलः (समीकृतस्तलभागो यस्य), द्वादशाङ्गुलप्रमाणः । इह यत्रोपयोगे एतादृशः शंकुः प्रशस्तः स्यात् । ज्यौतिषसिद्धान्ते दिग्देशकालज्ञानार्थं सर्वत्रैव शंकुरुपयोगित्वेन प्रसिद्धोऽस्ति । परं स कीदृशो निर्मापयितव्यस्तदेवानेन श्लोकेन श्रीपतिना कथ्यते, अतः कथित लक्षणयुक्तः शंकुरेव प्रशस्तस्तद्भिन्नश्चाशोभन इति ।

अत्र लल्लोक्तम्—

"भ्रमसिद्धः सममूलाग्रपरिधिरतिसुगुरुसारदारुमयः ।
रज्जुव्रणराजिलाञ्छनस्तथा च समतलः शंकुः ।।"

इति लल्लोक्तमेव श्रीपतिना छन्दोऽन्तरेणोक्तमिति स्फुटमेव विदुषाम् । भास्कराचार्योऽपि—

"समतलमस्तकपरिधिर्भ्रमसिद्धो दन्तिदन्तजः शंकुः ।
तच्छायातः प्रोक्तं ज्ञानं दिग्देशकालानाम् ।।"

इत्यनेन लल्लोक्तं श्रीपत्युक्तं च विविच्य स्पष्टाशयं शंकुयन्त्रं कथयतीति ।
सूर्य सिद्धान्ते "नरयन्त्रं तथा साधु दिवा च विमले रवौ ।
छायासंसाधनैः प्रोक्तं कालसाधनमुत्तमम् ॥"
एवं कथ्यते ॥ इति ३९ ॥

अब शंकु को कहते हैं ।

हि. भा.—मूल (नीचे) में दो अंगुल मोटा, अग्र में सूची (सुई) के आकार का, बारह अंगुल ऊंचा, अग्र में जो रन्ध्र (छिद्र) तद्गत अवलम्ब से ऋजु (लम्बाकार), आधारवृत्त केन्द्र से अग्रपर्यन्त रन्ध्र में मिला हुआ शंकु समझना चाहिये इति ।। सिद्धान्त शेखर में 'भ्रम विरचितवृत्तस्तुल्यमूलाग्र भागो । द्विरदरदनजन्मा सारदारूद्भवो वा' इत्यादि विज्ञान भाष्य में लिखित श्लोक से श्रीपति कहते हैं कि शाण से विरचित है वृत्त जिसमें अत एव समान है मूल भाग और अग्र भाग, अर्थात् घिसने वाले पत्थर से इस तरह घिसा गया है जिससे सब जगह किये हुये वृत्तों की परिधि तुल्य है । हाथी दांत के या सार वाले काष्ठ का बना हुआ, गुरु (भारी), सरलाकार, व्रण (आवड़ खूवड़) से रहित, तत्व भाग जिसका समान है, ऐसे बारह अंगुल के शंकु प्रशस्त है । ज्यौतिष सिद्धान्त ग्रन्थों में दिशा-देश और काल के ज्ञान के लिये सब स्थानों में शंकु उपयोगिता के कारण प्रसिद्ध है अर्थात् हर जगह शंकु की जरूरत होने से शंकु प्रसिद्ध है लेकिन वह शंकु कैसा होना चाहिये वही बात श्रीपति ने उपर्युक्त श्लोक से कही है, उपर्युक्त लक्षणों से युक्त शंकु से भिन्न शंकु प्रशस्त (शोभन) नहीं है । यहां लल्लाचार्य ने "भ्रम सिद्धः सममूलाग्रपरिधिरतिसुगुरु सारदारुमयः" इत्यादि विज्ञानभाष्य में लिखित श्लोक के अनुसार कहा है, लल्लोक्त का ही ने श्रीपति अनुवाद किया है । सिद्धान्त शिरोमणि के गोलाध्याय में "समतल मस्तक परिधिर्भ्रमसिद्धो दन्तिदन्तजः शंकुः" इत्यादि से भास्कराचार्य भी लल्लोक्त और श्रीपत्युक्त को ही सोच विचार कर स्पष्ट रूप से शंकु यन्त्र को कहते हैं । सूर्य सिद्धान्त में 'नरयन्त्रं तथा साधु दिवा च विमले रवौ । छाया संसाधनैः' इत्यादि विज्ञान भाष्य में लिखित श्लोक के अनुसार कहा गया है, शंकुच्छाया से कालज्ञान होता है जैसे छाया ज्ञान से $\sqrt{\text{छाया}^2 + \text{शंकु}^2} = \sqrt{\text{छाया}^2 + १२^2}$ $=$ छायाकर्ण । तब $\frac{\text{छायाक} \times \text{शंकु}}{१२} =$ इहृति । इष्टहृति से $\frac{\text{इष्टहृति.त्रि}}{\text{द्यु}} =$ इष्टान्त्या । इस में चरज्या संस्कार करने से सूत्र ज्ञान होता है, इससे उन्नत काल का ज्ञान सुलभता ही से होता है, सिद्धान्त शिरोमणि आदि देखने से स्फुट है इति ॥३९॥

इदानीं शंकुयन्त्रेण कालज्ञानमाह ।

छायां दृग्ज्यां दृष्टिं छायाकर्णमवलम्बकं शंकुम् ।
परिकल्प्य शंकुयन्त्रे योज्यं घटिकादि यष्टयुक्तम् ॥४०॥

सु. भा.—शंकुयन्त्रे छायां दृग्ज्यां दृष्टिं छायाग्रशंक्वग्रसूत्रं छायाकर्णं शंकुमवलम्बकं प्रकल्प्य यष्टियुक्तं यष्टियन्त्रोक्तं घटिकादिसर्वं योज्यम् । यष्टि-यन्त्रात् सर्वं यथा साधितं तथाऽस्मादपि साधनीयमित्यर्थः ।।४०।।

वि. भा.—शंकुयन्त्रे छायां दृग्ज्यां दृष्टिं छायाग्रशंक्वग्रगतं सूत्रं छायाकर्णं शंकुमवलम्बकं प्रकल्प्य यष्टियन्त्रोक्तं घटिकादिसर्वं योज्यमर्थाद्यष्टियन्त्राद्यथा सर्वं साधितं तथाऽस्मादपि साधनीयमिति ।।४०।।

अब शंकुयन्त्र से कालज्ञान को कहते हैं ।

हि. भा.—शंकुयन्त्र में छाया को दृग्ज्या, दृष्टि (छायाग्रशंक्वग्रगतसूत्र) को छाया-कर्ण, शंकु को अवलम्बसूत्र कल्पना कर यष्टि यन्त्र में कथित घटिकादि सब साधन करना चाहिये अर्थात् यष्टि यन्त्र से जैसे सब कुछ साधन किया गया है वैसे इससे भी साधन करना चाहिये इति ।।४०।।

इदानीं घटीयन्त्रमाह ।

घटिका कलशार्धाकृति ताम्रम् पात्रं तलेऽपृथुच्छिद्रम् ।
मध्ये तज्जलमज्जनषष्टया द्युनिशं यथा भवति ।।४१।।

सु. भा.—ताम्रं ताम्रभवं पात्रं कलसार्धाकृतिघटार्धप्रतिमं घटिका घटीयन्त्रं भवति । अस्य पात्रस्य तले मध्ये तथाऽपृथुच्छिद्रं कार्यं यथा यज्जलमज्जनषष्टया द्युनिशमहोरात्रमानं भवति । एवमेकनिमज्जनेनैका घटी भवतीति सर्वं स्फुटम् ।।४१।।

वि. भा.—ताम्रभवं पात्रं घटार्धानुकारं घटिका (घटी यन्त्रं) भवति । अस्य ताम्रपात्रस्य तले तथा ऽपृथु (लघु) च्छिद्रं कार्यं तथा तज्जलमज्जनषष्टया-ऽहोरात्रमानं भवति-अर्थादेकनिमज्जनेनैका घटी भवतीति ।। सिद्धान्तशेखरे—

शुल्बस्य दिग्भिर्विहितं पलैर्यत् षडङ्गुलोच्चं द्विगुणायतास्यम् ।
तदम्भसा षष्टिपलैः प्रपूर्यं पात्रं घटार्धप्रमितं घटी स्यात् ।।
सत्र्यंशमाषत्रय निर्मिता या हेम्नः शलाका चतुरङ्गुला स्यात् ।
विद्धं तया प्राक्तनमत्र पात्रं प्रपूर्यते नाडिकयाऽम्बुना तत् ।।"

श्रीपतिनैवमुच्यते । अस्यायमर्थः—शुल्बस्य (ताम्रस्य) दिग्भिः (दशभिः) पलैः—"कर्षैश्चतुर्भिश्चपलं तुलाज्ञा" इति भास्करोक्त्या चत्वारिंशद्भिः कर्षैः । विहितं (निर्मित)षड्ङ्गुलोच्छ्रायम्, (द्वादशाङ्गुलदीर्घमुखम्), घटार्धप्रमितं (कलशार्धरूपम्) अम्भसा (जलेन) षष्टिपलैः पूर्णं यत्पात्रमर्थाज्जलपात्रे निक्षिप्तं सत्—एकघटया

जलपूर्णं भूत्वा यत्पात्रं निमज्जति तत् घटीसंज्ञकं यन्त्रं स्यात् ॥ अथानया रीत्या निर्मितं घटीयन्त्रं यथा जलपात्रे षष्टिपलैर्निमज्जेत्तदर्थं तस्य तले छिद्रकरणरीतिं कथयति । सत्र्यंशमाषत्रयनिर्मितेत्यनेन, तुल्या यवाभ्यां कथिताऽत्र गुञ्जा, दशार्धगुञ्जं प्रवदन्ति माषम्" इत्युक्तलक्षणेन सत्र्यंशमाषत्रयेण निर्मिता चतुरङ्गुला सुवर्णशलाका या स्यात्तयाविद्धं (भेदितं) पूर्वकथितं घटीयन्त्ररूपं पात्रमेकेन दण्डेन जलेन पूर्णं भवतीति ॥ अत्र लल्लाचार्योक्तम्—

"दशभिः शुल्बस्य पलैः पात्रं कलशार्ध सन्निभं घटितम् ।
हस्तार्धमुखव्यासं समघटवृत्तं दलोच्छ्रायम् ॥
सत्र्यंशमाषकत्रयनलया समसवृत्तया हेम्नः ।
चतुरंगुलया विद्धं मज्जति विमले जले नाड्याः ॥"

इत्येवानूदितं श्रीपतिना, अत्र भास्कराचार्येण ।
"घटदलरूपा घटिता घटिका ताम्री तलेऽपृथुच्छिद्रा ।
द्युनिशनिमज्जनमित्या भक्तं द्युनिशं घटीमानम् ॥"

दशभिः शुल्बस्य पलैरित्यादि यद् घटीलक्षणं कैश्चित् कृतं तद्युक्तिशून्यं दुर्घटं चेत्येतदुपेक्षितम् । इष्टप्रमाणाकारसुषिरं पात्रं घटीसंज्ञमङ्गीकृतम् । यदि द्युनिशनिमज्जनसंख्यया षट्त्रिंशच्छता ३६०० नि पलानि लभ्यन्ते तदैकेन निमज्जनेन किमिति रीत्या घटीयन्त्रप्रमाणनिरूपणं लल्लश्रीपत्याद्युक्त्या षष्टिपलप्रपूर्यघटीयन्त्रनिर्माणस्य युक्तिशून्यत्वं च यत्कथ्यते तत्समीचीनमेवेति (क) ॥४१॥

अब घटीयन्त्र को कहते हैं ।

हि.भा.—आधा घट (घड़ा) के सदृश ताम्र (तांबा) का पात्र घटीयन्त्र होता है। इसके तल के मध्य में छोटा छिद्र (सूराख) ऐसा करना चाहिये जिससे जलपात्रस्थ जल में साठ बार उसके डूबने से अहोरात्रमान हो अर्थात् एक बार डूबने से एक घटी हो इति। सिद्धान्तशेखर में 'शुल्वस्य दिग्भिर्विहितं पलैर्यत्" इत्यादि विज्ञान भाष्य में लिखित श्लोकों से श्रीपति कहते हैं कि दशपल अर्थात् 'कर्षैश्चतुर्भिश्च पलं' इस भास्करोक्त सूत्र के अनुसार चालीस कर्ष ताम्र (तांबा) से बनाया हुआ छः अंगुल ऊंचाई, बारह अंगुल चौड़े मुख की लम्बाई, आधे घट (घड़े) के सदृश साठ पल में जल से पूर्ण जलपात्र में देने से एक घटी में जल से पूर्ण हो कर जो पात्र डूबता है वह घटी नाम का यन्त्र (घटीयन्त्र) है । इस तरह निर्मित घटी यन्त्र जैसे साठ पल में जलपात्र में डूबे, उसके लिये उसके तल के मध्य में

(क) सूर्यसिद्धान्ते 'ताम्रपात्रमधश्छिद्रं न्यस्तं कुण्डेऽमलाम्भसि । षष्टिर्मज्यत्यहोरात्रे स्फुटं यन्त्रं कपालकम्' इत्यनेन घटी यन्त्रमेव कपालयन्त्रं कथ्यते

छिद्र करने के प्रकार कहते हैं। 'तुल्या यवाभ्यां कथिताऽत्र गुञ्जा, दशार्धं गुञ्जं प्रवदन्ति माषम्" इस लक्षण से तृतीयांश सहित तीन माषा से निर्मित चार अंगुल सुवर्ण शलाका से विद्ध (भेदित) पूर्वकथित घटी यन्त्र रूप पात्र जल से एक दण्ड में पूर्ण होता है। यहां लल्लाचार्योक्त है "दशभिः शुल्बस्य पलैः पात्रं कलशार्धसन्निभं घटितम्" इत्यादि विज्ञान भाष्य में लिखित श्लोकों का अनुवाद श्रीपति ने 'शुल्बस्य दिग्भिर्विहितं' इत्यादि से किया है। भास्कराचार्य के गोलाध्याय में "घटदलरूपा घटिता घटिका ताम्री तलेऽपृथुच्छिद्रा" इत्यादि–दशभिः शुल्बस्य पलैः इत्यादि घटी लक्षण जो किसी ने किया है वह युक्ति शून्य और दुर्घट है इसलिये वह उपेक्षा के योग्य है। इष्ट प्रमाण आकार छिद्र वाला पात्र घटी संज्ञक स्वीकार किया गया है। यदि द्युनिश (अहोरात्र) निमज्जन संख्या में छत्तीस सौ ३६०० पल पाते हैं तो एक निमज्जन में क्या इस रीति से घटी यन्त्र प्रमाण निरूपण किया है। लल्ल और श्रीपति आदि आचार्योक्ति से साठ पल में जल से भरने योग्य घटीयन्त्र के निर्माण को युक्ति शून्य और दुर्घट जो कहते हैं सो समीचान ही है' इति ॥४१॥

इदानीं कपालमन्त्रमाह।

मध्याद्य स्वनतांशैः कपालकं दिक्स्थ सूत्रमध्याग्रात्।
व्यस्तोन्नतांश विवरे सूत्रैक्यापाततो नाड्यः ॥४२॥

सु. भा.—मध्याद्यस्वनतांशैः कपालकं कपालयन्त्रं भवति। क्षितिजानुकारं दिगङ्कितं फलके वृत्तं विरचय्य इष्टदिने द्युज्याचरज्यादिना प्रत्यंशं नतांशं प्रकल्प्योन्नतघटिका मध्यनतांशावधि प्रसाध्य व्यस्तकपाले ता घटिकाः स्वस्वनतांशाग्रे वृत्तपालावंक्याः। एवं कपालयन्त्रं भवति। इष्टकाले दृग्मण्डलाकारे धृते कपालयन्त्रे केन्द्रस्थकीलच्छायानुसारि केन्द्रगतं सूत्रं यत्र परिधौ लगति तत्राङ्किता नाडय इष्टघटिका भवन्ति। एवं दिक्स्थसूत्रमध्याग्रात् सूत्रैक्यापाततः सूत्रभयोर्यदैक्यं तस्यापाततो वृत्तपरिधौ संयोगतो व्यस्तोन्नतांशविवरे व्यस्तकपालस्थोन्नतांशान्तरे नाडयो भवन्ति गोलयुक्तितः ॥४२॥

वि. भा.—मध्याद्यस्वनतांशैः कपालयन्त्रं भवति। फलके दिगङ्कितं क्षितिजानुकारं वृत्तं कृत्वाऽभीष्टदिने द्युज्या चरज्यादिना प्रत्यंशं प्रकल्प्योन्नतघटिका मध्यनतांशावधि साधयित्वा ता घटिका व्यस्तकपाले स्वस्वनतांशाग्रे वृत्तपालावङ्क्याः एवं कपालयन्त्रं भवति। इष्टकाले कपालयन्त्रे दृग्मण्डलाकारे धृते केन्द्रस्थकीलछायानुसारि केन्द्रगतं सूत्रं वृत्तपरिधौ यत्र लगति तत्राङ्किता नाड्य

(१) सूर्यसिद्धान्त में 'ताम्रपात्रमधश्छिद्र" इत्यादि से पूर्व कथित घटी यन्त्र को ही कपाल यन्त्र कहते हैं।

इष्टघटिका भवन्ति । एवं दिक्स्थसूत्रमध्याग्रात् सूत्रैक्यापाततः सूत्रयोर्यदैक्यं तस्यापाततो वृत्तपरिधौ संयोगतो व्यस्तोन्नतांशविवरे (व्यस्तकपालयस्थोन्नतांशान्तरे) घट्यो भवन्ति । सिद्धान्तशेखरे ।

"इदं भवेदूर्ध्वशलाकमुर्व्यां स्थितं कपालं द्युतिदिक् च चापम् ।
मध्यस्थकीलप्रभया विमुक्ताः प्रत्यग्गतास्ता घटिकानिरुक्ताः ॥"

श्रीपतिनैवं कथ्यते—अस्यार्थः—इदं चापयन्त्रमूर्ध्वशलाकं (ऊर्ध्वगलम्बं वा) द्युतिदिक् उर्व्यां स्थितं (छायादिशि समभूमौ स्थितं) कपालयन्त्रं भवेत् । कपालयन्त्रे व्याससूत्रमध्यबिन्दौ स्थापितस्य कीलस्य छायया विमुक्तास्त्यक्ता घटिका प्रत्यग्गता भवन्तीति । आचार्योक्तसूत्रोपपत्तिरपि भाष्यरूपैवास्तीति । श्रीपत्युक्त-

सूत्रार्थमुपपत्तिः ।

वृत्तार्धस्वरूपं चापयन्त्रं यस्यां दिशि ऊर्ध्वगशलाकायाश्छाया पतति तस्यां दिशि चापं स्थितमर्थात् याम्योत्तरसूत्रधरातले यन्त्रस्य व्याससूत्रं छायादिशि च तद्वृत्तार्धमिति रीत्या स्थापितं तद्वशतोऽपि तथैव भुक्ता लम्बच्छायया या घटिकास्ताः प्रत्यग्गता दिनघटिका इति ॥ शिष्यधीवृद्धिदतन्त्रे लल्लोक्तम्—

इदमेवोर्ध्वशलाकं भुवि स्थितं स्यात् कपालकं यन्त्रम् ।
अनयोः कीलच्छायामुक्ता घटिका भवन्ति वारुण्याः॥

इत्येव श्रीपतेर्मूलम् । सिद्धान्तशेखरे शिष्यधीवृद्धिदे चैकत्रैव कपालयन्त्र-पीठयन्त्रयोरुल्लेखोऽस्ति । यथा सिद्धान्तशेखरे—

इदं भवेदूर्ध्वशलाकमुर्व्यां स्थितं कपालं द्युतिदिक् च चापम् ।
संसाधितांशं खलु चक्रयन्त्रं पीठं भवत्यूर्ध्वशलाकमेव ॥
मध्यस्थकीलप्रभया विमुक्ताः प्रत्यग्गतास्ता घटिका निरुक्ताः ।
पीठे तु सूर्योदयबिम्बवेधाद् भुक्तांशजीवा स्फुटमग्रका स्यात् ॥

शिष्यधीवृद्धिदे च

इदमेवोर्ध्वशलाकं भुवि स्थितं स्यात् कपालकं यन्त्रम् ।
चक्रं चोर्ध्वशलाकं वदन्ति पीठं सुसिद्धांशम् ॥
अनयोः कीलच्छायामुक्ता घटिका वदन्ति वारुण्याः ।
पीठार्कोदयवेधादग्राश्चापांशकाश्चापि ॥४२॥

अब कपालयन्त्र को कहते हैं।

हि. भा.—मध्यादि अपने नतांश से कपालयन्त्र होता है। फलक में दिशा से अङ्कित क्षितिजानुकार वृत्त बनाकर अभीष्ट दिन में द्युज्या–चरज्या आदि से प्रत्येक अंश को कल्पनाकर मध्य नतांश पर्यन्त उन्नतघटी साधन कर उस घटी को व्यस्त कपाल में अपने अपने नतांशाग्र में वृत्तपाली में अङ्कित करना चाहिये, इस तरह से कपाल यन्त्र होता है। इष्टकाल में कपाल यन्त्र को दृग्मण्डलाकार रखने से केन्द्रस्थ कीलच्छायानुसार केन्द्रगत सूत्र वृत्तपरिधि में जहां लगती है वहां अङ्कित नाड़ी इष्टघटी होती है। एवं दिक्स्थसूत्र मध्याग्र से सूत्रों का जो ऐक्य (योग) है उसके आपात से अर्थात् वृत्तपरिधि के साथ संयोग से व्यस्त (उल्टा) कपालस्थ उन्नतांशान्तर में घटी होती है। सिद्धान्तशेखर में "इदं भवेदूर्ध्वं-शलाकमुर्व्यां स्थितं कपालं द्युतिदिक् च चापम्" इत्यादि विज्ञान भाष्य में लिखित श्लोकों के अनुसार श्रीपति कहते हैं इस श्लोक का अर्थ यह है ऊर्ध्वगत है शलाका वा लम्ब जिसमें ऐसा यह चाप यन्त्र समान पृथिवी में छाया दिशा में स्थित कपाल यन्त्र होता है। कपाल यन्त्र में व्यास सूत्र के मध्य बिन्दु में स्थापित कील की छाया से त्यक्तघटी पश्चिम दिशा में होती है इति ।।४२।।

आचार्योक्त सूत्र की उपपत्ति व्याख्यारूप ही है। श्रीपत्युक्त सूत्रोपपत्ति के लिये शिष्यधीवृद्धिद तन्त्र में "इदमेवोर्ध्वशलाकं भुवि स्थितं स्यात् कपालकं यन्त्रम्" इत्यादि लल्लोक्त ही श्रीपत्युक्त का मूल है, सिद्धान्तशेखर में और शिष्यधीवृद्धिद में भी कपालयन्त्र और पीठ यन्त्र का उल्लेख साथ साथ है। जैसे सिद्धान्त शेखर में

इदं भवेदूर्ध्वशलाकमुर्व्यां स्थितं कपालं द्युतिदिक् च चापम्।
संसाधितांशं खलु चक्रयन्त्रं पीठं भवत्यूर्ध्वशलाकमेव ।।
मध्यस्थ कीलप्रभया विमुक्ताः प्रत्यग्गतास्ता घटिका निरुक्ताः।
पीठे तु सूर्योदय बिम्बवेधाद् भुक्तांशजीवा स्फुटमग्रका स्यात् ।।

शिष्यधीवृद्धिद तन्त्र में।

इदमेवोर्ध्वशलाकं भुवि स्थितं स्यात् कपालकं यन्त्रम्।
चक्रं चोर्ध्वशलाकं वदन्ति पीठं सुसिद्धांशम् ।।
अनयोः कीलच्छायामुक्ता घटिका वदन्ति वारुण्याः।
पीठार्कोदयवेधादग्राश्चापांशकाश्चापि ।।

इदानीं विशेषमाह।

अथवा कपालके नाड़िकादि सर्वं यथा धनुष्युक्तम्।
कर्त्तरि यन्त्रं स्थूलं कृतं यतोऽन्यैर्वदामि ततः ।।४३।।

सु. भा.—अथवा यथा धनुषि धनुर्यन्त्रे सर्वं नाडिकादि यथोक्तं तथैव कपालकेऽपि ज्ञेयम्। अथान्यैर्यतः कर्त्तरियन्त्रं स्थूलं कृतं ततस्तस्मादहं सूक्ष्मं वदामीति ।।४३।।

वि. भा.—अथवा धनुर्यन्त्रे सर्वं नाड़िकादियथोक्तं कपालके यन्त्रेऽपि तथैव ज्ञेयम् । यतोऽन्यैराचार्यैः कर्त्तरि यन्त्रं स्थूलं कृतं तस्मात्कारणादहं सूक्ष्मं वदामीति ।।४३।।

अब विशेष कहते हैं ।

हि. भा.—अथवा धनुर्यन्त्र में सब नाड़िकादि बातें जैसी कही गयी है वैसी ही कपालयन्त्र में समझनी चाहिये । क्यों कि अन्य आचार्य लोगों ने कर्त्तरी यन्त्र को स्थूलरूप से वर्णन किया है इस कारण से मैं सूक्ष्म कहता हूं इति ।।४३।।

इदानीं कर्त्तरी यन्त्रमाह ।

द्विक्स्थितफलकद्वियुतिस्तले तदग्रस्थसूत्रयोर्मध्ये ।
कीलस्तच्छायाग्रात् कर्त्तर्यां नाड़िकाः स्थूलाः ।।४४।।

सु. भा.—अर्धवृत्तानुकारं फलकद्वयं कार्यम् । एकमधोऽर्धनाडीवलयानुकारमन्यदधोऽर्धयाम्योत्तरवृत्तानुकारम् । ततस्तले यथादिक्स्थितयोर्द्वयोः फलकयोर्युतिः कार्या यथैकं नाडोमण्डलधरातलेऽन्यत् स्वयाम्योत्तरमण्डलधरातले स्यात् । तदग्रस्थे ये पूर्वापरदक्षिणोत्तरानुकारे सूत्रे तयोर्मध्येऽर्थाद्वृत्तयोः केन्द्रे कीलः स्थाप्यो यथाऽयं कीलो ध्रुवयष्टिरेव भवेत् । एवमिदं कर्त्तरीयन्त्रं भवेत् । अस्यां कर्त्तर्यां तच्छायाग्रात् कीलच्छायाग्रात् स्थूला नाडिका इष्टघट्यो भवन्ति । इदमेव भास्करेण 'भूस्थं ध्रुवयष्टिस्थं चक्रम्'—इत्यादिना नाडीवलयाख्यं यन्त्रमुदितं । भास्करविधिना यदि रविक्रान्तिरेकस्मिन् दिने स्थिरा तदैवोन्नतघटिका वास्तवा गोल युक्तया भवन्ति परन्तु रवेः क्रान्तेः प्रतिक्षणं चलत्वान्नाडिकाः स्थूला भवन्तीत्याचार्योक्तं गोलयुक्तियुतं बुद्धिमद्भिश्चिन्त्यम् । अनेन यन्त्रेण नतकाल-ज्ञानं सूक्ष्मं भवतीति सिद्धान्तविदां स्फुटम् ।।४४।।

वि. भा.—अर्धवृत्तानुकारं फलकद्वयं कार्यम् । एकमधोऽर्धनाड़ीवृत्ताकारमन्यदधोऽर्धं याम्योत्तरवृत्तानुकारम् । ततस्तत्तले यथादिक् स्थितयोर्द्वयोः फलकयोर्युतिः कार्या यथैकं नाड़ीवृत्तधरातलेऽन्यत् स्वयाम्योत्तरवृत्तधरातले स्यात् । तदग्रस्थे ये पूर्वापर दक्षिणोत्तरानुकारे सूत्रे तयोर्मध्येऽर्थाद्वृत्तयोः केन्द्रे कीलः स्थाप्यो यथाऽयं कीलो ध्रुवयष्टिरेव भवेत् । एवमिदं कर्त्तरीयन्त्रं भवेत् अस्यां कर्त्तर्यां कीलच्छायाग्रात् स्थूला इष्ट नाड़िका भवंति । सिद्धान्तशेखरे—

"ज्यामध्यतिर्यक्स्थितकीलमेतत् पूर्वापरस्थं स्थिरकर्त्तरी स्यात् ।
प्रत्यग् धनुः कोटिमुखात् द्युनाड्यः समुज्झिताः कीलरुचा भवन्ति ॥"

श्रीपतिनैवं कथ्यते अस्यार्थः—एतच्चक्रयन्त्रं ज्यामध्यतिर्यक् स्थितकीलकं व्यासरेखाया मध्यबिन्दौ तिर्यगाकारेण निवेशितलौहादिकीलं पूर्वापरस्थं (पूर्वपश्चिमानुरूपेण स्थापितं) स्थिरकर्त्तरीति कर्त्तर्याख्यं यन्त्रं स्यात् । प्रत्यग्धनुः कोटिमुखात् पश्चिमबिन्दौ यद्धनुः या च कोटिः (धनुषः प्रान्तः) तदारभ्य कीलरुचा (ज्यामध्यस्थापित कीलच्छायया) समुज्झिताः (मुक्ताः) नाड्यः द्युनाड्यः (दिनगत घटिका) भवन्ति ।

अत्रोपपत्तिः ।

चक्रयन्त्रस्यैव भेदान्तरं कर्त्तरीयन्त्रम् । चक्रयन्त्रे नाड़ीवृत्तानुसारेण स्थापिते पूर्ववदेव पश्चिमबिन्दोः कीलच्छायावधिका घटिकाः सूर्योदयतो दिनगता घटिकाः स्थूला भवन्ति । पूर्वबिन्दोः सूर्यो यथायथोपरि याति तथा तथा पश्चिमबिन्दोः कीलच्छायाऽधो यातीति । अत्र लल्लोक्तम्—

"समपूर्वापरमेतत् स्थिरं स्थितं भवति कर्त्तरीयन्त्रम् ।
ज्यामध्यस्थित तिर्यक्कीलच्छायोज्झिता घटिकाः ॥"

इति श्रीपत्युक्तसदृशमेव । सिद्धान्तशिरोमणेर्गोलाध्याये इदमेव 'भूस्थं ध्रुवयष्टिस्थम्' इत्यादिना भास्करेण नाड़ीवलयाख्यं यन्त्रं कथितम् । भास्करोक्तया यद्येकस्मिन् दिने रविक्रान्तिः स्थिरा भवेत्तदैवोन्नतघटिका वास्तवा भवितुमर्हन्ति परन्तु रवेः क्रान्तेः प्रतिक्षणं वैलक्षण्यान्नाड़िकाः स्थूलाभवन्तीत्याचार्योक्तं युक्तियुक्तम् । अनेन यन्त्रेण नतकालज्ञानं सूक्ष्मं भवतीति विज्ञैर्ज्ञेयम् ॥४४॥

अब कर्त्तरी यन्त्र को कहते हैं ।

हि॰ भा॰—एक नीचे में अर्ध नाड़ीवृत्ताकार, दूसरा नीचे में अर्धयाम्योत्तरवृत्ताकार, इस तरह के अर्धवृत्तानुकार दो फलक करना चाहिये । उसके बाद उनके तल में दोनों फलकों को इस तरह योग करा देना जिस से एक नाड़ीवृत्त धरातल में हो और दूसरा याम्योत्तरवृत्त धरातल में हो जाय । उन के अग्र में जो पूर्वापरानुकार और दक्षिणोत्तरानुकार सूत्र हो उन दोनों के मध्य में अर्थात् वृत्तद्वय के केन्द्र में कील को स्थापन करना जिससे यह कील ध्रुवयष्टि हो, इस तरह यह कर्त्तरी यन्त्र होता है । इस कर्त्तरीयन्त्र में कीलच्छायाग्र से स्थूल इष्टघटी होती है । सिद्धान्तशेखर में 'ज्यामध्यतिर्यक्स्थितकीलमेतत्' इत्यादि विज्ञान भाष्य में लिखित श्लोक के अनुसार श्रीपति कहते हैं । इसका तात्पर्य यह है कि यह चक्र यन्त्र व्यास रेखा के मध्य बिन्दु में तिर्यक् आकार से निवेशित लोह आदि कील

को पूर्वापर रूप से स्थापन करने से कर्त्तरी संज्ञक यन्त्र होता है । पश्चिम बिन्दु में जो धनुष और उसका जो प्रान्त उससे आरम्भ कर ज्यामध्य स्थापित कीलच्छाया से मुक्त (त्यक्त) नाड़ी—द्युनाडी (दिनगत घटी) होती है । इति ॥४४॥

उपपत्ति ।

चक्रयन्त्र ही का भेदान्तर कर्त्तरी यन्त्र है । नाड़ीवृत्तानुसार चक्रयन्त्र को स्थापन करने से पूर्ववत् ही पश्चिम बिन्दु से कीलच्छायापर्यन्त घटी सूर्योदय से दिनगत स्थूल घटी होती है, पूर्वबिन्दु से ज्यों-ज्यों ऊपर जाते हैं त्यों त्यों पश्चिमबिन्दु से कीलच्छाया नीचे जाती है । यहां 'समपूर्वापरमेतत् स्थिरं स्थितं भवति कर्त्तरी यन्त्रम्' इत्यादि संस्कृतोपपत्ति में लिखित लल्लाचार्योक्त श्रीपत्युक्त के सदृश ही है । सिद्धान्तशिरोमणि के गोलाध्याय में 'भूस्थं ध्रुवयष्टिस्थम्' इत्यादि से श्रीभास्कराचार्य ने इसी को नाड़ीवलय संज्ञक यन्त्र कहा है । यदि एक दिन में रवि की क्रान्ति स्थिर मानी जाय तब ही भास्कराचार्योक्ति से उन्नत घटी वास्तव हो सकती है परन्तु रवि की क्रान्ति प्रतिक्षण विलक्षण होती है इसलिये 'नाड़िकाः स्थूला भवन्ति' यह आचार्योक्त युक्तियुक्त है । इस यन्त्र से नतकाल ज्ञान सूक्ष्म होता है इति ॥४४॥

इदानीं पीठयन्त्रमाह ।

दृष्टद्यौच्च्यं समपीठं यष्टिव्यासार्धमन्तिकं परिधौ ।
दिग्भगणांशैर्मूर्धन्यग्रा घटिकादिभिश्चाङ्क्यम् ॥४५॥

सु. भा.—एकं दृग्यौच्च्यं दृग्यौच्च्यसमे प्रदेशे खे गतं यष्टिव्यासार्धमन्तिक समपीठं समं चाक्राकारं फलकं कार्यम् । परिधौ दिग्भिर्भगणांशैस्तथा मूर्धनि परिध्यग्रभागेऽग्राघटिकादिभिरग्रोन्नतघटयादिभिश्चाङ्क्यं पीठसंज्ञं यन्त्रं चक्रयन्त्राकारं भवतीत्यर्थः ॥४५॥

तथा च लल्लः— चक्रं चोर्ध्वशलाकं वदन्ति पीठं सुसिद्धाशम् ।
(शिष्यधीवृ० यन्त्राध्याय, श्लोक २५)

वि. भा.—दृष्टद्यौच्च्यसमे प्रदेशे खे गतं यष्टिव्यासार्धमन्तिकं समपीठं (समं चक्राकारं फलकं कार्यम्) परिधौ दिग्भिर्भगणांशैः, मूर्धनि (परिध्यग्रभागे) अग्राघटिकादिभिः (अग्रोन्नत घटिकादिभिः) अङ्क्यं पीठयन्त्रं चक्राकारं भवतीति । सिद्धान्तशेखरे—

"संसाधिताशं खलु चक्रयन्त्रं पीठं भवत्यूर्ध्वशलाकमेव ।
पीठे तु सूर्योदय बिम्बवेधाद् भुक्तांशजीवा स्फुटमग्रका स्यात् ॥"

श्रीपतिनैवं कथ्यते । अस्यार्थः—संसाधिताशं चक्रयन्त्रं (कृतदिक् साधनं पूर्वंकथितंचक्रयन्त्रं) ऊर्ध्वशलाकमेव (उपरिगतलम्बमेव) पीठं (पीठ संज्ञकं) यन्त्रं भवेत् । पीठे यन्त्रे सूर्योदयबिम्बवेधात् (सूर्योदयसमये रविबिम्बवेधेन) भुक्तांशजीवा (भुक्तानामंशानां जीवा) ऽग्रका स्यात् । स्फुट (प्रत्यक्षमेव दृश्यते) मिति ।

अत्रोपपत्तिः ।

कृतदिक् साधनं वृताकारं पीठयन्त्रं सूर्योदये सूर्याभिमुखं स्थापितं तेन पश्चिमबिन्दोर्यदन्तरेण छाया पतिता तदन्तरमग्रा चापांशास्तज्ज्याऽग्रा भवतीति यन्त्रस्थितिदर्शनेनैव स्फुटम् । शिष्यधीवृद्धिद तन्त्रे—

'चक्रं चोर्ध्वंशलाकं वदन्ति पीठं सुसिद्धाशम् ।
पीठार्कोदयवेधादग्राश्चापांशकाश्चापी ॥'

ति लल्लोक्तमेव श्रीपत्युक्तस्य मूलमिति विज्ञैर्विवेचनीयम् ॥४५॥

अब पीठ यन्त्र को कहते हैं ।

हि. भा.—दृष्टि की ऊंचाई के तुल्य प्रदेश में आकाशस्थ यष्टि व्यासार्धजनित चक्राकार फलक करना चाहिये । परिधि में दिशा और भगणांश को अङ्कित करना चाहिये तथा परिधि के अग्रभाग में अग्राघटी को अङ्कित करना अर्थात् पीठ यन्त्र चक्राकार होता है । सिद्धान्तशेखर में "संसाधिताशं खलु चक्रयन्त्रं" इत्यादि विज्ञान भाष्य में लिखित श्लोक के अनुसार कहते हैं, इसका अर्थ यह है—पूर्वकथित चक्रयन्त्र जिसमें दिक्साधन किया हुआ है उपरिगत लम्ब ही पीठ संज्ञक यन्त्र होता है, पीठ यन्त्र में सूर्योदयकाल में रविबिम्ब वेध से भुक्त अंशों की जीवा (ज्या) अग्रा है इति ॥४५॥

उपपत्ति ।

जिस में दिक्साधन किया हुआ है ऐसे वृत्ताकार पीठ यन्त्र को सूर्योदयकाल में सूर्याभिमुख स्थापन करने से पश्चिम बिन्दु से जितने अन्तर पर छाया पतित होती है वह अग्राचापांश है उसकी ज्या अग्रा होती है, यह यन्त्रस्थिति की भावना ही से स्फुट है । शिष्यधीवृद्धिदतन्त्र में 'चक्रं चोर्ध्वंशलाकं वदन्ति पीठं' इत्यादि लल्लोक्त ही श्रीपत्युक्ति का मूल है इसको विज्ञलोग विचार कर देखें इति ॥४५॥

इदानीं यन्त्रान्तरमाह ।

नलको मूले विद्धस्तत्त्रितिघटिकोद्धृतः समुच्छ्रायः ।
लब्धाङ्गुलैस्तु तैर्नाड़िका क्रिया यन्त्रसिद्धिरतः ॥४६॥

सु० भा०—एक इष्टप्रमाणो नलको मूले विद्धः कार्यः। स च जलैः पूर्णः कार्यः। अधोरन्ध्रेण यावतीभिर्घटीभिर्जलस्रुतिः स्यात् ताः स्रुतिघटिका ज्ञातव्याः। नलकस्य समुच्छ्रायस्तत्स्रुतिघटिकोद्धृतस्तैर्लब्धाङ्गु, लैर्नलके चैकैको विभागोऽङ्कनीयः:। अत एभ्यो विभागेभ्यो नाडिका क्रिया यन्त्रा सिद्धिर्भवति। नाडिकाक्रियया यन्त्रसिद्धिर्भवतीत्यर्थः। एकविभागपर्यन्तं जलस्रुत्यैका घटी द्वितीयभागपर्यंतं जलस्रुत्या घटीद्वयम्। एवमत्र कालज्ञानं भवति।

अत्रोपपत्तिः। यदि स्रुतिघटिकाभिर्नलकोच्छ्रितिसमा जलस्रुतिस्तदैकया घटचा किं जातैकघटी समकालजलस्रुतावुच्छ्रितिरिति ॥४६॥

वि. भा.—एक इष्टप्रमाणो नलको ग्राह्यस्तन्मूले विद्धः कार्यः। स जलैः पूर्णः कार्यः। अधोरन्ध्रेण यावतीभिर्घटीभिर्जलस्रुतिः स्यात् ताः स्रुतिघटिका बोद्धव्याः। तत्स्रुतिघटिकया नलकोच्छ्रायोभक्त लब्धांगुलैर्नलके एकैको विभागश्चिन्हितः कार्यः। अत एभ्यो विभागेभ्यो नाड़िकाक्रियया यन्त्रसिद्धिर्भवत्यर्थादेकचिन्हपर्यन्तं जलस्रुत्येका घटिका, द्वितीयचिन्हपर्यन्तं जलस्रुत्या घटिकाद्वयम्। एवमग्रेऽपि, अनया रीत्यात्र कालज्ञानं भवतीति।

अत्रोपपत्तिः।

यदि जलस्रुतिघटिकाभिर्नलकोच्छ्रितितुल्या जलस्रुतिर्लभ्यते तदैकया घटचा किं जातैकघटीतुल्यकालजनितस्रुतानुच्छ्रितिरिति। सिद्धान्तशेखरे श्रीपतिनैतद्भिन्नमेव यन्त्रान्तरं कालज्ञानार्थं कथ्यते यथा—

"नीरस्रुत्या चिन्हिते नाड़िकाद्यैर्मूलच्छिद्रे वारिपूर्णे च पात्रे।
गोलं तुम्बं पारताढयं गुणेन बद्धे केन प्रक्षिपेत्तत्र युक्ते॥

यथा यथाऽम्बु स्रवति क्रमेण तथा तथाऽधो व्रजदत्र तुम्बम्।
गोलं परिभ्रामयति स्वयं तत् सूर्यांशभुजान्तरगास्तु नाडचः॥"

अस्यार्थः—मूलच्छिद्रे (अधोरन्ध्रवति) वारिपूर्णे पात्रे (जलपूर्णे कांस्यादिभाजने) नीरस्रुत्या (जलप्रस्रवणेन) नाड़िकाद्यैः (घटीपलविपलाद्यैः) चिन्हिते पारतसहितं गोलं तुम्बं (वर्तुलाकारमलावु) तत्र जलपूर्णपात्रे गुणेन (रश्मिभिः) वद्धे, केन (जलेन) युक्ते प्रक्षिपेत्। अम्बु (तद्भाजनजलं) यथा यथा स्रवति (प्रस्रवितं भवति) तथा तथा अत्र अधो व्रजत् तुम्बं स्वयं (अनन्यसापेक्षं) गोलं परिभ्रामयति। तत्र सूर्यांशभुजान्तरगाः—क्रान्तिवृत्ते यस्मिन्नंशे सूर्यो वर्त्तते तस्य क्षितिजवृत्तस्य चान्तरे गता नाडचो भवन्ति। अत्र लल्लोक्तम्—

जलकुण्डेऽधश्छिद्रे घटिकाकालाङ्किते जलस्रुत्या।
गोले वेष्टनसूत्राग्रबद्धतुम्बं क्षिपेत् सरसम्॥

स्रवति च यथा यथाऽम्भस्तथा तथाऽलाबु गच्छमानमधः ।
भ्रमयति गोलकमंभो भुक्ताङ्का नाड़िका ज्ञेयाः ।

इदमेव श्रीपत्युक्तस्य मूलम् । सूत्रानुसारेण गोलनिर्माणं अधश्छिद्रजल-कुण्डे मूलच्छिद्रे जलपूर्णपात्रे वा सपारदतुम्बप्रक्षेपेण नीचतो गच्छत् तत्तुम्बं स्वयं गोलं भ्रामयतीति कारुकार्यनिपुणा एव तादृशं तुम्बयन्त्रमिदं निर्मातुमर्हन्ति। नाड़ीवृत्ते क्षितिजसूर्याभ्यन्तरगा अवयवाः सावनघटिका भवन्तीति ॥४६॥

अब यन्त्रान्तर को कहते हैं।

हि. भा.--एक इष्ट प्रमाण नलक लेकर उसके मूल में छेद करना चाहिये। नलक को जल से भर देना चाहिये, नीचे के छेद से जितनी घटी में जलस्रुति (जल का बहना) होती है, उसको जलस्रुतिघटी समझनी चाहिये। उस जलस्रुति घटी से नलक के उच्छ्राय (ऊंचाई) में भाग देने से जो लब्ध अंगुल हो उससे नलक में एक एक विभाग अङ्कित करना, इन विभागों से नाड़िका क्रिया द्वारा यन्त्र सिद्धि होती है अर्थात् एक विभाग पर्यन्त जलस्रुति से एक घटी, द्वितीय विभाग पर्यन्त जलस्रुति से दो घटी, आगे भी इसी तरह, एवं काल ज्ञान होता है ॥४६॥

उपपत्ति।

यदि स्रुति घटी में नलक की उच्छ्रिति तुल्य जलस्रुति पाते हैं तो एक घटी में क्या इससे एक घटी तुल्य काल जलस्रुति में उच्छ्रिति आती है इति ॥४६॥

इदानीं पुनर्यन्त्रान्तरमाह।

घटिकाङ्गुलान्तरस्थैश्चीरिर्गुटकैर्घटीधृतैरङ्क्या।
उपरिनरोऽधः सुषिरस्तिर्यक् कील्लोऽस्य मुखमध्ये ॥ ४७ ॥[२]

कीलोपरिगामिन्यां चीर्यां धृतपारमलावु तस्मिन्।
स्रवति जले क्षिपति नरो गुटिकां कूर्मादयश्चैवम् ॥ ४८ ॥[१]

सु. भा.—अल्पविस्तारं विपुलदैर्घ्यं वस्त्रखण्डं चीरिरित्युच्यते। एकस्यां घट्यां मनुष्यमुखाद्यावद्वस्त्रखण्डं तदग्रबद्धसपारदालाबुना जलस्रावाघातेन बर्हिनिः

२, घटिकाङ्गुलान्तरस्थैश्चीरिर्गुटकैर्घटीधृतैरङ्क्या।
उपरिनरोऽधःसुषिरस्तिर्यक् कीलोऽस्य मुखमध्ये ॥ ॥४७॥

१. कीलोपरिगामिन्यां चीर्यां धृतपारदमलाबु तस्मिन्।

सरति तद्घटिकाङ्गुल मुच्यते। चीरिर्घटिकाङ्गुलान्तरस्थैर्गुटकैर्घटीधृतै रज्ज्वा। घटिकाङ्गुलान्तरस्थैरेकद्वित्र्यादिघटिकाङ्कितगुटिकास्तत्र योज्या इत्यर्थः।

इयं चीरिर्नराकारस्य यन्त्रस्याधो रन्ध्रस्य मध्ये स्थाप्या तदुपरि च नरः स्थाप्यो यथा चीरिर्नराधो रन्ध्रतः प्रविष्टा नरमुखस्थतिर्यक्कीलोपरिगा भवेत्। नरमुखाग्रे कीलोपरि यच्चीरिखण्डं तदग्रे पारदपूर्णमलावुतुम्बं वध्नीयात्। तस्मिन् तथा जलधारा नलकादिना देया यथाधो गच्छताऽलाबुना घटिकया नरमुखादेकां गुटिकां बहिर्गच्छेत्। एवं जले स्रवति नरो नराकारयन्त्रं घटिकयैकां गुटिकां मुखाद् बहिः क्षिपति। एवं नराकार यन्त्रस्थाने कूर्मादयः कूर्मादीनामाकारा बुद्धिमता कार्या इत्यर्थः ॥४७–४८॥

वि. भा.—अल्पविस्तारं विपुलदैर्घ्यं वस्त्र खण्डम्-चीरिरित्युच्यते। एकस्यां घट्यां मनुष्यमुखाद्यावद्वस्त्रखण्डं तदग्रबद्धसपार-दालावुना जलस्रावाघातेन बहिर्निःसरति तद्घटिकाङ्गुलमुच्यते। चीरिर्घटिकाङ्गुलान्तरस्थैर्गुटकैर्घटीवृतै-रज्ज्वा, अर्थात् घटिकाङ्गुलान्तरस्थैरेकद्वित्र्यादिघटिकाङ्कितगुटिकास्तत्र देयाः। इयं चीरिर्नराकारस्याधोरन्ध्रस्य यन्त्रस्य मध्ये स्थाप्या यथा चीरिर्नराधोरन्ध्रतः प्रविष्टा नरमुखस्थ·तिर्यक् कीलोपरिगता भवेत्। नरमुखाग्रे कीलोपरि यच्चीरिखण्डं तदग्रे पारदपूर्णमलाबुतुम्बं बध्नीयात् तस्मिन् तथा जलधारा नलकादिना देया यथाऽधो गच्छताऽलाबुना घटिका बहिर्गच्छेत्। एवं जले स्रवति नराकारयन्त्रं घटिकां गुटिकां मुखाद्बहिःक्षिपति। एवं नराकारयन्त्रस्थाने कूर्मादीनामाकारा विज्ञैः कार्येति ॥ सिद्धान्त शेखरे—

"चीरीं प्रकुर्याद् घटिकाङ्गुलाङ्कामेतेन मुक्त्वा वदनेन धार्या।
तां निक्षिपेत् काष्ठनरोदरे तु तदाऽस्य तिर्यक्स्थितकीललग्नम् ॥
चीरीसूत्रं क्रोड़काधोगतं स्यात् तस्मिंस्तुम्बं पूर्ववद्बद्धमुच्चैः।
पात्रेऽधोऽधस्तद्व्रजेत् कर्णयन्त्रान्नाड़ीभुक्तामुन्सृजत्येष नाड्याः ॥"

श्रीपत्युक्तमस्ति। लल्लोक्तं च—

"घटिकाङ्काङ्गुल संख्यां बद्ध्वा चीर्यां निवेशयेद् घटिकाः।
मदनेन ता निरुध्यादुदरे नतवदनमनुजस्य ॥
चीर्यंत बद्धसूत्रे तिर्यक्स्थितवदनकीलकनलेन।
नीत्वा जठरच्छिद्रेण केनचित्तद्बहिः कुर्यात् ॥
तत्र निबद्धमलावु प्राग्वत् सलिलेन नीयमानमधः।
चीरीमाकृष्यान्त्यां जपत्यमुं नाड़िकां गुटिकाम् ॥

इति, आचार्योक्तं लल्लोक्तं च श्रीपत्युक्तेर्मूलमिति प्रतीयते । लल्लोक्तमार्यात्रयं बहुत्रैवाशुद्धमिव प्रतिभाति न चास्य किमपि व्याख्यानं सम्यक्-दृश्यते । एतयो (आचार्य लल्लयोः) रनुरूपरचनस्य श्रीपत्युक्तस्य नितरामेवाशयोऽशुद्धत्वान्नावगम्यते ।। इति. ४७–४८ ।।

अब पुनः यन्त्रान्तर कहते हैं ।

हि. भा.—अल्प विस्तार और ज्यादा दैर्घ्य (लम्बाई) वाला वस्त्र खण्ड (कपड़े का टुकड़ा) चीरी कहलाता है । एक घटी में मनुष्य के मुख (मुंह) से जितना बड़ा वस्त्र खण्ड जलस्राव (जल का निकलना) के आघात (धक्का) से बाहर निकलता है वह घटिकांगुल कहलाता है । घटिकांगुलान्तरस्थित एक, दो-तीन आदि घटी से अङ्कित (चिन्हित) गुटिका (गोली) चीरी में देनी चाहिये । इस चीरी को नरा (मनुष्य) कार यन्त्र के नीचे के छिद्र में रखना चाहिये, जिससे चीरी नर के नीचे छिद्र से प्रविष्ट होकर नर मुख में स्थित तिर्यक्रूप कील के उपरिगत हो जाय । नर मुखाग्र में कील के ऊपर जो चीरी का खण्ड है उसके अग्र में पारे से भरे हुए तुम्ब (तुम्बी) को बांध कर, उसमें नलक आदि से जलधारा देनी चाहिये जिस से नीचे जाती हुई तुम्बी से घटिका में नरमुख से एक गुटिका (गोली) बाहर चली जाय । एवं जलस्राव से नराकार यन्त्र घटिका से एक गुटिका को मुख से बाहर फेंकता (निकालता) हैं । इस तरह नराकार यन्त्र की जगह कूर्म (कछुआ) आदि आकार का यन्त्र भी समझना चाहिये । सिद्धान्तशेखर में "चीरीं प्रकुर्याद् घटिकांगुलाङ्कामेतेन मुक्त्वा वदनेन धार्या" इत्यादि विज्ञान भाष्य में लिखित श्लोकानुसार श्रीपति कहते हैं । "घटिकाङ्कांगुल संख्यां बद्ध्वा चीर्यां" इत्यादि विज्ञान भाष्य में लिखित लल्लोक्त श्लोक और आचार्योक्त ही श्रीपत्युक्ति का मूल है । लल्लोक्त तीनों श्लोक बहुत जगह अशुद्ध मालूम होते है । इनकी सम्यक् व्याख्या कहीं पर कुछ भी देखने में नही आती है । आचार्योक्त और लल्लोक्त के अनुरूप श्रीपत्युक्त का आशय अशुद्धता के कारण समझ में नहीं आता है इति ।।४७–४८।।

इदानीं विशेषमाह ।

जलपूर्णकृत घटीभिः स्तनास्यकर्णादिभिर्जलं क्षिपति ।
पुरुषोऽन्यस्यासक्ते वक्त्रे पुरुषस्य कृतमुपरि ।।४९।।[1]

सु. भा.—पुरुषो (नराकारयन्त्रम्) रचनीयः । जलपूर्णकृता घटी घटीयन्त्रमस्य स्तने मुखे कर्णादौ वाऽन्तस्था योज्या यथाऽयं पुरुषः स्तनास्यकर्णादिभिरन्यस्य प्रतिपुरुषस्य तदासक्ते वक्त्रे मुखे घटीमितेन कालेन जलं क्षिपति । एवमप्युपरि पूर्वश्लोके प्रतिपादितं यन्त्रं प्रकारान्तरेण कृतं भवेदित्यर्थः ।।४९।।

१: पुरुषोऽन्यस्याऽसक्ते वक्त्रं पुरुषस्य कृतमुपरि ।।४९।।

वि. भा.—पुरुषो (नराकार यन्त्रं) निर्मातव्यः । जलपूर्णकृतघटी (घटीयन्त्रं) अस्य स्तने-आस्ये (मुखे) कर्णादौ वाऽन्तस्तथा प्रयोक्तव्या यथाऽयं पुरुषः स्तनास्यकर्णादिभिरन्यस्य पुरुषस्य तदासक्ते वक्त्रे (मुखे) घटीतुल्यकालेन जलं क्षिपति । एवमुपरि कथितं यन्त्रं प्रकारान्तरेण कृतं भवेदिति ॥४९॥

अब विशेष कहते हैं ।

हि. भा.—नराकार यन्त्र बनाना चाहिये । जल से भरे हुए घटीयन्त्र को इसके स्तन-मुख (मुंह) कर्ण (कान) आदि में भीतर इस तरह प्रयोग करना चाहिये जिस से यह पुरुष स्तन-मुख–कर्ण आदिओं से अन्य पुरुष के उससे आसक्त मुख (मुंह) में एक घटी तुल्यकाल में जल को निकाले । इस तरह पूर्वकथित यन्त्र प्रकारान्तर से किया हुआ होता हैं इति ॥४९॥

इदानीं पुनर्विशेषमाह ।

एवं वधूवरं नाड़िकांगुलैः संयुता वरे योज्या ।
युद्धानि मल्लगजमहिषमेव विविधायुधभृतां च ॥५०॥
निगिरति गिरति घटिकांगुलाङ्कितैः खण्डकैर्मयूरोऽहिम् ।
चीर्यामिवं गुटिकोपरिस्थितैर्ब्रह्मचार्याद्यैः ॥५१॥[1]

सु. भा.—एवं वधूवर मुखस्थतिर्यक् कीलोपरिगचीरिगतनाडिकाङ्गुलैस्तथैव वरे वधूर्योज्या यथा वध्वधोरन्ध्रग्रचीर्यग्रबद्धालाबुनाऽधोगच्छता घटीमितेन कालेनैका गुटिका वरमुखाद्बहिर्निर्गत्य वधूमुखे प्रविशेत् । एवमनेनैव बीजेन घटीमितेन कालेन मल्लगजमहिषमेषविविधायुधभृतां च युद्धानि स्युः । मयूरो घटिकाङ्गुलाङ्कितैः खण्डकैरहिं सर्पं च निगिरति वा गिरति । एवं चीर्यां गुटिकोपरि स्थापितैर्ब्रह्मचार्याद्याकारैः कीलोत्क्षेपाभिहतः पटहो वा घण्टाशब्दं करोति । एवमत्र यन्त्र-सहस्राणि भवन्ति ॥५०–५२॥

वि. भा.—एवं वधूवरमुखस्थतिर्यक्कीलोपरिगतचीरिगतनाडिकांगुलैस्तथैव वरे वधूर्योज्या यथा वध्वधोरन्ध्रगचीर्यग्रवद्धालाबुनाऽधो गच्छता घटीमितेन कालेनैका गुटिका वरमुखाद्बहिर्निर्गत्य वधूमुखे प्रविशेत् । एवमनेनैव बीजेन घटीमितेन कालेन मल्ल-गज-महिष-मेषविविधायुधभृतां च युद्धानि स्युः । मयूरो घटिकांगुलाङ्कितैः खण्डकैरहिं (सर्पं) च निगिरति वा गिरति । एवं चीर्या गुटिकोपरि स्थापितैर्ब्रह्मचार्याकारैः कीलोत्क्षेपाभिहतः पटहो घण्टा वा शब्दं

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१. चीर्यमिवं गुटिकोपरिस्थितैर्ब्रह्मचार्याद्यैः ॥५१॥

करोति । एवमत्र यन्त्रसहस्राणि भवन्तीति । सिद्धान्तशेखरे—

"इत्थं स्वबुद्धचा गणकः प्रकुर्यान्मेषादियुद्धं गजयन्त्रमत्र।
यत्र स्वयंवाहकनाभिमध्यात् बीजं दशाङ्केन हि कर्मणा यः ॥"

श्रीपतिनैवं कथ्यते । अस्यार्थः— इत्थममुना विधिना मेषादियुद्धं यन्त्रं तथा गजयन्त्रं चात्र गणकः प्रकुर्यात् । अत्र श्लोकोत्तरार्द्धमप्रासङ्गिकमर्थरहितं च प्रतिभाति । अत्र लल्लोक्तं च—

"कुर्यादियोऽपि चैवं घटिका जन्हुर्यथेष्टकालेन ।
मेषादीनां युद्धं सूत्रे सक्ते भवेदुभयोः ॥
परिकल्पित कालाध्वनि युक्तया योगो भवेद्वधूवरयोः ।
घटिकांगुलाङ्कितं वा ग्रसति मयूरः क्रमादुरगम् ॥
हन्ति मनुष्यः पटहं छादयति छादकस्तथा छाद्यम् ।
एवं विधानि यन्त्राण्यैवमनेकानि सिध्यन्ति ॥"

इति श्रीपतेर्मूलम् । आचार्यादीनां समये ईदृशानि यन्त्राणि साधारणजनानामाश्चर्यं कराण्यासन्नित्यनुमीयते । श्रीपतिना त्वल्पान्येव यन्त्राणि सुगमोपायेनोप योगवन्ति तत एवादाय लिखितानीति ॥५०–५२॥

अब पुनः विशेष कहते हैं ।

हि. भा.—एवं वधू–वर मुखस्थ तिर्यक्–कीलोपरिगत चीरिगत नाड़िकांगुल से उसी तरह वर में वधू को जोड़ना (मिलाना) चाहिये जिससे वधू के नीचे रन्ध्र (छिद्र) गत चीरी के अग्र में बंधा हुआ नीचे जाते हुये अलाबु (तुम्बी) से एक घटीकाल में एक गुटिका वर के मुख (मुंह) से वाहर निकल कर वधू के मुख में प्रवेश करे । एवं इसी बीज (मूल) से एक घटीमितकाल में मल्ल (पहलवान) गज (हाथी) महिष (भैंसा) मेष (भेंणा) और अनेक तरह के हथियार रखने वालों के युद्ध होते हैं । मयूर घटिकांगुल से अङ्कित खण्डों से सर्प को निगलता है । एवं चीरी में गुटिका के ऊपर स्थापित (रखे हुए) ब्रह्मचारी आदि आकार से कील के उत्क्षेपण के आघात से घण्टा शब्द करती है । इस तरह यहां हजारों यन्त्र होते है । सिद्धान्तशेखर में 'इत्थं स्वबुद्धया गणकः प्रकुर्यात्' इत्यादि विज्ञान भाष्य में लिखित श्लोक के अनुसार श्रीपति कहते हैं । इसका अर्थ यह है—इस विधि से मेषा (भेंणा) दि युद्धयन्त्र तथा गजयन्त्र की रचना गणक (ज्योतिषी) करें । इस श्लोक का उत्तरार्ध बिना प्रसङ्ग का और बिना अर्थ का है । यहां "कुर्यादियोऽपि चैवं घटिका जन्हुर्यथे-ष्टकालेन" इत्यादि विज्ञान भाष्य में लिखित लल्लोक्त ही श्रीपत्युक्ति का मूल है । आचार्य (ब्रह्मगुप्त) आदि के समय में इस तरह के यन्त्र साधारण जनों के आश्चर्य कारक थे ऐसा

मालूम होता है । श्रीपति ने सुगम उपाय से उपयोग के लायक थोड़े ही यन्त्रों को (आचार्योक्त और लल्लोक्त से) लेकर लिखा है इति ॥५०–५२॥

इदानीं स्वयंवहयन्त्रमाह ।

लघुदारुमयं चक्रं समसुषिरारान्तर पृथगराणाम् ।
अर्धेन रसेन पूर्णं परिधौ संश्लिष्टकृतसन्धिः ॥५३॥
तिर्यक्कीलोमध्ये द्व्याधारस्थोऽस्य पारदो भ्रमति ।
छिद्राण्यूर्ध्वमधोऽतश्चक्रमजस्रं स्वयं भ्रमति ॥५४॥[1]

सु. भा.—अराणामाराणाम् । संश्लिष्टकृतसन्धिः संश्लिष्टो मुद्रितः कृतः सन्धिश्छिद्रम् यस्य चक्रस्य तत् । अस्य यन्त्रस्य मध्ये तिर्यक्कीलो मध्ये स्थाप्यश्चक्रश्चायस्कारशाणवद्द्वयाधारस्थः कार्यः । अस्य चक्रस्य पारदो रस आराणां छिद्राणि प्रति ऊर्ध्वमधश्च यतो भ्रमति अतस्तदाकृष्टं चक्रं स्वयमेवाजस्रं भ्रमति । 'लघुदारुजसम चक्रे समसुषिराराः समान्तरा नेम्याम्'–इत्यादि भास्करोक्तमेतदनुरूपमेव ॥५३--५४॥

वि. भा.—पृथक् आराणां समच्छिद्रं समान्तरं लघुकाष्ठमयं चक्रं विधेयम् । अर्धेन रसेन (पारदेन) पूर्णे परिधौ संश्लिष्टकृतसन्धिः (संश्लिष्टो मुद्रितः कृतः सन्धिश्छिद्रं यस्य चक्रस्य तत्), अस्य यन्त्रस्य मध्ये तिर्यक्कीलः स्थाप्यः, चक्रश्चायस्कारशाणवद्द्वयाधारस्थः कार्यः । अस्य चक्रस्य पारदो (रसः), आराणां छिद्राणि प्रति ऊर्ध्वमधश्च यतो भ्रमति, अतस्तदाकृष्टं चक्रं स्वयमेवाजस्रं (सततं) भ्रमति । यन्त्रपालिगता अंकुशाकृतयो रसप्रक्षेपार्थं धातुजाः काष्ठजा वा रूपविशेषा आराः । आरादिषु कियत्पारादिदानेन तद्यन्त्रं स्वयं भ्रमेदित्यस्य ज्ञानं दुर्घटं देशकालयन्त्रपरिमाणाधीनमीश्वरैकगम्यमिति । सिद्धान्तशिरोमणौ—

"लघुदारुजसमचक्रे समसुषिराराः समान्तरा नेम्याम् ।
किञ्चिद्वक्रा योज्या सुषिरस्यार्धे पृथक् तासाम् ॥

रसपूर्णं तच्चक्रं द्वयाधाराक्षस्थितं स्वयंभ्रमतो" ति भास्करोक्तमाचार्योक्तानुरूपमेवास्ति ॥ अस्यार्थः—ग्रन्थि कीलरहिते लघुदारुमये भ्रमसिद्धे चक्र आराः किं विशिष्टाः—समप्रमाणाः समसुषिराः समतौल्याः समान्तरा नेम्यां योज्याः । ताश्च नद्यावर्त्तवदेकत एव सर्वाः किञ्चिद्वक्रा योज्याः । ततस्तासामाराणां सुषिरेषु पारदस्तथा क्षेप्यो यथा सुषिरार्धमेव पूर्णं भवति, ततो मुद्रिताराग्रं तच्चक्रमयस्कारशाणवद् द्वयाधारस्थं स्वयं भ्रमति । अत्र युक्तिः—यन्त्रैकभागे रसोह्यारामूलं

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१. छिद्राण्यूर्ध्वमधोऽतश्चक्रमजस्रं स्वयं भ्रमति ॥५४॥

प्रविशति। अन्यभागे त्वाराग्रं धावति। तेनाकृष्टं तत् स्वयं भ्रमतीति ।।५३-५४।।

अब स्वयंवहयन्त्र को कहते हैं।

हि. भा.—लघुकाष्ठमय चक्र यन्त्र बनाना चाहिये, जिसके आराओं में समान छिद्र हो तथा समान्तर हो, जिस चक्र यन्त्र के संश्लिष्ट (मुद्रित) छिद्र है। तथा आधे पारे से पूर्ण (भराहुआ) परिधि है। इस यन्त्र के मध्य में तिर्यक् रूप में कील स्थापन करना। चक्र को शाण चढ़ाने वाले चक्र की तरह दो आधार पर रखना चाहिये। क्यों कि आराओं के छिद्र में पारा ऊपर और नीचे से घूमता है इसलिये उससे आकृष्ट (खींचाहुआ) चक्र बराबर स्वयं (अपने ही आप) भ्रमण करता है। यन्त्र की पालीगत अंकुश की आकृति (आकार स्वरूप की तरह पारे के प्रक्षेपण के लिये पारा ढालने के लिये धातु की वा काष्ट (लकड़ी) की बनी हुई चीज आरा शब्द से व्यवहृत है। सिद्धान्तशिरोमणि में 'लघुदारुज समचक्रे समसुषिराराः समान्तरा नेम्याम्'—इत्यादि विज्ञान भाष्य में लिखित भास्करोक्त प्रकार आचार्योक्त के अनुरूप ही है। भास्करोक्त श्लोक का तात्पर्य यह है। ग्रन्थि (गेठी—गिरह) लाघु दारु (लकड़ी) मय भ्रमसिद्ध (खरादा हुआ) चक्र में समप्रमाण के समछिद्र के सम-तौल्य (सम वजन) के समान्तर पर आराओं को नेमी (परिधि) में जोड़ देना, वे नदी के हिलोड़ (पानी बहने के घुमाव) की तरह एक ही तरफ सबों को जोड़ना चाहिये। तब उन आराओं के छिद्रो में पाराओं को उस तरह देना चाहिये जिससे छिद्र का आधा ही पूर्ण (पूरा) हो, तब मुद्रित आरा के अग्र वाला वह चक्र शान चढ़ाने के चक्र के सदृश दो आधार पर स्थित होकर स्वयं घूमता है। यहां युक्ति यह है—पारा जहां एक भाग में आरा के मूल में प्रवेश करता है और अन्य भाग में आरा के अग्र में दौड़ता है, उससे आकृष्ट वह चक्र स्वयं भ्रमण करता है इति ।।५३-५४।।

इदानीं विशेषमाह।

छिद्रे स्वधिया क्षिप्ता समं यथा पारदं भ्रमति।
कालसममिष्टमानैश्चक्रसमुत्तानमूर्ध्वं वा ।।५५।।

सु. भा.—छिद्रे स्वबुद्ध्या समं पारदं क्षिप्त्वा तथा चक्रं स्थाप्यं यथा कालसमं कालानुसारि समुत्तानं क्षितिजानुकारं वोर्ध्वमूर्ध्वाधरं जलयन्त्रवदिष्ट-मानैर्भ्रमति। एकभ्रमणेन यथेष्टमानसमं कालमुत्पादयेत् तथा ऋतुविशेषे लघुगुरुकाष्ठमयं चक्रम् स्वल्पाधिकपारदसहितारं विरचयेदिति ।।५५।।

वि. भा.—छिद्रे स्वधिया (स्वबुद्धया), समं पारदं क्षिप्त्वा चक्रं तथा स्थाप्यं यथा कालसमं (कालानुसारि) समुत्तानं क्षितिजानुकारं वोर्ध्वं (ऊर्ध्वाधरं जलयन्त्रवत्) इष्टमानैर्भ्रमति। एकभ्रमणेन यथेष्टमानसमं कालमुत्पादयेत्तथा

ऋतुविशेषे लघुगुरुकाष्ठमयं चक्रं स्वल्पाधिकपारदसहितारं विरचयेत्। भास्कराचार्येण—

"उत्कीर्य नेमिमथवा परितो मदनेन संलग्नम्।
तदुपरि तालदलाद्यं कृत्वा सुषिरे रसं क्षिपेत् तावत्॥
यावद्रसैकपार्श्वे क्षिप्तजलं नान्यतो याति।
पिहितच्छिद्रं तदतश्चक्रं भ्रमति स्वयं जलाकृष्टम्॥"

सिद्धान्तशिरोमणौ स्वयंवहयन्त्रसम्बन्धे एवमभिहितम्। अस्य व्याख्या यन्त्रनेमिं भ्रमयन्त्रेण समन्तादुत्कीर्य द्वयंगुलमात्रं सुषिरस्य वेधो विस्तारश्च यथा भवति ततस्तस्य सुषिरस्योपरि तालपत्रादिकं मदनादिना संलग्नं कार्यम्। तदपि चक्रं द्वयाधाराक्षस्थितं कृत्वोपरि नेम्यां तालदलं विद्ध्वा सुषिरे रसस्तावत् क्षेप्यो यावत् सुषिरस्याधोभागो रसेन मुद्रितः। पुनरेकपार्श्वे जलं प्रक्षिपेत्। तेन जलेन द्रवोऽपि रसो गुरुत्वात् परतः सारयितुं न शक्यते। अतो मुद्रितच्छिद्रं तच्चक्रं जलेनाकृष्टं स्वयं भ्रमतीति॥५५॥

अब विशेष कहते हैं।

हि. भा.—छिद्र में अपनी बुद्धि से पारा देकर चक्र को इस तरह स्थापन करना चाहिये जिससे कालानुसारी क्षितिजानुकार वा ऊर्ध्वाधर जलयन्त्रवत् इष्टमान से भ्रमण करता है। एक भ्रमण से जैसे इष्टमान के तुल्यकाल को उत्पादन करे वैसे ऋतु विशेष में लघु-गुरु काष्ठमय चक्र को जिसमें स्वल्प–अधिक पारे वाला आरा हो बनाना चाहिये। सिद्धान्तशिरोमणि में 'उत्कीर्य नेमिमथवा परितो मदनेन संलग्नम्। तदुपरितालदलाद्यं कृत्वा सुषिरे रसं क्षिपेत् तावत्' इत्यादि विज्ञान भाष्य में लिखित श्लोकानुसार भास्कराचार्य स्वयं इस यन्त्र के विषय में कहते हैं। इसका अर्थ यह है—यन्त्र की परिधि को चारों तरफ भ्रम-यन्त्र (खरादने के यन्त्र) से इस प्रकार ठीक करना चाहिये कि छिद्र की ऊंचाई और विस्तार दो अंगुल रह जाय। अनन्तर उस छिद्र के ऊपर तालपत्रादि को चिपका देना चाहिये चक्र को दो आधाराक्ष (आधार धुरी) स्थित करके ऊपर नेमि (परिधि) में ताल पत्र को वेध कर छिद्र में पारे को तब तक ढारना चाहिये जब तक छिद्र का अधोभाग पारे से मुद्रित (छिप जाय) हो। फिर एक पार्श्व (बगल) में जल देना—उस जल से द्रव (तरल) भी पारा गुरुत्व (भारीपन) के कारण चारों तरफ निकल नहीं सकता है, अतः वह चक्र जिसमें छिद्र मुद्रित है जल से आकृष्ट (खींचा गया) हो कर स्वयं भ्रमण करता है इति

इदानीं पुनर्विशेषमाह।

कीलस्योपरिगामिनि तत्पर्यंयसूत्रके धृतमलाबु।
प्रग्वन्नलके प्रक्षिप्य नाड़िका स्रवति पानीये॥५६॥

सु. भा.—येन तिर्यक्कीलेन सह चक्रमयस्कारशाणवद्धृतं तस्मिन् सूत्रस्यैकमग्रं बद्ध्वा विपुलदैर्घ्यं सूत्रं वेष्टयेत्। तत् सूत्रं च पर्यसूत्रकमुच्यते। तस्मिन् कीलस्योपरिगामिनि तत्पर्ययसूत्रकस्य द्वितीयाग्रेऽलाबुतुम्बं धृतं बद्धं कार्यम्। ततः प्राग्वन्नलकेऽधोरन्ध्रे जलं प्रक्षिप्य तथा जलाधारा प्रयोज्या यथा तदाघातेनाधोगच्छताऽलाबुना नाडिकया चक्रस्यैकं भ्रमणं भवेत्। एवं पानीये जले स्रवति नाडिकोत्पद्यते इत्याचार्याभिप्रायः ॥५६॥

वि. भा.—येन तिर्यक् कीलकेन सह चक्रमयस्कारशाणवद्धृतं तस्मिन् सूत्रस्यैकमग्रं बद्ध्वा विपुलदैर्घ्यं सूत्रं वेष्टयेत् तत्सूत्रं पर्ययसूत्रकं कथ्यते। तस्मिन् कीलस्योपरिगामिनि तत्पर्ययसूत्रद्वितीयाग्रेऽलाबु (तुम्बं) बद्धं कार्यम् ततः पूर्ववन्नलकेऽधोरन्ध्रे जलं प्रक्षिप्य जलाधारा तथा प्रयोक्तव्या यथा तदाघातेनाधोगच्छताऽलाबुना नाड़िकया चक्रस्यैकं भ्रमणं भवेत्। एवं पानीये (जले) स्रवति नाड़िकोत्पद्यते इत्यार्याभिप्राय इति। शिद्धान्तशिरोमणौ—

"ताम्रादिमयस्यांकुशरूपनलस्याम्बुपूर्णस्य ।
एकं कुण्डजलान्तर्द्वितीयमग्रं त्वधोमुखं च बहिः ॥
युगपन्मुक्तं चेत् कं नलेन कुण्डाद् बहिः पतति ।
नेम्यां बद्ध्वा घटिकाश्चक्रं जलयन्त्रवत्तथा धार्यम् ॥
नलकप्रच्युतसलिलं पतति यथा तद्घटीमध्ये ।
भ्रमति ततस्तत् सततं पूर्णघटीभिः समाकृष्टम् ॥
चक्रच्युतं तदुदकं कुण्डे याति प्रणालिकया ॥"

भास्कराचार्येणैवं स्वयंवहयन्त्र विषये कथ्यते ।

अस्य व्याख्या—ताम्रादिधातुमयस्यांकुशरूपस्य वक्रीकृतस्य नलस्य जलपूर्णस्यैकमग्रं जलभाण्डेऽन्यदग्रं बहिरधोमुखं चैकहेलया यदि विमुच्यते तदा सकलमपि भाण्डजलं नलेन बहिः क्षरति। तद्यथा। छिन्नकमलस्य कमलिनी नलस्य जलभृद्भाण्डे क्षिप्तस्य जलपूर्णसुषिरस्यैकमग्रं भाण्डाद्बहिरधोमुखं द्रुतं यदि ध्रियते तदा सकलमपि भाण्डजलं नलेन बहिर्याति। अथ चक्रनेम्यां घटीर्बद्ध्वा जलयन्त्रवत् द्व्याधाराक्षसंस्थितं तथा निवेशयेद्यथा नलकप्रच्युतजलं तस्य घटीमुखे पतति। एवं पूर्णघटीभिराकृष्टं तद्भ्रमत् केन निवार्यते। चक्रच्युतस्य जलस्याधः प्रणालिकया कुण्डगमने कृते कुण्डे पुनर्जलप्रक्षेपणैरपेक्ष्यमिति ॥५६॥

अब पुनः विशेष कहते हैं।

हि. भा.—जिस तिर्यक् रूप कील के साथ चक्र शाण देने के यन्त्र की तरह रक्खा

गया है उसमें सूत्र के एक अग्र को बांध कर बहुत लम्बे सूत्र को वेष्टित (लपटाना) करना वह सूत्र पर्यय सूत्र कहलाता है। उसमें कील के ऊपर गया हुआ उस पर्ययसूत्र के द्वितीयाग्र में अलाबु (तुम्ब) को बाँध देना। तब पूर्ववत् नलक के नीचे छेद में जल देकर जल धारा का उस तरह प्रयोग करना चहिए जिससे उसके आघात से नीचे जाने वाले तुम्ब से एक नाड़ी में चक्र का एक भ्रमण हो। एवं जलस्राव से नाड़िका उत्पन्न होती है यह आचार्य का अभिप्राय है। सिद्धान्तशिरोमणि में "ताम्रादिमयस्यांकुशरूपनलस्याम्बुपूर्णस्य। एकं कुण्डजलान्तर्द्वितीयमग्रं त्वधो मुखो च बहिः" इत्यादि विज्ञान भाष्य में लिखित श्लोकों से भास्कराचार्य ने स्वयं वह यन्त्र के सम्बन्ध में अपना विचार व्यक्त किया है॥ इसका अर्थ— ताम्बा आदि धातुमय अंकुशरूप टेढ़ा किये हुए जलसे भरे हुए नल के एक सिरे को जल–भाण्ड (वर्तन) में और दूसरे सिरे को बाहर यदि एक ही समय में खोल देते हैं तब सम्पूर्ण में भाण्ड (बर्तन) स्थित जल नल के द्वारा बाहर गिर जाता है। जैसे कमल के नल को जलकुण्ड में छोड़ने से जलपूर्णछिद्र के एक अग्र को अधोमुख भाण्ड से बाहर यदि शीघ्र धरते हैं तो सम्पूर्ण भाण्डस्थित जल नल के द्वारा बाहर चला जाता है। चक्र नेमी (परिधि) में घटी को बांध कर जलयन्त्रवत् दो आधाराक्ष संस्थित उस तरह रखना चाहिये जिससे नलक से गिरा हुआ जल उस के घटी मुख में पतित हो। एवं पूर्णघटी से आकृष्ट उसके भ्रमण को कौन रोक सकता है॥५६॥

इदानीं पुनर्विशेषमध्यायोपसंहारं चाह।

करणैर्ज्याक्षिप्रचलनमेवं शरमोक्षणं खशब्दाश्च।
अध्यायो द्वाविंशो यन्त्रेष्वार्यास्त्रिपञ्चाशत्॥५७॥

सु. भा.—एवं करणैर्जलधारा प्रवाहसाधनैर्धनुर्ज्यायाः क्षिप्रचलनं शीघ्र-चलनं भवति येन शीघ्रं शरमोक्षणं शरप्रक्षेपणं च भवति। जलधाराप्रवाह-विकारेणैव खशब्दा मेघगर्जनानि भवन्तीति। शेषं स्पष्टार्थम्॥५७॥

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते।
हृदि तं विनिधाय नूतनोऽयं रचितो यन्त्रविधौ सुधाकरेण॥

इति श्रीकृपालुदत्त सूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धांतनूतनतिलके यन्त्राध्यायो द्वाविंशः॥२२॥

वि. भा.—एवं करणैः (जलधाराप्रवाहसाधनैः) धनुर्ज्यायाः शीघ्रं चलनं भवति येन शरमोक्षणं (शरप्रक्षेपणं) च भवति। जलधाराप्रवाहविकारेणैव खशब्दाः (मेघगर्जनानि) भवन्ति। यन्त्राध्याये त्रिपञ्चाशदार्याः सन्ति। अयं

(यन्त्राध्यायः) द्वाविंशोऽध्यायः समाप्तिमगादिति ॥५७॥

इति ब्राह्मस्फुटसिद्धान्ते यन्त्राध्यायो नाम द्वाविंशोध्यायः समाप्तः ॥२२॥

अब पुनः विशेष और अध्याय के उपसंहार को कहते हैं।

हि. भा.—एवं करण (जलधारा प्रवाहसाधन) से धनुष की ज्या (डोरी) का शीघ्रचलन होता है जिससे शर प्रक्षेपण (शरका छोड़ा जाना) होता है। जलधारा प्रवाह विकार ही से खशब्द (आकाश में शब्द—मेघ गर्जन) होता है। यन्त्राध्याय में तिरपन आर्याएँ हैं। यह बाईसवां अध्याय (यन्त्राध्याय) समाप्त हुआ इति ॥५७॥

इति ब्राह्मस्फुटसिद्धान्त में यन्त्राध्याय नामक बाईसवां अध्याय समाप्त हुआ ॥२२॥

ब्राह्मस्फुटसिद्धान्तः

मानाध्यायः

ब्राह्मस्फुटसिद्धान्तः

अथ मानाध्यायः प्रारभ्य ।

तत्र केन केन मानेन के के पदार्था गृह्यन्त इत्याह ।

सौरेणाब्दा मासास्तिथयश्चान्द्रेण सावनैर्दिवसाः ।
दिनमासाब्दपमध्या न तद्विनाऽर्केन्दुमानाभ्याम् ॥१॥

सु० भा०—सौरेणाब्दाः । चान्द्रेण मासास्तिथयश्च । सावनैर्दिवसा दिनमासाब्दपा मध्या ग्रहाश्च गृह्यन्ते । तत् सावनमानं चार्केन्दुमानाभ्यां विना न भवति । सौरचान्द्राभ्यां विनाऽहर्गणसाधनं न भवतीत्यर्थः ॥१॥

वि.भा.—सौरेण मानेनाब्दा अर्थादहर्गणानयने सौरमानेन वर्षाणि गृह्यन्ते । तेषां (सौरवर्षाणां) द्वादश गुणनानन्तरं यदा मासा युज्यन्ते तदा चान्द्रमासा गृह्यन्ते । ततस्त्रिंशद् गुणनानन्तरं चान्द्रमानादेव तिथयोऽपि ग्राह्या भवन्ति । पुनरानीतेऽहर्गणे सावनमानाद्दिनानि गृह्यन्ते । सावनैरेव वर्षपतिमासपतिज्ञानम् । तथा चोक्तम्—

अहर्गणात् कल्पगतादवाप्तं खषड्गुणै ३६० र्लब्धमथ त्रि३ निघ्नम् ।
रूपाधिकं भूधर ७ भक्तशेषं रवेर्भवेत् सावनहायनेशः ॥
एवं वर्षाधिपतिज्ञानम् ।

तथा—

अहर्गणात् खाग्नि ३० हृतादवाप्तं द्विघ्नं सरूपं नगभक्तशेषम् ।
वदन्ति तं सावनमासनाथं क्रमेण सूर्यादिह वर्त्तमानम् ॥

एवं मासाधिपतिज्ञानम् । मध्यमग्रहाश्च सावनमानैरेव गृह्यन्ते । तत् सावनमानं च सौरचान्द्रमानाभ्यां विना न भवत्यर्थात् सौरचान्द्राभ्यां विनाऽहर्गणसाधनं न भवतीति । सिद्धान्तशेखरे "वर्षाणि सौरात् प्रवदन्ति

चान्द्रात् मानात्तिथिं सावनतो दिनानि। सौरैन्दवाभ्यां तु विना न तत्स्यात्" इति श्रीपत्युक्तमाचार्योक्तानुरूपमेव। एकराशिं हित्वा यावता कालेन रवी राश्यन्तरं याति स सौरोमासस्तत्त्रिंशद्भागः सौरं दिनं भवतीति सौरमानम्। त्रिंशत्तिथिभिश्चान्द्रो मासो भवति। रविचन्द्रयोर्युतिरमावस्यान्ते भवति ततो यावता कालेन पुनस्तद्युतिर्भवति स एव चान्द्रमासः। एकस्मिन् चान्द्रे मासे त्रिंशत् तिथयस्तदा रविचन्द्रयोरन्तरं च चक्रांशा ३६० अतोऽनुपातेनैकस्यां तिथौ रविचन्द्रयोरन्तरं द्वादशभागाः, इति चान्द्रमानम्। सूर्योदयद्वयान्त रविसावनदिनं तेषां त्रिंशता सावनमासो मासो भवतीति सावनमानम्। नाड़ीनां षष्ट्या नाक्षत्रमहोरात्रं भवति। एकनक्षत्रस्योदयानन्तरं यावता कालेन तस्य पुनरुदयः स नाक्षत्राहोरात्रकालः। तेषामहोरात्राणां त्रिंशता नाक्षत्रमासो भवतीति नाक्षत्रमानम्। सूर्यसिद्धान्ते—

नाड़ीषष्ट्या तु नाक्षत्रमहोरात्रं प्रकीर्त्तितम्।
तत्त्रिंशता भवेन्मासः सावनोऽर्कोदयैस्तथा।
ऐन्दवस्तिथिभिस्तद्वत् संक्रान्त्या सौर उच्यते।
मासैर्द्वादशभिर्वर्षमिति" एवं प्रतिपादितमस्ति। सिद्धान्त शेखरे—
"दर्शावधिं मासमुशन्ति चान्द्रं सौरं तथा भास्करराशिभोगम्।

त्रिंशद्दिनं सावनसंज्ञमार्या नाक्षत्रमिन्दोर्भगणभ्रमश्च" शुक्लप्रतिपदादिर्दर्शान्तश्चान्द्रो मासः। रवेः स्फुटगत्या त्रिंशद्भागभोगः सौरमासः। त्रिंशद्दिनं सावनमासः। चन्द्रस्य द्वादश राशिभोगो नाक्षत्रमास इति॥१॥

अब मानाध्याय प्रारम्भ किया जाता है।

उसमें पहले 'किस किस मान से कौन कौन पदार्थ ग्रहण किये जाते हैं' कहते हैं।

हि॰ भा॰—सौर मान से (अहर्गणानयन में सौरमान से) वर्ष ग्रहण किये जाते हैं। उन सौर वर्षो को बारह से गुणा करने के बाद जब मास जोड़ते हैं तो चान्द्रमास ग्रहण करते हैं। उसको तीस से गुणा करने के बाद तिथि जोड़ने के समय चान्द्रमान ही से तिथि ग्रहण करते हैं। पुनः साधित अहर्गण में सावन मान से दिन ग्रहण करते हैं। सावनमान ही से वर्षपति और मासपति का ज्ञान होता है। जैसे 'अहर्गणात् कल्पगतादवाप्त' मित्यादि विज्ञान भाष्य में लिखित श्लोक से वर्षाधिपति ज्ञान सावनमान ही से है तथा 'अहर्गणात् खाग्नि ३० हृतादवाप्त' मित्यादि विज्ञान भाष्य में लिखित श्लोक से मासाधिपतिज्ञान भी सावनमान ही से है। मध्यम ग्रहसाधन सावनमान ही से होने से मध्यम ग्रह सावनमान ही से ग्रहण किये जाते हैं। वह सावनमान सौरमान और चान्द्रमान के बिना नहीं होता है। अर्थात् सौर और चान्द्र के बिना अहर्गण साधन नहीं होता है। सिद्धान्तशेखर में "वर्षाणि सौरात् प्रवदन्ति चान्द्रात्" इत्यादि विज्ञानभाष्य में लिखित श्लोक से श्रीपति ने आचार्योक्त

के अनुरूप ही कहा है। एक राशि को छोड़ कर जितने काल में रवि राश्यन्तर(दूसरी राशि) में जाते हैं वह सौर मास है, उसका तीसवां अंश एक सौर दिन होता है, बारह सौर मासों का एक सौर वर्ष होता है, यह सौरमान है। तीस तिथि का एक चान्द्रमास होता है। रवि और चन्द्र का योग अमावस्यान्त में होता है, उसके बाद जितने काल में पुनः (फिर) उन दोनों का योग होगा वह चान्द्र मास है, एक चान्द्रमास में तीस तिथियां होती हैं तब रवि और चान्द्र का अन्तरांश चक्रांश ३६० के बराबर होता है इस से अनुपात द्वारा एक तिथि में रवि और चन्द्र का अन्तरांश बारह अंश होता है, यह चान्द्रमान है, दो सूर्योदय का अन्तरकाल एक रवि सावन दिन होता है, तीस सावन दिनों का एक सावन मास होता हैं, यह सावन मान है, साठ नाड़ी (दण्ड) का एक नाक्षत्र अहोरात्र होता है, एक नक्षत्र के उदय के बाद पुनः जितने काल में उसका उदय होता है वह नाक्षत्राहोरात्र काल है। तीस नाक्षात्राहोरात्र का एक नाक्षत्र मास होता है, यह नाक्षत्र मान है। सूर्य सिद्धान्त में 'नाड़ीषष्ट्या तु नाक्षत्रमहोरात्रं प्रकीर्त्तितम्' इत्यादि विज्ञान भाष्य में लिखित श्लोकों से सौरादि मान वर्णित है। सिद्धान्तशेखर में 'दर्शावधि मासमुशन्ति चान्द्रं सौरं तथा भास्करराशिभोगम्' इत्यादि से श्रीपति ने भी सूर्य सिद्धान्तोक्त के अनुरूप ही कहा है इति ॥१॥

इदानीं मानान्याह।

मानानि सौरचान्द्रार्क्षसावनानि ग्रहानयनमेभिः।
मानैः पृथक् चतुर्भिः संव्यवहारोऽत्र लोकस्य ॥२॥

सु. भा.—सौरं चान्द्रमार्क्षं सावनमिति मानानि सन्ति। एभिर्मानैर्ग्रहानयनमेभिश्चतुर्भिः पृथक् पृथगत्र भुवि लोकस्य प्राणिनो व्यवहारो भवति। 'ज्ञेयं विमिश्रं तु मनुष्यमानम्'—इत्यादि भास्करोक्तमेतदनुरूपमेव ॥२॥

वि. भा.—सौरं चान्द्रं नाक्षत्रं सावनमिति मानानि सन्ति। एभिर्मानैर्ग्रहानयनं भवति, तथैभिश्चतुर्भिः पृथक् पृथक् अत्र पृथिव्यां लोकस्य व्यवहारो भवति। सिद्धान्तशेखरे—

सौर चान्द्रमससावनमानैः सौड़वैर्ग्रहगतेरवबोधः।
एभिरत्र मनुजव्यवहारो दृश्यते च पृथगेव चतुर्भिः।

उडूनि नक्षत्राणि तत्संम्बन्धीन्यौड़वानि तैः सह वर्त्तन्त इति सौड़वानि तैरित्यर्थः। न केवलं शास्त्रव्यवहारसिद्धत्वं किन्तु लोक व्यवहारसिद्धत्वमप्यस्त्येभिः। श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेव। सिद्धान्तशिरोमणौ 'ज्ञेयं विमिश्रं तु मनुष्यमानम्' भास्करोक्तमपीदमाचार्योक्तानुरूपमेवेति ॥२॥

अब मानों को कहते हैं।

हि. भा.—सौर-चान्द्र-नक्षत्र-सावन ये मान हैं, इन मानों से ग्रहानयन होता है,

तथा इन चारों से पृथक् पृथक् इस पृथिवी में लोगों का व्यवहार होता है, सिद्धान्तशेखर में 'सौर चान्द्रमससावनमानैः सौड़वैर्ग्रहगतेरवबोधः' इत्यादि श्रीपत्युक्त आचार्योक्त के अनुरूप ही है। सिद्धान्तशिरोमणि में 'ज्ञेयं विमिश्रं तु मनुष्यमानम्' यह भास्कराचार्योक्त भी आचार्योक्त के अनुरूप ही है इति ।।२।।

इदानीं विशेषमाह ।

युगवर्षं विषुवदयनर्त्त्वहर्निशोर्वृद्धिहानयः सौरात् ।
तिथिकरणाधिकमासोनरात्रपर्वक्रियाश्चान्द्रात् ।।३।।

यज्ञसवनप्रमाणग्रहगत्युपवाससूतकचिकित्साः ।
सावनमानाज् ज्ञेयाः प्रायश्चित्तक्रियाश्चात्र ।।४।।

सु. भा.—पर्वक्रिया पूर्णान्तदर्शान्तक्रिया दर्शयागादि । सवनं पुंसवनादि । प्रमाणं द्रव्यदानादौ प्रमाणदिनादि । शेषं स्पष्टम् । 'वर्षायनर्त्तुयुगपूर्वकम्' इत्यादि भास्करोक्तमेतदनुरूपमेव ।।३-४।।

वि. भा.—युगानि कृतादीनि तेषां या वर्षसंख्या सौरेण मानेन ग्राह्या, तथा वर्षाश्रितमपि यत् कार्यं तदपि सौरेण मानेन । विषुवदपि सौरेणैव तत्र यदा रवेर्मेषादिप्रवेशस्तदोत्तरं विषुवत्, यदा तुलादिप्रवेशस्तदा दक्षिणं विषुवत् । अयनमप्युत्तरं दक्षिणं च सूर्यस्य मकरसंक्रान्तेः सकाशात् सौराः षण्मासा उत्तरायणं भवति, तथैव कर्किसंक्रान्त्यादेः सौराः षण्मासा दक्षिणायनं भवति, ऋतवोऽपि सौरेण मासद्वयेन भवन्त्यर्थान्मकरसंक्रान्तेर्द्वयोर्द्वयो राश्योरेकैक-ऋतुनाथः स्यात् मकरकुम्भयोः शिशिरः । मीनमेषयोर्वसन्तः । वृषमिथुनयोर्ग्रीष्मः । कर्कसिंहयोर्वर्षाः । कन्यातुलयोः शरत्, वृश्चिकधन्वोर्हेमन्तः । तथा श्रीपतिना सिद्धान्तशेखरे लिखितम् । मृगादि राशिद्वयभानुभोगात् षट् चर्त्तवः स्युः शिशिरो वसन्तः । ग्रीष्मश्च वर्षाश्च शरच्च तद्वद्धेमन्तनामा कथितोऽत्र षष्ठः । दिनरात्र्योरपि वृद्धिहानी सौरादेव ज्ञेये । तिथिः, करणं, बवादिः, अधिकमासाः, ऊनरात्राण्यमदिनानि, पर्वक्रिया पूर्णान्त दर्शान्त क्रियादर्श यागादि, एतत्सर्वं चान्द्रमानादेव ज्ञेयम् । सवनं (पुंसवनादि) प्रमाणं (द्रव्यदानादौ प्रमाणदिनानि) ग्रहाणां वक्रानुवक्राद्या गतयः, उपवासाः सूतकं शावाद्युत्पन्नमाशौचं, चिकित्सारोगप्रतीकाराः द्वादशदिनानि निर्वर्त्यं चरकसुश्रुताद्युक्तं प्रायश्चित्तं (कृच्छ्र—चान्द्रायणादि) । तथा चोक्तम्—

त्र्यहं नक्तस्त्र्यहं प्रातस्त्र्यहमद्यादयाचितम् ।
त्र्यहं चोपवसेदेवं प्राजापत्यं चरन् द्विजः ।।

चान्द्रायणं त्रिंशद्रात्रनिर्वर्त्यम् । एते सावनमानाज् ज्ञेयाः । सिद्धान्तशेखरे—
"युगायनर्त्तुप्रभृतीनि सौरान्मानाद् द्युरात्र्योरपि वृद्धिहानी ।
पर्वाधिमासोनदिनानि चान्द्रात् तथा तिथेरर्धमपि प्रदिष्टम् ।

प्रायश्चित्तं सूतकाद्याश्चिकित्सा यत्स्यादन्यत् सावन तच्च कर्म ।
शास्त्रे चास्मिन् खेचराणां च राशिर्विज्ञातव्याः सावनाद् भास्करीयात् ।"
श्रीपत्युक्तमिदमाचार्योक्तानुरूपमेवास्ति, सिद्धान्तशिरोमणौ—
"वर्षायनर्त्तुयुगपूर्वकमत्र सौरान्मासास्तथा च तिथयस्तुहिनांशुमानात् ।
यत् कृच्छ्रसूतक चिकित्सितवासराद्यं तत्सावनाच्चे"
ति भास्करोक्तमप्याचार्योक्तानुरूपमेव । सूर्यसिद्धान्ते—

"सौरेण द्युनिशोर्मानं षड्शीतिमुखानिच ।
अयनं विषुवच्चैव संक्रान्तेः पुण्यकालता ।"

अहोरात्र्योर्मानं षड्शीतिमुखानि, अयनं दक्षिणमुत्तरं वा, विषुवत् सायनमेषतुलादिमानं, संक्रान्तेः पुण्यकालता चैतत्सर्वं सौरेण प्रत्यहं सूर्यगतिभोगेनोत्पद्यते । रविकेन्द्रं यस्मिन् समये राश्यादौ याति स संक्रान्तेर्मध्यकाल उच्यते । अथ यावद्रविबिम्बार्धकलातुल्यमन्तरं केन्द्रात् प्रागनन्तरं च स्यात् तावद्बिम्बैक देशस्य राश्यादौ संचारात् संक्रान्तेः कालो भवति । तत्कालानयनार्थमनुपातः । यदि रविगतिकलाभिः षष्टिघटिकास्तदा रविबिम्बमानकलाभिः किं जाताः संक्रान्तिनाड्यः केन्द्राभिप्रायेण संक्रान्तेः प्राक् तथा परे च यास्तत्र स्नानदानादौ पुण्यं भवतीति ।

तिथिः करणमुद्वाहः क्षौरं सर्वक्रियास्तथा ।
व्रतोपवासयात्राणां क्रिया चान्द्रेण गृह्यते ॥

तिथिः । करणं बवादि । उद्वाहो विवाहः । क्षौरं क्षुरकर्म, व्रतवन्धादिकाः सर्वक्रियाः । व्रतोपवासयात्राणां मध्ये या क्रिया तत्सर्वं चान्द्रेण मानेन गृह्यते ।

उदयादुदयं भानोः सावनं तत्प्रकीर्त्तितम् ।
सावनानि स्युरेतेन यज्ञकालविधिस्तु तैः ॥
सूतकादि परिच्छेदो दिनमासाब्दपास्तथा ।
मध्यमा ग्रहभुक्तिस्तु सावनेनैव गृह्यते ॥

सूर्यस्योदयद्वयान्तरकालेनैकं सावनदिनमितिगणनया पूर्वं मध्यमाधिकारे युगसावनानि कथितानि, । अत्र भानोरुदयेन नाड़ीवृत्तस्थकल्पितभानोरुदयो ग्राह्योऽन्यथा विलक्षणसावनदिनमानानि पाठायोग्यान्यहर्गणादावनुपयुक्तानि च भवन्तीति । तैः सावनदिनैर्यज्ञकालविधिः कार्यः । तथा सूतकादीनां जननमरण सम्बन्धि सूतकानामादिशब्देन चिकित्साचान्द्रायणादीनां च परिच्छेदः (निर्णयः)

तथा दिनमासवर्षपतयश्च ग्रहाणां मध्यमा गतिश्च सावनेनैव दिनेन गृह्यते इति सूर्यसिद्धान्तकारेण कथ्यते ।।३-४।।

अब विशेष कहते हैं ।

हि.भा.—कृतादि(सत्ययुगादि)युगों की वर्ष संख्या सौरमान से ग्रहण करनी चाहिये । तथा वर्षाश्रित कार्यो को भी सौर मान ही से लेना चाहिये । विषुवत् (जब रवि का मेषादि में प्रवेश होता है तब उत्तर विषुवत्,तुलादि में प्रवेश होने से दक्षिण विषुवत्) सौर मान ही से समझना चाहिये । अयन भी (उत्तर और दक्षिण) (सूर्य की मकर संक्रान्ति से सौर छः महीना उत्तरायण होता है, कर्क संक्रान्ति से सौर छः महीना दक्षिणायन होता है) सौर मान ही से ग्रहण करना चाहिये । ऋतु भी दो दो सौर महीनों से होता है अर्थात् मकर संक्रान्ति से दो दो राशियों का एक एक ऋतुनाथ होता है मकर और कुम्भ का शिशिर, मीन और मेष का वसन्त, वृष और मिथुन का ग्रीष्म, कर्क और सिंह की वर्षा, कन्या और तुला का शरत्, वृश्चिक और धनु का हेमन्त, सिद्धान्तशेखर में 'मृगादि राशिद्वयभानुभोगात् षट् चर्त्तवः' इत्यादि से श्रीपति ने कहा है । दिन और रात्रि की वृद्धि और ह्रास (बढ़ना घटना) सौर ही से समझना चाहिये । तिथि करण (बवादि), अधिकमास (मलमास), अवमदिन, पर्वक्रिया (पूर्णान्तक्रिया—दर्शान्त क्रिया) ये सब चान्द्रमान से ग्रहण करना चाहिये । यज्ञ, पुंसवनादि, प्रमाण (द्रव्यदानादि में प्रमाण दिनादि), ग्रहों की वक्र अनुवक्र आदि गतियां, व्रत-उपवास, सूतक (जन्म—मरण सम्बन्धी अशौच), चिकित्सा (रोग प्रतीकार के लिये औषधि सेवन), प्रायश्चित्त (कृच्छ्र-चान्द्रायणादि), ये सब सावनमान से समझता चाहिये । सिद्धान्तशेखर में 'युगायनर्त्तु प्रभृतीनि सौरान्मानाद्द्युरात्र्योरपि वृद्धिहानी' इत्यादि विज्ञान भाष्य में लिखित श्रीपत्युक्त आचार्योक्त के अनुरूप ही है । सिद्धान्तशिरोमणि में "वर्षायनर्त्तुयुगपूर्वकमत्र सौरात्" इत्यादि भास्करोक्त आचार्योक्त के अनुरूप ही है । सूर्यसिद्धान्त में 'सौरेण द्युनिशोर्मानं षडशीति मुखानि च । अयनं विषुवच्चैव संक्रान्तेः पुण्यकालता' ये सब प्रत्येक दिन सूर्यगतिभोग (सौर) से उत्पन्न होते हैं । रवि केन्द्र जिस समय राश्यादि में जाता है । वह संक्रान्ति का मध्य काल कहलाता है । केन्द्र से पहले और पीछे जब तक रविबिम्ब कलातुल्य अन्तर होता है तबतक बिम्ब के एक प्रदेश के राश्यादि में संचार से संक्रान्ति काल होता है, उस काल के आनयन के लिये अनुपात करते हैं । यदि रवि गतिकला में साठ घटी पाते हैं । तो रवि बिम्बमानकला में क्या इस अनुपात से केन्द्राभिप्रायिकसंक्रांति से पहले और पीछे संक्रांतिघटी आती है । इस संक्रान्ति कालमें स्नान दानादि करने से अतिशय पुण्य होता है । 'तिथिः करणमुद्वाहः क्षौरं सर्वक्रियास्तथा । व्रतोपवासयात्राणां क्रिया चान्द्रेण गृह्यते ।" तिथि करण (बव-बालव आदि) उद्वाह (विवाह), क्षौर (क्षुरकर्म), सर्वक्रिया (व्रतबन्धादिक), व्रत उपवास यात्रा सम्बन्धी क्रिया, ये सब चान्द्रमान से ग्रहण करनी चाहिये । "उदयादुदयं भानोः सावनं तत्प्रकीर्त्तितम् । सावनानि स्युरेतेन यज्ञ काल विधिस्तु तैः" इत्यादि विज्ञान भाष्य में लिखित श्लोकों का अर्थ यह है कि सावन दिनों से यज्ञकाल विधि करनी

चाहिये, तथा जन्म-मरण सम्बन्धी अशौच, चिकित्सा-चान्द्रायणादि का निर्णय, मासपति और वर्षपति का ज्ञान, ग्रहों की मध्यमा गति ये सब सावनमान से ग्रहण करनी चाहिये, यह सूर्यसिद्धान्तकार कहता है इति ॥३-४॥

इदानीं नक्षत्रसावनप्रशंसामाह ।

नक्षत्रसावनदिनात् सूर्यादीनां स्वसावनदिनानि ।
यस्मात् तस्मादार्क्षं दुरधिगमं मन्दबुद्धीनाम् ॥५॥

सु. भा.—यस्मात् सूर्यादीनां स्वस्वसावनदिनानि नक्षत्रसावनदिनादेव सिद्धानि भवन्ति('भभ्रमास्तु भगणैर्विवर्जिता यस्य तस्य कुदिनानि तानि वा'–इति भास्करोक्त्या स्फुटम्) । तस्मान्मन्दबुद्धीनां मध्ये ह्यार्क्षं मानं दुरधिगममतीव कठिनमित्यर्थः । तदेव सूक्ष्मं विवेचनीयमन्यथा ग्रहासावनानि न भवन्तीत्याचार्याशयः ॥५॥

वि. भा.—यस्मात् कारणात् सूर्यादीनां ग्रहाणां स्वस्वसावनदिनानि नक्षत्रसावनदिनादेव सिध्यन्ति, तस्मात् कारणान्मन्दबुद्धीनां मध्ये हि आर्क्षं (नाक्षत्रं) मानं दुरधिगमम् (अति कठिनं) । तदेव सूक्ष्मं विचारणीयमन्यथा ग्रहसावनानि समीचीनानि न भवन्तीति । ग्रहाणां सावनदिनानि नक्षत्रसावनदिनादेव सिध्यन्ति, सूर्यसिद्धान्ते 'भोदया भगणैः स्वैः स्वैरूनाः स्वस्वोदया युगे" इत्युक्तेः । सिद्धान्तशेखरे—

"यस्य यस्य भगणैर्विवर्जिता ज्योतिषां भगणसंहतिः स्फुटम् ।
तस्य तस्य दिवसांस्तु सावनान् विद्धि तामरसजन्मनो दिने ।"

इत्यनेन श्रीपतिना ग्रहसावनदिनानयनमुक्त्वा पुनरग्रे 'भभ्रमोष्णकरमण्डलान्तरं सावनानि कुदिनानि तानि वा' ऽस्य प्रतिपादनं कृतमित्यनेन नक्षत्रसावनेन बहूनि प्रयोजनानि सन्तीति सूच्यते । तेनैव हेतुनाऽऽचार्येणाप्य 'तस्मादार्क्षं दुरधिगमं मन्दबुद्धीनाम्' नेन नक्षत्रसावनसम्बन्धे तस्यातीवोपयोगित्वं प्रतिपादितम् । सिद्धान्तशेखरे 'नाक्षत्रमानाद्घटिकादिकालः' इत्यनेन श्रीपतिना नाक्षत्रेण प्रयोजनं कथितमर्थात्–अनेन ग्रहेणास्मिन्नक्षत्रे इयत्यो घटिका भुक्ता इति ज्ञानं नाक्षत्रमानेनैव सिध्यति । सूर्य सिद्धान्ते—

"भचक्रभ्रमणं नित्यं नाक्षत्रं दिनमुच्यते ।
नक्षत्रनाम्ना मासास्तु ज्ञेयाः पर्वान्तयोगतः ।
कार्तिक्यादिषु संयोगे कृत्तिकादिद्वयं द्वयम् ।
अन्त्योपान्त्यौ पञ्चमश्च त्रिधा मासत्रयं स्मृत" ॥

मित्युक्तम् । अस्यार्थ :—

नित्यं प्रवहवायुना भचक्रस्यैकं भ्रमणं यद् भवति तदेव नाक्षत्रं दिनमुच्यते

प्राचीनैरिति । पर्वान्तः पूर्णिमान्तस्तत्र नक्षत्रयोगेन चान्द्रमासानां संज्ञा यथा कृत्तिका सम्बन्धात् कार्त्तिकः। मृगशीर्षसम्बन्धान्मार्गशीर्षः । पुष्य-सम्बन्धात् पौषः । मघासम्बन्धान्माघः। फाल्गुनी सम्बन्धात् फाल्गुनः । चित्रासम्बन्धाच्चैत्रः। विशाखासम्बन्धाद्वैशाखः । जेष्ठासम्बन्धाज्ज्यैष्ठः। आषाढ़ासम्बन्धादाषाढ़ः । श्रवणसम्बन्धाच्छ्रावणः । भाद्रपदसम्बन्धाद् भाद्रपदः। अश्विनीसम्बन्धादाश्विन इति। ननु पूर्णिमान्ते तत्तन्नक्षत्राभावे कथं तत्संज्ञा मासानामुचितेत्यत आह । कार्त्तिक्यादिषु-कार्त्तिकमासादीनां पौर्णमासीषु कृत्तिकादि द्वयं द्वयं नक्षत्रं कथितम् । यथा कृत्तिकारोहिणीभ्यां कार्त्तिकः। मृगार्द्राभ्यां मार्गशीर्षः । पुनर्वसुपुष्याभ्यां पौषः । आश्लेषामघाभ्यां माघः। चित्रास्वातीभ्यां चैत्रः । विशाखानुराधाभ्यां वैशाखः । ज्येष्ठमूलाभ्यां ज्यैष्ठः। पूर्वोत्तराषाढ़ाभ्यामाषाढ़ः। श्रवणधनिष्ठाभ्यां श्रावणः। इति फलितार्थः। अवशिष्टमासार्थं कथ्यते । अन्त्योपान्त्याविति। कार्त्तिक्यादित्वेन ग्रहणादन्त्य आश्विनः। उपान्त्यो भाद्रपदः । पञ्चमश्च फाल्गुनः । इति मासत्रयं त्रिधा नक्षत्रत्रयवशतः स्मृतम्। रेवत्यश्विनीभरणीभिराश्विनः। शततारापूर्वोत्तराभाद्र-पदैर्भाद्रपदः। पूर्वोत्तराफाल्गुनीहस्तैः फाल्गुन इति। एवं निरयणमानागतनक्षत्रै-र्मासानां संज्ञा लिखिता, अथर्ववेदेऽपि तथैव मासानां संज्ञा । सायनमानवशेन तत्तन्नक्षत्राणां सम्बन्धाभावात् संज्ञास्वनर्थापत्तिरतो निरयणमानेनैव व्यवहारः समुचित इत्येव प्राचीनानां वैदिकानां सम्मतिरिति ॥५॥

अब नक्षत्र सावन की प्रशंसा को कहते हैं।

हि. भा.—क्यों कि सूर्यादि ग्रहों का अपना अपना सावन दिन नक्षत्र सावन दिन ही से सिद्ध होता है। इसलिये मन्दबुद्धियों के लिये नाक्षत्रमान अत्यन्त कठिन है। उसी को सूक्ष्मरीति से विचार करना चाहिये। नहीं तो ग्रह सावन समीचीन नहीं होते हैं । ग्रहों का सावनदिन नक्षत्र सावन दिन ही से सिद्ध होता है जैसे सूर्यसिद्धान्त में 'भोदया भगणैः स्वैः स्वैरूनाः स्व स्वोदयायुगे' कहा है। सिद्धान्तशेखर में 'यस्य यस्य भगणैर्विवर्जिता ज्योतिषां भगणसंहतिः स्फुटम्' इत्यादि विज्ञान भाष्य में लिखित श्लोक से श्रीपति ने ग्रह सावन दिनानयन कहकर फिर आगे 'भभ्रमोष्णकरमण्डलान्तरं' इत्यादि कहा है, इससे सूचित होता है कि नक्षत्र सावन से बहुत प्रयोजन सिद्ध होते हैं, इसीलिये आचार्य भी 'तस्मादार्क्षं दुरधिगमं मन्दबुद्धीनाम्' इससे नक्षत्र सावन का अतिशय उपयोगित्व कहा है । सिद्धान्त शेखर में 'नाक्षत्रमानाद् घटिकादिकालः' इससे श्रीपति ने नाक्षत्र के प्रयोजन कहे हैं। अर्थात् अमुक ग्रह ने अमुक नक्षत्र में इतनी घटी भोग की हैं इसका ज्ञान नाक्षत्रमान ही से सिद्ध होता है। सूर्य सिद्धान्त में 'भचक्र भ्रमणं नित्यं नाक्षत्रं दिनमुच्यते' इत्यादि विज्ञान भाष्य में लिखित श्लोकों से नाक्षत्र दिन की परिभाषा और नक्षत्रों के सम्बन्ध से कार्त्तिकादि मासों की संज्ञा कही है। उन श्लोकों का अर्थ यह है—नित्य प्रवह वायु के द्वारा भचक्र का एक

भ्रमण जो होता है उसी को प्राचीन लोग नाक्षत्र दिन कहते हैं और पूर्णिमान्त में नक्षत्र योग से चान्द्रमासों की संज्ञा कहते हैं जैसे कृत्तिका के सम्बन्ध से कार्त्तिक । मृगशीर्ष के सम्बन्ध से मार्गशीर्ष (अग्रहण) । पुष्य के सम्बन्ध से पौष । मघा के सम्बन्ध से माघ । फाल्गुनी के सम्बन्ध से फाल्गुन । चित्रा के सम्बन्ध से चैत्र । विशाखा के सम्बन्ध से वैशाख । ज्येष्ठा के सम्बन्ध से ज्यैष्ठ । आषाढ़ा के सम्बन्ध से आषाढ़ । श्रवण के सम्बन्ध से श्रावण । भाद्रपद के सम्बन्ध से भाद्रपद (भादों) । अश्विनी के सम्बन्ध से आश्विन । यदि पूर्णिमान्त में उपर्युक्त नक्षत्र न हो तब मासों की संज्ञा कैसे उचित होगी इस के लिये कहते हैं । कार्त्तिकादि मासों की पौर्णमासी में कृतिकादि दो दो नक्षत्र लेना चाहिये । जैसे कृत्तिका-रोहिणी के सम्बन्ध से कार्त्तिक । मृगशीर्ष और आर्द्रा के सम्बन्ध से मार्गशीर्ष । पुनर्वसु और पुष्य के सम्बन्ध से पौष । आश्लेषा और मघा के सम्बन्ध से माघ । चित्रा और स्वाती के सम्बन्ध से चैत्र । विशाखा और अनुराधा के सम्बन्ध से वैशाख । ज्येष्ठा और मूल के सम्बन्ध से ज्यैष्ठ पूर्वाषाढ़ और उत्तराषाढ़ के सम्बन्ध से आषाढ़ । श्रवण और धनिष्ठा के सम्बन्ध से श्रावण । अवशिष्ट मासों के लिये कहते हैं, आश्विन-भाद्रपद और फाल्गुन के तीनों मास तीन नक्षत्र वश से होते हैं जैसे रेवती- अश्विनी-भरणी के सम्बन्ध से आश्विन । शतभिष-पूर्वभाद्र-उत्तर भाद्र के सम्बन्ध से भाद्रपद । पूर्वफल्गुनी-उत्तरफल्गुनी–हस्त नक्षत्रों के सम्बन्ध से फाल्गुन । इस तरह निरयण नक्षत्रमानों से मासों की संज्ञा कही गई है। अथर्व वेद में भी ऐसी ही मासों की संज्ञा है । सायनमान वश से पूर्वकथित नक्षत्रों के सम्बन्धाभाव से मासों की संज्ञाओं में आपत्ति होती है इसलिये निरयणमान ही से व्यवहार उचित है यही प्राचीन वैदिकों की सम्मति है इति ॥५॥

इदानीं नवमानान्याह ।

मानुष्यदिव्यपित्र्यब्राह्माण्यष्टावमूर्त्तकालस्य ।
उक्तानि ज्ञानार्थं बार्हस्पत्यं नवममन्यत् ॥६॥

सु. भा.—अमूर्त्तकालस्याव्यक्तात्मककालस्य ज्ञानार्थं मानुष्यं मानचतुष्टयम् । दिव्यं दैवं पित्र्यं ब्राह्ममन्यच्च बार्हस्पत्यमिति नवमानान्युक्तानीति ॥६॥

वि. भा.—'लोकानामन्तकृत् कालः कालोऽन्यः कलनात्मकः । स द्विधा स्थूलसूक्ष्मत्वान्मूर्त्तश्चामूर्त्त उच्यते' इति सूर्यसिद्धान्तोक्तेरिह ज्यौतिषसिद्धान्ते गणनात्मक काल एवामूर्त्तसंज्ञकः, एतस्यामूर्त्तसंज्ञकस्याव्यक्तात्मककालस्य ज्ञानार्थं मानुष्यं मान (सौरमानम् । चान्द्रमानम् । सावनमानम् । नाक्षत्रमानम्) चतुष्टयम् । दिव्यं मानं दैवं (प्राजापत्यं), पित्र्यं, ब्राह्मं, अन्यद्बार्हस्पत्यमिति नव मानानि कथितानि सन्तीति । सूर्य सिद्धान्ते—

"ब्राह्मं दिव्यं तथा पित्र्यं प्राजापत्यं गुरोस्तथा ।
सौरं च सावनं चान्द्रमार्क्षं मानानि वै नवेति"
नवमानानि तथा सिद्धान्तशेखरे—

'पैतामहं दिव्यमथासुरं च पित्र्यं तथा मानुषमानमन्यत् ।
सौरार्क्षहैमांशवसावनानि जैवं तथैवं नव कीर्त्तितानि'
श्रीपत्युक्तानि नव मानानि । सिद्धान्तशिरोमणौ—

'एवं पृथग् मानवदैवजैवपैत्रार्क्षसौरैन्दवसावनानि ।
ब्राह्मं च काले नवमं प्रमाणं ग्रहास्तु साध्या मनुजैः स्वमानात्'
भास्करोक्तनवमानानि चाचार्योक्तसदृशान्येवेति विज्ञैर्ज्ञेयानीति ।।६।।

अब नव मानों को कहते हैं ।

हि. भा.—'लोकानामन्तकृत् कालः' इत्यादि सूर्य सिद्धान्तोक्त मूर्त्त और अमूर्त्त कालों में ज्यौतिष सिद्धान्तीय गणनात्मक काल ही अमूर्त्त संज्ञक है । इस अमूर्त्त संज्ञक अव्यक्तात्मक काल के ज्ञान के लिये मानुष्य मान (सौरमान, चान्द्रमान, सावनमान, नाक्षत्रमान) । दिव्य-मान, दैव (प्राजापत्य) मान, पित्र्य (पितृ सम्बन्धी) मान, ब्राह्म (ब्रह्म सम्बन्धी) मान अन्य बार्हस्पत्य (बृहस्पति सम्बन्धी) मान ये नव मान कथित हैं । सूर्य सिद्धान्त में 'ब्राह्मं दिव्यं तथा पित्र्यं प्राजापत्यं' इत्यादि मानाध्यायोक्त नौ मान तथा सिद्धान्तशेखर में 'पैतामहं दिव्यमथासुरं च पित्र्यं तथा मानुषमानमन्यत् 'इत्यादि श्रीपत्युक्त नौ मान तथा सिद्धान्तशिरोमणि में 'एवं पृथग् मानव दैव जैव पैत्रार्क्ष सौरैन्दव सावनानि' इत्यादि भास्करोक्त नौ मान ये सब मान आचार्योक्त नौ मानों के सदृश ही हैं इति ।।६।।

इदानीमृतूनाह ।

द्वौ द्वौ राशी मकरादृतवः षट् सूर्यगतिवशाद् भाज्यः ।
शिशिरवसन्तग्रीष्मा वर्षाशरदः सहेमन्ताः ।।७।।

सु. भा.—मकराद् द्वौ द्वौ राशी षट्ऋतवः सूर्यगतिवशाद्भाज्या विभाजनीया इति शेषं स्पष्टार्थम् । 'मृगादिराशिद्वयभानुभोगात् षट् चर्तवः स्युः' इत्यादि श्रीपत्युक्तमेतदनुरूपमेव ।।७।।

वि. भा.—मकराद् द्वौ द्वौ राशी षट् ऋतवः सूर्यगतिवशाद्विभाजनीयाः । ते च ऋतवो हेमन्तसहिताः शिशिरवसन्तग्रीष्मवर्षाशरद् इति नामका भवन्तीति । सिद्धान्तशेखरे 'मृगादिराशिद्वय भानुभोगात् षट् चर्त्तवः स्युरिति' श्रीपत्युक्तमाचार्योक्तानुरूपमेवेति ।।७।।

अब ऋतुओं को कहते हैं ।

हि. भा.—मकर संक्रान्ति से दो दो राशि छः ऋतु सूर्यगति वश से विभाग करने के योग्य है । वे छः ऋतुएँ शिशिर, वसन्त, ग्रीष्म, वर्षा, शरत्, हेमन्त, इन नामों की हैं । सिद्धान्तशेखर में 'मृगादि राशिद्वय भानु भोगात्' इत्यादि श्रीपत्युक्त आचार्योक्त के अनुरूप ही है इति ।।७।।

इदानीं भूभादैर्घ्यं भूभामानं चाह ।

भूव्यासगुणो भक्तः कुवर्कव्यासान्तरेण रविकर्णः ।
भूमध्याद्भूछाया दीर्घत्वं चन्द्रकर्णोनम् ।।८।।
शेषं भूव्यासगुणं दीर्घत्वहृतं शशाङ्ककक्षायाम् ।
तमसो व्यासः शशिकर्णहृतस्त्रिज्यागुणो लिप्ताः ।।९।।

सु. भा.—स्पष्टार्थम् । उपपत्तिश्च भूभासाधनक्षेत्रानुपातेन स्फुटा ।।८-९।।

वि. भा.—रविकर्णो भूव्यासेन गुणो भूव्यासरविव्यासयोरन्तरेण भक्तस्तदा भूकेन्द्रात् भूछायाया दीर्घत्वं भवति । तद्दीर्घत्वं चन्द्रकर्णेन हीनं शेषं यत्तद् भूव्यासेन गुणितं दीर्घत्वेन भक्तं तदा चन्द्रकक्षायां तमसो (भूभायाः) व्यासो भवति । स च त्रिज्यया गुणश्चन्द्रकर्णभक्तस्तदा भूभामानकला भवन्तीति ।

अत्रोपपत्तिः ।

रविबिम्बभूबिम्बयोः क्रमस्पर्शरेखावर्धितरविकर्णेन साकमेकस्मिन्नेव बिन्दौ चन्द्रकक्षात उपरि मिलन्ति । स च बिन्दुः=यो, भूकेन्द्रात् स्पर्शरेखायाः समानान्तरा रेखा कार्या तदा रविकर्ण एको भुजः भूव्यासार्धोनरविव्यासार्धं द्वितीयो भुजः । भूकेन्द्रात्समानान्तरेखारविव्यासार्धयोर्योगबिन्दुं यावत्तृतीयो भुजः । इति कर्णभुजकोटिभिरेकं त्रिभुजम् । तथा भूकेद्रात् यो बिन्दुं यावद्भूछायादैर्घ्यमेको भुजः । भूव्यासार्धं द्वितीयो भुजः । भूबिम्बस्पर्शबिन्दुतो यो बिन्दुं यावत्तृतीयो भुजः । इति कर्णभुज कोटिभिर्द्वितीयं त्रिभुजम् । अनयोस्त्रिभुजयोः साजात्यादनुपातेन $\dfrac{\dfrac{\text{रविकर्ण}\times\text{भूव्या}}{2}}{\dfrac{\text{रव्या}}{2}-\dfrac{\text{भूव्या}}{2}}=\dfrac{\text{रविकर्ण}\times\text{भूव्या}}{\text{रव्या}-\text{भूव्या}}$ = भूयो = भूछाया द्वैर्घ्यम्

वर्धितरविकर्णचन्द्रकक्षयोर्योगबिन्दुः=च, भू=भूकेन्द्रम् । भूच=चन्द्रकर्णः । भूयो—भूच=भूछाया दैर्घ्य—चन्द्रकर्ण=चयो । च बिन्दुतः स्पर्शरेखोपरिलम्बः=

चल=भूभा—व्यासार्धम् । भूबिम्बस्पर्श बिन्दुः=स्प, भूस्प=भूव्यासार्धम् । तदा भूस्पयो, चलयो त्रिभुजयोः साजात्यादनुपातः । $\frac{\text{भूस्प} \times \text{चयो}}{\text{भूयो}}$ = चल

= $\frac{\text{भूव्या}\frac{1}{2} \times (\text{भूछायादैर्घ्य} - \text{चन्द्रकर्ण})}{\text{भूछायादैर्घ्य}}$ = भूभाव्यासार्धम् । द्विगुणीकरणेन

$\frac{\text{भूव्या} \, (\text{भूछायादैर्घ्य} - \text{चन्द्रकर्ण})}{\text{भूछायादैर्घ्य}}$ = भूभाव्यासः । परमयं भूभाव्यासश्चन्द्रकक्षायां नहि भवति । किन्तु चन्द्रकक्षात उपरि भवतीति भूभासाधनक्षेत्रदर्शनेन स्फुटम् । ततः 'सूर्येन्दुभूभातनुयोजनानी' त्यादिना $\frac{\text{भूभाव्यास} \times \text{त्रि}}{\text{चन्द्रक}}$ =आचार्योक्त भूभा-मानकलाः, एतेनाचार्योक्तमुपपन्नमिति । भूभामानकलासाधने या स्थूलता सा पूर्वमेव तत्साधनोपपत्तौ प्रदर्शितास्ति । सा तत्रैव द्रष्टव्येति ॥

अब भूभादैर्घ्य और भूभामान को कहते हैं ।

हि॰ भा॰—रविकर्ण को भूव्यास से गुणाकर भूव्यासोन रविव्यास से भाग देने से भूकेन्द्र से भूछाया का दीर्घत्व (लम्बाई) होता है । उस दीर्घत्व में से चन्द्रकर्ण को घटाकर जो शेष रहता है उसको भूव्यास से गुणाकर दीर्घत्व से भाग देने से चन्द्रकक्षा में भूभाव्यास होता है । उसको त्रिज्या से गुणाकर चन्द्रकर्ण से भाग देने से भूभामान कला होती है इति ॥८-९॥

उपपत्ति ।

रविबिम्ब और भूबिम्ब की क्रमस्पर्श रेखाएँ वर्धित रविकर्ण के साथ चन्द्रकक्षा से ऊपर एक ही बिन्दु में मिलती है, वह बिन्दु=यो, है । भूकेन्द्र से स्पर्श रेखा की समानान्तर रेखा रवि व्यासार्ध में जहां लगती है वहां से रविकेन्द्र तक रेखा=रविव्या$\frac{1}{2}$—भूव्या$\frac{1}{2}$ अब दो त्रिभुज बनते हैं जैसे रविकर्ण कर्ण एकभुजः । भूव्यासार्धोन रविव्यासार्ध भुज द्वितीयभुज, भूकेन्द्र से समानान्तर रेखा और रविव्यासार्ध के योग बिन्दु पर्यन्त कोटि तृतीय भुज, इन कर्ण–भुज कोटि से उत्पन्न एक त्रिभुज, तथा भूकेन्द्र से बिन्दु पर्यन्त भूछायादैर्घ्य कर्ण एकभुज, भूव्यासार्ध भुज द्वितीयभुज भूबिम्ब स्पर्श बिन्दु से यो बिन्दु पर्यन्त कोटि तृतीयभुज, इन कर्णभुजकोटि से उत्पन्न द्वितीय त्रिभुज; इन दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं यदि भूव्यासार्धोन रवि व्यासार्धभुज में रविकर्ण-कर्ण पाते हैं तो भूव्यासार्ध भुज में क्या इस अनुपात से भूछाया दीर्घत्व आता है इसका स्वरूप= $\frac{\text{रविकर्ण} . \text{भूव्या}\frac{1}{2}}{\text{रव्या}\frac{1}{2} - \text{भूव्या}\frac{1}{2}}$

$= \frac{\text{रविकर्ण. भूव्या}}{\text{रव्या—भूव्या}}$ =भूछाया दीर्घत्व=भूयो । वर्धित रविकर्ण और चन्द्रकक्षा का योग-बिन्दु=च । भू=भूकेन्द्र । भूच=चन्द्रकर्ण भूयो—भूच=चयो= भूछायादीर्घत्व—चन्द्रकर्ण; च बिन्दु से स्पर्श रेखा के ऊपर लम्ब=चल=भूभाव्यासार्ध भूबिम्ब स्पर्श बिन्दु=स्प, भूस्प =भूव्यासार्ध, तब भूस्पयो, चलयो दोनों त्रिभुजों के सजातीयत्व से अनुपात करते हैं $\frac{\text{भूस्प. चयो}}{\text{भूयो}}$

$=\text{चल}=\frac{\text{भूव्या}\frac{1}{2}\text{ (भूछायादीर्घत्व—चन्द्रकर्ण)}}{\text{भूछायादीर्घत्व}}$ =भूभाव्यासार्ध, द्विगुणित करने से भूभाव्यास

$= \frac{\text{भूव्यास (भूछायादीर्घत्व—चन्द्रकर्ण)}}{\text{भूछायादीर्घत्व}}$, लेकिन यह भूभाव्यास चन्द्र कक्षान्तर्गत नहीं आता है किन्तु चन्द्रकक्षा से ऊपर आता है यह भूभासाधन क्षेत्र देखने से स्फुट है । तब अनुपात करते है यदि चन्द्रकर्ण में त्रिज्या पाते हैं तो भूभाविम्ब व्यासार्ध में क्या इस अनुपात से भूभाबिम्बार्ध कलाज्या आती है इसको द्विगुणित करने से आचार्योक्त भूभामान कला होती है उसका स्वरूप $=\frac{\text{त्रि. भूभाबिम्बव्या}}{\text{चन्द्रकर्ण}}$, इससे आचार्योक्त उपपन्न हुआ । लेकिन भूभामानकला साधन में जो स्थूलता है उसको साधनोपपत्ति में देखना चाहिये । इति ॥८–९॥

पुनः प्रकारान्तरेण तत्साधनमाह ।

रविकर्णहृता त्रिज्या क्ष्वर्कव्यासान्तराहता शोध्या ।
त्रिज्या भूव्यासवधात् शशिकर्णहृतात् तमो व्यासः ॥१०॥

सु. भा.—स्पष्टार्थम् ॥

अत्रोपपत्तिः । योजनात्मकभूभाव्यासः=भूव्या$-\frac{\text{चक (रव्या—भूव्या)}}{\text{रक}}$

इयं त्रिज्यागुणा चन्द्रकर्णहृता जाता भूभाबिम्बकलाः $=\frac{\text{त्रि.भूव्या}}{\text{चक}}$ $-\frac{\text{त्रि (रव्या—भूव्या)}}{\text{रक}}$ । अत उपपन्नं यथोक्तम् ॥१०॥

वि. भा.—त्रिज्या भूव्यासोन रविव्यासेन गुणिता रविकर्णेन भक्ता लब्धिः त्रिज्या भूव्यासघातात् चन्द्रकर्णभक्तात् शोध्या तदा भूभाव्यासो भवतीति ॥१०॥

अत्रोपपत्तिः ।

भूव्यासहीनं रविबिम्बमिन्दुकर्णाहतमित्यादि भास्करोक्त्या भूव्या $- \frac{\text{चंक (रव्या—भूव्या)}}{\text{रक}}$ = भूभाव्यासः । ततः पूर्वप्रदर्शितोपपत्त्या भूभाबिम्बकलाः $= \frac{\text{भूव्या. त्रि}}{\text{चंक}} - \frac{\text{चंक (रव्या—भूव्या). त्रि}}{\text{चंक.रक}} = \frac{\text{भूव्या. त्रि}}{\text{चंक}}$ $- \frac{\text{(रव्या—भूव्या). त्रि}}{\text{रक}}$, एतेनोपपन्नमाचार्योक्तमिति । भूव्या = भूव्यासः । चंक = चन्द्रकर्णः । रव्या = रविव्यासः । रक = रविकर्णः इति ॥१०॥

अब प्रकारान्तर से भूभाबिम्बकला साधन को कहते हैं ।

हि. भा.—त्रिज्या को भूव्यासोन रविव्यास से गुणा कर रविकर्ण से भाग देने से जो फल हो उसको त्रिज्या और भूव्यास घात में चन्द्रकर्ण से भाग देकर जो लब्धि हो उसमें से घटाने से भूभाव्यास होता है इति ॥१०॥

उपपत्ति ।

भूव्या = भूव्यास । चंक = चन्द्रकर्ण । रक = रविकर्ण । रव्या = रविव्यास, तब 'भूव्यासहीनं रविबिम्बमिन्दुकर्णाहतं' इत्यादि भास्करोक्त प्रकार से भूव्या— $- \frac{\text{चंक (रव्या—भूव्या). त्रि}}{\text{रक}}$ = भू भाव्यास, इसको त्रिज्या से गुणाकर चन्द्रकर्ण से भाग देने से भूभाबिम्बकला $= \frac{\text{भूव्या. त्रि}}{\text{चंक}} - \frac{\text{चंक. (रव्या—भूव्या).त्रि}}{\text{चंक.रक}} = \frac{\text{भूव्या.त्रि}}{\text{चंक}}$ $- \frac{\text{त्रि (रव्या — भूव्या)}}{\text{रक}}$ इससे आचार्योक्त उपपन्न हुआ इति ॥१०॥

इदानीं प्रकारान्तरेण भूभामानमाह ।

भूव्यासेन्दुगतिवधात् कुवर्कव्यासान्तरार्कभुक्तिवधम् ।
प्रोह्य न्दुमध्यभुक्त्या तिथिगुणयाऽऽप्तं तमो व्यासः ॥११॥

सु. भा.—स्पष्टार्थम् ।

अत्रोपपत्तिः । पूर्वश्लोकेन भूभाबिम्बकलाः $= \frac{\text{त्रि.भूव्या}}{\text{चक}}$

$$-\frac{\text{त्रि (रव्या—भूव्या)}}{\text{रक}}=\text{२ चान्द्र परलंवनकलाः}$$

$$-\frac{\text{त्रि.भूव्या (रव्या—भूव्या)}}{\text{रक.भूव्या}}=\frac{\text{२ चग}}{\text{१५}}-\frac{\text{२ रग (रव्या—भूव्या)}}{\text{१५ भूव्या}}$$

$$=\frac{\text{२ चग.भूव्या—२ रग (रव्या—भूव्या)}}{\text{१५ भूव्या}}$$

$$=\frac{\text{चग. भूव्या—रग (रव्या—भूव्या)}}{\text{१५ भूव्याद}}$$ आचार्यमते भूव्यासदलं स्वल्पान्तराच्च-न्द्रमध्यगतिकलासममत उपपन्नं यथोक्तम् ॥११॥

वि. भा.— भूव्यासचन्द्रगतिघातात् भूव्यासरविव्यासयोरन्तरगुणित-रविगतिं विशोध्य पञ्चदशगुणितचन्द्रमध्यगत्या भक्तं तदा भूभा व्यासो-भवेदिति ॥११॥

अत्रोपपत्तिः ।

पूर्वश्लोकेन भूभाविम्बकला $=\frac{\text{त्रि.भूव्या}}{\text{चंक}}-\frac{\text{त्रि (रव्या—भूव्या)}}{\text{रक}}$

$=\frac{\text{त्रि भूव्या}\frac{1}{2}\times\text{२}}{\text{चंक}}-\frac{\text{त्रि (रव्या—भूव्या)}}{\text{रक}}$ २ चन्द्र परमलम्बनकला

$-\frac{\text{त्रि (रव्या—भूव्या)}}{\text{रक}}$ द्वितीय खण्डे हरभाज्यौ भूव्यागुणितौ तदा २ चन्द्र परमलम्बन कला $-\frac{\text{त्रि. भूव्या (रव्या—भूव्या)}}{\text{रक.भूव्या}}$ यतः $\frac{\text{चंग}}{\text{१५}}$ = चन्द्रपरमल-म्बनकला । अतः $\frac{\text{२ चंग}}{\text{१५}}-\frac{\text{त्रि. भूव्या (रव्या—भूव्या)}}{\text{रक. भूव्या}}=\frac{\text{२ चंग}}{\text{१५}}$

$$-\frac{\text{त्रि.भूव्या}\frac{1}{2}\times\text{२ (रव्या—भूव्या)}}{\text{रक.भूव्या}}=\frac{\text{२ चंग}}{\text{१५}}$$

$$-\frac{\text{२ रविपरमलम्बन (रव्या—भूव्या)}}{\text{भूव्या}}=\frac{\text{२ चंग}}{\text{१५}}-\frac{\text{२ रग (रव्या—भूव्या)}}{\text{१५}\times\text{भूव्या}}$$

समच्छेदेन $\frac{\text{२ चंग. भूव्या—२ रग (रव्या—भूव्या)}}{\text{१५}\times\text{भूव्या}}$ = भूभाबिम्बकला

$=\frac{\text{चंग. भूव्या—रग (रव्या—भूव्या)}}{\text{१५}\times\text{भूव्या}\frac{1}{2}}$ अत्राचार्येण स्वल्पान्तरात् भूव्यासार्धं

चन्द्रमध्यमगतिसमं स्वीकृतं तदा $\frac{\text{चंग. भूव्या—रग (रव्या—भूव्या)}}{\text{१५ चंग}}$ = भूभा-

बिम्बकला, अत आचार्योक्तमुपपन्नमिति ॥११॥

अब प्रकारान्तर से भू भामान को कहते हैं।

हि. भा.—भूव्यास और चन्द्रगति के घात में भूव्यास और रविव्यास के अन्तर से गुणित रविगति को घटाकर पन्द्रह से गुणित चन्द्रमध्यम गति से भाग देने से लब्ध भूभाव्यास होता है इति ॥११॥

उपपत्ति।

पूर्वश्लोक से भूभाबिम्बकला = $\frac{\text{त्रि भूव्या}}{\text{चंक}} - \frac{\text{त्रि (रव्या—भूव्या)}}{\text{रक}}$

$= \frac{\text{त्रि. भूव्या}\frac{1}{2}\times 2}{\text{चंक}} - \frac{\text{त्रि (रव्या—भूव्या)}}{\text{रक}}$ = २ चन्द्रपरमलम्बनकला

$= \frac{\text{त्रि.भूव्या (रव्या—भूव्या)}}{\text{रक.भूव्या}}$ ∴ $\frac{\text{चंग}}{\text{१५}}$ = चन्द्रपरमलम्बनकला, अतः, $\frac{\text{२ चंग}}{\text{१५}}$

$- \frac{\text{त्रि.भूव्या (रव्या—भूव्या)}}{\text{रक.भूव्या}} = \frac{\text{२ चंग}}{\text{१५}} - \frac{\text{त्रि.भूव्या}\frac{1}{2}\times\text{२ (रव्या—भूव्या)}}{\text{रक.भूव्या}}$

$= \frac{\text{२ चंग}}{\text{१५}} - \frac{\text{२ रविपरमलम्बन (रव्या—भूव्या)}}{\text{भूव्या}} = \frac{\text{२ चंग}}{\text{१५}}$

$- \frac{\text{२ रग (रव्या—भूव्या)}}{\text{१५}\times\text{भूव्या}}$ समच्छेद से $\frac{\text{२ चंग. भूव्या—२रग (रव्या—भूव्या)}}{\text{१५}\times\text{भूव्या}}$ भूभा-

बिम्बकला = $\frac{\text{चंग. भूव्या—रग (रव्या—भूव्या)}}{\text{१५}\times\text{भूव्या}\frac{1}{2}}$ यहां आचार्य ने स्वल्पान्तर से चन्द्र-

मध्यमगति के बराबर भूव्यासार्ध को स्वीकार किया है। तब

$\frac{\text{चंग.भूव्या—रग (रव्या—भूव्या)}}{\text{१५ चंग}}$ = भूभाविम्बकला, इससे आचार्योक्त उपपन्न हुआ

इति ॥११॥

इदानीमध्यायोपसंहारमाह।

योऽधिकमासावमरात्रसम्भवज्ञः स वेत्ति मानानि।

आर्याद्वादशभिरयं मानाध्यायस्त्रयोविंशः ॥१२॥

सु. भा.—यो गणकोऽधिकमासावमरात्रसम्भवज्ञः स एव सौरादिमानानि वेत्ति यतः सौरचान्द्रमानाभ्यां सम्यग्ज्ञाताभ्यामधिमासज्ञानं चान्द्रसावनमानाभ्यां च क्षयाहज्ञानं भवति । शेषं स्पष्टम् ॥१२॥

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते ।
हृदि तं विनिधाय नूतनोऽयं रचितो मानविधौ सुधाकरेण ॥

इति श्रीकृपालुदत्तसूनुसुधाकरद्विवेदिविरचिते ब्राह्मस्फुटसिद्धान्तनूतनतिलके मानाध्यायस्त्रयोविंशः ॥१२॥

वि. भा.—योऽधिमाससम्भवमवमसम्भवं च जानाति स मानानि (सौरचान्द्रमानादि) जानाति, यतो ज्ञाताभ्यां सौरचान्द्रमानाभ्यामधिमासज्ञानं भवति तथा चान्द्रसावनमानाभ्यां चावमदिनज्ञानं भवति । अयमार्याद्वादशभिस्त्रयोविंशो मानाध्यायोऽस्तीति ॥१२॥

इति ब्राह्मस्फुटसिद्धान्ते मानाध्यायस्त्रयोविंशः

अब अध्याय के उपसंहार को कहते हैं ।

हि. भा.—जो गणक अधिमास सम्भव को जानते हैं और अवम सम्भव को जानते हैं वे मान (सौर चान्द्रमानादि) को जानते हैं क्यों कि अच्छी तरह विदित सौरमान और चान्द्रमान से अधिमास ज्ञान होता है, तथा चान्द्रमान और सावनमान से क्षयाह ज्ञान होता है इति ॥१२॥

इति ब्राह्मस्फुट सिद्धान्त में तेईसवां मानाध्याय समाप्त हुआ ।

ब्राह्मस्फुटसिद्धान्तः

संज्ञाध्यायः

ब्राह्मस्फुटसिद्धान्तः

अथ संज्ञाध्यायः प्रारभ्यते ।

तत्रादौ तदारम्भ प्रयोजनमाह ।

यस्मात्संप्रतिपत्तिर्न संज्ञया संज्ञितो विना तस्मात् ।
लोके प्रसिद्धसंज्ञा रूपादीनां शशाङ्काद्याः ।। १ ।।

सु. भा.—यस्मात् संज्ञया विना यः संज्ञितः पदार्थस्तस्य संप्रतिपत्तिः प्राप्तिः परिचयो वा न भवति, तस्मात् लोके रूपादीनां रूपवतां पदार्थानां शशाङ्काद्याः प्रसिद्धसंज्ञाः सन्ति ये ये रूपवन्तस्ते ते संज्ञावन्तः । संज्ञा विना परिचयो न भवतीत्यर्थः ।।१।।

वि. भा.—यस्मात् कारणात् यः संज्ञितः (संज्ञायुक्तो नामयुक्तोवा) पदार्थस्तस्य संप्रतिपत्तिः (परिचयः सम्यक् ज्ञानं वा) संज्ञया विना न भवति तस्मात् कारणात् लोके रूपादीनां (स्वरूपवतां पदार्थानां) शशाङ्काद्याः (चन्द्रादयः) प्रसिद्ध संज्ञाः सन्ति । अर्थाद्ये ये रूपवन्तः पदार्थास्तेते संज्ञावन्तः, संज्ञा (नाम) विना तेषां परिचयो न भवतीति ।। १ ।।

अब संज्ञाध्याय प्रारम्भ किया जाता है । उसमें पहले आरम्भ
करने का प्रयोजन कहते हैं ।

हि. भा.—क्योंकि जो संज्ञायुक्त (नाम वाले) पदार्थ हैं उनका परिचय वा अच्छी तरह से ज्ञान विना संज्ञा (नाम) के नहीं होता है; इसलिये लोक में रूपवान् पदार्थों की शशाङ्क (चन्द्र) आदि प्रसिद्ध संज्ञा है । अर्थात् रूपवान् जितने पदार्थ है वे सब संज्ञावान् है । संज्ञा (नाम) के बिना उनका परिचय नहीं होता है इति ।। १ ।।

इदानीं सिद्धान्त एक एवेत्याह ।

युगपद्युगादिरुदयाद्याम्यायां भास्करस्य वारुण्याम् ।
रात्र्यर्धात् सौम्यायामस्तमयाद्दिनदलादैन्द्र्याम् ॥ २ ॥
अयमेव कृतः सूर्येन्दु पुलिश रोमक वशिष्ठ यवनाद्यैः ।
यस्मात्तस्मादेकः सिद्धान्तो विरचितो नान्यः ॥ ३ ॥

सु. भा.—कस्यचिन्मते भास्करस्य याम्यायां लङ्कायामुदयाद्युगपद्युगादिः । अन्यमते तदैव वारुण्यां रोमकपत्तने रात्र्यर्धाद्युगादिः । अन्यमते तदैव सौम्यायां सिद्धपुरेऽस्तमयाद्युगादिः । अन्यमते च तदैवैन्द्र्यां यमकोट्यां दिनदलाद्युगादिः । एवं देशविशेषेणोदयास्तादिकालः सूर्यस्य जातो वस्तुत आकाशे सूर्यस्य स्थितिश्च मेषादावेवातो ग्रहगणनायामेव सर्वत्र एक एवायं सिद्धान्तः सूर्येन्दुपुलिशरोमक-वसिष्ठय वनाद्यैः कृतः । यस्माद्देशविशेषस्य भिन्न-भिन्नकालग्रहणेन ग्रहगणनायां भेदो न भवति तस्मात् सूर्याद्यैर्वस्तुत एक एव सिद्धान्तो विरचितो नान्य इति सिद्धान्तविदां सर्वं स्फुटम् ॥२-३॥

वि. भा—भास्करस्य (सूर्यस्य) याम्यायां (लङ्कायां) उदयादेकदैव युगादेः प्रवृत्तिर्बभूवेति कस्यचिन्मतम् । तदैव (लङ्कार्कोदयकाल एव) वारुण्यां (रोमक-पत्तने) रात्र्यर्धात् (अर्धरात्रिकालात्) युगादिप्रवृत्तिः । तदैव सौम्यायां (सिद्धपुरे) अस्तमयकालाद्युगादि प्रवृत्तिरिति कस्यचिन्मतम् । तदैवैन्द्र्याम् (यमकोटि पुर्यां) दिनार्धकालाद्युगादेः प्रवृत्तिरित्यन्यस्य मतम् । सिद्धान्त शिरोमणौ—

"लङ्का कुमध्ये यमकोटिरस्याः प्राक् पश्चिमे रोमकपत्तनं च ।
अधस्ततः सिद्धपुरं सुमेरुः सौम्ये च याम्ये वडवानलश्च ॥
कुवृत्त पादान्तरितानि तानि स्थानानि षड्गोलविदो वदन्ती"
तिभास्करोक्तपुरनिवेशस्थित्या गोलस्थितिदर्शनेन चाऽग्रे ।
"लङ्कापुरेऽर्कस्य यदोदयः स्यात्तदा दिनार्धं यमकोटिपुर्याम् ।
अधस्तदा सिद्धपुरेऽस्तकालः स्याद्रोमके रात्रिदलं तदैव ॥"

इति भास्करोक्तमस्ति, यदा लङ्कायां सूर्योदयस्तदैव यमकोटिनगरे दिनार्धमधःसिद्धपुरेऽस्तकालः । रोमकपत्तने रात्र्यर्धं भवति, तेन लङ्कासूर्योदय-काले-यमकोटिदिनार्धकाले, अधः सिद्धपुरेऽस्तकाले, रोमकपत्तनस्य रात्र्यर्धकाले एकदैव युगादि प्रवृत्तिर्बभूवेति कथने न कोऽपि दोषोऽस्ति । तथापि सिद्धान्तशेखरे-

"मधुसित प्रतिपद्दिवसादितो रविदिने दिनमासयुगादयः ।
दश शिरः पुरि सूर्यसमुद्गमात् सममभी भवसृष्टिमुखेऽभवन्'

इत्यनेन श्री पतिना, सिद्धान्तशिरोमणौ
"लङ्कानगर्यामुदयाच्च भानोस्तस्यैव वारे प्रथमं बभूव।
मधोः सितादेर्दिनमासवर्षं युगादिकानां युगपत्प्रवृत्तिः ॥"

इत्यनेन भास्कराचार्येण, अन्येनाप्यनेकाऽऽचार्येण लङ्कायाः प्रधानत्वाल्लङ्कासूर्योदयकालत एव युगाद्यारम्भः कथ्यते, यमकोटि-सिद्धपुर-रोमकपत्तननगराण्यप्रसिद्धानि सन्ति, बहुभिस्तेषां नामान्यपि न श्रुतानि, तस्मादेव कारणात्—बहुभिरेवाचार्यैर्लङ्कासूर्योदयकालत एव युगादिप्रवृत्तिः स्वीक्रियते। वस्तुतस्तु—आकाशे मेषादावेव सूर्यस्य स्थितिरतो ग्रहगणिते सर्वत्रैक एवायं सिद्धान्तः सूर्य-चन्द्र-पुलिश-रोमक-वशिष्ट यवनाद्यैः कृतः। यस्मात्कारणात् देशविशेषाणां भिन्नभिन्नकालग्रहगणिते कोऽपि भेदो न भवत्यतः पूर्वोक्तैराचार्यैरेक एव सिद्धान्तो विरचितोऽन्यो नेति ॥ २-३ ॥

अब सिद्धान्त एक ही है कहते हैं।

हि. भा.— लङ्का सूर्योदय काल से एक ही समय में युगादियों की प्रवृत्ति हुई यह किसी का मत है। उसी समय में (लङ्कोदयकाल ही में) रोमक पत्तन में अर्ध रात्रिकाल से युगाद्यारम्भ हुआ यह अन्य आचार्य का मत है। उसी समय में सिद्धपुर में सूर्यास्त काल से युगादियों की प्रवृत्ति हुई यह किसी दूसरे आचार्य का मत है। उसी समय में यमकोटि पुरी में दिनार्ध काल से युगादियों की प्रवृत्ति हुई यह किसी अन्य आचार्य का मत है। सिद्धान्त-शिरोमणि में 'लङ्का कुमध्ये यमकोटिरस्याः प्राक्पश्चिमे रोमक पत्तनं च' इत्यादि भास्कराचार्य कथित पुरों के निवेश की स्थिति से और गोल स्थिति देखने से आगे 'लङ्कापुरेऽर्कस्य यदोदयः स्यात्तदा दिनार्धं यमकोटि पुर्याम्' इत्यादि भास्करोक्त है अर्थात् जब लङ्का में सूर्योदय हुआ उसी समय यमकोटि पुरी में दिनार्ध होता है, सिद्धपुर में अस्तकाल होता है, और रोमकपत्तन में रात्र्यर्ध होता है, इसलिये लङ्कासूर्योदय काल में-यम कोटि दिनार्ध काल में सिद्धपुर के अस्तकाल में रोमक पत्तन में अर्धरात्रि काल में एक ही समय में युगादि प्रवृत्ति हुई इस कथन में कोई भी दोष नहीं है।

तथापि सिद्धान्त शेखर में 'मधुसित प्रतिपद् दिवसादितो रविदिने दिनमासयुगादयः' इत्यादि विज्ञान भाष्य में लिखित श्रीपत्युक्ति से सिद्धान्त शिरोमणि में 'लङ्कानगर्यामुदयाच्च भानोस्तस्यैव वारे प्रथमं बभूव' इत्यादि भास्करोक्ति से और अनेक आचार्यों के कथन के अनुसार प्रधाननगरी लङ्का के सूर्योदय काल ही से युगाद्यारम्भ माना जाता है। यमकोटि-सिद्धपुर-रोमकपत्तन नगर अप्रसिद्ध है, बहुत लोग उनके नाम भी नहीं जानते हैं लंका को आबाल वृद्ध सब जाते हैं, इसीलिये बहुत से आचार्यों ने लङ्का में सूर्योदय काल ही से युगादि प्रवृत्ति को स्वीकार किया है।

वस्तुतः आकाश में मेषादि ही में सूर्य की स्थिति थी इसलिये ग्रहगणना में सर्वत्र एक ही यह सिद्धान्त को सूर्य-चन्द्र-पुलिश-रोमक-वशिष्ठ-यवनादि आचार्यों ने स्वीकार किया है। क्योंकि देश विशेषों के भिन्न-भिन्न काल ग्रहण करने से ग्रहगणना में कोई भी भेद नहीं होता है अतः पूर्वोक्त आचार्यों ने एक ही सिद्धान्त बनाया, अन्य नहीं इति ।। २-३ ।।

इदानीं कस्मिन्नंशे सूर्यसिद्धान्तादयो भिन्ना इति कथ्यते ।

यदि भिन्नाः सिद्धान्ताः भास्कर संक्रान्तयो विभेदसमाः ।

स स्पष्टः पूर्वस्यां विषुवत्यर्कोदयो यस्य ।। ४ ।।

सु० भा०—यदि सौरादयः सिद्धान्ताः भिन्नास्तर्हि विभेदसमा भास्कर-सङ्क्रान्तयः सन्ति । रविसंक्रान्तिसमय एक एव तेषां सौरादीनां गणनया नायाति तेन हेतुना सिद्धान्ता भिन्नाः । तेषां कतमः स्फुट इत्याह स स्पष्ट इति । यस्य गणनया विषुवति मेषतुलादौ पूर्वस्यां दिश्येव प्राक् स्वस्तिकविन्दावर्कोदयो वेधेनो-पलभ्यते स एव स्पष्टः स्फुटो ज्ञेय इति । यद्युदयकाल एव रविर्मेषतुलादिगस्तदै-वैवं भवत्यन्यथा तारतम्येन रव्युदयेन सिद्धान्तगणना परीक्षणीयेति ।।४।।

वि. भा.—यदि सूर्यसिद्धान्तादयः सिद्धान्ता भिन्नास्तर्हि रविसंक्रातिसमय एक एव तेषां (सौरादीनां) गणनया नायात्यतः सिद्धान्ता भिन्ना सन्ति । तेषु सिद्धातेषु कतमःस्फुट इति कथ्यते । यस्य गणनया विषुवति (मेषादौ तुलादौ च) पूर्वस्यां दिश्येव (पूर्वस्वस्तिकविन्दावेव) रव्युदयो वेधेनोपलभ्यते स एव स्फुटः सिद्धान्तो बोद्धव्यः । यदि रविरुदय काल एव मेषतुलादिगतस्तदैवैवं भवितुमर्हति । अन्यथा रव्युदयेन सिद्धान्तगणनायास्तारतम्येन परीक्षणं कार्यमिति ।। ४ ।।

अब किस अंश में सूर्य सिद्धान्तादि भिन्न हैं सो कहते हैं ।

हि. भा.—यदि सौरादि सिद्धान्त भिन्न है तो रवि संक्रान्ति काल उन सबों की गणना एक ही से नहीं आता है अतः सिद्धान्त भिन्न हैं । उन सिद्धान्तों में कौन सिद्धान्त स्फुट है सो कहते हैं । जिसकी गणना से मेषादि और तुलादि में पूर्वस्वस्तिक बिन्दु ही में वेध से रवि का उदय उपलब्ध हो उसी को स्फुट सिद्धान्त समझना चाहिये । यदि उदयकाल ही में रवि मेषादि-तुलादि गत हो तब ही ऐसा हो सकता है अन्यथा तारतम्य से रवि के उदय से सिद्धान्तगणना की परीक्षा करनी चाहिये इति ।। ४ ।।

इदानीं स्व सिद्धान्तस्योत्तरार्धे क्रमिकाध्यायसंख्यामाह ।

तन्त्र परीक्षा गणितं मध्यमगत्युत्तरादयः पञ्च ।

कुट्टाकारो छेद्यश्छन्दश्चित्युत्तरं गोलः ।। ५ ।।

यन्त्राणि मानसंज्ञा ख्याताध्यायाश्चतुर्दश ब्राह्मे ।
अध्यायचतुर्विंशतिराद्यै र्दशभिर्युताध्यायैः ॥ ६ ॥

सु. भा.—उत्तरार्धे तन्त्रपरीक्षाध्यायः । गणितं गणिताध्यायः । पञ्च मध्यमगत्युत्तरादयोऽधिकाराः सन्ति । मध्यगत्युत्तराध्यायः । स्पष्टगत्युत्तराध्यायः । त्रिप्रश्नोत्तराध्यायः । छेद्यकाध्यायः । शृङ्गोन्नत्युत्तराध्यायः । कुट्टाकाराध्यायः । छन्दश्चित्युत्तराध्यायः । गोलो गोलाध्यायः । यन्त्राणि,यन्त्राध्यायः । मानसंज्ञाध्यायः । ख्याताध्यायः संज्ञाध्यायोऽयमेव । एवमुत्तरार्धे ब्राह्मे सिद्धान्ते चतुर्दशाध्यायाः सन्ति । एत आद्यैर्दशभिरध्यायैर्युता अध्यायचतुर्विंशतिरत्र ग्रन्थे ज्ञेयेति ॥५-६॥

वि. भा.—ब्राह्मे सिद्धान्ते (ब्राह्मस्फुट सिद्धान्ते) उत्तरार्धे (१) तन्त्रपरीक्षाध्यायः, (२) गणिताध्यायः, मध्यमगत्युत्तरादयः पञ्चाध्यायाः (३) मध्यगत्युत्तराध्यायः, (४) स्फुटगत्युत्तराध्यायः, (५) त्रिप्रश्नोत्तराध्यायः, (६) ग्रहणोत्तराध्यायः, (७) शृङ्गोन्नत्युत्तराध्यायः, (८) कुट्टाकाराध्यायः, (९) छेद्यकाध्यायः, (१०) छन्दश्चित्युत्तराध्यायः, (११) गोलाध्यायः (१२) यन्त्राध्यायः, (१३) मानसंज्ञाध्यायः, (१४) ख्याताध्यायः (संज्ञाध्यायोऽयमेव) इतिचतुर्दशाध्यायाः सन्ति । एते चतुर्दशाध्याया आद्यैर्दशभिरध्यायैर्युताश्चतुर्विंशति संख्यका अध्याया अत्र ग्रन्थे ज्ञेया इति ॥ ५-६ ॥

अब अपने सिद्धान्त के उत्तरार्ध में क्रमिक अध्याय संख्या कहते हैं ।

हि. भा.—इस ब्राह्मस्फुट सिद्धान्त के उत्तरार्ध में (१) तन्त्रपरीक्षाध्याय, (२) गणिताध्याय, (३) मध्यगत्युत्तराध्याय, (४) स्फुटगत्युत्तराध्याय, (५) त्रिप्रश्नोत्तराध्याय, (६) ग्रहणोत्तराध्याय, (७) शृङ्गोन्नत्युत्तराध्याय, (८) कुट्टाकाराध्याय, (९) छेद्यकाध्याय, (१०) छन्दश्चित्युत्तराध्याय, (११) गोलाध्याय, (१२) यन्त्राध्याय, (१३) मानसंज्ञाध्याय, (१४) संज्ञाध्याय, ये चौदह अध्याय है । इनमें पहले (पूर्वार्ध) के दश अध्याय जोड़ने से इस ग्रन्थ में चौबीस अध्याय समझने चाहिये इति ॥ ५-६ ॥

इदानीं ग्रन्थग्रथनकालमाह ।

श्री चापवंशतिलके श्रीव्याघ्रमुखे नृपे शकनृपाणाम् ।
पञ्चाशत्संयुक्तै र्वर्षशतैः पञ्चभिरतीतैः ॥ ७ ॥
ब्राह्मस्फुटसिद्धान्तः सज्जनगणितगोलवित्प्रीत्यै ।
त्रिंशद्वर्षेण कृतो जिष्णुसुतब्रह्मगुप्तेन ॥ ८ ॥

सु. भा.—श्रीव्याघ्रमुखे नृपे पृथ्वीं शासति । किंविशिष्टे नृपे श्रीचापवंश-

तिलके । शकनृपाणां पञ्चाशत्संयुक्तैः पञ्चभिर्वर्षशतैरतीतैरर्थात् पञ्चाशदधिक-पञ्चशतशके शेषं स्पष्टम् ॥७–८॥

वि. भा.—श्रीचापवंशस्य तिलके (टीकारूपे) श्रीव्याघ्रमुखे (एतन्नामके) महीपाले पृथ्वीं शासति, शकनृपाणां पञ्चाशत्संयुक्तैः पञ्चभिर्वर्षशतैरर्थात् पञ्चाशदधिकपञ्चशतवर्षैः, अतीतैः (गतैः) अर्थात् पञ्चाशदधिकपञ्चशत-शकाब्दे सज्जनगणितगोलविदां विनोदाय त्रिंशद्वर्षवयस्केन जिष्णोस्तनयेन ब्रह्मगुप्तेन ब्राह्मः स्फुटसिद्धान्तः कृत इति ॥ ७-८ ॥

अब ग्रन्थ रचना काल कहते हैं ।

हि. भा.—श्रीचापवंश में तिलक (टीका) रूप श्री व्याघ्रमुख नामक राजा के शासन में पांच सौ पचास शक(शाके ५५०) में सज्जन (दौष्ट्यादि दोष रहित) गणित और गोल के पण्डितों के हर्ष के लिये तीस वर्ष अवस्था के जिष्णुपुत्र ब्रह्मगुप्त ने ब्राह्मस्फुट सिद्धान्त नामक इस ग्रन्थ को रचा अर्थात् ब्राह्मस्फुट सिद्धान्त को बनाया इति ॥ ७–८ ॥

इदानीमस्मिन् सिद्धान्ते गणितलाघवेन करणग्रन्थवत् फलसाधनं
कथं न कृतमिति कथयति

गणितेन फले सिद्धिर्ब्राह्मे ध्यानग्रहे यतोऽध्याये ।
ध्यानग्रहो द्विसप्ततिरार्याणां न लिखितोऽत्र मया ॥ ९ ॥

सु. भा.—यातो ब्राह्मे ब्रह्मकृते ध्यानग्रहे ध्यानग्रहनाम्न्यध्याये गणितेन फले मान्दादिफलसाधने लाघवेन सिद्धिः कृताऽतोऽत्रार्याणां द्विसप्ततिर्ध्यानग्रहोऽध्यायः पुनरुक्तिदोषभयान्मया न लिखित इति ॥९॥

वि.भा.—यतो ब्राह्मे (ब्रह्मगुप्तकृते) ध्यानग्रहेऽध्याये (ध्यानग्रहोपदेशाध्याये) मान्दादि फलसाधने गणितलाघवेन फलसिद्धिः कृता मयाऽतोऽत्रार्याणां द्विसप्तति ध्यर्नग्रहोऽध्यायः पुनरुक्तिदोषभयान्न लिखित इति ॥ ९ ॥

अब इस सिद्धान्त में गणितलाघव से करण ग्रन्थ की तरह फलसाधन
क्यों नहीं किया गया कहते हैं ।

हि. भा.—क्योंकि ब्रह्मगुप्तकृत ध्यान ग्रह नामक अध्याय में गणित से मान्दादि फल साधन में लाघव द्वारा सिद्धि की गयी है इसलिये यहां बहत्तर आर्याओं का ध्यान ग्रहाध्याय पुनरुक्तिदोष के डर से नहीं लिखा गया इति ॥ ९ ॥

इदानीं ग्रन्थ संख्यां कथयति ।

भटब्रह्माचार्येण जिष्णोस्तनयेन गणितगोलविदा ।
आर्याष्टसहस्रेण स्फुटसिद्धान्तः कृतो ब्राह्मः ॥ १० ॥

सु. भा.—आर्याणामष्टाधिकैक सहस्रेण शेषं स्पष्टार्थम् ॥१०॥

वि भा.—गणितगोलज्ञेन जिष्णुपुत्रेण भटब्रह्माचार्येण मया, आर्याणामष्टाधिकैकसहस्रेण ब्राह्मस्फुटसिद्धान्तः कृत इति ॥

अब ग्रन्थ संख्या (ग्रन्थ में श्लोक संख्या) कहते हैं ।

हि. भा.—गणित और गोल के पण्डित जिष्णु के पुत्र भटब्रह्माचार्य ने एक हजार आठ आर्याओं के इस ब्राह्मस्फुटसिद्धान्त ग्रन्थ को बनाया इति ॥ १० ॥

इदानीं सूर्यग्रहणे चन्द्रशङ्कुः कथंन कृत एतदर्थमाह ।

भग्रहयुतिवच्छङ्कुर्वित्रिभलग्नाद्रविग्रहोक्तिसमः ।
शशिनः कर्मबहुत्वात् न कृतोऽतो भास्करग्रहणे ॥ ११ ॥

सु. भा.—भग्रहयुतिवद्रविग्रहोक्तिसमः शशिनो वित्रिभलग्नाच्छंकुः कर्मबहुत्वात् महताऽऽयासेन भवति। अतो मया भास्करग्रहणे शशिशङ्कुर्न कृतः प्रयोजनाभावात् इयमार्या निष्प्रयोजना ॥११॥

वि. भा.—भग्रहयुतिवत् सूर्यग्रहणोक्तस्थितिरस्ति-अर्थात् भग्रह योगे यथा स्थिति रस्ति तथैव सूर्यग्रहणेऽपि विद्यते । वित्रिभलग्नाच्छङ्कुश्चन्द्रस्य क्रिया गौरवान्महता प्रयासेन भवत्यतो मया सूर्यग्रहणे चन्द्रशङ्कुर्न कृत इति ॥११॥

हि. भा.—भग्रह (नक्षत्र और ग्रह) योग की तरह सूर्यग्रहण में कथित स्थिति है अर्थात् भग्रह योग स्थिति के तुल्य ही सूर्यग्रहणोक्त स्थिति है, वित्रिभलग्न से चन्द्रशङ्कु क्रिया की अधिकता (कर्मबाहुल्य) से वहुत प्रयास द्वारा होता है इसलिये मैंने सूर्यग्रहण में चन्द्रशङ्कु नहीं किया इति ॥ ११ ॥

इदानीं प्रश्न विशेषमाह ।

आग्नेये नैर्ऋत्येवेष्टदिने संस्थितस्य योऽर्कस्य ।
शङ्कुच्छाये कथयति वर्षादपि वेत्ति सूर्यं सः ॥ १२ ॥

सु. भा.—इष्टदिने आग्नेये वा नैर्ऋत्ये कोणवृत्ते संस्थितस्यार्कस्य वा यो

वर्षादपि वर्षपर्यन्तकालेनापि शङ्कुच्छाये कथयति स एव सूर्यं वेत्तीति ।

अस्योत्तरं कोणशङ्कोरानयनेन स्फुटम् ॥१२॥

वि. भा.—यो गणक इष्टदिने आग्नेये का नैऋर्त्ये कोणवृत्ते संस्थितस्यार्कस्य (रवेः) शङ्कुच्छाये वर्षपर्यन्तकालेनापि कथयति स सूर्यं वेत्ति (जानाति), इति ॥ १२ ॥

अस्योत्तरार्थमुपपत्तिः सूर्यसिद्धांते ।

"त्रिज्यावर्गार्धतोऽग्राज्या वर्गोनाद् द्वादशाहतात् ।
पुनर्द्वादश विघ्नाच्च लभ्यते यत् फलं बुधैः ॥
शङ्कुवर्गार्धसंयुक्तविषुवद्वर्गभाजितात् ।
तदेव करणी नाम तां पृथक् स्थापयेद् बुधः ॥
अर्कघ्नी विषुवच्छायाऽग्राज्यया गुणिता तथा ।
भक्ता फलाख्यं तद्वर्गसंयुक्तकरणीपदम् ॥
फलेन हीनसंयुक्तं दक्षिणोत्तर गोलयोः ।
याम्ययोर्विदिशोः शङ्कुरेवम्"
इति कोणशङ्कोरानयनमस्ति ।

एतद्व्याख्या—त्रिज्यावर्गार्धात् अग्राज्यावर्गहीनात् । शेषाद् द्वादशगुणात् पुनर्द्वादशगुणात् । द्वादशवर्गार्धसंयुक्त पलभावर्गेण भाजिताद्य त्फलं तदेव करणी नाम भवति । तां करणीं पृथगेकत्र स्थापयेत्, द्वादशगुणा पलभाऽग्रया गुणा तेनैव हरेण (द्वादशवर्गार्धसंयुक्त पलभावर्गेण) भक्ता लब्धं फलसंज्ञकम् । फलाख्यस्य वर्गेण संयुक्ता या करणी तत्पदं (वर्गमूलं) दक्षिणोत्तरगोलयोःक्रमेण फलाख्येन हीन संयुक्तं कार्यम् । दक्षिणगोले फलेन हीनमुत्तरगोले युक्तमित्यर्थः । एवं याम्ययोरग्निनैऋर्त्य-कोणयोः शङ्कुः स्यादिति । एतदुपपत्तिदर्शनेन प्रश्नोत्तरं स्फुटमस्तीति ॥ १२ ॥

अब प्रश्न विशेष को कहते हैं ।

हि. भा.—जो गणक इष्टदिन में आग्नेय वा नैऋर्त्य कोणवृत्त स्थित रवि के शङ्कु और छाया को एक वर्ष पर्यन्त समय में भी कहते हैं वे सूर्य को जानते हैं; इति ॥ १२ ॥

इसकी उपपत्ति ।

सूर्य सिद्धान्त में 'त्रिज्यावर्गार्धतोऽग्राज्यावर्गोनाद्द्वादशाहतात् । पुनर्द्वादशनिघ्नाच्च लभ्यते यत्फलं बुधैः' इत्यादि संस्कृतोपपत्ति में लिलित श्लोकों में 'फलेन हीन संयुक्तं

दक्षिणोत्तर गोलयोः। याम्ययोर्विदिशोः शङ्कुः' इसमें उपर्युक्त प्रश्न का उत्तर स्पष्ट है। उपर्युक्त सूर्य सिद्धान्तीय श्लोकों की उपपत्ति देखने से स्फुट है इति ॥ १२॥

इदानीमध्यायोपसंहारमाह।

अत्र मया यन्नोक्तं गोलादुत्प्रेक्ष्य धीमता वोह्यम्।
आर्यात्रयोदशोऽयं संज्ञाध्यायश्चतुर्विंशः ॥ १३ ॥

सु. भा.—अत्र मया यत् किञ्चिन्नोक्तं तत्सर्वं धीमता गणकेन गोलादुत्प्रेक्षां कृत्वोह्यम्। गोलबोधे हीदमेव फलं यदनुक्तमपि बुद्धिमता ज्ञायते। शेषं स्पष्टम् ॥१३॥

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते।
हृदि तं विनिधाय नूतनोऽयंरचितो नामविधौ सुधाकरेण ॥

इति श्रीकृपालुदत्तसूनुसुधाकरद्विवेदिरचिते ब्राह्मफुटसिद्धान्तनूतनतिलके संज्ञाध्यायश्चतुर्विंशतितमः सम्पूर्णतामगमत् ॥

वि. भा.—अत्र मया यत्किञ्चित् न कथितं तत्सर्वं बुद्धिमता गणकेन गोलादुत्प्रेक्षां कृत्वा ज्ञेयम्। गोलज्ञानस्येदमेव फलं यदकथितमपि बुद्धिमद्भिर्ज्ञायत इति ॥ १३ ॥

इति ब्राह्मस्फुट सिद्धान्ते संज्ञाध्यायश्चतुर्विंशतितमः समाप्तिमगमत् ॥ २४ ॥

अब अध्याय के उपसंहार को कहते हैं।

हि. भा.—इसमें हमने जो कुछ नहीं कहा है उन सबों को बुद्धिमान् गणक (ज्योतिषिक) गोल ज्ञान से समझें क्योंकि गोलबोध का यही फल है कि जो विषय नहीं कहे हैं उनको समझे इति ॥ १३ ॥

इति ब्राह्मस्फुटसिद्धान्त में संज्ञाध्याय नाम का चौवीसवां अध्याय समाप्त हुआ ॥ २४ ॥

ब्रह्मगुप्त कृतो

ध्यानग्रहोपदेशाध्यायः

ब्रह्मगुप्त कृतो

ध्यानग्रहोपदेशाध्यायः

तत्रादौ चैत्रादौ मासगणानयनमाह—

पञ्चाशत्संयुक्तैर्वर्षशतैः पंचभिर्विना शाकः
त्रिष्ठोऽर्कैर्वसुवेदैर्नवचन्द्रैस्ताडितः क्रमशः ॥ १ ॥
पंचाब्धियुतोऽधः षष्टिभाजितो लब्धियुक् सरसवेदः ।
मध्यमराशिर्विश्वैर्विभाजितोऽभ्यधिकमासाः स्युः ॥ २ ॥
तैरुपरितनो युक्तो मासगणोऽभ्यधिकशेषकः शुद्धः ।
घटिकादिको भचक्राद्रविरविशेषो भवेद्भादिः ॥ ३ ॥

सु. भा.—शाकः खपञ्चपञ्चोनस्त्रिधा स्थाप्यः । एको रविभिर्गुणः । द्वितीयो वसुवेदैस्तृतीयो नवचन्द्रैश्च गुणः । अधोराशिः पञ्चाब्धि ४५ युतः षष्टि-भाजितः फलं मध्यराशौ क्षेप्यम् । तत्रैव रसवेदाश्च ४६ क्षेप्याः । एवं संस्कृतो मध्यो मध्यमराशिः शशाङ्कविश्वै विभाजितोऽधिमासाः स्युः । तैरधिमासैरुपरितनो राशिर्युक्तो मासगणश्चान्द्रो भवति ।

अत्रोपपत्तिः ।

$$\text{एकस्मिन् वर्षेऽधिमासः} = \frac{१५९३३००००००}{४३२००००००००}$$

$$= \frac{५३११ \times ३००००००}{१४४०० \times ३००००००} = \frac{५३११}{१४४००} = \frac{५३११ \times १३१}{१३१ \times १४४००} = \frac{\frac{५३११ \times १३१}{१४४००}}{१३१} = \frac{४८\frac{१९}{६०}}{१३१}$$

स्वल्पान्तरात् ।

अयमिष्टैः सौरवर्षैर्गुणोऽधिमासाः स्युः । शेषोपपत्तिः स्फुटा । ४५।४६ अस्य क्षेपस्योपपत्तिर्ग्रन्थान्ते द्रष्टव्या ।

सौरवर्षचैत्राद्योर्मध्येऽधिमासशेषो मासात्मकश्चान्द्रस्तच्चालनं कल्पचान्द्रमासैः कल्पसौरमासास्तदाऽधिशेषेण किं लब्धं राश्यादि चालनमृणम् $=\frac{५१८४००००००००}{५३४३३३००००००}$
$\times\frac{\text{अधिशे}}{१३१}=\frac{१७२८०० \times ३०००००}{१७८१११ \times ३०००००}\times\frac{\text{अधिशे}}{१३१}=\frac{१७२८००}{१७८१११}\times\frac{\text{अधिशे}}{१३१}$ ।

इदं नवगुणं चतुर्भक्तं लब्धं नक्षत्रात्मकं चालनं षष्टिगुणं जातं घट्यात्मकम् ।

$$=\frac{१७२८०० \times ९ \times \text{अधिशे} \times ६०}{१७८१११ \times ४ \times १३१}=\frac{१७२८०० \times १३५ \times \text{अधिशे}}{१७८११८ \times १३१}$$

$=\frac{२३३२८००० \times \text{अधिशे}}{२३३३२५४१}=$ अधिशे । स्वल्पांतरात् ।

सौरवर्षादौ रविर्भचक्रेण नक्षत्रसप्तविंशत्या समोऽतो भचक्रादधिशेषघटीसमचालनं विशोध्य चैत्रादौ भादी रविर्ज्ञेय इति स्फुटम् ॥१-३॥

हि. भा—शाके में से ५५० घटाकर शेष को तीन जगह रखो, एक को बारह (१२) से, दूसरे को अड़तालीस (४८) से तथा तीसरे को १९ से गुणा करो।

तीसरी राशि में ४५ जोड़कर ६० से भाग दो। लब्धि को दूसरी राशि में जोड़ दो, और उसी में रसवेद (४६) जोड़ दो। इस तरह करने पर मध्यमराशि होगी। उसको शशाङ्कविश्व (१३१) से भाग देने पर अधिमास होता है। अधिमास और उपरितन राशि का योग चान्द्रमास होता है।

उपपत्ति।

$$\text{एक वर्ष में अधिमास}=\frac{१५९३३००००००}{४३२००००००००}$$

$$=\frac{५३११ \times ३०००००}{१४४०० \times ३०००००}=\frac{५३११}{१४४००}=\frac{५३११ \times १३१}{१३१ \times १४४००}$$

$$=\frac{\frac{५३११ \times १३१}{१४४००}}{१३१}=\frac{४८+\frac{१९}{६०}}{१३१}$$ स्वल्पान्तर से। इसको इष्ट सौर वर्ष से गुणने पर अधिमास होता है, शेष की उपपत्ति स्पष्ट ही है। ४५ और ४६ के क्षेपक की उपपत्ति ग्रन्थ के अन्त में देखें।

चैत्रादि सौर वर्ष में अधिमास शेष मासात्मक चान्द्र होता है उसका चालन लाने की युक्ति यथा—

कल्प चान्द्रमास में कल्प सौरमास पाते हैं तो अधिशेष में क्या इस तरह लब्धि राश्यादिक ऋण चालन $= \frac{५१८४००००००}{५३४३३३००००००} \times \frac{अधिशे}{१३१}$

$= \frac{१७२८०० \times ३०००००}{१७८१११ \times ३०००००} \times \frac{अधिशे}{१३१}$

$= \frac{१७२८००}{१७८१११} \times \frac{अधिशे}{१३१}$ । इसको ९ से गुणा कर ४ से भाग दें तो लब्धि न क्षत्रात्मक चालन होगा, उसको ६० से गुणा करने पर घटचात्मक चालन होगा, यथा—

$= \frac{१७२८०० \times ९ \times अशे \times ६०}{१७८१११ \times ४ \times १३१} = \frac{१७२८०० \times १३५ \times अधिशे}{१७८१११ \times १३१}$

$= \frac{२३३२८००० \times अधिशे}{२३३३३२५४१}$ = अधिशेष । स्वल्पान्तर से सौर वर्षादि में रविका भचक्र २७ नक्षत्र के बरावर होता है इसलिए भचक्र में से अधिक शेष घटी के तुल्य चालन को घटाने पर चैत्रादि में राश्यादि रवि होता है, यह स्पष्ट है ।१-३।

इदानीं चैत्रादौ दिनादिकं तिथिध्रुवसाधनमाह ।

रूपेण रूपरामैः खसायकैस्ताडितो गणो युक्तः ।
षड्भिर्वेदैर्धृत्या वासरघटिकाविघटिकाः स्युः ॥ ४ ॥
खखरसलब्धं च गणाद् घटिकासु नियोजयेत् तिथिध्रुवकाः ।
रव्यादिकस्तदुदये चैत्रादावर्कचन्द्रौ च ॥ ५ ॥

सु. भा.--गणो मासगणो रूपेण १ दिनेन रूपरामै—३१ घटीभिः खसायकैर्विघटीभिस्ताडितो दिनादिस्थाने क्रमेण षड्भि ६ र्वेदै —४ र्धृत्या १८ युक्तः । गणान्मासगणात् खखरसै ६०० र्यल्लब्धं घटचात्मकं फलं तद्घटिकासु नियोजयेत् तदा वासरघटिकाविघटिकाश्चैत्रादौ तिथिध्रुवकाः स्युः । वासरश्च रव्यादिको ज्ञेयस्तदुदये च चैत्रादावर्कचन्द्रौ मध्यमौ भवतः । नक्षत्रात्मको रविश्च पूर्वं साधितो दर्शान्ते चैत्रादौ तावानेव चन्द्रश्चेति ।

अत्रोपपत्तिः ।

एकस्मिन् चान्द्रमासे सावनदिनादि २९ । ३१ । ५० । ६ सप्ततष्टं जातम् =१ । ३१ । ५० । ६=१।३१+$\frac{३}{६००}$।५० । अनेन मासगणो गुणितो ग्रन्थारम्भ-क्षेपयुक्तोऽभीष्टे चैत्रादौ तिथिध्रुवो भवेदिति स्पष्टम् । क्षेपोपपत्तिर्ग्रन्थान्ते द्रष्टव्या ॥४–५॥

हि. भा.—मास समूह को १ दिन, ३१ घटी, ५० विघटी से गुणा करो। दिन स्थान में क्रम से ६, ४, १८ जोड़दो। मास समूह को ६०० से भाग देकर जो लब्धि होगी उसको घटी में जोड़दो। तब दिन, घटी, विघटी, चैत्रादि में तिथि का ध्रुवा होता है। रवि आदि दिन जानना चाहिये, उसके उदयकाल अर्थात् चैत्रादि में सूर्य तथा चन्द्रमा मध्यम होता है, नक्षत्रात्मक सूर्य को पहले साधन कर चुके हैं, अमावस्या के अन्त में चैत्रादि में उतना ही चन्द्रमा होता है।

उपपत्ति।

एक चान्द्रमास में सावन दिन=२९। ३१। ५०। ६ इसको ७ से भाग देने पर शेष=१। ३१। ५०। ६=१। ३१+$\frac{१}{६००}$। ५०। इससे मास समूह को गुणाकर उसमें ग्रन्थारम्भ काल का क्षेप जोड़ दें तो चैत्रादि में अभीष्ट तिथि ध्रुवा होगी, क्षेपक की उपपत्ति ग्रन्थान्त में देखें।

इदानीं चन्द्रकेन्द्रसाधनमाह

मासगणो यमगुणितः पृथक् कुतत्त्वोद्धृतः फलसमेतः।
सार्धाष्टयुतो वसुयमविभक्तशेषो विधोः केन्द्रम्॥ ६॥

सु. भा.—यम-२ गुणितो मासगणः पृथक् स्थाप्यः कुतत्त्व २५१ भक्तः पृथक्स्थः फलेन सहितः कार्यस्ततः सार्धाष्टयुतः। योगो वसुयमै-२८ विभक्तः शेषश्चन्द्रस्य केन्द्रं भवति।

अत्रोपपत्तिः।

एकस्मिन् चन्द्रकेन्द्रभगणे वसुयमा २८ विभागाः कृताः। तद्विभागजातीयमेव केन्द्रमत्र साध्यते।

कल्पे चन्द्रभगणाः=५७७५३३००००००

चन्द्रोच्चभगणाः=४८८१०५८५८

केन्द्रभगणाः=५७२६५१९४१४२

एते कल्पचान्द्रमासभक्ता जातमेकस्मिन् चान्द्रमासे भगणात्मकं केन्द्रम्=
$$=\frac{५७२६५१९४१४२}{५३४३३३००००००}=१+\frac{३८३१८९४१४२}{५३४३३३००००००}।$$

अत्र प्रयोजनाभावाद्भगणं त्यक्त्वा भगणशेषं वसुयमैः संगुण्य हरेण विभज्यलब्धमभीष्टभागात्मकं केन्द्रमेकस्मिन् चान्द्रमासे=$२+\frac{१०६६०८९९४\times४}{१३३५८३२५०००\times४}२+\frac{२}{२५१}$

स्वल्पान्तरात् । सार्धाष्टसंख्या ग्रन्थारम्भे क्षेपमानं तदुपपत्तिश्च ग्रन्थान्ते द्रष्टव्या अत उपपन्नं केन्द्रानयनम् ॥६॥

हि. भा.—दो से गुणित मास समूह को दो स्थान में रखो, एक स्थान में २५१ से भाग दो, लब्धि को दूसरे स्थान में जोड़ दो, फिर उसमें ८+½ जोड़ दो, उस योग में २८ से भाग दो, जो शेष होगा वह चन्द्रमा का केन्द्र होता है ।

उपपत्ति ।

एक चन्द्रभगण को २८ से विभाग करने से तत् विभागजातीय केन्द्र यहां साधन करते हैं ।

कल्प में चन्द्रभगण=५७७५३३००००० ।

चन्द्रोच्च भगण =४८८१०५८५८ ।

दोनों का अन्तर =५७२६५१९४१४२=केन्द्र भगण ।

इसमें चान्द्रमास से भाग देने पर, एक चान्द्रमास में भगणात्मक केन्द्र

$$=\frac{५७२६५१९४१४२}{५३४३३३००००००}=१+\frac{३८३१८९४१४२}{५३४३३३००००००} ।$$

यहां प्रयोजन नहीं है इसलिये भगण को छोड़कर भगण शेष को २८ से गुणाकर हार से भाग देकर लब्धि जो होगी वही अभीष्ट भागात्मक केन्द्र होगा, एक चान्द्र मास में $=२+\frac{१०९६०८९९४\times४}{१३३५८३२५०००\times४}$ $२+\frac{२}{२५१}$ स्वल्पान्तर से । ग्रन्थारम्भ काल में ८+½ क्षेप मान की उपपत्ति ग्रन्थ के अन्त में देखें । इससे केन्द्रानयन उपपन्न हुआ ।

इदानीमिष्टमासादौ रव्यानयनमाह ।

चैत्रादिमासगुणिते द्वे नक्षत्रे क्षिपेत् सहस्रांशौ ।
घटिकैकादशयुक्ते सार्धेन फलेन सहिते च ॥ ७ ॥

सु. भा.—द्वे नक्षत्रे घटिकैकादशयुक्ते सार्धेनैकेन पलेन रहिते च चैत्रादितो ये गतचान्द्रमासास्तैर्गुणिते चैत्राद्युद्भववरवौ फलं क्षिपेत् तदेष्टमासादौ नक्षत्रादिको रविर्भवेत् ।

अत्रोपपत्तिः कल्परविभगणाः=४३२०००००० । सप्तविंशतिगुणाः कल्पचान्द्रमास—५३४३३३००००० भक्ता जातमेकस्मिन् चान्द्रमासे नक्षत्रात्मकं रविमानम् $=\frac{४३२००००००\times२७}{५३४३३३००००००}=\frac{१४४००\times३०००००\times२७}{१७८१११\times३०००००}=\frac{१४४००\times२७}{१७८१११}$

$=\frac{३८८८००}{१७८१११}=२\frac{३२५७८}{१७८१११}$ शेषं षष्ट्यागुणं हरभक्तमेवं नक्षत्रादिकं रविमानम् =२।१०।५८$\frac{१}{२}$ स्वल्पान्तरात् ।

तद्रूपान्तरम् $=\frac{न}{२}$। $\frac{घ}{११}-\left(१\frac{१}{२}\right)$ प. । इदमिष्टमासगुणं तज्जो नक्षत्रादिको रविर्भवेत् । शेषोपपत्तिः स्फुटा ॥७॥

हि. भा.—दो नक्षत्रों में ११ घटी जोड़ दें, और १+$\frac{१}{२}$ पल घटादें, चैत्रादि से जो गत चान्द्रमास हो उससे गुणा दें, फल को चैत्रादि में उत्पन्न सूर्य में जोड़ दें, वह इष्ट-मासादि में नक्षत्रादिक रवि होता है ।

अत्रोपपत्तिः

एक कल्प में सूर्य भगण=४३२०००००० ।

एक कल्प में चान्द्रमास=५३४३३३०००० ।

यहां कल्प सूर्य भगण को २७ से गुणाकर कल्प चान्द्रमास से भाग देने पर एक चान्द्रमास में नक्षत्रात्मक रवि का मान

$$=\frac{४३२०००००००\times२७}{५३४३३३००००००}=\frac{१४४००\times३०००००\times२७}{१७८१११\times३०००००}$$

$$=\frac{१४४००\times२७}{१७८१११}=\frac{३८८८००}{१७८१११}=२+\frac{३२५७८}{१७८१११} ।$$

शेष को ६० से गुणाकर हर से भाग देने पर नक्षत्रादिक रवि का मान=२ । १० । ५८+$\frac{१}{२}$ स्वल्पान्तर से । इसका रूपान्तर $=\frac{न}{२}$ । $\frac{घ}{११}-\left(१+\frac{१}{२}\right)$ प, इसको इष्ट-मास से गुणाकर फल नक्षत्रादिक रवि होता है । यहां अवशेष की उपपत्ति स्पष्ट ही है ।

इदानीं प्रतिमासं शशिकेन्द्रतिथिध्रुवक्षेपावाह ।

नाड्यर्धेन समेतं भद्वितयं प्रक्षिपेच्च शशिकेन्द्रे ।
रूपं रूपहुताशाः खशराश्च तिथिध्रुवे क्रमशः ॥ ८ ॥

सु. भा.—प्रतिमासं शशिकेन्द्रे नक्षत्रद्वितयं नाड्यर्धेन सहितं तिथिध्रुवे च क्रमशो दिनादौ रूपं १ रूपहुताशाः ३१ खशराश्च ५० इति प्रक्षिपेत् ।

अत्रोपपत्तिः । ६ श्लोकेनैकस्मिन् चान्द्रमासे शशिकेन्द्रमानम् २+ $\frac{२}{२५१}$

२ न$+\frac{१}{२}$ घ स्वल्पान्तरात्। अत्रैकस्मिन् भचक्रे अष्टाविंशति नक्षत्राणि कल्पितानीति शशिकेन्द्रानयन एव प्रतिपादितम्। तिथिध्रुवक्षेपमानं च सप्ततष्टं चान्द्रमाससावनमानं दिनादि १।३१।५० स्फुटमेव। अत्राधिकं ६ विपलमानं त्यक्तं पलात्मकमानपर्यन्तमेव गणिते ग्राह्यत्वादिति स्फुटम् ॥८॥

हि. भा.—प्रति मास शशि केन्द्र में आधा नाड़ी से युक्त दो नक्षत्र युक्त करो। एवं तिथिध्रुवा में क्रम से १, ३१, ५० युक्त करो।

उपपत्ति।

६ श्लोक के अनुसार एक चान्द्रमास में चन्द्रमा का केन्द्रमान $= २ + \frac{२}{२५१}$ $= २$ न $+ \frac{१}{२}$ घ, स्वल्पान्तर से ग्रहण किया।

यहां एक भचक्र में २८ नक्षत्र की कल्पना की गई है, और चन्द्रमा का केन्द्रानयन भी कहा गया है, तिथि ध्रुव क्षेप मान को सात से शेषित करने पर चान्द्र मास सावन मान दिन १। ३१। ५० होता है, यह स्पष्ट है गणित में पलमान का ही ग्रहण होता है इसलिये यहां अधिक ६ विपलमान को छोड़ दिया है।

इदानीं प्रतिदिनचालनमाह।

वारं दद्यात् प्रतिदिनमब्धिपलोनां परित्यजेत् नाडीम्।
केन्द्रे क्षिपेद्भमेकं भद्वित्तयफलं घटीचतुष्कमिते ॥ ९ ॥

सु० भा०—प्रतिदिनं प्रतिचान्द्रदिनं तिथिध्रुवे दिनमेकं दद्याद्योजयेत्। अब्धिपलोनामेकां नाडीं च परित्यजेत्। शशिनः केन्द्रे च प्रतिचान्द्रदिनमेकं भं नक्षत्रं घटीचतुष्कमितं भूतत्त्वफलं घटीचतुष्कं भूतत्त्व २५१ हृतं फलं घट्यात्मकं च क्षिपेत्।

अत्रोपपत्तिः। त्रिंशत्तिथ्यात्मके चान्द्रमासे सावनदिनादि २९।३१।५० इदं त्रिंशद्भक्तं जातमेकस्मिन् चान्द्रदिने तिथिध्रुवे क्षेपकमानम् $= \frac{२९।३१।५०}{३०} =$ ०।५९।४ $=$ १ दि० $-$ ५६ प० $=$ १ दि० $-$ (१ घ $-$ ४प)। एवमेकस्मिन् चान्द्रमासे शशिकेन्द्रं नक्षत्रात्मकम् $=$ ३०$\frac{२}{२५१}$।

(६ सूत्रे भगणात्मकं केन्द्रं २८ संगुण्य नक्षत्रात्मकं यदि क्रियते तदा

३० $\frac{२}{२५१}$ समुत्पद्यते) इदं त्रिंशद्धृत्तं जातमेकस्मिन् चान्द्रदिने केन्द्रे क्षेपकमानम्

$=\frac{३०+\frac{२}{२५१}}{३०}=१+\frac{२}{३०\times२५१}=१+\frac{२\times६०}{३०\times२५१}$ घटी $=१$ न $+\frac{४}{२५१}$ घटी। अत उपपद्यते यथोक्तम् ।

भद्वितयेन भद्वितयमानेन १२० घटिकामितेन हृते घटीचतुष्कमिते यत्फलं घटयात्मकं तदपि क्षिपेदित्येके 'भद्वितयफलं घटीचतुष्कमिते' इति पाठानुसारेण व्याख्यां कुर्वन्ति । अनेन '२५१' स्थाने १२० इयं स्थूला सङ्ख्योत्पद्यतेऽत एव मया पाठान्तरमुपनिबद्धम् ।।६।।

हि. भा.—हर चान्द्रदिन के तिथि ध्रुवा में एक दिन युक्त करें और चार पल कम एक नाड़ी घटा दें । चन्द्रकेन्द्र में, प्रति चान्द्र दिन में से एक नक्षत्र और ४ घटी को २५१ से भाग देने पर जो फल मिले वह युक्त करना चाहिये ।

उपपत्ति ।

तीस तिथ्यात्मक चान्द्रमास में सावदिन=२९ । ३१ । ५० इसको ३० से भाग देने से एक चान्द्र दिन में—तिथिध्रुवा क्षेपमान= $\frac{२९ । ३१ । ५०}{३०}$ = ० । ५९ । ४ =

=१ दि—५६ प=१ दि—(१ घ—४ प) ।

इस तरह एक चान्द्रमास में चन्द्रकन्द्र नक्षत्रात्मक = ३० + $\frac{२}{२५१}$ । ६ श्लोक से भगणात्मक केन्द्र को २८ से गुणाकर नक्षत्रात्मक यदि करते हैं तब $(३०+\frac{२}{२५१})$ यह उपपन्न होता है। इसको तीस से भाग देने पर एक चान्द्र दिन में केन्द्र क्षेपक मान

$$=\frac{३०+\frac{२}{२५१}}{३०}=१+\frac{२}{३०\times२५१}=१+\frac{२\times६०}{३०\times२५१}\text{ घटी}$$

= १ न + $\frac{४}{२५१}$ घटी । इससे ९ श्लोक उपपन्न होता है ।

भद्वितयेन अर्थात् १२० घटी के मान से हृत चार घटी का जो फलघटयात्मक हो वह भी जोड़ दें यह किसी का मत है । दो नक्षत्र का फल चार घटी में जोड़ दें यह पाठ के अनुसार व्याख्या करते हैं, इससे २५१ की जगह १२० यह स्थूल संख्या उपपन्न होती है। इसलिये मैंने पाठान्तर कर दिया है ।

इदानीं देशान्तरसंस्कारमाह ।

उज्जयिनी याम्योत्तररेखायाः प्राग्धनं क्षयः पश्चात् ।
योजनषष्ट्या नाडी चरदलमपि सौम्यदक्षिणयोः ॥ १० ॥

सु. भा.—योजनषष्ट्यैका नाडी उज्जयिनी याम्योत्तररेखायाः प्राग्धनं पश्चात् क्षयो भवति। एवं सौम्यदक्षिणयोर्गोलयोश्चरदलं चरासवोऽपि धनं क्षयश्च क्रमेण बोध्या इति ।

अत्रोपपत्तिः । यदि स्पष्टभूपरिधियोजनैः षष्टिघटिकास्तदा देशान्तरयोजनैः किं जाता देशान्तरनाडी $=\frac{६० \text{ देयो}}{\text{स्पभूप}}$ । आचार्येण स्थूलस्पष्टभूपरिधिः $=३६००$ योजनानि गृहीतः । ततो जाता देशान्तरनाडिका $=\frac{\text{देयो}}{६०}$ । धनर्णवासना चरधनर्णवासना च गोलयुक्त्या स्फुटा ॥१०॥

हि. भा.—उज्जयिनी याम्योत्तर रेखा से षष्टि योजन पूर्व में एक नाड़ी धन तथा पश्चिम में एक नाड़ी ऋण होता है। इसी तरह उत्तर दक्षिण गोल में चरदल तथा चरासु भी क्रम से धन तथा ऋण होता है।

उपपत्ति ।

स्पष्ट भूपरिधि योजन में ६० घटी मिलता है तो देशान्तर योजन में क्या इस अनुपात से देशान्तर नाड़ी $=\frac{६० \times \text{देयो}}{\text{स्पभूप}}$ । यहां आचार्य ने स्थूल स्पष्ट भूपरिधिः ३६०० योजन स्वीकार किया है।

अतः $\frac{६० \times \text{देयो}}{३६००}$ = देशान्तर नाड़ी।

$=\frac{\text{देयो}}{६०}$ = देशान्तर नाड़ी। इसकी धन और ऋण की युक्ति गोलाध्याय में स्पष्ट है।

इदानीं चन्द्रसाधनमौदयिकरविसाधनं चाह ।

तिथयो दशभागोना रविणा समन्विता शशी भवति मध्यः ।
तिथ्यंशाढ्याः शोध्यास्तिथिभोगजनाडिकाः केन्द्रात् ॥ ११ ॥[1]

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१. तिथयो दशभागोना रविणा सहिताः शशी भवति मध्यः ।
तिथिभोगनाडिकाश्च द्विगुणोडुहृता रवेः शोध्याः ॥

सु. भा.—स्वदशभागोनास्तिथयो नक्षत्रात्मकं रविचन्द्रयोरन्तरं भवति। ता रविणा नक्षत्रात्मकसूर्येण सहिता नक्षत्रात्मको मध्यः शशी भवति। तिथिभोगनाडिका द्विगुणा उडु २७ हृताः फलं नक्षत्रघटिका भवन्ति। ता रवेः शोध्यास्तदा नक्षत्रादिको रविरुदये भवति।

अत्रोपपत्तिः। तिथौ तिथौ रविचन्द्रयोर्द्वादशभागा अन्तरमतस्तिथयो द्वादशगुणा भागात्मकं रविचन्द्रयोरन्तरम् $=$ १२ ति। चक्रांशै सप्तविंशतिर्नक्षत्राणि तदेष्टान्तरेण १२ति अनेन किम्। जातं नक्षत्रात्मकमन्तरम् $= \frac{२७ \times १२ \text{ ति}}{३६०}$

$\frac{२७ \text{ ति}}{३०} = \frac{९ \text{ ति}}{१०} = ९ - \frac{\text{ति}}{१०}$। एवं तिथ्यंते रविचन्द्रौ जातौ। तिथ्यन्तसूर्योदययोर्मध्ये तिथिभोगनाडिकास्तत्संबंधिनक्षत्रात्मकचालनेन रवौ रहित उदये रविर्भवति। तिथिभोगघटिकाश्च सावनाः प्रसिद्धाः। एकस्मिन् सावनदिने रविगतिः $=$ ५९'।८" $=$ ३५४८"। अतो नक्षत्रात्मिकागतिः $= \frac{३५४८}{६० \times ८००}$। यदि घटीषष्ट्या रवेरियं नक्षत्रात्मिका गतिस्तदा तिथिभोगघटिकाभिः किं लब्धं नक्षत्रात्मकमृणचालनं षष्टिगुणं जातं घट्यात्मकम् $= \frac{३५४८}{६० \times ८००} \times \frac{\text{भोघ} \times ६०}{६०}$

$$= \frac{३५४८}{६० \times ८००} = \frac{२ \times १७७४ \times \text{भोघ}}{४८००} = \frac{२ \text{ भोघ}}{\frac{४८००}{१७७४}} = \frac{२ \text{ भोघ}}{२७}$$ स्वल्पान्तरात्।

अत उपपन्नो मच्छोधितः पाठः ॥११॥

हि. भा.—अपने दसवें भाग से हीन तिथि नक्षत्रात्मक रविचन्द्रान्तर के बराबर होती है, उसको नक्षत्रात्मक सूर्य में जोड़ने से मध्यमचन्द्र होता है। द्विगुणित तिथिभोगक नाड़ी को २७ से भाग देने पर लब्धि नक्षत्र की घटी होती है, उस नक्षत्र घटी को रवि में घटाने से उदयकालिक नक्षत्रादिक रवि होता है।

उपपत्ति।

रवि चन्द्रमा के अन्तर को १२ से भाग देने पर एक तिथि का मान होता है— इसलिये १२ $\times$ ति $=$ अंशात्मक रविचन्द्रान्तर,

तब अनुपात से—

$$\frac{२७ \times १२ \text{ ति}}{३६०} = \text{नक्षत्रात्मक अन्तर} = \frac{२७ \text{ ति}}{३०} = \frac{९ \text{ ति}}{१०} = \text{ति} - \frac{\text{ति}}{१०}$$ ।

इस तरह तिथि के अन्त में रवि और चन्द्र हुए। तिथ्यन्त सूर्योदय के बीच तिथि भोग नाड़िका से सम्बन्धित नक्षत्रात्मक चालन को सूर्य में से घटाने से उदयकाल में सूर्य होता है। तिथि भोग घटी तो सावन होता है, यह प्रसिद्ध ही है। एक सावन दिन में रवि की गति=५९'।८"=३५४८" इस पर से नक्षत्रात्मक गति = $\frac{३५४८}{६० \times ८००}$।

यदि ६० घटी में रवि की नक्षत्रात्मक गति पाते हैं तो तिथि भोग घटिकाओं में क्या इस अनुपात से नक्षत्रात्मक ऋण चालन = $\frac{३५४८ \times भोघ}{६० \times ८००}$। इसको ६० से गुणने पर

घट्यात्मक चालन $= \frac{३५४८}{६० \times ८००} \times \frac{भोघ \times ६०}{६०} = \frac{३५४८ \times भोघ}{६० \times ८००}$

$= \frac{२ \times १७७४ \times भोघ}{४८०००} = \frac{२ \text{ भोघ}}{\frac{४८०००}{१७७४}} = \frac{२ \text{ भोघ}}{२७}$। स्वल्पान्तरसे। यहां श्री सुधाकरद्विवेदी का संशोधित पाठ उपपन्न हुआ ॥११॥

इदानीमौदयिकार्थं चन्द्रस्य तत्केन्द्रस्य च चालनमाह।

तिथिभोगनाडिकासु द्विगुणा रसगुणोद्धृताः शोध्याः।
पंचाशीत्यधिकोनास्तिथिनाड्यः शोधयेत् शशिनः ॥ १२ ॥[1]

सु. भा.—स्पष्टार्थयमार्या।

अत्रोपपत्तिः। रविचालनवदत्रापि चन्द्रगतिः=७९०'।३५"=४७४३५"।
नक्षत्रात्मिकागतिः = $\frac{४७४३५}{६० \times ८००}$।

अतो रविवन्नक्षत्रघट्यात्मकं चालनं $\frac{४७४३५ \text{ भोघ} \times ६०}{६० \times ८०० \times ६०} = \frac{४७४३५ \text{भोघ}}{६० \times ८००}$

$= \frac{९४८७ \text{ भोघ}}{१२ \times ८००} = \frac{९४८७ \text{ भोघ}}{९६००} = \text{भोघ} - \frac{११३ \text{ भोघ}}{९६००} = \text{भोघ} - \frac{\text{भोघ}}{८५}$

स्वल्पान्तरात्। एवं चन्द्रकेन्द्रगतिः=७९०'।३५"−६"।४१"=७८३'।५४"=$\frac{४७०३४}{६०}$' चक्रकलाभिरष्टाविंशतिर्नक्षत्राणि तदा चन्द्रकेन्द्रकलाभिः किम्। जाता नक्षत्रात्मिका चन्द्रगतिः $= \frac{४७०३४ \times २८}{६० \times २१६००} = \frac{४७०३४ \times ७}{६० \times ५४००} = \frac{२३५१७ \times ७}{६० \times २७००}$

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१. पञ्चाशीतिलवोनास्तिथिनाड्यस्ताश्च शोधयेच्छशिनः।
षष्ट्यंशाढ्याः शोध्यास्तिथिभोगजनाडिकाः केन्द्रात् ॥१२॥

$= \frac{२६१३\times७}{६०\times३००} = \frac{८७१\times७}{६०\times१००} = \frac{६०९७}{६०००}$ । (यतश्चकेन्द्रसाधने चक्रकलास्वष्टाविंशतिनक्षत्राणि कल्पितानि) । ततो रविवन्नक्षत्रघटयात्मकं चालनम्

$= \frac{६०९७ \text{ भोघ}\times६०}{६०००\times६०} = \frac{६०९७ \text{ भोघ}}{६०००} = \text{भोघ} + \frac{९७ \text{ भोघ}}{६०००} = \text{भोघ} + \frac{\text{भोघ}}{६२}$

स्वल्पान्तरात् । इहाचार्येण सुखार्थं ६२ स्थाने ६० गृहीता अत उपपद्यते मच्छोधितः पाठः ॥१२॥

हि. भा. – इसका अर्थ स्पष्ट ही है ।

उपपत्ति ।

यहां चन्द्रगतिः=७९०′ । ३५″ अतः विकलात्मक चंग=४७४३५″ नक्षत्रात्मकगति

$= \frac{४७४३५}{६०\times८००}$ । यहां रवि की तरह नक्षत्रघट्यात्मक चालन $= \frac{४७४३५\times\text{भोघ}\times६०}{६०\times८००\times६०}$

$= \frac{४७४३५ \text{ भोघ}}{६०\times८००} = \frac{९४८७ \text{ भोघ}}{१२\times८००} = \frac{९४८७ \text{ भोघ}}{९६००} = \text{भोघ} - \frac{११३ \text{ भोघ}}{९६००}$

$= \text{भोघ} - \frac{\text{भोघ}}{८५}$ स्वल्पान्तर से ।

इस तरह चन्द्रकेन्द्रगति=७९०′ । ३५″—६′ । ४१″=७८३ । ५४″ $= \frac{४७०३४}{६०}$

चक्र कला में २८ नक्षत्र पाते हैं तो चन्द्रकेन्द्रगतिकला में क्या इस त्रैराशिक गणित से

नक्षत्रात्मक चन्द्रकेन्द्रगति $= \frac{४७०३४\times२८}{६०\times२१६००} = \frac{४७०३४\times७}{६०\times५४००} = \frac{२३५१७\times७}{६०\times२७००}$

$= \frac{२६१३\times७}{६०\times३००} = \frac{८७१\times७}{६०\times१००} = \frac{६०९७}{६०००}$ यहां चन्द्रकेन्द्र साधन के हेतु चक्रकला में २८ नक्षत्र स्वीकार किये गये है । उससे रवि की तरह नक्षत्रात्मक चालनघटी

$= \frac{६०९७\times\text{भोघ}\times६०}{६०००\times६०} = \frac{६०९७\times\text{भोघ}}{६०००} = \text{भोघ} + \frac{९७ \text{ भोघ}}{६०००} = \text{भोघ}$

$+ \frac{\text{भोघ}}{६२}$, स्वल्पान्तर से । यहां आचार्य ने सुखार्थ ६२ के स्थानपर ६० को ग्रहण किया है ।

इससे उपपन्न होता है म. म. श्रीसुधाकर द्विवेदी जी का संशोधित प्रकार ॥

इदानीं रविचन्द्रकेन्द्राणां राशिमानमाह।

त्रिगुणं सप्तविभक्तं नगाद्रयोऽंशा रवेरुच्चम्।
विकलाष्टकसंयुक्ता नवबाणा लिप्तिका ५९।८ रवेर्भुक्तिः ॥ १३ ॥[1]

विकलाष्टकसंयुक्ता नवबाणा लिप्तिका ५९।८ रवेर्भुक्तिः।
खनवनगाः शीतांशोः पंचत्रिंशद्विलिप्ताश्च ॥ १४ ॥

स्वोच्चोनं केन्द्रमितो नवभिर्लिप्ताशतैस्ततो जीवाः।
विषमे भुक्तस्य समे भोग्यस्य सदैव केन्द्रपदे ॥ १५ ॥[1]

सु. भा.—नक्षत्रात्मकौ रविचन्द्रौ वेद ४ गुणौ नव ९ भक्तौ तदा राश्यादिकौ भवतः। चन्द्रकेन्द्रं च त्रिगुणं सप्तहृतं राश्यादि भवेत्। नवभिर्लिप्ताशतैराचार्येण षोडशार्यैयैकैका जीवा पठिता। अतः केन्द्रान्नवभिर्लिप्ताशतैस्ततो जीवाः साध्या इत्युक्तम्। विषमे केन्द्रपदे भुक्तस्य समे च सदैव भोग्यस्य जीवा कार्या। शेषं स्पष्टार्थम्।

अत्रोपपत्तिः।

यदि सप्तविंशतिनक्षत्रैर्द्वादश राशयस्तदा नक्षत्रात्मकेन रविणा वा चन्द्रेण किम्। एवं द्वादशगुणः सप्तविंशतिर्भागहारः। गुणहरौ त्रिभिरपवर्त्तितौ जातौ गुणः ४। हरश्च ९। केन्द्रराश्यानयने चक्रकलास्वष्टाविंशति नक्षत्रात्मक विभागत्वात्। यदि वसुयमै २८ नक्षत्रैर्द्वादश राशयस्तदा नक्षत्रात्मककेन्द्रेण किम्। अत्र गुणभागहारौ चतुर्भिरपवर्त्तितौ। जातो गुणः ३। हरः ७। अत उपपन्नं सर्वम्। शेष वासना चातिसरला ॥१३-१५॥

हि. भा—नक्षत्रात्मक चन्द्ररवि को ४ से गुणाकर ९ से भाग देने से राश्यादिक चन्द्र और रवि होता है। चन्द्र केन्द्र को ३ से गुणाकर ७ से भाग देने पर राश्यादि केन्द्र होता है। ९०० कला पर एक जीवा पठित है इसलिये केन्द्र से ९०० कला पर से जीवा साधन करने के लिये आचार्य ने कहा है। विषम केन्द्रपद में भुक्तांश पर से तथा समकेन्द्रपद में भोग्यांश पर से जीवा साधन करना चाहिये। शेष शब्दों का अर्थ स्पष्ट ही हैं।

उपपत्ति।

२७ नक्षत्र में बारह राशि होती हैं वहां नक्षत्रात्मक सूर्य या चन्द्र में कितनी राशियां होंगी, इस तरह यहां १२ तो गुणक और २७ भागहार होता है। गु=१२, हर=२७ यहां

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१. रविचन्द्रौ वेदगुणौ नन्दविभक्तौ गृहादिकौ केन्द्रम्।
त्रिगुणं सप्तविभक्तं नगाद्रयोऽंशा खेरुच्चम् ॥१३॥

गुण और हर को ३ से अपवर्त्तन करने पर गु=४ हर=९ । केन्द्रराशि के आनयन में चक्रकाल में नक्षत्रात्मक २८ भाग माना गया है । इसलिये अनुपात से $\frac{\text{१२ रा} \times \text{न.केन्द्रमें}}{\text{२८}}$ =तत् सम्बन्धी राशि का, यहां गुणभाग को ४ से अपवर्त्तन करने पर गुण=३ । हर =७ । इससे उपपन्न हुआ ॥१३-१५॥

इदानीं ज्याखण्डानि केन्द्रज्यासाधनं चाह ।

त्रिंशत्सनवरसेन्दुजिनतिथिविषया गृहार्धचापानाम् ।
अर्धज्याखण्डानि ज्याभुक्तैक्यं सभोग्यफलम् ॥ १६ ॥
गतभोग्यखण्डकान्तरदलविकलवधाच्छतैर्नवभिराप्तैः ।
तद्युतिदलं युतोनं भोग्यादूनाधिकं भोग्यम् ॥ १७ ॥

सु. भा.—त्रिंशत् नवभिः षड्भिरिन्दुना सहिता ३९।३६।३१ जिन २४ तिथि १५ विषया ५श्च गृहार्धचापानां पञ्चदशभागानां ज्याखण्डानि सन्ति । चापकला-नवशतैर्विभक्ता फलसंख्यासमाना ज्यार्धानामैक्यमेव ज्याभुक्तैक्यं ज्ञेयम् । शेषकला भोग्यखण्डेन गुणा नवशतैर्भक्ताः फलमेव भोग्यफलं ज्ञेयम् । ज्याभुक्तैक्यं भोग्यफलेन सहितमभीष्टज्या भवति । अत्र स्फुटाद्भोग्यखण्डाज्ज्या सूक्ष्माऽन्यया स्थूला भवति । सूक्ष्मं भोग्यखण्डं कथं सिध्यतीत्याह गतभोग्येति । गतभोग्यखण्ड-योरन्तरस्य दलमर्धं कार्यम् । तस्य विकलस्य शेषस्य च वधात् नवभिः शतैर्यानि आप्तानि तैस्तद्युतिदलं गतैष्यखण्डयोगदलं युतं कार्यं यदि तद्युतिदलं भोग्यादूनम । यदि तद्युतिदलं भोग्यादधिकं तदा तैराप्तैस्तद्युतिदलमूनं कार्यम् । क्रमज्याकरणे हीनमुत्क्रमज्या करणे युतं तद्युतिदलं कार्यं, तदैव तद्युतिदलस्य भोग्यादधिकाल्पत्वादिति । 'यातैष्ययोः खण्डकयोर्विशेषः' इत्यादि भास्करोक्तमेत-दनुरूपमेव । भास्करेण खार्क १२० मितेहाचार्येण च खतिथि - १५० मिता त्रिज्या गृहीता ।

अत्रोपपत्तिः ।

यदि ९००=प्र । ज्याप्र=३९ । चापम्=इ.प्र+शे । ज्या (इ.प्र)=ज्याग, तत्कोटिज्या च=कोज्याग ।

तदा ज्योत्पत्तिविधिना ज्याचा $= \frac{\text{ज्याग.कोज्याशे} + \text{ज्याशे.कोज्याग}}{\text{त्रि}}$ ...१

गतखण्डम् =ज्याग—ज्याग (ग—प्र)

एष्यखण्डम् =ज्या (ग+प्र)—ज्याग

तद्युतिदलम् $= \frac{\text{ज्या (ग.प्र)} - \text{ज्या (ग—प्र)}}{\text{२}} = \frac{\text{ज्या.प्र.कोज्याग}}{\text{त्रि}}$ ।

$$\text{तदन्तरदलम्} = \frac{२\,\text{ज्याग} - \{\text{ज्या}\,(\text{ग}+\text{प्र}) + \text{ज्या}\,(\text{ग}-\text{प्र})\}}{२}$$

$$= \text{ज्याग} - \frac{\text{ज्याग. कोज्याप्र}}{\text{त्रि}} = \frac{\text{ज्याग.उज्याप्र}}{\text{त्रि}}$$

$$\text{ज्याशे} = \frac{\text{ज्याप्र.शे}}{\text{प्र}}$$ स्वल्पान्तरात् ।

$$\text{कोज्याशे} = \sqrt{\text{त्रि}^{२} - \text{ज्या}^{२}\text{शे}} = \sqrt{\text{त्रि}^{२} - \frac{\text{ज्या}^{२}\text{प्र.शे}}{\text{प्र}^{२}}}$$

$$= \text{त्रि} - \frac{\text{ज्या}^{२}\text{प्र.शे}^{२}}{२\,\text{त्रि.प्र}^{२}}$$ स्वल्पान्तरात् ।

(१) समीकरणेऽनयोरुत्थापनेन—

$$\text{ज्याचा} = \frac{\text{ज्याग.}\left(\text{त्रि} - \frac{\text{ज्या}^{२}\text{प्र.शे}^{२}}{२\,\text{त्रि.प्र}^{२}}\right)}{\text{त्रि}} + \frac{\text{कोज्याग.ज्याप्र.शे}}{\text{त्रि.प्र}}$$

$$= \text{ज्याग} - \frac{\text{ज्याग.ज्या}^{२}\,\text{प्र.शे}^{२}}{२\,\text{त्रि}^{२}.\text{प्र}^{२}} + \frac{\text{कोज्याग.ज्याप्र.शे}}{\text{त्रि.प्र}}$$ अतोज्याचा—ज्याग

$$= \frac{\text{कोज्याग.ज्याप्र.शे}}{\text{त्रि.प्र}} - \frac{\text{ज्याग.ज्या}^{२}\,\text{प्र.शे}^{२}}{२\,\text{त्रि}^{२}\,\text{प्र}^{२}}$$

$$= \frac{\text{शे}}{\text{प्र}}\left(\frac{\text{कोज्याग.ज्याप}}{\text{त्रि}} - \frac{\text{ज्याग.ज्या}^{२}\,\text{प्र.प्र}^{२}.\text{शे}}{२\,\text{त्रि}^{२}.\text{प्र}^{२}}\right)$$

$$= \frac{\text{शे}}{\text{प्र}}\left(\text{युद} - \frac{\text{ज्याग.उज्याप्र.शे}}{\text{प्र}}\right)$$

$$= \frac{\text{शे}}{\text{प्र}}\left(\text{युद} - \frac{\text{अंद.शे}}{\text{प्र}}\right)$$

अत्र कोष्ठान्तर्गतसंख्या यदि भोग्यखण्डं स्फुटं कल्प्येत तर्हि ज्याचा—ज्याग $= \frac{\text{शे.स्फुभोखं}}{\text{प्र}}$ । अत इदं सूक्ष्मं भोग्यफलं ज्याभुक्तैक्ये गतज्यामिते योज्यं तदा वास्तवासन्ना सूक्ष्मज्या स्यात् । एतेन भास्करोक्तमुपपद्यते । उत्क्रमज्याकरणे भोग्यखण्डस्योपचयात् क्षयस्थाने धनं भवतीति स्फुटम् । जीवातश्चापानयने भोग्य-खण्डस्फुटीकरणं च भास्करविधिना ज्ञेयम् । तत्रैव बापूदेवशास्त्रिकृतं गौरवाननं च विचिन्त्यमिति ॥१६-१७॥

हि. भा—तीस में क्रम से ६, ६, १ युक्त करने पर ३९, ३६, ३१ हुआ । २४ । १५ । ५ यह ग्रहार्धं चाप का पञ्चदशभाग ज्याखण्ड है, चाप कला को ९०० सौ से भाग देने पर लब्धि के बराबर ज्यार्ध खण्ड के योग को ही ज्या का भुक्तैक्य जानना चाहिये । ज्याभुक्तैक्य और भोग्यफल का योग=इष्टज्या । यहां स्फुटभोग्यखण्ड से ज्या साधन सूक्ष्म होता है। अन्य प्रकार से स्थूल होता है ।

अब सूक्ष्म भोग्यखण्ड की युक्ति को कहते हैं ।

व्यतीत दो भोग्यखण्ड के अन्तर को आधा करो । उसके और शेष के गुणनफल में (९००) से भाग देने पर जो फल मिले उस को गतैष्यखण्ड के योगदल में जोड़ दो, यदि युतिदलभोग्य खण्ड से अल्प हो । यदि योगदल भोग्यखण्ड से अधिक हो तो उसे योग दल में से घटा दो । क्रमज्या प्रकार में घटावें, और उत्क्रमज्या प्रकार में जोड़ दें । 'यातैष्ययोः खण्ड-कयोर्विशेष' इत्यादि भास्करोक्त इसके अनुरूप ही है। भास्कराचार्य के मत में १२०=त्रि । आचार्य के मत में १५०=त्रिज्या ।

उपपत्ति ।

यदि ९००=प्र । ज्या.प्र=३९ । चापम्=इ.प्र+शे । ज्या (इ.प्र)=ज्यागा । इसकी कोटि=कोज्यागा ।

यहां ज्योत्पत्ति से—

$$\text{ज्याचा} = \frac{\text{ज्या.ग} \times \text{कोज्याशे} + \text{ज्याशे.कोज्याग}}{\text{त्रि}} \cdots\cdots\cdots (१)$$

$$\text{गख} = \text{ज्या} - \text{ज्या}\ (\text{ग} - \text{प्र})$$

$$\text{ऐष्यखं} = \text{ज्या}\ (\text{ग} + \text{प्र}) - \text{ज्याग}$$

दोनों का योग दल ।

$$\text{योदयो} = \frac{\text{ज्या}\ (\text{ग} + \text{प्र}) - \text{ज्या}\ (\text{ग} - \text{प्र})}{२} = \frac{\text{ज्याप्र} \times \text{कोज्याग}}{\text{त्रि}} \ ।$$

$$\text{योदअं} = \frac{२\ \text{ज्याग} - \{\text{ज्या}\ (\text{ग} + \text{प्र}) + \text{ज्या}\ (\text{ग} - \text{प्र})\}}{२}$$

$$= \text{ज्याग} - \frac{\text{ज्याग.कोज्याप्र}}{\text{त्रि}} = \frac{\text{ज्याग.उज्याप्र}}{\text{त्रि}}$$

$$\text{ज्याशे} = \frac{\text{ज्याप्र.शे}}{\text{प्र}} \ \text{स्वल्पान्तर से ।}$$

$$\text{कोज्या शे} = \sqrt{\text{त्रि}^2 - \text{ज्या}^2\text{.शे}} = \sqrt{\frac{\text{त्रि}^2 - \text{ज्या}^2\text{.प्र.शे}^2}{\text{प्र}^2}}$$

$= \left(\text{त्रि} = \frac{\text{ज्या}^2\text{प्र.शे}^2}{2\ \text{त्रि.प्र}^2} \right)$ स्वल्पान्तर से।

(१) एक समीकरण में उत्थापन देने से—

$$\text{ज्यचा} = \frac{\dfrac{\text{ज्याग}\ (\text{त्रि} - \text{ज्या}^2.\text{प्र.शे}^2}{2\ \text{त्रि.प्र}^2}}{\text{त्रि}} + \frac{\text{कोज्याग.ज्याप्र.शे}}{\text{त्रि.प्र}}$$

$$= \text{ज्याग} = - \frac{\text{ज्याग.ज्या}^2.\text{प्र.शे}^2}{\text{त्रि}^2.\text{प्र}^2} + \frac{\text{कोज्याग.ज्याप्र.शे.}}{\text{त्रि.प्र.}}$$ अतः ज्याचा—ज्याग

$$= \frac{\text{कोज्याग.ज्याप्र. शे}}{\text{त्रि.प्र}} - \frac{\text{ज्याग} \times \text{ज्या}^2\ \text{प्र.शे}^2}{2\text{त्रि}^2.\text{प्र}^2}$$

$$= \frac{\text{शे}}{\text{प्र}} \left(\frac{\text{कोज्याग. ज्या शे}}{\text{त्रि}} - \frac{\text{ज्याग.ज्या.}^2\text{प्र.प्र.}^2\text{शे}}{2\ \text{त्रि}^2.\text{प्र}^2} \right)$$

$$= \frac{\text{शे}}{\text{प्र}} \left(\text{युद} - \frac{\text{ज्याग.उज्या प्र.शे}}{\text{प्र}} \right)$$

$$= \frac{\text{शे}}{\text{प्र}} \left(\text{युद} - \frac{\text{भ्रदं.शे}}{\text{प्र}} \right)$$

यहां कोष्ठ के अन्तर्गत को यदि भोग्यखण्ड स्फुट मानते हैं तो ज्याचा—ज्याग $= \frac{\text{शे.स्फुभो.खं}}{\text{प्र}}$। इस सूक्ष्म भोगफल को गतज्या में जोड़दें तब वासवासन्न सूक्ष्मज्या होती है। इससे भास्करसूत्र उपपन्न होता है।

इदानीं रविचन्द्रयोर्मन्दफलानयनमाह।

स्वाष्टांशोना सवितुर्द्विगुणा ज्या शीतगोः फलं लिप्ताः।
स्वफलमृणं चक्रार्धादूने केन्द्रेऽधिके मध्ये॥ १८॥

सु. भा.—सवितुः सूर्यस्य केन्द्रज्या स्वाष्टांशोना। शीतगोश्चन्द्रस्य च केन्द्रज्या द्विगुणा तदा तयोः क्रमेण लिप्तात्मकं मन्दफलं भवति। केन्द्रे चक्रार्धात् षड्राशित ऊने मध्ये स्वफलं स्वमन्दफलमृणं कार्यम्। अधिके तुलादिकेन्द्रे मध्ये धनं कार्यमित्यर्थत एव सिध्यति।

अत्रोपपत्तिः ।

रविपरममन्दफलकलाः = १३०$\frac{१}{२}$ स्वल्पान्तरात् । चन्द्रस्य च ३०० कलाः । ततोऽनुपातो यदि त्रिज्यातुल्यकेन्द्रज्यया परममन्दफलकलास्तदेष्ट केन्द्रज्यया किं जाता रविमन्दफलकलाः = $\frac{१३०\frac{१}{२} \times ज्याके}{१५०}$, $\frac{(१३० \times ८ + ४)\ ज्याके}{१५० \times ८}$

= $\frac{१०४४\ ज्याके}{१५० \times ८}$ = $\frac{७\ ज्याके}{८}$ स्वल्पान्तरात् । एवं चन्द्रमन्दफलकलाः

= $\frac{३००\ ज्याके}{१५०}$ = २ ज्याके । अत उपपन्नम् ।। १८ ।।

हि. भा.—रवि की केन्द्रज्या में से अपना अष्टमांश घटा दो, और चन्द्रकेन्द्रज्या को दो से गुणा करो । दोनों का लिप्तात्मक मन्दफल होता है । केन्द्र ६ राशि में कम हो तो मन्दफल को मध्यम में से घटा दें । जहां केन्द्र दो राशि से अधिक हो वहां मन्दफल को मध्यम में जोड़ दो, यह बात मूलोक्त में स्पष्ट ही है ।

उपपत्ति ।

रविपरममन्दफलकाला = १३० + $\frac{१}{२}$ स्वल्पान्तर से चन्द्रमा का मन्दफलका = ३०० कला । तब अनुपात से—

रविमन्दफलक = $\frac{१३०\frac{१}{२} \times ज्याके}{१५०}$ = $\frac{(१३० \times ८ + ४)\ ज्या\ के}{१५० \times ८}$

= $\frac{१०४४\ ज्याके}{१५० \times ८}$ = $\frac{ज्याके\ ७}{८}$ । स्वल्पान्तर से, एवं चन्द्रमन्द फलकला = $\frac{३००ज्याके}{१५०}$

= २ ज्या के । इससे उपपन्न हुआ ।।१८।।

इदानीं रविचन्द्रयोर्गतिफलसाधनमाह ।

नगभूहृद्रविभोग्यं खण्डं चान्द्रं विवसुलवं द्विगुणम् ।
भुक्तिफलं स्वमृणं स्यात् कुलीरमकरादिके केन्द्रे ।। १९ ।।

सु. भा.—केन्द्रज्या करणे रवेर्यद्भोग्यखण्डं तन्नवभू १९ हृद्रवेर्भुक्तिफलं स्यात् । चान्द्रं चन्द्रसम्बन्धि यद्भोग्यखण्डं तद्विवसुलवं स्वाष्टांशोनं द्विगुणं च चन्द्रभुक्तिफलं स्यात् । तद्गति फलं कुलीरमकरादौ केन्द्रे क्रमेण स्वमृणं स्यात् ।

अत्रोपपत्तिः ।

प्रथमचापेन नवशतमितेन भोग्यखण्डं तदा केन्द्रगत्या किमिति लब्धमद्यत-

नश्वस्तनकेन्द्रज्ययोरन्तरं तेन या मन्दफलकलास्तदेव गतिफलम् ।

तद्यथा रवेः केन्द्रगतिः=५९′ । ८″ ॥

केन्द्रज्यान्तरम् $=\frac{(५९' । ८'') \text{ भोखं}}{९००}$ । १८ सूत्रेणानेनान्तरेण मन्दफल-कला एव रवेर्गतिफलम् $=\frac{७ (५९' । ८'') \text{ भोख}}{८ \times ९००}=\frac{७ \times ३५४८ \times \text{भोख}}{७२०० \times ६०}$

$=\frac{२४८३६ \text{ भोख}}{४३२०००}=\frac{\text{भोख}}{१७}$ स्वल्पान्तरात् ।

एवं चन्द्रस्य केन्द्रगतिः=७९०′ । ३५″−६′ । ४१″=७८३′ । ५४″=७८४′ स्वल्पान्तरात् ।

ततो गतिफलं पूर्वोक्तेन विधिना

$$=\frac{२ \times ७८४ \text{ भोख}}{९००} २+\frac{१९६ \times ४ \times \text{भोख}}{२२५ \times ४}$$

$$=२+\frac{१९६ \times ७ \times \text{भोखं}}{२२५ \times ७}=२+\frac{७ \text{ भोखं}}{\frac{१५७५}{१९६}}$$

$$=२+\frac{७ \text{ भोख}}{८} \text{ स्वल्पान्तरात् ।}$$

अत उपपन्नम् । धनर्णवासना भास्करविधिना स्फुटा ॥ १९ ॥

हि. भा.—केन्द्रज्या करण में रवि का जो भोग्यखण्ड है उसको १९ से भाग देने पर रवि का गतिफल होता है । चन्द्र सम्बन्धी भोग्य खण्ड का आठवां भाग भोग्यखण्ड में से घटाकर शेष को दो से गुणा करने पर चन्द्र का गतिफल होता है ।

उपपत्ति ।

पहलाचाप=९०० ।

अनुपात से—

$\frac{\text{भोखं} \times \text{केग}}{९००}$=कंभ्र । इस पर जो मन्दफल कला होगा वह गतिफल है ।

रवि केन्द्र ग=५९′ ८″ ।

केन्द्रज्यान्तर$=\frac{(५९' । ८'') \text{ भोखं}}{९००}$ ।

१८ सूत्र से मन्दफलकला=रविगफ$=\frac{७ (५९' । ८'') \text{ भोखं}}{८ \times ९०००}$

$= \frac{७ \times ३५४८ \times भोखं}{७२०० \times ६०} = \frac{२४८३६ \ भोखं}{४३२०००} = \frac{भोख}{१७}$ स्वल्पान्तर से। इस तरह चन्द्र की केन्द्रगति=७९०'। ३५"—६'। ४१"=७८३'। ५४"=७८४' स्वल्पान्तर से।

अतः पहली तरह गफ$= \frac{२ \times ७८४ \ भोखं}{९०००}$

$= २ + \frac{१९६ \times ४ \times भोखं}{२२५ \times ४} = २ + \frac{१९६ \times ७ \times भोखं}{२२५ \times ७}$

$= २ + \frac{७ \ भोखं}{\frac{१५७५}{१९५}} = २ + \frac{७ \ भोखं}{८}$ स्वल्पान्तर से। इससे उपपन्न हुआ।

धन तथा ऋण की युक्ति भास्कर प्रकार से स्पष्ट ही है।

इदानीं चन्द्रे भुजफलसंस्कारं तिथौ फलसंस्कारं चाह।

भांशोऽर्कफलस्येन्दौ रविवद्दद्याद्विशोधिते तथा स्वोच्चे।

रविफलमिनवच्च तिथौ चान्द्रे व्यस्तं स्फुटार्काप्तम् ॥ २० ॥

सु. भा.—इन्दौ मध्यचन्द्रेऽर्कफलस्य यो भां २७ शः स रविवद्देयः। तथा इन्दौ स्वोच्चे विशोधितेऽर्थाच्चन्द्रमन्दकेन्द्रे च स रविफलभांशो रविवद्देयः। ततः संस्कृतचन्द्रकेन्द्रात् मन्दफलमानेयं चन्द्रस्येत्यर्थः। इनवद्धनमृणं वा यथा रविमन्दफलमागतं तच्चान्द्रे चन्द्रमन्दफले व्यस्तं संस्कार्यं संस्कृतमंशात्मकं फलमर्काप्तं द्वादशभक्तं फलं तिथौ देयं तदा स्फुटं तिथिमानं भवेदिति।

अत्रोपपत्तिः।

स्फुटार्कोदयतश्चन्द्रसाधनार्थं रविभुजफलसंस्कार आनीतः। तदानयनोपपत्तिश्च 'भाप्तं च द्युमणिफलं लवे' इत्यस्य ग्रहलाघवस्य वासनायां मत्कृतोपपत्तिरवलोक्या। रव्यूनचन्द्रतस्तिथिसाधनं भवति। अतो मध्यमतिथौ रविफलोनचन्द्रफलं द्वादशभिर्विभज्य संस्कार्यम्। अतो रविफलव्यस्तसंस्कृतचन्द्रफलं द्वादशहृतमित्युपपद्यते ॥२०॥

हि. भा.—मध्यम चन्द्रमा में रविफल का २७ वां भाग रवि की तरह जोड़ दें या घटा दें। चन्द्रमा को उच्च में घटाकर जो केन्द्र हो उसमें रविफल का २७ वां भाग रवि की तरह धन या ऋण करें। तब संस्कृत चन्द्रकेन्द्र पर से चन्द्रमा का मन्द फल लाना चाहिये। सूर्य की तरह धन या ऋण जो रविफल आवे उसको चन्द्र मन्दफल में व्यस्त (उलटा) संस्कार करें। संस्कृत अंशात्मक फल को १२ से भाग दें। लब्धि को तिथि में संस्कार करने पर स्पष्ट तिथिमान होता है।

उपपत्ति ।

स्पष्टार्कोदय पर से चन्द्र साधन के लिये रवि का भुजफल संस्कार माना गया है । उस आनयन की उपपत्ति । 'भाप्तं च द्युमणिफलं' इस श्लोक का आशय सुधाकर कृत ग्रह-लाघव की युक्ति से स्पष्ट ही है । रवि में से चन्द्र घटाकर तिथि साधन होता है । इसलिये रविफलोन चन्द्रफल को बारह से भाग देकर फल को मध्यमतिथि में संस्कार करने से मूलोक्त उपपन्न होता है ।

इदानीं केन्द्रत एव तिथिसंस्कारयोग्यं घटिकात्मकं मन्दफलमाह ।

पंचेषुपंचयुगगुणयमचन्द्राश्चन्द्रकेन्द्रजफलानि ।
द्विकुभुवखरहिते······तथा सूर्ये · ···॥ २१ ॥[1]

सु. भा.—एकस्मिन् पादेऽष्टाविंशतिनक्षत्रात्मक केन्द्रसंख्या ७ तत्र प्रतिनक्षत्रं चन्द्रमन्दफलघटीभवान्यन्तरखण्डानि पञ्चेषु पञ्चेत्यादीनि । एवं सूर्ये स्वोच्चविरहिते तथैव चन्द्रकेन्द्रवत् केन्द्रे क्रियमाणे प्रतिनक्षत्रं रविमन्दफलघटीभवान्यन्तरखण्डानि द्विद्विद्वीत्यादीनि ज्ञेयानि ।

अत्रोपपत्तिः ।

एकस्मिन् चक्रे २८ चन्द्रकेन्द्रभानि पूर्वं कल्पितानि । अतो वृत्तपादे नवतिभागात्मके सप्त भानि । एकैकस्मिन् भे स्वल्पान्तरतस्त्रयोदशभागाः अतः—

भानि	=१	२	३	४	५	६	७
भागाः	=१३	२६	३९	५२	६५	७८	९०
केन्द्रज्याः	=३४	३५	९४	११७	१३५	१४६	१५०
मंदफल—							
कलाः	=६८	१३०	१८८	२३४	२७०	२९२	३००
द्वादशहृता							
घटिकाः	=५।४०	१०।५०	१५।४०	१९।३०	२२।३०	२४।२०	२५।०
अन्तराणि	=५।४०	५।१०	४।५०	३।५०	३।०	१।५०	०।४०

आचार्येणैतेषां स्थाने स्वल्पान्तरात् क्रमेणै ५।५।५।४।३।२।१ ता अन्तररूपा निरवयवघटिका गृहीताः । अत्र प्रथमस्थाने महती स्थूला तत्र वस्तुतोऽर्धाधिके रूपं

1. द्विद्विद्विद्वि कुभूखान्युच्च विरहिते तथा सूर्ये ॥२१॥

ग्राह्यमिति नियमेन षड् घटयः समुचिताः। एवं तत्केन्द्रज्यावशतः क्रमेण रविमन्द-फलकलाः 'स्वाष्टांशोना सवितु' रित्याचार्योक्तितः।

मंफक	=३०	५७	८२	१०२	११८	१२८	१३१
द्वादशहृता							
घटयः	=२।३०	४।४५	६।५०	८।३०	९।५०	१०।४०	१०।५५
अन्तराणि	=२।३०	२।१५	२।५	१।४०	१।२०	०।५०	०।१५

आचार्येणैतेषां स्थाने स्वल्पान्तरात् क्रमेणै २।२।२।२।१।१।० ता अन्तरा-त्मका निरवयवघटिकाः पठिताः ॥२१॥

हि. भा.—एक पाद में २८ नक्षत्रात्मक केन्द्र संख्या = ७, वहां प्रतिनक्षत्र चन्द्र मन्दफलघटी से प्राप्त अन्तरखण्ड 'पञ्चेषु पञ्च' इत्यादि पठित है। एवं सूर्य में सूर्योच्च घटाकर तथा चन्द्र के केन्द्र की तरह केन्द्र बनाने पर प्रतिनक्षत्र रविमन्दफल घटी से प्राप्त अन्तरखण्ड द्विद्विद्वीत्यादि के बराबर समझना चाहिये।

उपपत्ति।

एक चक्र में २८ चन्द्रकेन्द्र नक्षत्र कल्पित हैं। इसलिये वृत्त के चातुर्थांश पाद ९० अंश के सात नक्षत्र हैं। हर एक नक्षत्र में स्वल्पान्तर के १३ भाग हैं। अतः

भानि	=१	२	३	४	५	६	७
भागाः	=१३	२६	३९	५२	६५	७८	९७
केन्द्रज्या	=३४	६५	९४	११७	१३५	१४६	१५०
मन्दफलकला	=६८	१३०	१८८	२३४	२७०	२९२	३००
द्वादशहृताघटिका	=४५०	१०।५०	१५।४०	१९।३०	२२।३०	२४।२०	२५।०
अन्तराणि	=५।४०	५।१०	४।१०	३।५०	३।०	१।५०	०।४०

यहां आचार्य ने इन स्थानों में स्वल्पान्तर से अन्तररूप निरवयव घटी को क्रम से ५।५।५।४।३।२।१ ग्रहण किया है। पहले स्थान में बड़ी स्थूलता है। वस्तुतः अर्धाधिके रूपं ग्राह्य" इस नियम से ६ घटी समुचित हैं।

इस तरह केन्द्रज्या पर क्रम से 'रविमन्दफल कला। स्वाष्टांशोना' इत्यादि आचार्य की उक्ति से जानना चाहिये।

मं. फक	=३०	५७	८२	१०२	११८	१२८	१३१
द्वादशभक्त घटी	=२।३०	४।४५	६।५०	८।३०	६।५०	१०।४०	१०।५५
अन्तराणि	=२।३०	२।१५	२।५	१।४०	१।३०	०।५०	०।१५

आचार्य स्वल्पान्तर से इन सबों के स्थान पर (२।२।२।२।१।१।०) इतनी अन्तरघटी स्वीकार की है।

इदानीं तिथिसाधनमाह।

अर्कोनचन्द्रलिप्ताः रवयमस्वरभाजिताः फलं तिथयः।
गतगम्ये षष्टिगुणे भुक्तयन्तरभाजिते घटिकाः ॥ २२ ॥

सु. भा.—स्पष्टार्थम्। स्पष्टाधिकारेण स्फुटोपपत्तिश्च ॥२२॥

हि. भा.—चन्द्रकला में से रविकला को घटाकर ७२० से भाग देने से फल तिथि होती है। गत और गम्य तिथि को ६० से गुणाकर गत्यन्तर से भाग देने पर क्रम से गत और गम्य तिथि घटी होती है।

उपपत्ति।

उपपत्ति स्पष्टाधिकार में कही गई है।

इदानीं भयोगसाधनमाह।

भान्यश्विन्यादीनि ग्रहलिप्ताः खखवसूद्धृता लब्धम्।
भुक्तिहृते गतगम्ये दिवसाः षष्ट्याहते घटिकाः ॥ २३ ॥
रविचन्द्रयोगलिप्ताः खखवसुभिर्भाजिता फलं योगः।
गतगम्ये षष्टिगुणे गतयो निभाजिते घटिकाः ॥ २४ ॥

सु. भा.—स्पष्टार्थम् स्पष्टाधिकारस्य ३३ श्लोकसमा प्रथमार्या। द्वितीयार्थं तत्रैव टीका विलोक्या ॥२३-२४॥

हि. भा.—ग्रह कला को खखवसूद्धृता (८००) से भाग देने पर लब्धि अश्विन्यादि नक्षत्र होता है। गत और गम्य नक्षत्र को साठ से गुणाकर भुक्ति से भाग देने पर लब्धि क्रम से गत और गम्यघटी होती है। २४ वें श्लोक का अर्थ स्पष्ट ही है।

उपपत्ति।

यहां २३-२४ दोनों श्लोकों की युक्ति स्पष्टाधिकारोक्त ६३ श्लोकों की सु० भा० या वि०भा० देखनी चाहिये।

इदानीं करणानयनमाह।

व्यर्केन्दुकला भक्ताः खरसगुणैर्लब्धमूनमेकेन।
चरकरणानि ववादीन्यगताच्छेषात् तिथिवदन्यत् ॥ २५ ॥

सु. भा.—अगताद्भोग्यात्। शेषाद्गतात्। अन्यद् भुक्तभोग्यघटिकादिकं तिथिवत्साध्यम्। शेषं स्पष्टार्थम् ॥२५॥

हि. भा.—चन्द्रकला में से रविकला घटाकर साठ से भाग दें, लब्धि में से एक घटाकर शेष ववादिचरकरण होता है। तिथि की तरह इसकी गत और गम्य घटी का साधन करना चाहिये। और सब बातें स्पष्ट रूप से ज्ञात है।

इदानीं रव्यब्दान्ते भौमादिसाधनमाह-तत्रादौ भौमसाधनम्।

अङ्गै रुद्रैः सिद्धैर्गजैर्यमैरर्कवत्सरान् गुणयेत्।
शैलैर्विश्वैर्गुणितैरष्टवह्निभिर्योजयेद्भौमः ॥ २६ ॥

सु. भा.—अत्रोपपत्तिः। भौमभगणविकलाः कल्पसौरवर्षविहृता जातैकस्मिन् सौरवर्षे भौमविकलामितिः $=\frac{२१६०० \times ६० \times \text{भौम}}{४३२०००००००}=\frac{५० \times ६० \text{ भौम}}{१००००००००}=\frac{३ \text{ भौम}}{१००००}$

$=\frac{३ \times २२९६८२८५२२}{१००००}=\frac{६८९०४८५५६६}{१००००}=६८९०४८'' \frac{५५६६}{१००००}=६८९०४८''$

$+३३''$ स्वल्पान्तरात् $=११४८४'।८''।३३''=१९१^{\circ}।२४'।८''।३३''=\frac{\text{रा}}{६}।\quad ११^{\circ}।$
$२४'।८''।३३''$।

एते राश्याद्या इष्टसौरवर्षैर्गुणाः क्षेपयुक्ता अभीष्टसौरवर्षे राश्याद्यो भौमः स्यात्।

अत्रार्चोक्तलिखितसंख्याभिर्विलोमेन कल्पे कुजभगणाः स्वल्पान्तरात् २२९६८२६७७८ एते सिध्यन्ति।

अत्र पाठपठितभगणेभ्यः कलिगताब्देभ्य ३७२९ एभ्यो विकलात्मकः कुजः $=\frac{\text{कुभ} \times १२ + ३० \times ६० \times \text{गव}}{४३२००००००००}=\frac{\text{कुभ} \times ३ \text{ गव}}{१००००}=\frac{\text{कुभ } ११८७}{१००००}$

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१. अङ्गै ६ रुद्रैः ११ सिद्धै २४ र्गजैः ८ सुरैरर्कवत्सरान् गुणयेत्।
शैलै ७र्वसुभिः ८ कुगुणै ३१ रिभाग्निभि ३८ र्योजयेद्भौमः ॥२६॥

$= \frac{२२९६८२८५२२ \times ११८७}{१००००} = २५६९४६२०६७'' \; \frac{५६१४}{१००००} = रा_{७}।९°।२७'।४८''$

स्वल्पान्तरात् । अयं कल्यादिकुजेन $रा_{११}।२९°।३'।५०''$ अनेन युतोजातः क्षेपः=$रा_{७}।८°।$ ३१'।३८''।।२६।।

हि. भा.—व्याख्या स्पष्ट ही है, इस (अङ्गै रुद्रैः सिद्धैं) से भौम का साधन किया गया है।

उपपत्ति ।

भौम भगण विकला का कल्प सौरवर्ष से भाग देने पर एक सौर वर्ष में भौम का

$$विकला मान = \frac{२१६०० \times ६० \times भौम}{४३२००००००० }$$

$$= \frac{५० \times ६० \times भौम}{१००००००००} = \frac{३ भौम \times २२९६८२५२२}{१००००}$$

$$= \frac{६८९०४८५५६६}{१००००} = ६८९०४८'' + \frac{५५६६}{१००००}$$

=६८९०४८''+३३'' स्वल्पान्तर से ११४८४'। ८''। ३३''=१९१°। २४'। ८''। ३३'' =६ रा। ११°। २४'। ८''। ३३३'। राश्यादि भौम को इष्ट सौर रविवर्ष से गुणाकर गुणनफल में क्षेप जोड़ने से इष्ट सौर वर्ष का भौम होता हैं। आचार्योक्त लिखित संख्या के विलोम से भी कल्प में भौम भगण स्वल्पान्तर से (२२९६८२६७७८) के बराबर होता है।

यहां पाठ पठित भगण से तथा कलिगताङ्क ३७२९ इससे विकलात्मक भौम=

$$= \frac{कुभ \times १२ + ३० \times ६० \times ६० \times गप}{४३२००००००००} = \frac{कुभ \times ३ गव}{१००००}$$

$$= \frac{कुभ \times ११८७}{१००००} = \frac{२२९६८२८५२२ \times ११८७}{१००००}$$

$$= २५६९४६२०६७'' + \frac{५६१४}{१००००} = ७ रा. ९° । २७' । ४८''$$ स्वल्पान्तर से। एवं कल्पादि भौम ११ रा। २९'।३'।५०'' से युक्त क्षेप= रा ७। ८°। ३१'। ३८'' इति।

इदानीं बुधशीघ्रानयनमाह ।

शशिना जिनैः रङ्कैः षड्वह्निभिर्हताद्ब्दात् ।
शशिना द्विपैरर्यमैश्चतुरब्धिभिरन्वितं भवति बुधशीघ्रम् ॥ २७ ॥[1]

सु. भा.—अत्रोपपत्तिः ।

भौमवद्बुधशीघ्रविकलामितिरेकस्मिन् सौरवर्षे $= \frac{३ \cdot \text{बुशीभ}}{१००००}$

$= \frac{३ \times १७९३९९९८९८४}{१००००} = \frac{५३८१०९९९५२}{१००००} = ५३८१०९९'' ।\ \frac{९९५२}{१००००}$

$= ५३८१०९९'' + ४१''' = ८९६८४' । ५९'' । ४१''' = १४९४^\circ । ४४' । ५९'' । ४१''' = \text{रा}_{४९} ।$

$२४^\circ । ४४' । ५९'' । ४१''' = \text{रा}_{१} । २४^\circ । ४४' । ५९'' । ४१''' ।$

आचार्योक्तलिखितसंख्याभिर्विलोमेन कल्पे बुधशीघ्रभगणा १७९३७०३२००० एते सिध्यन्ति ।

अत्र भौमसाधनवत् कलिगताब्देभ्य३७२९ एभ्यो मध्यमाधिकारे पाठपठित-भगणेभ्यश्च विकलात्मकबुधशीघ्रम् ।

$= \frac{\text{बुभ} \times ३\ \text{गव}}{१००००} = \frac{१७९३९९९८९८४ \times १११८७}{१००००} = २००६६१२०७६३'' \quad \frac{४००८}{१००००}$

$= \text{रा}१ । १२^\circ । २६' । ३''$ अयं कल्पादिबुधशीघ्रेणानेन—

$\text{रा}_{११} । २७^\circ । २४' । २९''$

युतो जातः क्षेपः =	१ ।	९° ।	५०' ।	३२"
आचार्योक्तक्षेपः =	१ ।	८ ।	३३ ।	४४
अन्तरम् =		१	१६	४८

हि. भा.—शशिना = १, जिन = २४, अङ्क = ९, षट्वह्नि = ३६, इन अङ्कों से अब्द गण को गुणा दें, और शशिना = १, द्विप = ८, अर्यमा = ३३ चतुरब्धि = ४४, इन अङ्कों को क्रम से युक्त करें तो बुध का शीघ्र केन्द्र होता है ।

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१. शशिना १ जिनैः २४ शराब्दिभिः ४५ रङ्कै षड्वह्निभिर्हताब्दात् ।
शशिना १ द्विपैः सुरै ३३श्चतुरब्धिभि ४४ रन्वितं बुधशीघ्रम् ॥२७॥

उपपत्ति।

एक सौरवर्ष में बुधशीघ्र विकला $= \frac{३ \text{ बुशीभ}}{१००००}$

$= \frac{३ \times १७९३६९९८९८४}{१००००} = \frac{५३८१०९९६९५२}{१००००}$

$= ५३८१०९९'' + \frac{६९५२}{१००००} = ५३८१०९९'' + ४१'''$

$= ८९६८४' । ५९'' । ४१''' = १४९४^\circ । ४४' । ५९'' । ४१'''$

= ४९ रा । २४ अं । ४४ क । ५९ वि । ४१ प्र. वि ।

= १ रा । २४ अं । ४४ क । ५९ वि । ४१ प्र. वि ।

यहां आचार्योक्त संख्या के विलोम से कल्प में बुधशीभगण १७९३७०३२००० होता है। अब कलिगताब्द ३७२९ इससे और मध्यमाधिकार में पाठ पठित भगण पर से विकलात्मक बुधशीघ्रकेन्द्र—

$= \frac{\text{बुभ} \times ३ \text{ गव}}{१००००} = \frac{१७९३६९९८९८४ \times १११८७}{१००००}$

$= २००६६१२०७६३'' + \frac{४००८}{१००००} = १ \text{ रा} । १२^\circ । २६' । ३''$ इसका

और कल्पादि बुधशीघ्र का योग क्षेप होता है।

यथा $(११ \text{ रा} । २७^\circ । २४' । २९'') + (१ \text{ रा} । १२^\circ । २६' । ३'')$

$= \text{क्षेप} = १ । ९^\circ । ५०' । ३२''$ ।

आचार्योक्त क्षेप = १ । ८ । ३३ । ४४ ।

इन दोनों का अन्तर = ० । १ । १६ । ४८ । इससे उपपन्न हुआ।

इदानीं गुरोरानयनमाह।

रूपेण १ खेन० कुयमै-२१ रङ्गै-६ र्नवभिश्च करणाब्दाः।[1]
गुणिता युक्ता वेदैः कुयमैस्त्रियमैश्च भवति गुरुः॥ २८॥

सु. *भा.*—अत्रोपपत्तिः।

पूर्ववद्गुरुविकलामितिरेकस्मिन् सौरवर्षे $= \frac{३ \text{ गुभ}}{१००००} = \frac{३ \times ३६४२२६४५५}{१००००}$

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१. रूपेण १ खेन० कुयमै २१ रश्वैरङ्गैश्च करणाब्दाः।

$= \frac{१०९२६७९३६५}{१००००} = १०९२६७'' \frac{९३६५}{१००००} = १०९२६७'' + ६'''$ स्वल्पान्तरात्

$= १८२१' । ७'' । ६''' = ३०° । २१' । ७'' ६''' = रा_{१} । ०° । २१' । ७'' । ६'''$

आचार्योक्तसंख्याभिर्विलोमेन कल्पे गुरुभगणा ३६४२२०५०० एते सिध्यन्ति ।

मध्यमाधिकारे पाठपठितगुरुभगणेभ्यः कलिगताब्देभ्य ३७२९ एभ्यो भौमसाधनवद्ग्रन्थारम्भे विकलात्मको गुरुः $= \frac{गुभ \times ३ गव}{१००००}$

$= \frac{३६४२२६४५५ \times १११८७}{१००००} = ४०७४६०१३५'' \frac{२०८५}{१००००} = रा_{४} । २३° । २२' ।$

१५'' अयं कल्पादिगुरुणानेन

$रा_{११} । २९° । २७' । ३६''$

युक्तो जातः क्षेपः	=	४ । २२ । ४९ । ५१
आचार्योक्त क्षेपः	=	४ । २१ । २३ । ००
अन्तरम्	=	१ । २६ । ५१

हि. भा.—रूप=१, खेम=० । कुयम=२१ । अङ्ग=६, नव=९ इन संख्याओं से करणाब्द से गुणा दें । और क्रम से वेद=४, कुयम=२१, त्रियम=२३ युक्त कर दें तो गुरु होता है ।

उपपत्ति ।

एक सौरवर्ष में गुरु का विकला मान $= \frac{३ गुभ}{१००००} = \frac{६ \times ३६४२२६४५५}{१००००}$

$= \frac{१०९२६७९३६५}{१००००} = १०९२६७'' + \frac{९३६५}{१००००}$

$= १०९२६७'' + ६'''$ स्वल्पान्तर से ।

$१८२१' । ७'' । ६''' = ३०° । २१' । ७'' । ६'''$

$= १$ रा । ०° । २१' । ७'' । ६'' ।

यहां आचार्योक्त संख्या के विलोम से कल्प में गुरु भगण = ३६४२२०५०० ।

मध्यमाधिकारोक्त पाठ पठित भगण से तथा कलिगताब्द ३७२९ इस पर से ग्रन्थारम्भ काल में विकलात्मक गुरु $= \frac{गुभ \times ३ गव}{१००००} = \frac{३६४२२६४५५ \times १११८७}{१००००}$

$= ४०७४६०१३५'' + \frac{२०८५}{१००००} =$ ४ रा । २३° । २२' । १५" इसको कल्पादि गुरु से युक्त करने पर क्षेप=४ । २२ । ४९ । ५१ ।

आचार्योक्त क्षेप =४ । २१ । २३ । ०० ।

दोनों क्षेप का अन्तर=१ । २६ । ५१ ।

इससे उपपन्न हुआ ।

इदानीं शुक्रशीघ्रानयनमाह ।

शैलैस्तिथिभी रुद्रैर्यमविषयैः सागरैर्गुणिताः ।

वसुभिरनिलैर्जिनैः षड्गुणैश्च युक्तं भृगोः शीघ्रम् ।। २९ ।।

सु. भा.—अत्रोपपत्तिः ।

पूर्ववदेकस्मिन् सौरवर्षे शुक्रशीघ्रोच्चविकलामितिः $= \frac{३ \text{ शुशीभ}}{१००००}$

$= \frac{७०२२३८९४९२ \times ३}{१००००} = \frac{२१०६७१६८४७६}{१००००} = २१०६७१६'' \frac{८४७६}{१००००}$

=२१०६७१६"+५१‴=३५१११ । ६६" । ५१‴=५८५° ११' । ५६" । ५१‴

$=$ रा$_{१९}$ । ५१° । ११' । ५६" । ५१‴=रा$_{७}$ । १५° । ११' । ५६" । ५१‴

आचार्योक्तसंख्याभिर्विलोमेन कल्पे शुक्रशीघ्रभगणा ७०२२३७३५५६ एते सिध्यति ।

मध्यमाधिकारे पाठपठितेभ्यः शुक्रशीघ्रभगणेभ्यः कालिगताब्देभ्य ३७२९ एभ्यो भौमसाधनवद्ग्रन्थारम्भे शुक्रशीघ्रविकलामितिः $= \frac{\text{शुभ} \times ३ \text{ गव}}{१००००}$

$\frac{७०२२३८९४९२ \times १११८७}{१००००} = ७८५५९४७१२४'' \frac{७००४०}{१००००} =$ रा$_{८}$ । ७° । ३२' । ४"

अयं कल्पादिशुक्रशीघ्रेणानेन

रा$_{११}$ । २८° । ४२' । १४"

युतो जातः क्षेपः =रा$_{८}$ । ६° । १४' । १८

आचार्योक्तक्षेपः =८ । ५ । २४ । २६

अन्तरम् ० । ४९ । ४२

हि. भा.—अब्दगण को शैल=७, तिथि=१५, रुद्र = ११, यमविषय ५२। सागर=४ इन अङ्कों से गुणाकर वसु=८। अनिल=७, जिन=२४, षट्गुण=३६ इन अङ्कों को उसमें जोड़ देने पर शुक्र का शीघ्रोच्च होता है।

उपपत्ति।

एक सौरवर्ष में शुद्ध शीघ्रोच्च विकला = $\frac{\text{३ शुशीभ}}{\text{१००००}}$

$= \frac{\text{७२२२३८९४९२} \times \text{३}}{\text{१००००}} = \frac{\text{२१०६७१६८४७६}}{\text{१००००}}$

$= \text{२१०६७१६}'' + \frac{\text{८४७६}}{\text{१०००}} = \text{२१०६७१६}'' + \text{५१}'''$

= ३५१११′ । ५६″ । ५१‴ = ५८५° । ११′ । ५६″ । ५१‴ ।

= १९ रा । ५१° । ११′ । ५६″ । ५१‴ = रा ७ । १५° । ११′ । ५६″ । ५१″ ।

आचार्योक्त संख्याके विपरीत से कल्प में शीक्रशीघ्रभगण=७०२२३७३५५६ ॥

मध्यमाधिकार में कहा हुआ शुक्रशीघ्र भगण से तथा कलिगताब्द ३७२९ पर से ग्रन्थारम्भ में शुक्रशीघ्र विकलामान = $\frac{\text{शुभ} \times \text{३ गव}}{\text{१००००}} = \frac{\text{७०२२३८९४९२} \times \text{१११८७}}{\text{१००००}}$

$= \text{७८५५९४७१२४}'' + \frac{\text{७००४०}}{\text{१००००}}$ = ८ रा । ७° । ३२′ । ४″ ।

इसका और कल्पादि शुक्र शीघ्र का योग= क्षेपक =८ रा । ६° । १४′ । १८″ साधित क्षेप और आचार्योक्त क्षेप का अन्तर=अन्तर=० । ४९ । ४२ । इति

इदानीं शन्यानयनमाह।

शून्येन द्वादशभिर्द्वादशभिः खेषुभिस्त्रयोदशभिः।
गुणिता युता रसैरब्धिभिस्त्रिविषयैर्दशभिरार्किः॥ ३० ॥

सु. भा.— अत्रोपपत्तिः।

पूर्ववदेकस्मिन् सौरवर्षे शनिविकलामितिः = $\frac{\text{३ शभ}}{\text{१००००}}$

$= \frac{\text{१४६५६७२९८} \times \text{३}}{\text{१००००}} = \frac{\text{४३९७०१८९४}}{\text{१००००}} = \text{४३९७०}'' \; \frac{\text{१८९४}}{\text{१००००}} = \text{४३९७०}''$

+११‴=७३२′ । ५०″ । ११‴=१२° । १२′ । ५०″ । ११‴=रा । १२° । १२′ ।

५०″ । ११‴

आचार्योक्तसंख्याभिर्विलोमेन कल्पे शनिभगणा १४६५६७३८९ एते सिध्यन्ति । ग्रन्थारम्भे कलिगताब्दाः=३१७९+५५०=३७२९ एभ्यः शनिर्विकलात्मकः = $\frac{१४६५६७३८९ \times १२ \times ३० \times ६० \times ६० \times ३७२९}{४३२००००००००}$

$= \frac{१४६५६७३८९ \times ३ \times ३७२९}{१००००} = \frac{१४६५६७३८९ \times १११८७}{१००००} = १६३९६४६३८'' \frac{७४३}{१००००}$ $= २७३२७४८' । ५८'' = ४५५४५^{\circ} । ४८' । ५८'' = रा_{१५१८} । ५^{\circ} । ४८' ।$ $५८'' = रा_{६} । ५^{\circ} । ४८' । ५८''$ अयं

कल्पादिशनिना $रा_{११} । २८^{\circ} । ४६' । ३४''$

युतो जातो ग्रन्थादौ क्षेपकः $= रा_{६} । ४^{\circ} । ३४' । ३२''$

आचार्योक्तः $= ६ । ४ । ५३ । १०$

अंतरम् $= + \; १७' । ३८$ ॥ ३० ॥

हि. भा.—शून्येन=०, द्वादश=१२, द्वादश=१२, खेषुभिः=५०, त्रयोदश=१३ इन अङ्कों से अब्दगण को गुणाकर उसमें क्रम से रस=६, अब्धि=४, त्रिविषय=५३, दश=१०, इन सबों को जोड़ने पर शनि होता है ।

उपपत्ति ।

एक सौरवर्ष में शनि विकलामान $= \frac{३ \text{ शभ}}{१००००} = \frac{१४६५६७२९८ \times ३}{१००००}$

$= \frac{४३९७०१८९४}{१००००} = ४३९७०'' + \frac{१८९४}{१००००} = ४३९७०'' + ११'''$

$= ७३२'' । ५०'' । ११''' = १२^{\circ} । १२' । ५०'' । ११'''$

$= रा० । १२^{\circ} । १२' । ५०'' । ११'''$ ।

यहां आचार्य कथित संख्या के विलोम से कल्प में शनिभगण=१४६५६७३८९।

ग्रन्थारम्भ में कलिगतवर्ष=३१७९+५५०=३७२९ इस पर से विकलात्मकशनि

$= \frac{१४६५६७३८९ \times १२ \times ३० \times ६० \times ६० \times ३७२९}{४३२००००००००} = \frac{१४६५७३८९ \times ३ \times ३७२९}{१००००}$

$=\frac{१४६५७३८६\times ११११८७}{१००००}=१६३६६४६३८''+\frac{७४३}{१००००}$

$=२७३२७४८' । ५८''=४५५४५^\circ । ४८' । ५८''=१५१८$ रा । $५^\circ । ४८' । ५८''$

$=६$ रा । $५^\circ । ४८' । ५८''$ इसको कल्पादि शनि में युक्त करने पर ग्रन्थादि में

क्षेप $=६$ रा । $४^\circ । ३५' । ३२''$

आचार्य कथित क्षेप $=६ । ४ । ५३ । १०$

इन दोनों का अन्तर $=$ अं $=० । ० । १७' । ३८ ।$

इससे उपपन्न हुआ ।

इदानीं राहोरानयनमाह ।

गगनेन नवचन्द्रैः कुयमैः रसाब्धिभिः संवरेण हृताः ।
रुद्रैः खवेदैर्युक्ता राश्यादिकः पातः ॥ ३१ ॥[1]

सु. भा. अत्रोपपत्तिः ।

पूर्ववदेकस्मिन् सौरवर्षे चन्द्रपातविकलामितिः $=\frac{३ \text{ पाभ}}{१००००}$

$=\frac{२३२३१११६८\times ३}{१००००}=\frac{६९६९३३५०४}{१००००}=६९६९३''\ \frac{३५०४}{१००००}=६९६९३''+२१'''$

$=११६१' । ३३'' । २१'''=१९^\circ । २१' । ३३'' । २१'''=०$ रा । $१९^\circ । २१' । ३३'' ।$

$२१'''$ आर्यभटानुसारेण $\frac{३ \text{ पाभ}}{१००००}=\frac{२३२२२६००० \times ३}{१००००}=\frac{६९६६७८०००}{१००००}$

$=६९६६७''\ \frac{८०००}{१००००}$

$=६९६६७''+४८'''=११६१' । ७'' । ४८'''$

$=१९^\circ । २१' । ७'' । ४८'''=०$ रा । $१९^\circ । २१' । ७'' । ४८'''$

अत्रापि भौमसाधनवद् ग्रन्थारम्भे कलिगताब्दतः पातविकलाः $=\frac{\text{पाभ} \times \text{इगव}}{१००००}$

$=\frac{२३२३१११६८\times ११११८७}{१००००}=२५८८८६५०३''\ \frac{६४१६}{१००००}=६$ रा । $१०^\circ । ४१' ।$

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१. गगनेन नन्दचन्द्रैः कुयमैः रसाग्निभिरम्बरेण हताः ।
रुद्रैर्विश्वखवेदैर्युक्ता राश्यादिकः पातः ॥ ३१ ॥

अयं कल्पादिपातेनानेन —

$$\underset{५}{\text{रा}} \mid ३^\circ \mid १२' \mid ५८''$$

युतो जातः क्षेपः $= \underset{११}{\text{रा}} \mid १३^\circ \mid ५४' \mid ४१''$

आचार्योक्तक्षेपः ११ । १२ । ३० । ००

अन्तरम् = १४ । ४१ ॥ ३१ ॥

हि. भा.—गगनेन =०, नवचन्द्रैः = १६, कुयमै=२१, रसाब्धि=४६, संवरेण =०, इन सबों से गताब्द को गुणाकर और उसमें रुद्र=११, खवेद=४०, जोड़ दें तो राश्यादिक पात होता है ।

उपपत्ति ।

एक सौरवर्ष में चन्द्रपात विकलामान $= \frac{३ \text{ पाभ}}{१००००}$

$= \frac{२३२३१११६८ \times ३}{१००००} = \frac{६९६९३३५०४}{१००००} = ६९६९३'' + \frac{३५०४}{१००००}$

$= ६९६९३'' + २१''' = ११६१' \mid ३३'' \mid २१''' = १९^\circ \mid २१' \mid ३३'' \mid २१'''$

$= ० \text{ रा} \mid १९^\circ \mid २१' \mid ३३'' \mid २१'''$

आर्यभट के मत से पातविकला $= \frac{३ \text{ पाभ}}{१००००} = \frac{२३२२२६००० \times ३}{१००००}$

$= \frac{६९६६७८०००}{१०००} = ६९६६७'' + \frac{८०००}{१००००} = ६९६६७'' + ४८''$

$= ११६१' \mid ७'' \mid ४८''' = १९^\circ \mid २६' \mid ७'' \mid ४८''' = \text{रा}० \mid १९^\circ \mid २१' \mid १७'' \mid ४८'''$

यहां कलिगताब्द से पातविकला $= \frac{\text{पाभ} \times ३ \text{ गव}}{१००००}$

$= \frac{२३२३१११६८ \times १११८७}{१००००} = २५९८८६५०३'' + \frac{६४१६}{१००००}$

$= ६ \text{ रा} \mid १०^\circ \mid ४१' \mid ४३''$ इसको कल्पादि पात में जोड़कर

क्षेप $= ११ \text{ रा} \mid १३^\circ \mid ५४' \mid ४१''$

आचार्योक्त क्षेप $= ११ \mid १३ \mid ४० \mid ००$

इन दोनों का अन्तर = अन्तर =०० । ० । १४ । ४१ । इससे उपपन्न हुआ ।

इदानीं ग्रहानयने विशेषमाह ।

सर्वाणि स्थानानि क्रमतः स्वहरैर्नयेदुपरि ।
एवं रव्यब्दान्ते ग्रहध्रुवा मध्यमाः स्युस्ते ।। ३२ ।।

सु. भा.—सर्वाणि राश्यादीनि स्थानानि क्रमतः स्वहरैरुपरि नयेत् । प्रतिविकलाः षष्टिहृताः फलं विकलासु योज्यम् । विकलाः षष्टिहृताः फलं कलासु योज्यम् एवं स्वहरैरुपरि नयेदित्यर्थः । शेषं स्पष्टार्थम् ।। ३२ ।।

ग्रहानयन में विशेष कहते हैं—

हि. भा.—सब राश्यादि स्थान को अपने अपने भाग हार के ऊपर लावें । प्रतिविकला को ६० से भाग देकर विकला में जोड़ दें । विकला को ६० से भाग देकर लब्धि कला में जोड़ दें । कला को ६० से भाग देकर अंश में जोड़ दें । इस तरह राश्यादि को लावें । शेष का अर्थ स्पष्ट ही है ।

इदानीं प्रकारान्तरेण भौमादीनाह तत्रादौ भौमानयनमाह ।

पृथगर्को दशगुणितो वसुशरचन्द्रैर्हृतः फलेन युतः ।
दलितो भौमध्रुवके क्षेप्यः स्यान्मध्यमो भौमः ।। ३३ ।।

सु. भा.—स्पष्टार्थम् ।

अत्रोपपत्तिः ।

कल्पे रविभगणाः=४३२००००००० ।

भौमभगणाः २२९६८२८५२२ ।

अनयोर्निष्पत्तिः—$\frac{२२९६८२८५२२}{४३२००००००}=\frac{११४८४१४२६१\times२}{२१६००००००\times२}=\frac{११४८४१४२६१}{२१६००००००}$

$$=\cfrac{१}{१+\cfrac{१}{१+\cfrac{१}{७+\cfrac{१}{२+\cfrac{१}{१+\cfrac{१}{१+\cfrac{१}{५+\cfrac{८९६६३८}{४७२६६१९}}}}}}}}$$

अस्मादासन्नमानानि

$\frac{१}{१}$, $\frac{१}{२}$, $\frac{८}{१५}$, $\frac{१७}{३२}$, $\frac{२५}{४७}$, $\frac{४२}{७९}$, $\frac{२३५}{४४२}$,......आचार्येणेद $\frac{२३५}{४४२}$ मासन्नं गृहीतम् । अनेनार्को गुण्यो भौमः स्यादतो भौमः $=\frac{२३५}{४४१}\times$ रवि $=\frac{१}{२}$ रवि $\times\frac{२३५}{२२१}=\frac{१}{२}$ रवि $(१+\frac{१४}{२२१})=\frac{१}{२}$ रवि $\left(\frac{१}{२}+\frac{१०\times१०}{२२१०}\right)=\frac{१}{२}$ रवि $(१+\frac{१०}{१५८})$ स्वल्पान्तरात् ।

अत उपपन्नम् । शेषवासना सुगमा ॥ ३३ ॥

अब प्रकारान्तर से भौमादिक ग्रहों का आनयन करते हैं ।

हि. भा.—सूर्य को दो जगह रखें, एक जगह १० से गुणा दें, और वसुशरचन्द्र (१५८) से भाग दें, लब्धि को प्रथम स्थान में जोड़ दें, उसका आधार करें। भौम का ध्रुवा उसमें जोड़ दें तो मध्यम भौम होता है ।

उपपत्ति ।

कल्प में रविभगण $=४३२०००००००$ ।

कल्प में भौमभगण $=२२९६८२८५२२$ ।

दोनों का सम्बन्ध $=\frac{२२९६८२८५२२}{४३२०००००००}$

$$=\frac{११४८४१४२६१\times२}{२१६०००००००\times२}=\frac{११४८४१४२६१}{२१६०००००००}$$

$$=\cfrac{१}{१+\cfrac{१}{१+\cfrac{१}{७+\cfrac{१}{२+\cfrac{१}{१+\cfrac{१}{१+\cfrac{१}{५+\cfrac{८९६६३८}{४७२६६१९}}}}}}}}$$

इससे आसन्न मानें $= \frac{१}{१}, \frac{१}{२}, \frac{८}{१५}, \frac{१७}{३२}, \frac{२५}{४७}, \frac{४२}{७९}, \frac{२३५}{४४२}, \ldots\ldots\ldots\ldots$ यहां आचार्य ने $\frac{२३५}{४४२}$ ग्रहण किया। $\left(\frac{२३५}{४४२}\right)$ इससे रवि को गुणने पर भौम होता है।

$$भौम = \frac{२३५}{४४२} \times रवि = \frac{१}{२} रवि \times \frac{२३५}{२२१}$$

$$= \frac{१}{२} रवि \left(१ + \frac{१४}{२२१}\right) = \frac{१}{२} रवि \left(१ + \frac{१४ \times १०}{२२१०}\right)$$

$= \frac{१}{२}$ रवि $\left(१ + \frac{१०}{१५८}\right)$ स्वल्पान्तर से। इससे उपपन्न हुआ। बाकी की उपपत्ति स्पष्ट ही है।

इदानीं बुधानयनमाह।

चतुराहतोऽब्धिगुणितः पृथक् च सप्ताहतोऽब्धिधृतिभक्तः।
फलसंयुतो विधेयो ज्ञचलध्रुवको ज्ञशीघ्रं स्यात् ॥ ३४ ॥

सु. भा. – स्पष्टार्थम्।

अत्रोपपत्तिः।

कल्पबुधशीघ्रभगणाः = १७९३६९९८९८४

रविभगणाः = ४३२००००००

$$तयोर्निष्पत्तिः = ४ + \frac{६५६९९८९८४}{४३२००००००}$$

$$अथ \frac{६५६९९८९८४}{४३२००००००} = \frac{१६४२४९७४६ \times ४}{१०८०००००० \times ४}$$

$$= \frac{८२१२४८७३ \times २ \times ४}{५४०००००० \times २ \times ४} = \frac{८२१२४८७३}{५४००००००}$$

$$= \cfrac{१}{६ + \cfrac{१}{+१ \cfrac{१}{१ + \cfrac{१}{२ + \cfrac{१}{१ + \cfrac{१}{४ + \cfrac{१}{२ + \frac{६०९६०}{१०९७४४१}}}}}}}}$$

अत आसन्नमानानि $\frac{१}{६}$, $\frac{१}{७}$, $\frac{२}{१३}$, $\frac{५}{३३}$, $\frac{७}{४६}$, $\frac{७}{४६}$ = इदमाचार्येण गृहीतम् ।

ततो निष्पत्तिमानम् $= ४+\frac{७+४}{१८४}$ अनेन रविगुणो बुधशीघ्रमानम्

$$=४र+\frac{७\times४र}{१८४}$$ ।

शेषवासना चातिसुगमा ।। ३४ ।।

अब बुध का आनयन करते है ।

हि. भा.—रवि को चार से गुणा करें, उसमें चार से गुणित सात को एक सौ चौराशी से भाग देकर फल जो हो उसको जोड़ दो और बुध का चलध्रुवा जोड़ दें तो बुध का शीघ्रकेन्द्र होता है ।

उपपत्ति ।

कल्प में बुधशीघ्र भगण = १७९३६९९९८९८४

रविभगण = ४३२०००००००० ।

दोनों का सम्बन्ध $= ४+\frac{६५६९६९८९८४}{४३२००००००००}$

अथ $\frac{६५६९६९८९८४}{४३२००००००००}=\frac{१६४२४२४७४६\times४}{१०८००००००००\times४}$

$$=\frac{८२१२१२३७३\times२\times४}{५४०००००००\times२\times४}=\frac{८२१२४८७३}{५४०००००००}$$

$$\cfrac{१}{\cfrac{१}{६+\cfrac{१}{१+\cfrac{१}{१+\cfrac{१}{२+\cfrac{१}{१}}}}}}$$

$$१+\cfrac{१}{\cfrac{१}{४+\cfrac{१}{\cfrac{१}{२+\cfrac{६०९६०}{१०९७४४१}}}}}$$

यहां आसन्न मानें $=\frac{\text{१}}{\text{६}}, \frac{\text{१}}{\text{७}}, \frac{\text{२}}{\text{१३}}, \frac{\text{५}}{\text{३२}}, \frac{\text{७}}{\text{४५}}, \cdots\cdots\cdots$

$\frac{\text{७}}{\text{४५}} = \frac{\text{२८}}{\text{१८४}}$ यह आचार्य ने स्वीकार किया है।

इसलिये निष्पत्तिमान $=\text{४}+\frac{\text{७}\times\text{४}}{\text{१८४}}$

इससे रवि को गुणने पर—

$$\text{बुधशीघ्रमानम्}=\text{४ र}+\frac{\text{७}\times\text{४}\times\text{र}}{\text{१८४}}$$

इससे उपपन्न हुआ।

इदानीं गुरुशनिराह्वानयनमाह।

सप्तहतस्त्रिवसुहृतो गुरुः शनिर्द्विगुणितो नवेषु हृतः।
दिग्गुणितो रसधृतिहृत् राहोर्लिप्तासुक्तलिप्तः॥ ३५॥

सु. भा.—अत्रोपपत्तिः।

$$\text{पूर्ववत्}\ \frac{\text{गुभ}}{\text{रभ}}=\frac{\text{३६४२२६४५५}}{\text{४३२००००००००}}$$

$$=\cfrac{\text{१}}{\text{११}+\cfrac{\text{१}}{\text{१}+\cfrac{\text{१}}{\text{६}+\cfrac{\text{१}}{\text{५}+\cfrac{\text{४६९६२८५}}{\text{९२०४२३५}}}}}}$$

अत आसन्नमानानि $\frac{\text{१}}{\text{११}}, \frac{\text{१}}{\text{१२}}, \frac{\text{७}}{\text{८३}}\cdots\cdots$

$\frac{\text{७}}{\text{८३}}$ इदमाचार्येण गृहीतम्।

$$\frac{\text{शभ}}{\text{रभ}}=\frac{\text{१४६५६७२९८}}{\text{४३२००००००००}}=\cfrac{\text{१}}{\text{२९}+\cfrac{\text{१}}{\text{२}+\cfrac{\text{७४७०५८२}}{\text{६९५४८३५८}}}}$$

अत आसन्नमानानि, $\frac{\text{१}}{\text{२९}}, \frac{\text{२}}{\text{५९}}\cdots\cdots$

$\frac{\text{२}}{\text{५९}}$ इदमाचार्येण गृहीतम्।

एवं । $\frac{\text{चं. पाभ}}{\text{रभ}} = \frac{२३२३१११६८}{४३२००००००००} = \cfrac{१}{१८ + \cfrac{१}{१ + \cfrac{१}{१ + \cfrac{१}{२ + \frac{४९३८६२४}{४४४८६७८४}}}}}$

अत आसन्नमानानि

$\frac{१}{१८}, \frac{१}{१९}, \frac{२}{३७}, \frac{५}{९३} \cdots\cdots \frac{५}{९३} = \frac{१०}{१८६}$ इदामाचार्येण गृहीतम् । अत उपपद्यते सर्वम् ॥ ३५ ॥

अब गुरु शनि और राहु का साधन करते हैं ।

हि. भा.—रवि को सात से गुणाकर ८३ से भाग देने पर गुरु होता है । दो से गुणाकर ५९ से भाग देने पर शनि होता है । दश से गुणाकर रसघृति (१८६) से भाग देने पर राहु (पात) होता है ।

उपपत्ति ।

पूर्व की तरह $\frac{\text{गुभ}}{\text{रभ}} = \frac{३६४२२६४५५}{४३२००००००००}$

$$= \cfrac{१}{११ + \cfrac{१}{१ + \cfrac{१}{६ + \cfrac{१}{५ + \frac{४६९६२८५}{९२०४२३५}}}}}$$

इस पर से आसन्नमान $= \frac{१}{११}, \frac{१}{१२}, \frac{७}{८३} \cdots\cdots\cdots$

परन्तु $\frac{७}{८३}$ को आचार्य ने ग्रहण किया है ।

एवम्—

$$\frac{शभ}{रभ} = \frac{१४६५६७२९८}{४३२००००००००}$$

$$= \cfrac{१}{२९ + \cfrac{१}{२ + \cfrac{७४७०५८२}{६९५४८३५८}}}$$

इससे आसन्नमान $= \frac{१}{२९}, \frac{२}{५९}$ ....

यहां $\frac{२}{५९}$ आचार्य ने ग्रहण किया है।

$$एवम् \frac{चंपाभ}{रभ} = \frac{२३२३१११६८}{४३२००००००००} = \cfrac{१}{१८ + \cfrac{१}{१ + \cfrac{१}{१ + \cfrac{१}{२ + \cfrac{४६३८६२४}{४४४८६७८४}}}}}$$

इससे आसन्नमान $\frac{१}{१८}, \frac{१}{१९}, \frac{२}{३७}, \frac{५}{९३}$, ... । $\frac{५}{९३} = \frac{१०}{१८६}$ इसको आचार्य ने ग्रहण किया। इससे (३५) श्लोक उपपन्न हुआ।

इदानीं शुक्रचलानयनमन्येषां चलं चाह।

त्रिगुणो दलितः स्वद्वादशांशयुक्तः सितचलं ध्रुवं स्यात्।
तात्कालिकं चलं स्याद्रविरन्येषां ज्ञशुक्रौ स्तः ॥ ३६ ॥

सु. भा.—अन्येषां भौमगुरुशनीनां रविरेव तात्कालिकं चलं शीघ्रोच्चमस्ति। तथा रविरेव मध्यमौ ज्ञशुक्रौ स्तः। शेषं स्पष्टम्।

अत्रोपपत्तिः।

$$पूर्ववत् \frac{शुशीभ}{रभ} = \frac{७०२२३८९४९२}{४३२००००००००}$$

$$=१+\cfrac{१}{१+\cfrac{१}{१+\cfrac{१}{१+\cfrac{१}{२+\frac{१९११५९३६}{५३२८३१५२४}}}}}$$

अत आसन्नमानानि

$\frac{१}{१}, \frac{२}{१}, \frac{३}{२}, \frac{६}{३}, \frac{१३}{८}$ ...... । $\frac{१३}{८}=\frac{१३\times३}{८\times३}=\frac{३९}{२४}=\frac{३६}{२४}+\frac{३}{२४}=\frac{३}{२}+\frac{३}{२\times१२}$

इदमाचार्येण गृहीतम् । ततो जातं सितचलम् $=र\left(\frac{३}{२}+\frac{३}{२\times१२}\right)=\frac{३र}{२}+\frac{३र}{२}\cdot$

$\frac{र}{२४}$ अत उपपन्नं सितचलानयनम् ।

शेषवासना स्फुटा ॥ ३६ ॥

अब शुक्र तथा अन्य ग्रहों का चलध्रुवानय करते हैं ।

हि. भा.—रवि को तीन से गुण दें, उसका आधा करें उसमें त्रिगुणित रवि का बारहवां भाग जोड़ने से शुक्र का शीघ्रोच्च होता है। अन्य ग्रह (भौम-गुरु-शनि) का रवि ही तात्कालिक चल शीघ्रोच्च होता है। रवि ही मध्यम शुक्र और भौम होता है।

उपपत्ति ।

पूर्वयुक्ति से $\frac{शुशीभ}{रभ}=\frac{७०२२३८९४९२}{४३२०००१०००}$

$$=१+\cfrac{१}{१+\cfrac{१}{१+\cfrac{१}{१+\cfrac{१}{२+\frac{१९११५९३६}{५३२८३१५२४}}}}}।$$

इससे आसन्नमान $=\frac{१}{१}, \frac{२}{१}, \frac{३}{२}, \frac{५}{३}, \frac{१३}{८}$, ... ।

$\frac{१३}{८} = \frac{१३ \times ३}{८ \times ३} = \frac{३९}{२४} = \frac{३६}{२४} + \frac{३}{२४} = \left(\frac{३}{२} + \frac{३}{८ \times ३} \right)$ इसको

आचार्य ने ग्रहण किया। अतः शुक्र का शीघ्रोच्च $= र\left(\frac{३}{२} + \frac{३}{२ \times १२} \right)$

$= \frac{र \times ३}{२} + \frac{३र}{२} \times \frac{१}{१२}$ इससे शुक्र शीघ्रोच्च उपपन्न हुआ। बाकी की युक्ति स्पष्ट ही है ॥

इदानीं भौमादीनां मन्दोच्चांशानाह।

मन्दांशा नगरवयो भयमाः खनगेन्दवः खनन्दाश्च।
यमतत्त्वानि तदूनान्मध्याज्ज्या सूर्यवत् ग्राह्या ॥ ३७ ॥

सु.भा.—भौमादीनां मन्दांशा मन्दोच्चांशाः क्रमेश १२७°। २२७°। १७०°। ९०°। २५२°। एते सन्ति। तदूनान्मध्याद्ग्रहात् सूर्यवज्ज्या ग्राह्या। मन्दोच्चेन हीनो मध्यो मन्दकेन्द्रम्। सूर्यकेन्द्रवत् तस्य गतगम्यस्य ज्या केन्द्रभुजज्या ग्राह्येत्यर्थः।

अत्रोपपत्तिः।

मन्दोच्चानामल्पगतित्वात् सुखार्थं बहुकालोपयोगित्वात् स्वसमये स्थिरांशाः पठिताः। शेषवासना चातिसुगमा ॥ ३७ ॥

अब भौमादि ग्रहों के मन्दोच्चांश को कहते हैं।

हि. भा.—भौमादि ग्रहों का मन्दोच्चांश क्रम से पठित है यथा भौमका १२७°। बुध का २२७°। गुरु का १७०°। शुक्र का ९०°। शनि का २२५°। इसको मध्यमग्रह में घटा कर सूर्य की तरह ज्या ग्रहण करें। मन्दोच्च मध्यमग्रह में घटाने से शेष मन्द केन्द्र होता हैं। सूर्य केन्द्र की तरह उसकी (गतगम्य की) ज्या तथा केन्द्रभुजज्या को ग्रहण करें ॥

उपपत्ति।

मन्दोच्च की गति अल्प है, बहुत समय में जाना जाता है इसलिये सुखार्थं उसका स्थिरांश पठित कर दिया गया है।

इदानीं भौमादीनां मन्दफलानयनमाह

रदगुणिता सप्तहृता कुजस्य सौम्यस्य नागगुणा त्रिहृता।
द्विगुणा हि फलं सूरेर्द्विगुणाग्निविभाजिता स्फुजितः ॥ ३८ ॥

त्रिगुणा त्रिंशद्भक्ता रविजस्य फलस्य मन्दफललिप्ताः ।
मन्दफलयुतोनं स्वशीघ्रोच्चाच्छोधयेन्मध्यम् ॥ ३६ ॥

सु. भा.—स्पष्टाधिकारोक्तमन्दपरिधिना भौमादीनां स्वल्पान्तरात् परममंदफल कलाः । भौ=६७०′ । बु=३६२′ । गु=३१४′ । शु=१०५′ । श=४७६′ ।

ततो यदि त्रिज्यया परममन्दफलकलास्तदा केन्द्रज्यया किम् । जाता मन्द फलकलाः, भौ $=\frac{६७० \text{ ज्याके}}{१५०}=\frac{६७ \text{ ज्याके}}{१५}\ \frac{६७\times ३२ \text{ ज्याके}}{१५\times ३२}$

$=\frac{६७\times ३२}{४८०}=\frac{३२ \text{ ज्याके}}{\frac{४८०}{६७}}=\frac{३२ \text{ ज्याके}}{७}$ स्वल्पान्तरात् ।

बु $=\frac{३६२ \text{ ज्याके}}{१५०}=\frac{७ \text{ ज्याके}}{३}$ स्वल्पान्तरात् ।

गु $=\frac{३१४ \text{ ज्याके}}{१५०}=$ २ ज्याके स्वल्पान्तरात् ।

शु $=\frac{१०५ \text{ ज्याके}}{१५०}=\frac{२ \text{ ज्याके}}{३}$ ।

श $=\frac{४७६ \text{ ज्याके}}{}=$ ३ ज्याके $+\frac{२६ \text{ ज्याके}}{१५०}$

$=$ ३ ज्याके $+\frac{\text{ज्याके}}{६}$ स्वल्पान्तरात् ॥३८-३९॥

अब भौमादि ग्रहों का मन्दफलानयन करते हैं ।

हि. भा.—केन्द्रज्या को रद (३२) से गुणाकर सप्त (७) सात से भाग देने पर भौम की मन्दफलकला होती है । केन्द्रज्या को नग (सात) से गुणाकर तीन से भाग देने पर बुध की मन्दफलकला होती है । द्विगुणित को केन्द्र के गुरु की मन्दफल कला होती है । द्विगुणित केन्द्रज्या को तीन से भाग देने पर शुक्र की मन्दफलकला होती है । केन्द्रज्या को तीन से गुणाकर तीस से भाग देने पर शनि की मन्दफल कला होती है ।

उपपत्ति ।

स्पष्टाधिकार में कही गई मन्दपरिधि से भौमादिग्रहों की स्वल्पान्तर से परम मन्द फलकला पठित है । भौम की=६७०′ । बुध की=३६२′ । गुरु की=३१४′ । शुक्र की =१०५′ । शनि की=४७६′ इस पर से त्रैराशिक अनुपात से भौमादिग्रहों की मन्दफल–

कला, भौम $= \frac{३७० \times ज्याके}{१५०} = \frac{६७ ज्याके}{१५} = \frac{६७ \times ३२ ज्याके}{१५ \times ३२} = \frac{६७ \times ३२ ज्याके}{४८०}$

$= \frac{३२ ज्याके}{\frac{४८०}{६७}} = \frac{३२ ज्याके}{७}$ स्वल्पान्तर से।

एवं बुध $= \frac{३६२ \times ज्याके}{१५०} = \frac{७ ज्याके}{३}$, स्वल्पान्तर से।

गुरु $= \frac{३१४ ज्याके}{१५०} = २$ ज्या के, स्वल्पान्तर से।

शुक्र $= \frac{१०५ ज्याके}{१५०} = \frac{२ ज्याके}{३}$, स्वल्पान्तर से।

शनि $= \frac{४७६ ज्याके}{१५०} =$ ज्याके $+ \frac{२६ ज्याके}{१५०} =$ ज्याके $+ \frac{ज्याके}{६}$

स्वल्पान्तरग्रहण से उपपन्न हुआ ॥

इदानीं स्फुटग्रहार्थं संस्कारमाह।

तस्माच्छीघ्रफलदलं स्वमृणं वा मन्दसंस्कृते दत्त्वा।
प्राग्वन्मन्दफलमतः सकलं मन्दग्रहात् कुर्यात् ॥ ४० ॥
तस्मात् पृथक् सितादिशीघ्रोच्चविवर्जितात् (स्फुटं केन्द्रम्)।
तस्मात् शीघ्रफलेन संस्कृतः स्फुटो जायते स्पष्टः ॥ ४१ ॥

सु. भा.—मन्दफलयुतोनं मध्यं शीघ्रोच्चाच्छोधयेदेवं शीघ्रकेन्द्रं भवति। तस्माच्छीघ्रफलं कृत्वा तदर्धं स्वं वा ऋणं यथागतं मन्दसंस्कृते मन्दफलसंस्कृते मध्यग्रहे दत्त्वा तं मध्यग्रहं प्रकल्प्यातः प्राग्वत्पुनर्मंदफलं साध्यं तद्यथागतं सकलं सम्पूर्णं मध्यग्रहे देयम्। एवं गणको मन्दग्रहं मन्दस्पष्टं कुर्यात्। तस्मात् पृथक् स्थापितात् शुक्रादिशीघ्रोच्चविवर्जितात् स्फुटं केन्द्रं द्वितीयं शीघ्रकेन्द्रं कुर्यात्। तस्मात् पुनः शीघ्रफलं साध्यम् तेन संस्कृतमन्दः पृथक् स्थापितो मन्दस्पष्टश्च संस्कृतः एवं स्पष्टो ग्रहो जायते। लाघवेन शीघ्रफलसाधनार्थमग्रे खण्डानि वक्ष्यति।

अत्रोपपत्तिः। उपलब्धिरेव ॥४०-४१॥

अब स्पष्टग्रह के लिये संस्कार का नियम कहते हैं।

हि. भा.—मन्दफल से युत या ऋण मध्यग्रह मन्दस्पष्टग्रह होता है। मध्यमग्रह में से

मन्दोच्च घटाने पर शेष मन्दकेन्द्र होता है। शीघ्रोच्च घटाने पर शीघ्र केन्द्र होता है शीघ्र केन्द्र से शीघ्रफलसाधन कर उसका आधा धन या ऋण जो हो उसको मन्दस्पष्ट ग्रह में देकर उसको मध्यमग्रह मानकर उस पर से फिर मन्दफल लाकर सम्पूर्ण फल मध्यमग्रह में धन या ऋण करदें। इस तरह गणक मन्दग्रह को मन्द स्पष्ट करें। पृथक् स्थापित शुक्रादि शीघ्रोच्च से वर्जित स्फुट केन्द्र दूसरा शीघ्रकेन्द्र होता है। उस पर से फिर शीघ्रफल को साधन करें। उससे संस्कृत मन्दस्पग्रह स्पष्टग्रह होता है। लघुता से शीघ्रफल साधन के लिये आगे खण्डों को पठित किया गया है।

उपपत्ति।

उपलब्धि ही यहां उपपत्ति है॥

इदानीं लाघवेन शीघ्रफलानयनार्थं पिण्डमाह।

भागीकृतचलकेन्द्रे त्रिगुणे खाग्न्युद्धृते फलं पिण्डः।[1]
षड्राश्यधिके चक्राद् विशोध्य शेषेण पिण्डः स्यात्॥ ४२॥[1]

सु. भा.—चलकेन्द्रस्य भागाः कर्तव्याः। केन्द्रे षड्राश्यधिके चक्रात् राशिद्वादशकात् केन्द्रं विशोध्य शेषस्य भागाः कर्तव्याः। भागास्त्रिगुणाः खाब्ध्यु ४० द्धृताः फलं फलसमो गतपिण्डः स्यात्।

अत्रोपपत्तिः।

उच्चनीचयोः शीघ्रकर्णस्य वैलक्षण्यादाचार्येण केन्द्रषड्राशिमध्ये सत्र्यंशत्रयोदशभागवृद्धया भौमादीना चलकेन्द्राणि प्रकल्प्य तेभ्यः शीघ्रफलान्यानीय तद्भागा नवगुणाः पिण्डाङ्काः पठिताः। ते षड्राशिमध्ये सार्धत्रयोदश पिण्डाङ्का भवन्ति। त्रयोदश चतुर्दशपिण्डयोर्मध्ये च केन्द्रान्तर $\frac{४०}{३}$ मस्य दल $\frac{२०}{३}$ मिदमस्तीति चिन्त्यम्। इष्टकेन्द्रभागेषु कियन्तः पिण्डाङ्का गता एतदर्थमनुपातः। यदि $\frac{४०}{३}$ केन्द्रभागैरेकः पिण्डस्तदेष्टकेन्द्रांशैः किम्। जातो गतपिण्डः। शेषफलानयनार्थमग्रे वक्ष्यति॥४२॥

अब लाघव से शीघ्रफल साधन के लिये पिण्ड को कहते हैं।

हि. भा.—शीघ्रकेन्द्र का अंश करें, केन्द्र यदि ६ राशि से अधिक हो तो चक्र (१२) में घटाकर शेष को अंश करलें। अंश को त्रि (३) से गुणकर खाग्नि (३०) से भाग दें तो लब्धि के बराबर गतपिण्ड होगा।

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१. भागीकृत चलकेन्द्रे त्रिगुणे खाब्ध्युद्धृते फलं पिण्डः।

उपपत्ति ।

उच्चनीच और शीघ्रकर्ण की विलक्षणता के कारण ६ राशि के मध्य में केन्द्र होने पर तृतीयांशयुक्त १३ भाग की वृद्धि से भौमादि ग्रहों को चल केन्द्र मानकर, उस पर से शीघ्रफल लाकर उसके भाग को ९ से गुणकर जो हो उसको पिण्डाङ्क पठित किया है। वे ६ राशि के भीतर १३+$\frac{१}{२}$ पिण्डाङ्क होते हैं। तेरह और चौदह पिण्ड के मध्य में केन्द्रान्तर =$\frac{४०}{३}$° इसका आधा $\frac{२०}{३}$° यह होता है इसका विचार करें। इष्टकेन्द्र भाग में कितना पिण्डाङ्क बीतगया इसकी जानकारी के लिये अनुपात करते हैं जैसे - यदि ($\frac{४०}{३}$°) केन्द्र भाग में १ पिण्ड पाते हैं तो इष्टकेन्द्रभाग में क्या इस अनुपात से इष्ट केन्द्रांश सम्वन्धी गतपिण्ड होगा। शेष सम्बन्धी फलानयन प्रक्रिया की युक्ति आगे कहेंगे।

इदानीं शेषसम्बन्धिपिण्डावयवानयनमाह ।

पिण्डान्तरेण गुणिते शेषे खाब्ध्युद्धृते क्रमाद्देयम् ।
उत्क्रमविधौ विशोध्यं गतपिण्डे शीघ्रफलमेतत् ॥ ४३ ॥

सु. भा.—शेषे पिण्डान्तरेण गतैष्यपिण्डयोरन्तरेण गुणिते खाब्ध्यु ४० द्धृते फलं क्रमादुपचयात् गतपिण्डत एष्यपिण्डेऽधिके गतपिण्डे देयम् । उत्क्रमविधावर्थाद्-गतपिण्डत एष्यपिण्डेऽल्पे फलं गतपिण्डे विशोध्यं तदैतत् संस्कृत शीघ्रफलं शीघ्र-फलसंबन्धि पिण्डमानं भवेत् ।

अत्रोपपत्तिः ।

यदि चत्वारिंशत् समेन त्रिगुणशेषेण गतैष्यपिण्डयोरन्तरं लभ्यते तदाऽभीष्ट त्रिगुण शेषेण किमित्यनुपातेन स्फुटा धनर्णोपपत्तिश्चातिसुगमा ॥४३॥

अब शेष सम्वन्धी पिण्डके अवयव को लाने का नियम कहते हैं।

हि. भा.— शेषको गतैष्यपिंडान्तर से गुण दें, खाब्धि (४०) से भाग दें, फल को ग्रहण करें। यदि गतपिण्ड से एष्यपिण्ड अधिक हो तो फल को गतपिण्ड में धन करने पर शीघ्र फल सम्बन्धी पिण्डमान होता है। यदि गतपिण्ड से एष्यपिण्ड अल्प हो तो पूर्वसाधित फल को गतपिण्ड में घटा दें तो शीघ्र फल सम्बन्धी पिण्डमान होता है।

उपपत्ति ।

यदि चत्वारिंशत् (४०) के वरावर त्रिगुण शेष में गतैष्यपिण्ड का अन्तर प्राप्त होता है तो इष्ट त्रिगुण शेष में क्या इस अनुपात से लाभ हुआ तत् सम्बन्धी पिण्डमान, यहां धन और ऋण की वासना स्पष्ट ही है।

इदानीं विशेषमाह।

पिण्डाभावे विकलं गुणयेदाद्येन पिंडकेन ततः ।
गण्यन्ते तु खवेदैस्तदेव फलमत्र बोद्धव्यम् ।। ४४ ।।

सु० भा०—चलकेन्द्रे त्रिगुणे खाब्ध्युद्धृते यदि फलं शून्यं तदा पिण्डाभावः स्यात् । तस्मिन् पिण्डाभावे विकलं शेषमाद्येन पिण्डेन गुणयेत्, ततो गुणनफलानि खवेदै ४० र्गण्यन्ते विभज्यन्ते । अत्र यत् फलं तदेव शीघ्रफलसम्बन्धि पिण्डमानं बोद्धव्यं ज्ञातव्यमित्यर्थः ।

अत्रोपपत्तिः ।

प्राग्वद्यदि खवेदमितेन त्रिगुणशेषेण प्रथमपिण्डमानं लभ्यते तदेष्टत्रिगुणशेषेण किं जातं शेषसंबन्धिफलं गतपिण्डाभावात् तदेव शीघ्रफलसंबन्धि पिण्डमानम् । एतदनुक्तमपि बुद्धिमता ज्ञायते । आचार्येण बालावबोधार्थं लिखितम् ॥४४॥

अब पिण्डानयन में विशेष कहते हैं ।

हि. भा.—त्रिगुणित चलकेन्द्र को खाब्धिते (४०) से भाग देने पर फल यदि शून्य हो तब वहां पिण्ड का अभाव होगा अर्थात् पिण्ड नहीं होगा । ऐसी अवस्था में विकल शेष को आद्य पिण्ड से गुणा दें । गुणनफल को खवेद (४०) से भाग दें यहां जो फल (लब्धि) होगा वही पिण्डमान होगा, यह जानना चाहिये ।

उपपत्ति ।

पूर्व युक्ति से खवेद (४०) के तुल्य त्रिगुण शेष में पहला पिण्ड मिलता है तो इष्ट त्रिगुणशेष में क्या इस अनुपात से शेष सम्बन्धी फल मिला, यहां गतपिण्ड का अभाव है । इसलिये वही फल शीघ्रफल सम्बन्धी पिण्डमान हुआ । इस तरह अनुक्त को भी विद्वान समझें । आचार्य ने तो बालक के ज्ञान के लिये यह लिखा है ॥

इदानीं विश्वमिते गतपिण्डे विशेषमाह ।

पिण्डे चतुर्दश विश्वैर्गुणिते नखोद्धृते विकलाः ।[1]
लब्धेन विश्वपिण्डो रहितः शेषं फलं भवति ।। ४५ ।।

सु. भा.—चतुर्दश संख्यक एष्यपिण्डे सति विकले शेषे विश्वविगुणिते त्रयोदशसंख्यकपिण्डेन गुणिते नखो २० द्धृते यल्लब्धं भवेत् तेन लब्धेन विश्वपिण्डस्त्र-

१. पिण्डे चतुर्दशेऽष्ये विश्वविगुणिते नखोद्धृते विकले ।

योदशसंख्यक: पिण्डो रहित: शेषं फलं शीघ्रफलसम्बन्धि पिण्डमानं भवेत् ।

अत्रोपपत्तिः ।

त्रयोदशचतुर्दशपिण्डयो रन्तरे $\frac{२०}{३}$ केन्द्रान्तरमस्ति । इति पूर्वमेव ४२ सूत्रे प्रतिपादितम् । चतुर्दशपिण्डमानं शून्यसमम् । अतोऽनुपातो यदि विंशतिमितेन त्रिगुणशेषेण विश्वचतुर्दश पिण्डयोरन्तरं विश्वपिन्डसमं लभ्यते तदेष्टशेषेण किं लब्धेन विश्वपिण्डो रहितश्चतुर्दशपिण्डस्याल्पत्वात् शेषं शीघ्रफलसम्बन्धि पिण्डमानं भवेत् ॥४५॥

अब विश्व के बराबर गतपिण्ड में विशेष नियम कहते हैं ।

हि. भा.—चतुर्दश (१४) संख्यक एष्य पिण्ड हो तो विकल शेष को त्रयोदश (१३) के बराबर पिण्ड से गुणादें । उसमें नख (२०) से भागदें । फल जो हो, उसको तेरहवें पिण्ड में से घटा देने पर शेष शीघ्रफल सम्बन्धी पिण्डमान होगा ।

उपपत्ति ।

तेरह और चौदह पिण्ड का अन्तर $\frac{२०}{३}$ में केन्द्रान्तर है यह बात पहले ही ४२ सूत्र में कही गई है । चौदहवां पिण्डमान = ० । अब अनुपात करते हैं । बीस के तुल्य त्रिगुणशेष में तेरह चौदह पिण्ड का अन्तर तेरह पिण्ड के तुल्य मिलता है तो इष्टशेष में क्या लाभ जो हो उसको विश्व (१३) पिण्ड में घटा देने पर शेष शीघ्रफल सम्बन्धी पिण्डमान होगा । यहां चौदहवां पिण्ड छोटा है इसलिये १३वें पिण्ड में फल को घटा दिया गया है ।

इदानीं पिण्डत: शीघ्रफलमाह ।

पिण्डफलनवमभागो भागादिफलं ग्रहेषु वा स्वमृणम् ।
चलकेन्द्रे मेषादौ तुलादिके कारयेत् क्रमशः ॥ ४६ ॥

सु. भा.—पिण्डफलस्य नवमांशो भागादिशीघ्रफलं भवेत् शेषं स्पष्टार्थम् ।

अत्रोपपत्तिः ।

नवगुणितं भागादि शीघ्रफलमेव पिण्डांका: पठिता: इति ४२ सूत्रे प्रतिपादितम् । अत: पिण्डफलं नवहृतं भागादि शीघ्रफलं भवति धनर्णवासना स्पष्टाधिकारत: स्फुटा ॥४६॥

अब पिण्ड पर से शीघ्र फल लाते हैं ।

हि. भा.—पिण्ड फल का नवम भाग भागादि शीघ्र फल होता है । इस फल को

केन्द्र के वश ग्रह में धन ऋण करना चाहिये। मेषादि केन्द्र हो तो शीघ्र फल को ग्रह में धन और तुलादि केन्द्र में फल को ग्रहण करना चाहिये।

उपपत्ति।

नव (९) से गुणित भागादि शीघ्रफल ही पिण्डाङ्क पठित है। यह बात २४वें सूत्र में कही गई है। इसलिये पिण्डफल को नव (९) से भाग देने पर फल भागादि शीघ्रफल होता है। धन और ऋण का नियम स्पष्टाधिकार से जानना चाहिये।

इदानीं भौमस्य चतुर्दशपिण्डानाह।

वसुवेदा युगनन्दाः खवेदचन्द्राः समुद्रवसुचन्द्राः।
वसुयमयमा रसनभोरामा नन्दाग्निरामाश्च ॥ ४७ ॥[1]
मोक्षगुणा रसरसरामा विलोचनाब्धिगुणाः।
वसुवसुयमा वसुदिशो नभश्च कुजशीघ्रपिण्डाः स्युः ॥ ४८ ॥[2]

सु. भा.—क्रमेण चतुर्दशपिण्डाः = ४८।९४।१४०।१८४।२२८।२७०।३०६।३३९।३५९।३६६।३४२।२६८।१०८।०॥ अत्र महत्तमपिण्डो नवभक्तो भोमस्य परमं शीघ्रफलम् = $\frac{३६६}{९}$ = ४०°। ४०′ ॥

अत्रोपपत्तिः।

केन्द्रांशाः = १३°।२०′॥२६°।४०′॥४०°।०′॥५३°।२०′।६६°।४०′॥८०°।०′॥९३°।२०′॥१०६°।४०′॥१२०°।०′॥१३३°।२०′॥१४६°।४०′॥१६०°।०′॥१७३°।२०′॥

खार्कमिते व्यासार्धे

केन्द्रज्या = २७।४०॥५३।४०॥७७।००॥९६।००॥११०।००॥२१८।००॥११९।१९॥

केन्द्रकोटिज्या = ११६।२०॥१०७।००॥९२।०.०॥७१।२०॥४७।२०॥२१।००।७००॥

अन्त्यफलज्या = ७८।००॥७८।००।७८।००॥७८।००॥७८।००॥७८।००॥७८।७८।००॥

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१. वसुवेदा युगनन्दाः खवेदचन्द्रा समुद्रवसुचन्द्राः।
वसुयमयमा वियन्नगयमास्तथा रसनभोरामाः ॥४७॥

२. गोऽग्निगुणा गोऽक्षगुणा रसरसरामा विलोचनाब्धिगुणाः।
वसुरसयमा वसुदिशो नभश्च कुजशीघ्रपिण्डाः स्युः ॥४८॥

स्पष्टाकोटिः=१६४।२०॥१८५।००॥१७०।००॥१४६।२०॥१२५।२०॥६६।००॥७१।००॥

शीघ्रकर्णः=११७७६″॥११५५८॥१११९८॥१०६५२॥१०००६॥६२४२॥८३३२॥

शीघ्रफलज्या=१०·५६६॥२१·७३१॥३२·१८१॥४२·१७८॥५१·४४६॥५९·७५३॥६७·०२८॥

शीघ्रफलम् =५°.०५॥१०°.४॥१५°.६॥२०°.६॥२५°.५॥२९°.८॥३४°.१३॥

९×शीफ =४५·४५॥९३·६॥१४०·४॥१८५·४॥२२९·५॥२६८·२॥३०७·२॥

केन्द्रज्या =११४।४०॥१०४।००॥८७।००॥६५।४०॥४१।००॥१४।००॥

केन्द्रकोटिज्या=३४।२०॥६०।००॥८२।००॥१००।००॥११३॥११८।४०॥

अन्त्यफलज्या=७८।००॥७८।००॥७८।००॥७८।००॥७८।००॥७८।००॥

स्पष्टाकोटि. =४३।४०॥१८।००॥४।००॥२२।००॥३५।००॥४०।००॥

शीघ्रकर्णः =७३४३॥६३३३॥५२२६॥४१५५॥३२३५॥२५०२॥

शीघ्रफलज्या=७२.८६६॥७६·८५४॥७७·९११॥७३·६६४॥५९·३१४॥२६·१८७॥

शीघ्रफलम् =३७°.६॥३९°.९॥४०°.६॥३८°.२॥२९°.६॥१२.६॥

९×शीफ =३३८·४॥३५९·१॥३६५·४॥३४३·८॥२६६·४॥११३·४॥

यथा पिण्डेषु महदन्तरं न भवेत्तथा साधितसूक्ष्मपिण्डसंख्या अवलम्ब्य मया पिण्डान् संशोध्य मूलार्ये संशोधिते—

आचार्यपिण्डाः=४८।९४।१४०।१८४।२२८।२७०।३०६।

मत्साधिताश्च =४६।९४।१४०।१८५।२३०।२६८।३०७।

आचार्यपिण्डाः=३३९।३५९।३६६।३४२।२६८।१०८।०।

मत्साधिताश्च=३३८।३५९।३६५।३४४।२६६।११३।०।

अब भौम का १४ पिण्डों को कहते हैं।

हि. भा— भौम के क्रम से १४ पिण्ड=४८ । ९४ । १४० । १८४ । २२८ । २७० । ३०६ । ३३९ । ३५९ । ३६६ । ३४२ । २६८ । १०८ । ० ॥ यहां सबसे बड़े पिण्ड ३६६ को ९ से भाग देने पर $\frac{३६६}{९}$=४०° । ४०′ ॥

उपपत्ति

केन्द्रांश = १३° । २०′ ॥ २६° । ४०′ ॥ ४०° । ०′ ॥ ५३′ । २०′ ॥ ६६° । ४०′ ।८०° । ०′ ॥ ९३° । २०′ ॥१०६° । ४०′ ॥ १२०° । ०′ ॥१३३°।२०′॥ १४६° । ४०′ ॥ १६०° । ०′ ॥ १७३° । २०′ ॥

खार्क (१२०) व्यासार्धं में—

केन्द्रज्या = २७।४०॥५३।४०॥७७।००॥९६।००।११०।००॥ ११८।००॥ ११९ । १९ ॥

केन्द्रकोटिज्या = ११६।२०॥१०७।००।९२।००॥७१।२०॥४७।२०॥२१।००॥ ७।००॥

अन्त्यफलज्या = ७८।००॥७८।००॥७८।००॥७८।००॥७८।००॥७८।०॥७८। ००॥

स्पष्टा कोटि = १९४।२०॥१८५।००॥१७०।००॥१४९।२०॥१२५।२०॥ ९९।००॥७१।००॥

शीघ्रकर्ण = ११७७६″॥११५५८॥१११९८॥१०६५२॥१०००६॥९२४२॥ ८३३२॥

शीघ्रफलज्या = १०·५९९॥२१·७३१॥३२·१८१॥४२·१७८॥५१·४४९॥ ५९·७५३॥६७·०२८॥

शीघ्रफलम् = ५°·०५॥१०°·४॥१५°.६॥२०°.६॥२५°.५॥२९°.८॥३४°.१३॥

९ × शीफ = ४५·४५॥९३·६॥१४०·४॥१८५·४॥२२९·५॥२६८·२॥३०६·२॥

केन्द्रज्या = ११४।४०॥१०४।००॥८७।००॥६५।४०॥४१।००॥१४।००॥

केन्द्र कोटिज्या = ३४।२०॥६०।००॥८२।००॥१००।००॥११३।००॥११८।४०॥

अन्त्यफलज्या = ७८।००॥७८।००॥७८।००॥७८।००॥७८।००॥७८।००॥

स्पष्टा कोटिः = ४३।४०॥१८।००॥४।००॥२२।००॥३५।००॥३५।००॥ ४०।००॥

शीघ्रकर्ण = ७३४३″॥६३३३॥५२२६॥४१।५५॥३२३५॥२५०२॥

शीघ्रफलज्या = ७२·८६९॥७६·८५४॥७७·९११॥६३·९६४॥५९·३१४॥ २६·१८७॥

शीफ = ३७°·६॥३९°·९॥४०°·६॥३८°·२॥२९°·६॥१२·६२॥

९ × शीघ्रक = ३३८·४।।३५९·१।।३६५·४।।३४३·८।।२६६·४।।११३·४।।

जिस लिये पिण्ड में अधिक अन्तर न हो इसलिये साधित सूक्ष्म पिण्डसंख्या को स्वीकार कर पिण्डों को शोधनकर मूल में पठित आर्या का मैंने संशोधन किया है।

आचार्योक्त पिण्ड = ४८।९४।१४०।१८४।२२८।२७०।३०६।

श्री सुधाकरोक्त पिण्ड = ४६।९४।१४०।१८५।२३०।२६८।३०७

आचार्योक्त पिण्ड = ३३९।३५९।३६६।३४२।२६८।१०८।०

श्री सुधाकरोक्त पिण्ड = ३३८।३५९।३६५।३४४।२६६।११३।०

इदानीं बुधपिण्डानाह।

गुणरामाः षट्करसा वसुनन्दागजविलोचनशशाङ्काः।
सागरविषयशशाङ्का नगनगचन्द्राः कृताङ्कभुवः ॥ ४९ ॥
वेदनखा जलधिनखा वसुवसुचन्द्रास्तुरङ्गविषयभुवः।
तुरगदिशो रसरामा नभश्च पिण्डाश्च शशिसूनोः ॥ ५० ॥

सु. भा.—बुधस्य क्रमेण चतुर्दशपिण्डाः = ३३।६६।९८।१२८।१५४।१७७।१९४।२०४।१८८।१५७।१०७।३६।०।।

अत्र महत्तमपिण्डो २०४ नवभक्तो बुधस्य परमं शीघ्रफलम् = $\frac{२०४}{९}$ = २२°।४०'। अस्य ज्याऽन्त्यफलज्या = ४६।४। खार्कमिते व्यासार्धे।

अत्रोपपत्तिः।

भौमपिण्डसाधनवदत्रापि—

केन्द्रज्या = २७।४०।।५३।४०।।७७।००।।९९।००।।११०।।००।।११८।००।।
११९।२०।।

केन्द्रकोटिज्या = ११६।२०।।१०७।००।।९२।००।।७१।२०।।४७।२०।।२१।००।।
७।००।।

अन्त्यफलज्या = ४६।४।।४६।४।।४६।४।।४६।४।।४६।४।।४६।४।।४६।४।।

स्पको = १६२।२४।।१५३।४।।१३८।४।।११७।२४।।९३।२४।।६७।४।।
३९।४।।

शीक = ९८८४।।९७३२।।९४८५।।९०९९।।८६५४।।८१४४।।७५३५।।

शीघ्रफलज्या = ७·७३।।१५·३३।।२२·४४।।२९·१६।।३५·१३।।४०·०५।।४३·७८।।

शीफ = ३°.७।।७°.३।।१०°.७।।१४°.०८।।१७°.०६।।१९°.५२।।
२१°.५।।

९ × शीफ = १३·३॥६५·७॥९६·३॥१२६·७२॥१५३·५४॥१७५·६८॥
१९३·५॥

केन्द्रज्या = ११४।४०॥१०४।००॥८७।००॥६५।४०॥४१।००॥१४।०॥

केन्द्रकोटिज्या = ३४।२०॥६०।००॥८३।००॥१००·००॥११३।००॥११८।४०॥

अन्त्यफलज्या = ४६।४॥४६।४॥४६।४॥४६।४॥४६।४॥४६।४॥

स्पको = ११।४४॥१३॥५६॥३५।५६॥५३।५६॥६६।५६॥७२।३६॥

शीक = ६८९६"॥६२९६॥५६४८॥५०९८॥४७०६॥४६३३॥

शीघ्रफलज्या = ४५.९५॥४५·६५॥४२·५७॥३५·६०॥२४·०७॥८·३५॥

शीफ = २२°.६॥२२°.५॥२०°.८॥१७°.३॥११°.५॥३°.९८॥

९ × शीफ = २०३.४॥२०२·५॥१८७·२॥१५५·७॥१०३·५॥३५·८२॥

आचार्यपिण्डाः = ३३।६६।९८।१२८।१५४।२७७।१९४।

मत्साधिताः = ३३।६६।९६।१२७।१५४।१७६।१९४।

अचार्यपिण्डाः = २०४।२०४।१८८।१५७।१०७।३६।०।

मत्साधिताः = २०३।२०३।१८७।१५६।१०४।३६।०।

अब बुध पिण्डों को कहते हैं।

हि. भा.—बुध के क्रम से चतुर्दश (१४) पिण्ड = ३३।६६।९८।१२८।१५४।१७७।१९४।२०४।२०४।१८८।१५७।१०७।०॥ यहां सबसे बड़ा पिण्ड = २०४ को नौ (९) से भाग देने पर परमशीघ्रफ = $\frac{२०४}{९}$ = २२°।४०′, इसकी अन्त्यफलज्या = ४६। ४। खार्कमित (१२०) व्यासार्ध में।

उपपत्ति।

भौमपिण्ड साधन की तरह—

केन्द्रज्या = २७।४०॥५३।४०॥७७।००॥९६।००॥११०।००॥११८।००॥
११९।२०॥

केन्द्र कोटिज्या = ११६।२०॥१०७।००॥९२।००॥७१।२०॥४७।२०॥२१।००॥
७।००॥

अन्त्य फलज्या = ४६।४॥४६।४॥४६।४॥४६।४॥४६।४॥४६।४॥४६।४॥

स्पष्ट कोटि = १६२।२४॥१५३।४॥१३८।४॥११७।२४॥९३।२४॥६७।४॥
३९।४॥

शीघ्रकर्ण　=९८८४।।९७३२।।९४८५।।९०९१।।८६५४।।८१४४।।७५३४।।

शीघ्रफज्या　=७·७३।।१५·३३।।२२·४४।।२९·१६।।३५·१३।।४०·५।।४३·७८।।

शीघ्रफल　=३°.७।।७°.३।।१०°.७।।१४°·८।।१७°.६।।१९°५२।।२१°.५।।

९ × शीफ　=३३·३।।६५.७।।९६°३।।१२६·७२।।१५३·५४।।१७५·६८।।
१९३·५।।

केन्द्रज्या　=११४।४०।।१०४।००।।८७।००।।६५।४०।।४१।००।।१४।००।।

केन्द्रकोटिज्या　=३४।२०।।६०।००।।८२।००।।१००।००।।११३।००।।११८।४०।।

अन्त्यफलज्या　=४६।४।।४६।४।।४६।४।।४६।४।।४६।४।।४६।४।।

स्पष्टकोटि　=११।४४।।१३।५६।।३५।५६।।५३।५६।।६६।५६।।७२।३६।

शीक　=६८९६″।।६२९६।।५६।४८।।५०९८।।४७०९।।४६३।।

शीघ्रफलज्या　=४५·९५।।४५·६५।।४२·५७।।३५·६०।।२४·७।।८·३५।।

शीफ　=२२°·६।।२२°·५।।२०°·८।।१७°·३।।११°·५।।३°·९८।

९ × शीफ　=२०३·४।।२०·५२।।१८७·२।।१५५·७।।१०३·५।।३५·८२।।

आचार्यपिण्ड　=३३।६६।९८।१२८।१५४।२७७।१९४।

मेरे से साधितपिण्ड=३३।६६।९६।१२७।१५४।१७६।१९४।

आचार्य का पिण्ड=२०४।२०४।१८८।१५७।१०७।३६।०।

मेरा पिण्ड　=२०३।२०३।१८७।१५६।१०४।३६।०।

इदानीं गुरोः पिण्डानाह ।

धृतिरसगुणाश्च खशराः षट्करसा गजनगा रसाष्टौ च ।
खाङ्काश्च भुजगवसवः सागरवसवः समुद्रनगाः ॥ ५१ ॥
भुजगशरा रसरामा रसेन्दवः पिण्डकाः सूरेः ।
चक्राद्विशुद्धशेषः स्फुटो भवेत् सिंहिकासूनुः ॥ ५२ ॥

सु. *भा.*—गुरोः क्रमेण चतुर्दशपिण्डाः=१८।३६।५०।६६।७८।८६।९०।८८।८४।७४।५८।३६।१६।०। अत्र महत्तमपिण्डो ९० नवभक्तः परमं शीघ्रफलम्=१०° अस्य ज्यान्त्यफलज्या=२१ खार्कमिते व्यासार्धे । गगनेन नवचन्द्रै रित्यादि ३१ श्लोकविधिना यः पातः स चक्राद्विशुद्धः शेषः सिंहिकासूनू राहुः स्फुटो भवेदिति ।

अस्योपपत्तिः ।

भौमपिण्डसाधन वदत्रापि—

केन्द्रज्या =२७।४०॥५३।४०॥७७।००॥९६।००॥११०।००॥११८।००॥ ११९।२०॥

केन्द्रकोटिज्या=११६।२०॥१०७।००॥९२।००॥७१।२०॥४७।२०॥२१।००॥ ७।००॥

अन्त्यफलज्या =२१।००॥२१।००॥२१।००॥२१।००॥२१।००॥२१।००॥ २१।००॥

स्पको = १३७।२०॥१२८।००॥११३।००॥९२।२०॥६८।२०॥४२।००१४।००॥

शीक =८४०६″॥८३२८॥८२०४॥७९९२॥७७७०॥७५१५॥७२१०॥

शीफज्या =४·१५॥८·१२॥११·८२॥१५·१३॥१७ ८३॥१९·७८॥२०·८३॥

शीक =१·९७॥३·८७॥५·६२॥७·२०॥८·४८॥९·४२॥९·९२॥

९×शीफ =१७·७३॥३४ ८३॥५०·५८॥६४·८०॥७६·३२॥८४·७८॥८९·२८॥

केन्द्रज्या =११४।४०॥१०४।००॥८७।००॥६५।४०॥४१।००॥१४।००॥

केन्द्रकोटिज्या=३४।२०॥६०।००॥८२।००॥१००।००॥११३।००॥११८।४०॥

अन्त्यफलज्या =२१।००॥२१।००॥२१।००॥२१।००॥२१।००॥२१।००॥

स्पको =१३।२०॥३९।००॥६१।००॥७९।००॥९२।००॥९७।४०॥

शीक =६९०७″॥६६६४॥६३७५॥६१६४॥६०४४॥५९२०॥

शीफज्या =२०·८५॥१९·६७॥१७·१८॥१३·४२॥८·५३॥२·९८॥

शीफ ९·९२॥९·३७॥८·१८॥६·३५॥४·०७॥१·४२॥

९×शीफ =८९·२८॥८४·३३॥७३·६२॥५७·१५॥३६·६३॥१२·७८॥

आचार्यपिण्डाः=१८।३६।५०।६६।७८।८६।९०॥

मत्साधिताः =१८।३५।५१।६५।७६।८५।८९॥

आचार्यपिण्डाः=८८।८४।७४।५८।३६।१६।०॥

मत्साधिताः =८९।८४।७४।५७।३७।१३।०॥

अब गुरु के पिण्ड को कहते हैं ।

हि. भा.—गुरु के क्रम से चतुर्दश (१४) पिण्ड=१८।३६।५०।६६।७८।८६।९०। ८८।८४।७४।५८।३६।१६।०। यहां सबसे बड़ा पिण्ड=९०″ $\frac{९०}{९}$=१०°=शीघ्रफलपरम

इसकी ज्या अन्त्यफलज्या (१२०) व्यासार्ध में=२१ । 'गगनेन नवचन्द्रैः' इत्यादि श्लोक से जो पात (राहु) कहा गया है, उसको १२ में घटाने से स्पष्ट राहु होता हैं ।

उपपत्ति ।

भौमपिण्ड साधन की तरह यहां भी—

केन्द्रज्या =२७।४०॥५३।४०॥७७।०॥९६।००॥११०।००॥११८।००॥
११९।२०॥

केन्द्रकोटिज्या =११६।२०॥१०७।००॥९२।००॥७१।२०॥४७।२०॥२१।००॥
७।००॥

अन्त्यफलज्या =२१।००॥२१।००॥२१।००॥२१।००॥२१।००॥२१।००॥
२१।००॥

स्पको =१३७।२०॥१२८।००॥११३।००॥९२।२०॥६८।२०॥४२।००॥
१४।००॥

शीक =८४०६″॥८३२८॥८२०४॥७९९२॥७७७०॥७५१५॥७२१०॥

शीफज्या =४·१५॥८·१२॥११ ८२॥१५·१३॥१७·८३॥१९·७८॥२०·८३॥

शीक =१·९७॥३·८७॥५·६२॥७·२०॥८·४८॥९·४२॥९·९२॥

९×शीफ =१७·७३॥३४·८३॥५०·५८॥६४·८०॥७६·३२॥८४·७८॥
८९·२८॥

केन्द्रज्या =११४।४९॥१०४।००॥८७।००॥६५।४०।४१।००॥१४।००॥

केन्द्रकोटिज्या =३४।२०॥६०।००॥८२।००॥१००।००॥११३।००॥११८।४०॥

अन्त्यफलज्या =२१।००॥२१।००॥२१।००॥२१।००॥२१।००॥२१।००॥

स्पकोटि =१३।२०॥३९।००॥६१।००॥७९।००॥९२।००॥९७।४०॥

शीक =६९०७″॥६६६४॥६३७५॥६१६४॥६०४४॥५९२०॥

शीफज्या =२०·८५॥१९·६७॥१७·१८॥१३·४२॥८·५३॥२·९८॥

शीफ =९·९२॥९·३७॥८·१८॥६·३५॥४·७॥१·४२॥

९×शीफ =८९·२८॥८४·३३॥७३·६२॥५७·१५॥३६·६३॥१२·७८॥

आचार्य का पिण्ड=१८।३६।५०।६६।७८।८६।९०॥

अनुवादककापिण्ड=१८।३५।५१।६५।७६।८५।८९॥

आचार्य का पिण्ड=८८।८४।७४।५८।५८।३६।१६।०॥

अनुवादककापिण्ड=८९।८४।७४।५७।३७।१३।०॥

इदानीं शुक्रपिंडानाह ।

खशराः शतं खतिथ्यः सागरनन्देन्दवो ऽङ्कजिनाः ।
गुणगुणरामाः कुनगगुणाः शून्यखाम्बुधयः ॥ ५३ ॥[1]
कुञ्जरचन्द्रसमुद्रा गजाभ्रवेदा नभोऽम्बुधिज्वलनाः ।
गगनशिलीमुख चन्द्राावियच्च पिण्डाः सुरारिगुरोः ॥ ५४ ॥[2]

सु. *भा.*—शुक्रस्य क्रमेण चतुर्दशपिण्डाः ५०।१००।१५०।१९९।२४६।२९०। ३३३।३७१।४००।४१८।४०८।३४०।१५०।० । अत्र महत्तमपिण्डो ४१८ नवभक्तः परमफलम्$=\frac{४१८}{९}=४६^{\circ}।२६'।४०''$। अस्य ज्या अन्त्यफलज्या=८६।४१। खार्कमितव्यासार्धे ।

अत्रोपपत्तिः ।

भौमपिण्डसाधनवदत्रापि ।

केन्द्रज्या =२७।४०॥५३।४०॥७७।००॥९६।००॥११०।००॥११८।०० ॥
११९।२०॥

केन्द्रकोटिज्या =११६।२०॥१०७।००॥९२।००॥७१।२०॥४७।२०॥२१।००॥
७।००॥

अन्त्यफलज्या =८६।४१॥८६।४१॥८६।४१॥८६।४१॥८६।४१॥८६।४१॥
८६।४१॥

स्पको =२०३॥१॥१९३।४१॥१७८।४१॥१५८।१॥१३४।१।
१०७।४१॥७९।४१॥

शीक =१२२९४॥॥१२०६०॥११६७४॥११०९४॥१०४०२॥९५८५॥
८६०९॥

शीफज्या =१०·७०॥२३·१३॥३४·३०॥४५·००॥५५·००॥६४·०२॥
७२·०८॥

शीफ =-५°.१७॥११°.७७॥१६°.६६॥२२°. .०॥२७°.३७॥
३२°.३७॥३७°.१०॥

९×शीफ =५०१३॥९९·६३॥१४९.८५॥१९८·९॥२४६·३३॥२९१.३३॥
३३३·९॥

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१. खशराः शतं खतिथ्यस्तथाङ्कनन्देन्दवोऽङ्कजिनाः ।
खाङ्कयमाः सुररामाःकुनगगुणाः शून्यखाम्बुधयः ॥५३॥

२. कुञ्जरचन्द्रसमुद्रा गजाभ्रवेदा नभो ऽम्बुधिज्वलनाः ।
गगनशिलीमुखचन्द्रा वियच्चपिण्डाः सुरारिगुरोः ॥५४॥

केन्द्रज्या =११४।४०॥१०४।००॥८७।००॥६५।४०॥४१।००॥१४।००॥

केन्द्रकोटिज्या=३४।२०।६०।००॥८२।००॥१००।००॥११३।००॥
११८।४०॥

अन्त्यफलज्या =८६।४१॥८६।४१॥८६।४१॥८६।४१॥८६।४१॥८६।४१॥

स्पको =५२।२१॥२६।४१॥४।४१॥१३।१६॥२६।१६॥३१।५६॥

शीक =७५४४॥६४४२॥५२२७॥४०५१॥२६२३॥२०६५॥

शीफज्या =७८·८२॥८३·६५॥८६·६५॥८४·२५॥७२·६५॥३४·७५॥

शीफ =४१°.२२॥४४°.६२॥४६°.४३॥४४°.८३॥३७°.६२॥
६१°.८७॥

९ × शीफ =३७०·६८॥४०१.५८॥४१७·८७॥४०३·४७॥३३८·५८॥
१५१·८३॥

आचार्यपिण्डाः=५०।१००।१५०।१६६।२४६।२६०।३३३॥

मत्साधिताः =५०।१००।१५०।१६६।२४६।२६१।३३४॥

आचार्यपिण्डाः=३७१।४००।४१८।४०८।३४०।१५०।०॥

मत्साधिताः =३७१।४०२।४१८।४०४।३३६।१६२।०॥

यथा महदन्तरं न भवेत्तथाऽऽदर्शार्य मया शोधिते षष्ठपिण्डत्रुटिश्च पूर्णी-कृतेति ॥५३-५४॥

अब शुक्रपिण्ड को कहते हैं।

हि. भा.—यहां मूलोक्त शुक्र के क्रम से चतुर्दश (१४) पिण्ड इस प्रकार है। ५०।१००।१५०।१६६।२४६।२६०।३३३।३७१।४००।४१८।४०८।३४०।१५०।०॥

यहां सबसे बड़ा पिण्ड=४१८।

$\frac{४१८}{९}$=४६°।२६′।४०″=परमफल। इसकी ज्या (१२०) व्यासार्ध में ८६।४१। =अन्त्यफलज्या।

उपपत्ति।

भौमपिण्ड साधन की तरह यहां—

केन्द्रज्या =२७।४०॥५३।४०॥७७।००॥६६।००॥११०।००॥११८।००॥
११६।२०॥

केन्द्रकोटिज्या =११६।२०॥१०७।००॥६२।००॥७१।२०॥४७।२०॥२१।००॥
७।००॥

अन्त्यफलज्या =८६।४१॥८६।४१॥८६।४१॥८६।४१॥८६।४१॥८६।४१॥
८६।४१॥

स्पको =२०३।१॥१९३।४१॥१७८।४१॥१५८।१॥१३४।१॥१०७।४१॥
७९।४१॥

शीक =१२२९४॥१२०६०॥११६७४॥११०९४॥१०४०२॥९५८५॥
८६०९॥

शीफज्या =१०·७०॥२३.१३॥३४·३०॥४५·१००॥५५·००॥६४·२॥
६२·८॥

शीफ =५°·५७॥११°·७॥१६°·६५॥११°·१०॥२७°·३६॥३२°·७॥
३७°·१०॥

शीफ =५०·१३॥९९·६३॥१४९·८५॥१९८·९॥२४६·३३॥२९१ ३३॥
३३३.९॥

केन्द्रज्या =११४।४०॥१०४।००॥८७।००॥६५।४०॥४१।००॥१४।००॥

केन्द्रकोटिज्या =३४।२०॥६०।००॥८२।००॥१००।००॥११३।००॥११८।४०॥

अन्त्यफलज्या =८६।४१॥८६।४१॥८६।४१॥८६।४१॥८६।४१।८६।४१॥

स्पको =५२।२१॥२६।४१॥४।४१॥१३।१९॥२६।१९॥३१।५९॥

शीफ =७५४४॥६४४२॥५२२७॥४०५१॥२९२३॥२०९५॥

शीफज्या ७८·८२॥८३.९५॥८६·६५॥८४·२५॥७२.९५॥३४ ७५॥

शीफ =४१°·२२॥४४°.६२॥४६°·४४॥४३·°८३॥३७°·६२॥१६°·८७॥

९ × शीफ =३७०·९८॥४०१·५८॥४१७·८७॥४०३·४७॥३३८.५८॥
१५१·८३॥

आचार्य का पिण्ड=५०।१००।१५०।११९।२४६।२९०।३३३॥

संशोधक का पिण्ड=५०।१००।१५०।१९९।२४६।२९१।३३४॥

आचार्य का पिण्ड=३७१।४००।४१८।४०८।३४०।१५०।०॥

संशोधक का पिण्ड=३७१।४०२।४१८।४०४।३३९।१५२।०

जिस तरह अधिक अन्तर न हो उस तरह मैंने मूलोक्त आर्या का संशोधन कर छठेपिण्ड को पूरा किया है।

इदानीं शनिपिण्डानाह ।

रुद्रा द्वियमाः कुगुणा वसुरामाः सागराम्बुनिधयश्च ।
वसुवेदा गजवेदाः षडब्धयो लोचनाम्बुधयः ॥ ५५ ॥
पंचगुणा सप्तयमा रसचन्द्राः षड् नभश्च रविसूनोः ॥ ५५½ ॥

सु. भा.—शनैः क्रमेण चतुर्दशपिण्डाः=११।२२।३१।३८।४४।४८।४६।४२।३५।२७।१६।६।०।अत्र महत्तमपिण्डो ४८ नवभक्तः परमं शीघ्रफलम्=$\frac{४८}{९}$=५°।२०′। अस्य ज्यान्त्यफलज्या=११।१२ खार्कमिते व्यासार्धे।

अत्रोपपत्तिः।

भौमपिण्डसाधनवदत्रापि—

केन्द्रज्या =२७।४०॥५३।४०॥७७।००॥९६।००॥११०।००॥११८।००॥
१२१।२०॥

केन्द्रकोटिज्या=११६।२०॥१०७।००॥९२।००॥७१।२०॥४७।२०॥२१।००॥
७।००॥

अन्त्यफलज्या =११।१२॥११।१२॥११।१२॥११।१२॥११।१२॥११।१२॥
११।१२॥

स्पको =१२७।३२॥११८।१२॥१०३।१२॥८२।३२॥५८।३२॥३२।१२॥
४।१२॥

शीक =७८३०॥७७८९॥७७२५॥७५९६॥७४७६॥७३३९॥७१६५॥

शीफज्या =२·७३॥४·६०॥६·७०॥८·४८॥९·८८॥१०·८०॥११·२०॥

शीफ =१°·१३॥२°·१८॥३°·१८॥४°·०३॥४°·७०॥५°·१२॥
५°·३३॥

९×शीफ =१०·१७॥१९·६२॥२८·६२॥३६·२७॥४२·३०॥४६·०८॥
४७·९०॥

केन्द्रज्या =११४।४०॥१०४।००॥८७।००॥६५।४०॥४१।००॥१४।००॥

केन्द्रकोटिज्या=३४।२०॥६०।००॥८२।००॥१००।००॥११३।००॥
११८।४०॥

अन्त्यफलज्या =११।१२॥११।१२॥११।१२॥११।१२॥११।१२॥११।१२॥

स्पको =२३।८॥४८।४८॥७०।४८॥८८।४८॥१०१।४८॥१०७।२८॥

शीक =६९९९॥६८९३॥६७३१॥६६२७॥६५८५॥६५०३॥

शीफज्या =१०·९७॥१०·१३॥८·६८॥६·६५॥४·२०॥१·४३॥

शीफ =५°·२२॥४°·८३॥४°·१३॥३°·१७॥२°·००॥०°·६८॥

९×शीफ =४६·९८॥४३·४७॥३७·१७॥२८·५३॥१८·००॥६·१२॥

आचार्यपिण्डाः=११।२२।३१।२८।४४।४८।४८॥

मत्साधिताः =१०।२०।२९।३६।४२।४६।४८॥

आचार्यपिण्डाः =४६।४२।३५।२७।१६।६।००॥

जत्साधिताः =४७।४३।३७।२९।१८।६।००॥

पिण्डमानमिति साधितं मया शीघ्रकर्णवशतः पराख्यया ।
जीवया लघुफलस्य विद्वरैश्चिन्तनीयमखिलं च चिद्वरैः ॥५५$\frac{1}{2}$॥

अब शनिपिण्डों को कहते हैं।

हि. भा.—शनि के क्रम से चतुर्दश (१४) पिण्ड =११।२२।३१।३८।४४।४८।४८।४६।४२।३५।२७।१६।६।०॥

यहाँ सबसे बड़ा पिण्ड=४८॥$\frac{४८}{९}$=शीघ्रफल=५°।२०′। इसकी ज्या अन्त्यफलज्या =११। यह ११ अन्त्यफलज्या १२० व्यासार्ध में होता है।

उपपत्ति ॥

भोमपिण्ड साधन की तरह यहां भी—

केन्द्रज्या =२७।४०॥५३।४०॥७७।००॥९६।००॥११०।००॥११८।०० ॥११९।२०॥

केन्द्रकोटिज्या =११६।२०॥१०७।००॥९२।००॥७९।२०॥४७।२०॥२१।००॥७।००॥

अन्त्यज्याफलज्या =११।१२॥११।१२॥११।१२॥११।१२॥११।१२॥११।१२॥११।१२॥

स्पको =१२७।३२॥११८।१२॥१०३।१२॥८२।३२॥५८।३२॥३२।१२॥४।१२॥

शीक =७८३०॥७७८९॥७७२५॥७५९६॥७४७६॥७३३९॥७१६५॥

शीफज्या =२·३७॥४·६०॥६·७०॥८·४८॥९·८८॥१०·८०॥११·२०॥

शीफ =१°·१३॥२°·१८॥३°·१८॥४°·३॥४°·७०॥५°·१२॥५°·३३॥

९×शफ =१०·१७।१९·६२॥२८.६२॥३६·२७॥४२·३०॥४६०८॥४७·९७॥

केन्द्रज्या =११४।४०॥१०४।००॥८७।००॥६५।४०॥४१।००॥१४।००॥

केन्द्रकोज्या =३४।२०॥६०।००॥८२।००॥१००।००॥११३।००॥११८।४०॥

अन्त्यफलज्या =११।१२॥११।१२॥११।१२॥११।१२॥११।१२॥११।१२॥

स्पको =२३।८॥४८।४८॥७०।४८॥८८।४८॥१०१।८८॥१०७।२८॥

शीक =६९९९॥६८९३॥६७३१॥६६२७॥६४८५॥६५०३॥

शीफज्या =१०·९७॥१०·१३॥८·६८॥६·६५॥४·२०॥१·४३॥

शीफ =५°·२२॥४°·८३॥४°·१३॥३°·१७॥२°·००॥००°·६८॥

९ × शीफ =४६·९८॥४३·४७॥३७·१७॥२८·५३॥१८·००॥६·१२॥

आचार्य का पिण्ड=११ । २२ । ३१ । ३८ । ४४ । ४८ । ४८

संशोधक का पिण्ड=१० । २० । २९ । ३६ । ४२ । ४६ । ४८

आचार्य का पिण्ड =४६ । ४२ । ३५ । २७ । १९ । ९ । ००

संशोधक का पिण्ड=४७ । ४३ । ३७ । २९ । १८ । ६ । ०० ॥

इदानीं भौमादीनां मध्यगतीर्मृदुगतिफलानि चाह ।

रूपगुणा ३१ बाणजिना: २४५ शर ५
षण्णव ९५ यम २ गुणा: ३ क्रमश: ॥ ५६ ॥
मध्यमभुक्तिकला: स्यु: षड् द्वि २६
रदा: ३२ खंवसु ८ शका ११ विकला: ।
मन्दगुणिता भुक्ति: खखनवविहृता भुक्ति: स्यात् ॥ ५७ ॥[1]
ग्रहवत् तन्मन्दफलं मृदुकेन्द्रवशात् स्वमृणं तदूनां च ॥ ५७½ ॥

सु. भा.—भौमादीनां मध्यमागतिकला: क्रमेण भौ ३१। बुशी २४५।गु५। शुशी ९६। श २ । रा ३। कलानामध एता विकलाश्च भौ २६। बुशी ३२। गु०। शुशी ८ ।श०। रा ११ ॥ भुक्तिर्भौमादीनां मृदुकेन्द्रगतिर्मन्दोच्चानामत्यल्पगतित्वाद्ग्रहमध्यगतिरेव मन्दविगुणिता मन्दभोग्यखण्डेन विगुणिता खखनवो ९०० द्धृता फलमद्यतनश्वस्तन मन्दकेन्द्रज्ययोरन्तरं स्यात् । इदमन्तरमेव केन्द्रज्यां प्रकल्प्य ग्रहवत् ३८-३९ सूत्रतस्तन्मन्दफलं साध्यं तच्च भुक्ते: फलं मृदुगतिफलं भवति । तच्च स्वमृदुकेन्द्रवशात् कुलीरादौ केन्द्रे धनं मकरादावृणं कार्यं मध्यमगतौ । एवं मन्दस्पष्टा गति: स्यात् । तदूनां शीघ्रगतिं शीघ्रोच्चगतिमित्यग्रे सम्बन्ध: ॥

अत्रोपपत्ति: ।

खमन्दगतिफलसाधनवत् स्फुटा ॥५६-५७½॥

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१. मन्दविगुणिता भुक्ति: खखनविहृता स्वभुक्ते:स्यात् ॥५७॥

अब भौमादि ग्रहों की मध्यगति और मन्दगतिफलों को कहते हैं।

हि. भा.—भौमादि ग्रहों की क्रम से मध्यम गति कला

=३१ भौ। बुशी २४५। गु ५। शुशी ६६। श २। रा. ३

भौमादि ग्रहों की क्रम से मध्यमगति विकला—

भौ=२६। बुशी=३२। गु=०॥ शुशी=८। श=०। रा=११॥

भौमादि ग्रहों की मृदुकेन्द्र गति बहुत ही अल्प होती हैं। इसलिये मध्यमगति को ही मन्दभोग्य खण्ड से गुणाकर ६०० से भाग देने पर फल अद्यतन श्वस्तन मन्द केन्द्रज्या का अंतर होता है। इस अन्तर को ही केन्द्रज्या मानकर ग्रह की तरह (३८-३९) सूत्र से मन्दफल लाना चाहिये। वह मृदुगति फल होता है। केन्द्र के वश से धनऋण करना उचित है। जैसे—कर्कादि केन्द्र में धन और तुलादि केन्द्र में ऋण करना चाहिये। इस तरह मन्दस्पष्टागति होती है। (तदूनां च) इसका अगले श्लोक से सम्बन्ध है।

उपपत्ति।

इसकी उपपत्ति रविमन्दगतिफल साधन की उपपत्ति से स्पष्ट ही है।

इदानीं शीघ्रगतिफलमाह।

शीघ्रगतिं सङ्गुणयेदेवं शीघ्रस्य खण्डेन ॥ ५८॥

पिण्डान्तरेण खार्कैः १२० लिप्ताद्यं स्यात् फलं गतेः शीघ्रम्।

स्वमृणं क्रमोत्क्रमविधौ चतुर्दश विधिश्च पिण्डको गुणकः ॥ ५९ ॥

हरस्वगतिरेवं वह्नृणात्याज्ये भुक्तेपदलिते

द्वे द्वे सूकाले कारयेत् स्फुटा भुक्तिः ॥ ६० ॥[1]

सु. भा.—मन्दस्फुटगत्यूनां शीघ्रगतिं शीघ्रोच्चगतिं शीघ्रकेन्द्रगतिंतां शीघ्रस्य खण्डेनार्थात् पिण्डान्तरेण पिण्डयोर्गतैष्यपिण्डयोरन्तरेण सङ्गुणयेत् खार्के १२० विभजेद्यल्लिप्ताद्यं फलं तद्गते शीघ्रं फलं स्यात्। तच्च क्रमोत्क्रमविधौ स्वमृणं स्यात्। गतपिण्डत एष्यपिण्डेऽधिके धनमल्पे ऋणमित्यर्थः। अथ यदि चतुर्दशश्चतुर्दशपिण्ड एष्यो भवेत् तदा शीघ्रकेन्द्रगतेर्गुणको विश्वपिण्डो हरश्च षष्टिर्भवेत्। शीघ्रकेन्द्रगतिं त्रयोदशपिण्डप्रमाणेन सङ्गुण्यषष्ट्या विभजेत् फलं तदा गतेः शीघ्रफलं स्यादित्यर्थः। मन्दस्फुटा गतिः शीघ्रगतिफलसंस्कृता स्फुटा गतिः

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१. खरसहरो गतिरेवं बहुऋणमानं स्वमन्दभुक्तेश्चेत्।
भुक्त्यपरहिते वक्रां तत्काले कारयेद् भुक्तिम् ॥६०॥

स्यात् । एवं यदि मन्दस्पष्टगतेः शीघ्रगतिफलमृणं बहु स्यात् तदा ऋणमाने भुक्त्यपरहिते मन्दस्पष्टगतिरहिते सति शेषं तत्काले वक्रां भुक्तिं कारयेद्गणक इति शेषः ॥

अत्रोपपत्तिः ।

यदि चत्वारिंशन्मितेन भागात्मकेन त्रिगुणशेषेण गतैष्यपिण्डयोरुन्तरं लभ्यते तदा त्रिगुणकेन्द्रगतिभाग समशेषेण किं पिण्डस्य नवगुणत्वात् फलं नवहृत-मद्यतनश्वस्तन शीघ्रफलयोरन्तरं भागात्मकं तत् षष्टिगुणं जातं कलात्मकं शीघ्र गतिफलम् $\frac{(\text{गपि} \backsim \text{एपि})\ \text{३शीकेग}}{४० \times ९ \times ६०} \times ६० = \frac{(\text{गपि} \backsim \text{एपि})\ \text{शीकेग}}{१२०}$ ।

त्रयोदशचतुर्दशपिण्डयोरन्तरे केन्द्रांशाः $= \frac{२०}{३}$ इति पूर्वं ४२ सूत्रे प्रतिपादि-तम् । तत्र गतैष्यपिण्डान्तरं चतुर्दशपिण्डाभावात् त्रयोदशपिण्ड सममतः शीघ्रफल गति साधने तत्र केन्द्रगतेस्त्रयोदशपिण्डो गुणः षष्टिर्हरो भवेत् धनर्णवासना चाति-सुगमा ॥५८–६०॥

अब ग्रह के शीघ्रगति फल को कहते हैं ।

हि. भा.— मन्दस्फुटगति से ऊन शीघ्रोच्चगति शीघ्रकेन्द्रगति होती है । शीघ्रकेन्द्र-गति को शीघ्रखण्ड (अर्थात् गत-एष्य पिण्ड का अन्तर) से गुणा दें और खार्क (१२०) से भाग दें लब्धि कलादि होगी, वही शीघ्रफल होगा । उस शीघ्रफल को क्रम और उत्क्रम विधि में धन और ऋण करें । जैसे जहां पर गतपिण्ड से एष्यपिण्ड अधिक हो वहां फल को धन करें । जहां पर गतपिण्ड से एष्यपिण्ड अल्प हो वहां ऋण करदें ।

जहां चतुर्दश (१४) पिण्डएष्य हो वहां शीघ्रकेन्द्रगति का गुणक विश्व (१३) पिण्ड होता है और भाग हर षष्टि (६०) होता है । शीघ्रकेन्द्रगति को त्रयोदश (१३) पिण्ड से गुणाकर साठ से भाग दें फल शीघ्रगतिफल होगा, मन्दस्फुटगति $\pm$ शीगफ $=$ स्फुटगति । यदि मन्दस्पष्टगति से ऋणशीघ्रगतिफल अधिक हो तो शेष को वक्रगति करना चाहिये ।

उपपत्ति ।

त्रिगुणशेष भागात्मक चत्वारिंशत् (४०) में गत एष्यपिण्ड का अंतर मिलता है तो त्रिगुणित केन्द्रगति समशेष में क्या इस अनुपात से भागात्मक अद्यतन श्वस्तन शीघ्रफल का अन्तर $= \frac{(\text{गपि} \sim \text{एपि})\ \text{३ शीकेग}}{४० \times ९ \times ६०}$ । इसको साठ से गुणने पर कलात्मक शीघ्रगतिफल $= \frac{(\text{गपि} \backsim \text{एपि})\ \text{१ शीकेग}}{१२०}$ ।

तेरह-चौदह पिण्डों के अन्तर में केन्द्रांश $= \frac{२०}{३}$ । पहले ४२ सूत्र में कहा गया है ।

वहां चौदहवें पिण्ड के अभाव में तेरहवां पिण्ड ही गत एष्य पिण्ड का अन्तर होता है। इसलिये शीघ्रगति फल साधन में केन्द्र गति को तेरहवां पिण्ड गुणक और षष्टि (६०) भाग हर होता है। धन ऋण की युक्ति स्पष्ट ही है।

खण्डखाद्यस्य श्लोका एते।[1]

नवतिथयो १५९ ऽष्टि १६ विभक्ताः[2]
पंचरसा ६५ वसु ८ हृता दश १० त्रिहृताः।
विषुवच्छायागुणिताः
स्वदेशजाश्चरदलविनाड्यः ॥ ६१ ॥

सु. भा.—नवतिथयो १५९ विषुवतीगुणिताः षोडशविभक्ताः फलं फलात्मकं स्वदेशे प्रथमं चरखण्डम्। पञ्चरसा ६५ विषुवतीगुणा वसु ८ हृताः फलं द्वितीयं चरखण्डम्। एवं दश १० पलभा हतास्त्रि ३ हृतास्तृतीयं चरखण्डं भवतीति।

अत्रोपपत्तिः।

एकाङ्गुलपलभादेशे चाचार्यमतेन क्रमेण पलात्मकानि चरखण्डानि प्रख $= \frac{१५९}{१६}$। द्विखं $= \frac{६५}{८}$। तृख $= \frac{१०}{३}$ एतानि पलभागुणानि स्वदेशे भवन्तीति स्फुटा वासना। भास्कराचार्येण $\frac{१५९}{१६}$। $\frac{६५}{८}$ अनयोः स्थाने क्रमेण १०, ८ संख्ये गृहीते। अत उक्तं 'दिङ्नागसत्र्यंशगुणैर्विनिघ्नी पलप्रभे' त्यादि ॥६१॥

अब चरखण्ड को कहते हैं।

हि. भा.—नवतिथयः (१५९) को विषुवती (पलभा) से गुणाकर षोड्श (१६) से भाग देने पर फल अपने देश का पलात्मक पहला चरखण्ड होता है॥ पञ्चरसा (६५) को विषुवती (पलभा) से गुणाकर वसु (८) से भाग देने पर फल दूसरा चरखण्ड होता है।

इस तरह दश (१०) को पलभा से गुणाकर तीन से भाग देने पर फल तीसरा चरखण्ड होता है।

उपपत्ति।

जिस देश की पलभा १ अंगुल की है। उस देश का पलात्मक चरखण्ड = प्रखं

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१. नवतिपयोधिविभक्ता इत्यादि आर्याषट्कं खण्डखाद्याच्चिन्त्यम्।

२. नवतिथयोऽष्टिविभक्ता इति पाठः साधुः

$=\frac{१५६}{१६}$ । द्विखं$=\frac{६५}{८}$ । तृखं $\frac{१०}{३}$ । आचार्य ने स्वीकार किया है ।

भास्कराचार्य ने $\frac{१५६}{१६}$, $\frac{६५}{८}$ इन दोनों के क्रम से १०, ८ को ग्रहण किया है । इसलिये "दिग् नाग सत्र्यंशगुणैर्विनिघ्नीपलप्रभे" इत्यादि में कहा गया है ।

उपरोक्त चरखण्ड को अपने-अपने देश की पलभा से गुणने पर अपने-अपने देश का चरखण्ड होता है । इसकी उपपत्ति स्पष्ट ही है ।

ज्याः केन्द्रं स्फुटभानुं
कृत्वा ये राशयश्चरार्धानि ।
भुक्तानि भोग्यगुणिता
च्छेषात् खखधृतिहृतात् तु फलम् ।। ६२ ।।

सु. भा.—स्फुटभानुं केन्द्रं कृत्वा तस्य तस्य भुजः साध्यस्तत्र चरार्धानि ज्या ज्या खण्डानि प्रकल्प्य केन्द्रभुजे ये राशयस्तन्मितानि भुक्तानि ज्याखण्डानि भवन्ति । शेषात् केन्द्रभुजशेषकलामानाद्भोग्यचरखण्डगुणात् खखधृति १८०० हृतात् फलं च गतचरखण्डयोगे क्षेप्यमेवमभीष्टंपलात्मकं चरमानं भवेत् । अत्रोपपत्तिस्त्रैराशिकेन स्फुटा ।।६२।।

पलात्मक चरमान को कहते हैं ।

हि. भा.—स्पष्टसूर्य का केन्द्र को भुज बना लें, वहां चरखण्डज्या को ज्या खण्ड कल्पना करें । केन्द्र भुज में जितनी राशियां हों उनके तुल्य व्यतीत ज्याखण्ड होते हैं । भुज शेषकला के मान से भोग्य चरखण्ड से गुणा करें, उसमें खखधृति (१८००) से भाग दें, फल को गत चरखण्ड योग में जोड़ दें तो अभीष्ट पलात्मक चरमान होता है ।

उपपत्ति ।

यहां चरानयन की उपपत्ति त्रैराशिक गणित द्वारा स्पष्ट ही है ।

गतिपादं पादोनां गतिं विशोध्यास्तकाल उदये च ।
संसाधितस्य तस्य ग्रहस्य चरकर्म चान्यस्य ।। ६३ ।।

सु. भा.—निशीथकालिकग्रहे गतिचतुर्थांशं चतुर्थांशोनां गतिं च विशोध्य क्रमेणास्तकाले उदये च ग्रहो भवति । एवं तस्य रवेर्वाऽन्यस्य ग्रहस्य संसाधितस्य मध्ये चरकर्म कार्यम् अस्ते उदये वा ग्रहे चरकर्म देयं न दिनार्धे निशीथे चेति स्फुटं सिद्धान्तविदामिति ।।६३।।

हि. भा.—निशीथ कालिक ग्रह में गति का चौथे भाग और चौथा भाग से हीन गति को घटाने पर क्रम से अस्तकाल तथा उदयकाल में ग्रह होता है । जैसे—निशीथ

कालिक ग्रह में गति का चतुर्थांश घटाने से अस्तकालिक एवं चतुर्थांश भाग से हीनगति को निशीथकालिक ग्रह में घटाने से शेष उदयकालिक ग्रह होता है।

इस तरह साधित ग्रहों के मध्य में चरकर्म करना चाहिये। उदयकाल या अस्तकाल में ग्रह में चरकर्म करना चाहिये। दिनार्ध और रात्र्यर्ध में चरकर्म नहीं करना चाहिये, यह बात सिद्धान्त वेत्ता स्पष्ट रूप से जानते ही हैं।

चरदलविनाडिकागतिकलावधात् खखरसाग्नि ३६०० लब्धकलाः।
ऋणमुदयेऽस्तमये धनमुत्तरगोले ऽन्यथा याम्ये ॥ ६४ ॥

सु० भा०—स्पष्टार्थम्। उपपत्तिश्च 'चरघ्नभुक्तिर्द्युनिशासु भक्ते'त्यादिना भास्करोक्तेन स्फुटा ॥६४॥

हि. भा..—चरदल घटी और गतिकला के गुणनफल में खखरसाग्नि (३६००) से भाग दें। फल कलात्मक होगा। उत्तर गोल में सूर्य हो तो उस फल कला को उदयकाल में ऋण और अस्तकाल में धन करना चाहिये। याम्य गोल में सूर्य हो तो फलकला को उदयकाल में धन और अस्तकाल में ऋण करना चाहिये।

पंचदश हीनयुक्ताश्चरार्धनाडीभिरुत्तरे गोले।
याम्ये युक्तविहीना द्विसङ्गुणा रात्रिदिननाड्यः ६५

सु. भा.—स्पष्टार्थम्। उपपत्तिश्च 'चरघटीसहिता रहिता क्रमात् तिथिमिता घटिका खलु गोलयोरि' त्यादिना भास्करविधिना स्फुटा ॥६५॥

हि. भा.—पञ्चदश (१५) से युत चरघटी उत्तर गोल में दिनार्ध होता है। पञ्चदश (१५) से हीन चरघटी रात्र्यर्ध होता है।

दक्षिण गोल में पञ्चदश (१५) से युत चरघटी रात्र्यर्ध तथा (१५) से हीन चरघटी दिनार्ध होता है। दिनार्ध और रात्र्यर्ध को दूना करने से दिनमान और रात्रिमान होता है।

उपपत्ति।

चरघटी सहिता रहिता क्रमात् तिथिमिता घटिका खलु गोलयोरित्यादि भास्करोक्त श्लोक की उपपत्ति से स्पष्ट ही है।

मिश्रेष्टान्तरगुणिता भुक्तिर्दिवसे निशादले प्रथमे।
षष्ट्या विभज्य लब्धं विशोध्य तात्कालिको भवति ॥ ६६ ॥

सु. भा.—दिवसे दिनेष्टकाले वा प्रथमे निशादले निशीथतोऽर्वाक् चेष्ट

काले मिश्रस्य राज्यर्धकालस्य स्वेष्टकालस्य च यदन्तरं तेन भुक्तिर्ग्रहगतिर्गुणा फलं षष्टया विभज्य लब्धं निशीथकालिकग्रहाद्विशोध्य शेषं तात्कालिको ग्रहो भवति । एवं निशीथानन्तरेष्टकाले लब्धं निशीथकालिकग्रहे संयोज्य तात्कालिक-ग्रहः कार्य इत्यनुक्तमपि बुद्धिमता ज्ञायत इति ।

अत्रोपपत्तिस्त्रैराशिकेन स्फुटा ॥६६॥

हि. भा.—दिन में या राज्यर्ध से पूर्व इष्टकाल हो तो मिश्रकाल, इष्टकाल के अंतर को ग्रहगति से गुणा करें, गुणनफल में साठ (६०) से भाग देने पर फल जो हो उसको निशीथ (राज्यर्ध) कालिक ग्रह में घटा देने से शेष तात्कालिक (इष्टकालिक) ग्रह होता है। इस तरह राज्यर्ध के बाद इष्टकाल हो तो मिश्रकाल और इष्टकाल के अन्तर को ग्रहगति से गुणाकर ६० से भाग दें, लब्ध फल को राज्यर्धकालिक ग्रह में जोड़ देने से इष्टकालिक ग्रह होता है।

उपपत्ति ।

यहां इसकी उपपत्ति त्रैराशिक गणित से स्पष्ट ही है। विज्ञजन के लिये इससे अधिक स्पष्ट क्या हो सकता है।

क्रान्त्ययुतिवियोगादक्षपदेः शोधिते दिनदले भा ।
भाश्रुतिकृत्योः कृतमनुयुतोनयाकृत्वकर्षः स्यात् ॥ ६७ ॥[1]

सु. भा.—क्रान्त्यक्षयोर्युतिवियोगात् त्रिप्रश्नोक्त्या मध्यनतांशाः साध्याः । नतांशमाने चक्रपदान्नवतेः शोधिते शङ्कुचापमाने विदिते सति त्रिप्रश्नाधिकार विधिना शङ्कुना मध्यनतांशज्या तदा द्वादशांगुल शंकुना किमित्यनुपातेन दिनदले मध्याह्ने भा छाया साध्या । छायाकर्ण कृत्योः कृतमनुयुतोनयोः सत्योयारकर्षस्या-परस्य कृतिः क्रमेण भवति । छायाकृतिः कृतमनु १४४ युता छायाकर्णकृतिस्तथा छायाकर्णकृतिः कृतमनु १४४ भिरूना छायाकृतिर्भवतीत्यर्थः ।

अत्रोपपत्तिः ।

त्रिप्रश्नाधिकारविधिना स्फुटा ॥६७॥

हि. भा.—क्रान्ति और अक्षांश का योग या अन्तर मध्य नतांश होता है। नतांश मान को चक्रपद (९०) में घटाने से ९०—नतांश=उन्नतांश होता है। इस पर से शंकुमान जानकर त्रिप्रश्नाधिकारोक्त प्रकार से अनुपात द्वारा दिनार्ध में छाया साधन करना चाहिये

१ क्रान्त्यक्षयुतिवियोगाच्चक्रपदात् शोधिते दिनदले भा ।
भाश्रुतिकृत्योः कृतमनुयुतोनयोः कृतिरकर्षस्य ॥६७॥

यथा $\frac{\text{मनज्या}\times\text{द्वाशंकु}}{\text{शंकु}}$ मछाया । छाया$+$१४४$=$छाक तथा छाक$-$१४४$=$छा ।
दोनों का मूल लेने से छायाकर्ण तथा छाया होती है ।

उपपत्ति ।

यहां त्रिप्रश्नाधिकरोक्त विधि से उपपत्ति स्पष्ट है ।

इदानीमिष्टकाले स्थूलं छायाकर्णमाह ।

षड्गुणिता गतशेषा नाड्यो दिवसविभाजिताज्या तत् ।
दिनदलकर्मगुणाः स्वानया त्रिभज्याभक्तं फलं कर्णः ।। ६८ ।।[1]

सु. भा.—गतशेषा नाड्य उन्नतकालः । षड्गुणिता दिनार्धभाजिता यत् फलं स्यात् तत्संख्यया ज्या साध्या । यल्लब्धं तत्संख्यकानां १५ सूत्रे लिखितानां ज्याखण्डानां योगः कार्यः सा ज्या भवतीत्यर्थः । एवमियं ज्या स्थूलेष्टान्त्या ज्ञातव्येति । त्रिभज्या दिनार्धकर्णेन गुणाऽनया पूर्वसाधितया स्थूलेष्टान्त्याऽऽप्ता फलं स्थूल इष्टकाले छायाकर्णो भवतीति ।

अत्रोपपत्तिः ।

यदि दिनदलोन्नतकालेन नवतिभागास्तदेष्टोन्नतकालेन किं लब्धा भागाः षष्टिगुणाः कलास्ताः खखनवो ९०० ह्रृता लब्धाः$=\frac{\text{९०} \text{ उका}\times\text{६०}}{\text{दिद}\times\text{९००}}=\frac{\text{६} \text{ उका}}{\text{दिद}}$ । लब्धसंख्यकानां ज्याखण्डानां योगः स्थूलेष्टान्त्या जाता । ततो यदि दिनार्धान्त्यया स्थूलतया त्रिज्यासमया दिनार्धकर्णो लभ्यते तदेष्टान्त्यया किं व्यस्तानुपातेन जात इष्टकर्णः $=\frac{\text{दिकं}\times\text{त्रि}}{\text{इ अ}}$ । अत उपपन्नम् ।।६८।।

अब इष्टकाल में स्थूल छायाकर्ण को कहते हैं ।

हि. भा.—गतशेषनाड़ी (उन्नतकाल) को षट् (६) से गुणाकर दिनार्धं से भाग दें जो फल मिले उससे ज्या साधन करना चाहिये । फल के बराबर (१५) सूत्र के अनुसार ज्या खण्डों का योग करें, वही ज्या होगी । यह ज्या को स्थूल इष्टान्त्या समझनी चाहिये । त्रिभज्या को दिनार्ध कर्ण से गुणाकर पूर्वसाधित स्थूल इष्टन्त्या से भाग देने पर फल जो हो वह इष्टकाल में स्थूल छायाकर्ण होता है ।

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१ षड्गुणिता गतशेषा नाड्यो दिवसार्धभाजिता तज्ज्या ।
दिनदलकर्णगुणाऽऽप्तानया त्रिभज्या फलं कर्णः ।।६८।।

उपपत्ति ।

यदि दिनार्धतुल्य उन्नतकाल में नवति (९०′) भाग मिलता है तो उन्नतकाल में क्या इस अनुपात से जो फल भाग हो उसको षष्टि (६०) से गुणाकर कला होती हैं। उसको खखनव (९००) से भाग देने से उसका स्वरूप $= \frac{९० \text{ उका} \times ६०}{\text{दिक} \times ९००} = \frac{६ \text{ उका}}{\text{दिक}}$ ।

यहां लब्ध संख्यक ज्या खण्डों का योग स्थूल इष्टान्त्या होती है। इस पर से उलटे अनुपात से इष्टकर्ण $= \frac{\text{दिक} \times \text{त्रि}}{\text{इअं}}$ । इससे उपपन्न हुआ ।

इदानीमिष्टकर्णत उन्नतकालमाह ।

दिनदलकर्णे त्रिभज्यागुणे श्रवणोद्धृते फलस्य धनुः ।
द्युदलगुणं तिथिभक्तं दिनगतशेषासवः क्रमशः ॥ ६९ ॥

सु. *भा.*—धनुर्दिनार्धगुणं पञ्चदशभक्तं फल क्रमशः पूर्वापरकपालयोर्दिनगतशेषासवो भवन्ति । शेषं स्पष्टार्थम् ।

अत्रोपपत्तिः ।

पूर्वप्रकारवैपरीत्येन धनुः$= \frac{९० \times ६० \times \text{उका}}{\text{दिद}}$ अतो घट्यात्मक उन्नतकाल $= \frac{\text{दिन} \times \text{ध}}{९० \times ६०}$ । अयं ३६० गुणो जातोऽस्वात्मक उन्नत कालः$= \frac{\text{दिद} \times \text{ध}}{१५}$ अत उपपन्नम् ॥६९॥

अब इष्टकर्ण पर से उन्नतकाल को लाते हैं ।

हि. भा.—दिनार्ध कर्ण को त्रिज्या से गुणा दें, कर्ण से भाग दें, फल जो हो उसका चाप कर लें, उसको दिनार्ध से गुणाकर तिथि (१५) से भाग दें फल क्रम से दिनगत शेषासव होता है ।

उपपत्ति ।

(६८) सूत्र के विपरीत क्रम से यहां धनु $= \frac{९० \times ६० \times \text{उका}}{\text{दिद}}$ ।

इससे घट्यात्मक उन्नतकाल $= \frac{\text{दिद} \times \text{ध}}{९० \times ६०}$ ।

इसको (३६०) से गुणने पर, उन्नतकाल $= \frac{ि दद \times ध}{१५}$ ।

इस युक्ति से (६९) वां श्लोक उपपन्न हुआ।

इदानीं ज्यातश्चापानयनमाह ।

ज्याखण्डोने शेषे गुणिते नवभिः शतैरशुद्धहृते ।
क्षेप्याणि शुद्धखण्डैर्गुणितानि शतानि नव चापम् ।। ७० ।।

सु. भा.—ज्यामाने ज्याखण्डैः १५ सूत्रे पठितैरूने शेषे नवशतैर्गुणितेऽशुद्ध-खण्डहृते लब्धौ शुद्धखण्डैः शुद्धखण्डसंख्याभिर्गुणितानि नवशतानि क्षेप्याणि तदा चापं भवति ।

अत्रोपपत्तिः ।

ज्यासाधनवैपरीत्येन सुगमा ।।७०।।

अब ज्या से चाप साधन को कहते हैं ।

हि. भा.—यहां (१५) सूत्र में कथित ज्या खण्ड को ज्या मान में से घटाकर—नव-शत (९००) से गुणा दें, अशुद्ध खण्ड से भाग दें, लब्ध शुद्धखण्ड संख्या से गुणा हुआ नव-शत (९००) उसमें जोड़ दें तो चाप मान होता है ।

उपपत्ति ।

यहां ज्या साधनोपपत्ति के विपरीत (उलटा) उपपत्ति द्वारा (७०) वां श्लोक उपपन्न होता है—व्यर्थ बार-बार लिखने के प्रयास से क्या लाभ ।

इदानीमुपसंहारमाह ।

इति तिथिनक्षत्रदिनमाद्यादिकसिद्धौ ब्रह्मगुप्तेन ।
द्वासप्तत्यार्याणां संक्षिप्तोऽतिस्फुटश्चैषः ।। ७१ ।।

सु. भा.—स्पष्टार्थम् ।।७१।।

हि. भा.—इसका अर्थ तो स्पष्ट ही है । इस ग्रन्थ में आचार्य ब्रह्मगुप्त ने तिथि, नक्षत्र, दिन आदि समस्त विषयों का उल्लेख इन बहत्तर आर्याओं के द्वारा संक्षिप्त रूप से कर दिया है ।। ७१ ।।

इदानीमयं कस्मै न दातव्य इत्याह ।

दुर्जनकृतघ्नशत्रुप्रतिकंचुककारिणे न दातव्यः ।
ध्यानग्रहाधिकारो जिष्णु सुतब्रह्मगुप्तकृतः ।। ७२ ।।

इति श्री ब्रह्मगुप्तकृतो ध्यानग्रहोपदेशाध्यायः समाप्तः ।।

सु. *भा.*—प्रतिकञ्चुककारी पिशुनः । शेषं स्पष्टम् ।।७२।।

मधुसूदनसूनुनोदितो यस्तिलकः श्रीपृथुनेह जिष्णुजोक्ते ।
हृदि तं विनिधाय नूतनोऽयं रचितो ध्यानखगे सुधाकरेण ।।१।।

अपकृष्य दशावतारलीलां प्रकृतिर्वामकलामलङ्करोति ।
परिहाय सुपात्रमत्र लोकाः सकला सङ्कलयन्ति कौ कुपात्रम् ।।२।।

या ब्रह्मगुप्तकृतिरत्र सहस्रसूत्रैर्नाना प्रकारकरणेन च भास्करेण ।
मन्दीकृता पृथुवृथातिलकेन सेयं विद्योतिता निजकरेण सुधाकरेण ।।३।।

ये भास्करादिकृतिपारगता नवीने चापप्रपञ्चजविधौ कुशलाः सुशीलाः ।
श्रीमत्सुधाकरकृतं तिलकं निधाय सज्ज्यौतिषेऽत्र विहरन्तु त एव धीराः ।।४।।

कृपालुसूनुना सुधाकरद्विवेदिना सुतं परात्परं निधाय मानसे सुकोशलापतेः ।
गजेषुनन्दभूमिहायने मधौ सितेगुरौ,सुरामजन्मसत्तिथावकारि सोपपत्तिका ।५।

सन् १९०१ मार्चमासस्याष्टाविंशतिदिने श्रीजानकीरमणचरण सरोजरजः प्रसादेनायं तिलकः सम्पूर्णतामगात् ।।

इति श्रीकृपालुदत्तसूनु सुधारकद्विवेदिविरचितो ब्रह्मगुप्तकृतध्यानग्रहोपदेशाध्यायतिलकः समाप्तः ।

यह किसको न देना चाहिये सो कहते हैं ।

हि. भा—जिष्णु सुत ब्रह्मगुप्त से निर्मित इस "ध्यानग्रहोपदेशाध्याय" को दुर्जन, कृतघ्न, शत्रु, प्रतिकञ्चुक (चुगलखोर) इन सबों को न देना चाहिये, यह ग्रन्थ बनाने वाले का उपदेश है ।।७२।।

यहां ब्रह्मगुप्तकृत ध्यानग्रहोपदेशाध्याय समाप्त हुआ ।

अथ ध्यानग्रहोपदेशाध्याये क्षेपसाधनम् ।

२ श्लोके पञ्चचत्वारिंशत् षष्टिभक्ता फलम् $=\frac{४५}{६०}=\frac{३}{४}$ इदं स्थूलत्वेन व्यर्थमेव मध्यराशावाचार्येण प्रक्षिप्तम् ।

'अथ सरसवेदयुक्त' एतदर्थम्—

'गोद्रीन्द्वद्रिकृताङ्कदस्रनगगोचन्द्राः—१९७२९४७१७९ शकाब्दान्विताः' इति भास्करोक्त्या खपञ्चपञ्च ५५० मिते शके कल्पगताब्दाः $=$ १९७२९४७७२९ । वर्षादावधिशेषज्ञानायाऽनुपातः, कल्पसौरवर्षैः कल्पाधिमासा लभ्यन्ते तदेष्टसौरवर्षैरेभिः क इति जाता इष्टाऽधिमासाः $=\frac{१९७२९४७७२९\times१५९३३००००००}{४३२००००००००}$

$=\frac{१९७२९४७७२९\times५३११}{१४४००}$ ।

(१) कल्पगताब्देषु हरतष्टेषु शेषम् $=$ ३९२९ ।**

(२) $\frac{३७२९}{१४४००}=\frac{१९८०४७१९}{१४४००}=१३७५\frac{४७१९}{१४४००}$ ।

(३) यद्येतावति १४४०० हरे ४७१९ क्षेपकोऽयं तदैतावति १३१ क इति संचारितः क्षेपकः $=\frac{४७१९\times१३१}{१४४००}=\frac{६१८१८९}{१४४००}=४२\frac{१३३८९}{१४४००}=४३$ स्व० ।

अतोऽत्र 'सगुणवेदः' इति पाठः सम्यगिति सिध्यति ।

(१) १४४००) १९७२९४७७२९ (१३७०१०—लब्धिः

५३२
———
१००९
१४७

**००३७२९ $=$ कलिगताब्दाः ।

(२) ५३११ / ३७२६

३७२६
१११८७
१८६४५

१९८०४७१९ (१३७५=कलिमुखाद् गताधिमासाः ।
५४०
१०८४
७६७
४७१९
१३१
(३) -
४७१९
१४१५७
४७१९

६१८१८९(४२=क्षेपकः
४२१
१३३८९=शेषम्

लब्धिः=१३७०१०। गुणः=५३११। अनयोर्घातः—

१३७०१०
१३७०१
४११०३
६७५०५

७२७६६०११०=कल्पारम्भे गता अधिमासाः।
१३७५=कल्पारम्भाद् ग्रन्थारम्भशकावधिगता अधिमासाः

७२७६६१४८५=कल्पादितो ग्रन्थारम्भशकावधि गता अधिमासाः ।

४ श्लोकक्षेपसाधनम्—

पूर्वसाधिताः कल्पगताब्दाः १९७२९४७७२९ मासीकृताः २३६७५३७२७४८ पूर्वसाधितैः ७२७६६१४८५ अधिमासैर्युता जाताश्चान्द्रमासाः=२४४०३०३४२३३। कल्पचान्द्रमासैः कल्पकुदिनानि लभ्यन्ते तदैभिः किमिति जातो वर्षारम्भसमीपस्थ-

मध्यमदर्शान्त कालिकः कुदिनगणः= $\frac{२४४०३०३४२३३ \times १५७७९१६४५००००}{५३४३३३००००००}$

= $\frac{२४४०३०३४२३३ \times १०५१९४४३}{३५६२२२}$ सप्तगुणितहरेण २४९३५५४ नेन गुण्यगुणकयोस्तक्षणाय न्यासः—

२४९३५५४)२४४०३०३४२३३(९७८६
२२४४१९८६
१९६१०४८२
१७४५४८७८
२१५५६०४३
१९९४८४३२
१६०७६११३
१४९६१३२४
१९९४८४३२
१६०७६११३
१४९६१३२४
१११४७८९=गुण्यशेषम् ।
५४५२२७—गुणकशेषम् ।
७८०३५२३
२२२९५७
२२२९५७८
५५७३९४५
४४५९१५६
५५७३९४५

२४९३५५४)१०५१९४४३(४
९९७४२१६
५४५२२७=गुणकशेषम्

३५६२२२)६०७८१३०६२१०३(१७०६२७६ सप्ततष्टे शेषं वाराः=५
३५६२२२
२५१५९१०
२४९३५५४
२२३५६६२
२१३७३३२
९८३३०१
७१२४४४
२७०८५७०
२४९३५५४
२१५०१६३
२१३७३३२
१२८३१
६०

७६९८६९(घटचौ २ ।
७१२४४४
५७४१६
६०
३४४४९६०(पलानि ९$\frac{२}{३}$ स्व० ।
३२०५९९८
२३८९६२

अत्र वर्त्तमानवारार्थं ५ स्थाने ६ संख्या गृहीताऽऽचार्येण तथा २ स्थाने ४, ६ स्थाने च १८ संख्या गृहीता। एवमत्र घटीद्वयं पलनवकं चाधिकं गृहीतमाचार्येणेति ज्योतिर्विद्भिश्चिन्त्यम्।

६ श्लोक क्षेपसाधनम्।

पूर्वसाधिताः कल्पगताब्दाः=१९७२९४७७२९। एते द्वादशगुणिता जाताः सौरमासाः=२३६७५३७२७४८। इष्टशका—५५० रम्भे गताधिमासाः=१३७०१० ×५३११+१३७५=७२७६६१४८५*

इष्टचान्द्रमासाः = २३६७५३७२७४८+७२७६६१४८५ =२४४०३०३४२३३ कल्पचान्द्रमासैः कल्पचन्द्रमन्दकेन्द्रभगणाः कल्पचान्द्रमासोना लभ्यन्ते तदैभिः क इति जातं भगणात्मकं चन्द्रकेन्द्रम् = $\frac{२४४०३०३४२३३ \times ३८३१८९४१४२}{५३४३३३००००००}$

१	२४४०३०३४२३३	१	५३४३३३
२	४८८०६०६८४६६	२	१०६८६६६
३	७३२०९१०२६९९	३	१६०२९९९
४	९७६१२१३६९३२	५	२६७१६६५
८	१९५२२४२७३८६४	६	३२०५९९८
९	२१९६२७३०८०९७	७	३७४०३३१
		८	४२७४६६४
		९	४८०८९९७

४८८०६०६८४६६
९७६१२१३६९३२
२४४०३०३४२३३
९७६१२१३६९३२
२१९६२७३०८०९७
१९५२२४२७३८६४
२४४०३०३४२३३
७३२०९१०२६९९
१९५२२४२७३८६४
७३२०९१०२६९९

* श्लोक क्षेपसाधनं द्रष्टव्यम्।

५३४३३३०००००)९३५०९८४३९२४४५८१६३०८६(१७५००२९३६२
५३४३३३
४००७६५४
३७४०३३१
२६७३२३३
२६७१६६५
१५६८९२४
१०६८६६६
५००२५८४
४८०८९९७
१९३५८७५
१६०९९९९
३३२८७६८
३२०५९९८
१२२७७०१
१०६८६६६
१५९०३५६३०८६ = भगणशेषम्
२८
१२७२२८५०४६८८
३१८०७१२६१७२
४४५२९९७,६६४०८ (८ $\frac{१७८३३३६६४०८}{५३४३३३०००००}$
४२७४६६४ = ८$\frac{१}{३}$ स्व
१७८३३३६६४०८

अत्राऽऽचार्येण सुखार्थं छन्दोऽनुरोधाद् वा ८$\frac{१}{३}$ स्थाने ८$\frac{१}{२}$ गृहीतेति कल्प्यते।

अब ध्यानग्रहोपदेशाध्याय में क्षेप साधन करते हैं।

हि. भा.—ध्यान ग्रहोपदेशाध्याय का दूसरे श्लोक में पञ्चचत्वारिंशत् (४५) को षष्टि (६०) से भाग देकर फल $= \frac{४५}{६०} = \frac{३}{४}$ इसको व्यर्थ ही मध्यमराशि में आचार्य ने जोड़ दिया है। इसके बाद "सरसवेदयुक्त" इसके लिये गौद्रीन्द्वद्रिकृताङ्क दस्त्रनगगोचन्द्राः

=१६७२६४७१७६, इसको शाकाब्द में जोड़ दें, यह भास्करोक्ति से खपञ्चपञ्च के तुल्य शाका में कल्प गताब्द=१६७२६४७७२६। वर्ष के आदि में अधिशेष के ज्ञान के लिये अनुपात करते हैं।

$$\frac{\text{कअमा} \times \text{इष्टसौर वर्ष}}{\text{कसौव}} = \frac{१६७२६४७७२६ \times १५६३३००००००}{४३२००००००००}$$

$$= \frac{१६७२६४७७२६ \times ५३११}{१४४००}।$$

(१) कल्पगताब्द में हर से भाग देने पर शेष=३६२६।

(२) $\frac{३६२६ \times ५३११}{१४४००} = \frac{१६८०४७१६}{१४४००} = १३७५ + \frac{४७१६}{१४४००}$।

(३) यदि १४४०० इस हर में ४७१६ यह क्षेप मिलता है तो १३१ में क्या इससे मिला संचारितक्षेपक $= \frac{४७१६ \times १३१}{१४४००}$

$$= \frac{६१८१८६}{१४४००} = ४२ + \frac{१३३८६}{१४४००}$$ =४३ स्वल्पान्तर से।

इसलिये यहां 'सगुणवेदः' यह पाठ उचित सिद्ध होता है।

(१) १४४,००)१६७२६४७७,२६(१३७०१०=लब्धिः।

```
        ५३२
        १००६
         १४७
           ३७२६=कलिगताब्द।
```

(२)

```
             ३७२६=कलिगताब्द
             ५३११
           ---------
             ३७२६
            ३७२६
          १११८७
         १८६४५
      -------------
        १६८०४७,१६ (१३७५
```

=कलि के आदि से बीता हुआ अधिमास।

```
        ५४०
       १०८४
        ७६७
       ४७१६
        १३१
      -------
```

(३) ४७१६
१४१५७
४११८

६१८१,८६(४२=क्षेपकः
४२१

१३३८६=शेषम् ।

लब्धि=१३७०१० । गुण=५३११

इन दोनों का गुणनफल =१३७०१०
१३७०१०
१०१०
४११०३०
६८५०५०

७२७६०११० =कल्प के आदि में गताधिमास

७२७६६०११०+१३७५= कल्पारम्भ से ग्रन्थारम्भशक पर्यन्त गताधिमास = ७२७६६१४८५ ।

चौथे (४) श्लोक की क्षेप साधनोपपत्ति ।

पूर्व साधित कल्पगतवर्ष =१९७२९४७७२९ ।

इसको १२ से गुणाकर कल्पगतमास =२३६७५३७२७४८ ।

पूर्व साधित अधिमास =७२७६६१४८५ ।

अधिमास को कल्पगतमास में जोड़ने से चान्द्रमास=२४४०३०३४२३३

अब अनुपात करते हैं ।

कल्प चान्द्रमास में कल्पकुदिन पाते हैं तो उपरोक्त चान्द्रमास में क्या इस अनुपात से वर्षारम्भ समीपस्थ मध्यमदर्शान्तकालिक कुदिन समूह=

$$=\frac{२४४०३०३४२३३ \times १५७७९१६४५००००}{५३४३३३००००००}$$

$$=\frac{२४४०३०३४२३३ \times १०५१९४४३}{३५६२२२} ।$$

अब सात से गुणा हुआ हार (२४९३५५४) इससे गुण्य और गुणक को तक्षण के लिये न्यास करते हैं ।

२४६३५५४)२४४०३०३४,२३३(९७८६
२२४४१९८६
१९६१०४८२
१७४५४८७८
×२१५५६०४३
१९९४८४३२
०१६०७६१११३
१४९६१३२४
१११४७८९ = गुण्यशेषम् ।

२४६३५५४)१०५१९४४३(४
९९७४२१६
०५४५२२७ = गुणकशेषम् ।

गुण्यशे × गुणकशे = १११४७८९ × ५४५२२७ = ६०७८१३०६२१०३ ।

३५६२२२)६०७८१३०६२१०३(१७०६२७६ = ल प्र ।
३५६२२२
२५१५९१०
२४९३५५४
००२२३५६६२
२१३७३३२
९८३३०१
७१२४४४
२७०८५७०
२४९३५५४
२१५०१६३
२१३७३३२
××१२८३१ = शेष

यहां शेष को ६० से गुणाकर (३५६२२२) इससे भाग देने से
१२८३१ × ६० = ७६९८६० ।

३५६२२२)७६९८६०(२ घटी
७१२४४४
×५७४१६ = शेष

फिर शेष को ६० से गुणाकर भागहर (३५६२२२) से भाग देने पर—

५७४१६ × ६० = ३४४४९६०।

३५६२२२)३४४४९६०(९+$\frac{३}{५}$ पल स्वल्पान्तर से
३२०५९९८
―――――
२३८९६२

यहां प्रथम लब्धि (१७०६२७६) इसको ७ से भाग देने पर शेष = ५ = वार।

क्रम से वार ५। घटी २। पल ९+$\frac{३}{५}$। स्वल्पान्तर से यहां वर्त्तमान दिन के लिये ५ की जगह ६ संख्या को आचार्य ने ग्रहण किया और २ की जगह ४, एवं ९ की जगह १८ संख्या को आचार्य ने स्वीकार किया है।

इस तरह यहां २ घटी, ९ पल को आचार्य ने अधिक ग्रहण किया है, इस बात को ज्योतिषी लोग विचार करें।

(६) छठे श्लोक के क्षेप साधन की युक्ति—

पूर्वसाधित कल्प से व्यतीत वर्ष = १९७२९४७७२९।
१९७२९४७७२९ × १२ = २३६७५३७२७४८ = सौरमास।
इष्टशाका = ५५०। ५५० शाकारम्भ समय में—
गताधिमास = १३७०१० × ५३११ + १३७५ = ७२७६६१४८५*
इष्टचान्द्रमास = २३६७५३७२७४८ + ७२७६६१४८५ =
= २४४०३०३४२३३

अब अनुपात करते हैं—

कल्पमास में कल्पचान्द्रमास घटा हुआ कल्पचन्द्र मन्दकेन्द्रभगण मिलता है तो इष्टचान्द्रमास में क्या इस अनुपात से भगणात्मक चन्द्रकेन्द्र =

$$= \frac{२४४०३०३४२३३ \times ३८३१८९४१४२}{५३४३३३००००००}।$$

१	२४४०३०३४२३३	१	५३४३३३
२	४८८०६०६८४६६	२	१०६८६६६
३	७३२०९१०२६९९	३	१६०२९९९
४	९७६१२१३६९३२	५	२६७१६६५
८	१९५२२४२७३८६४	६	३२०५९९८
९	२१९६२७३०८०९७	७	३७४०३३१
		८	४२७४६६४
		९	४८०८९९७

* २ श्लोक का क्षेप साधन देखें।

४८८०६०६८४६६
९७६१२१३६९३२
२४४०३०३४२३३
९७६१२१३६९३२
२१९६२७३०८०९७
१९५२२४२७३८६४
२४४०३०३४२३३
७३२०९१०२६९९
१९५२२४२७३८६४
७३२०९१०२६९९

५३४३३३०००००) ९३५०९८४३९२४४५८१६३०८६ (१७५००२९३६२
५३४३३३
४००७६५४
३७४०३३१
२६७३२३३
२६७१६६५
१५६८९२४
१०६८६६६
५००२५८४
४८०८९९७
१९३५८७५
१६०२९९९
३३२८७६८
३२०५९९८
१२२७७०१
१०६८६६६
१५९०३५६३०८६ = भगणशेषम् ।
२८
१२७२२८५०४६८८
३१८०७१२६१७२
४४५२९९७, ६६४०८ ($८ + \frac{१७८३३३६६४०८}{५३४३३३०००००} = ८ + \frac{१}{३}$
४२७४६६४
१७८३३३६६४०८

स्वल्पान्तर से ।

यहां आचार्य ने छन्द के अनुरोध से सुखार्थ ($८ + \frac{१}{३}$) की जगह ($८ + \frac{१}{२}$) को ग्रहण किया, यह कल्पना की जाती है ।

यहां ध्यानग्रहोपदेशाध्याय का क्षेप साधन समाप्त हुआ ।

ब्राह्मस्फुटसिद्धान्तः

पृथूदक स्वामिकृतवासनाभाष्य समेतः

गोलाध्यायः

अथ गोलाध्यायः

ग्रहनक्षत्रभ्रमणं न समं सर्वत्र भवति भूस्थानाम् ।
तद्विज्ञानं गोलाद्यतस्ततो गोलमभिधास्ये ॥१॥

वासना०—असंभवे नक्षत्राणि ग्रहाश्चैकस्मिन्कपाले तद्वशेन चोपर्यधश्च स्थितानां मकरकर्क्यादौ......वौदिन निशा प्रवृत्तिर्देवानाम् । तथा रवींद्वोराव-रणं राहुकृतं तथा दर्पणोदरायां पृथिव्यां । समुद्राद्वीपाश्वास्थिता परतः परतो द्विगुणः अन्येषां महाप्रमाणचतुरश्रमेरुपक्षे । सूर्यद्वयं चन्द्रद्वयं नक्षत्राणि चतुष्पंचाजिनशास्त्र इत्येवमादिसर्वं निरुपपत्तिकं कपोलव्यायानपरायणानामसत्प्रज्ञा-विलासितमाशक्यं गोलप्रयोजनकथनपरत्वेन प्रतिज्ञासूत्रमियमार्या सकलगोला-ध्याये स्यादादौ प्रयुक्तेति । तद्यथा ग्रहं नक्षत्रभ्रमणं न समं प्रतियोजनमपीयं प्रतिज्ञा तिष्ठतु तावत्सर्वत्र लंकास्थानामुपरि यो ग्रहः समेरुपस्थानां दक्षिणक्षिति-जासकृत् । पश्चिमेरुपरिमलंकायामुत्तरक्षितिजासकः । एवं सपवलंको परिग्रहो यमकोट्यां पश्चिमक्षितिजासक्त......रोमकवासिनां पूर्वक्षितिजासकृत् इत्याद्युदाह-रणानि गोलादेव ज्ञायंते, नान्यत इति । प्रतिज्ञाकृ.........या । यस्माद्भूगोल-काकाराभपंजरोऽपि गोलकाकारो यतो भूगोलं परिवेष्टयरिथ......ज्ञानं समं सर्वत्र भूस्थानां न समं न तुल्यम्, सर्वत्र सर्वदेशेषु भूस्थानां भुवि स्थितानां द्रष्टृणामित्यर्थः । तद्विज्ञानं गोलात्तदवगतिगोला, यतो यस्मात्ततो गोलमभि-धास्ये, तस्माद्गोलं वक्ष्ये इति सूत्रार्थः । ननु च ग्रहनक्षत्रभ्रमणं यदि न तुल्यं 'तुल्यं' वा तत्स्वदेशस्थैः द्रष्टृभिः, तत्र यथा दृष्टमुपलभ्यत एवमुच्यते । तद्वि-ज्ञानं गोलादिति । अथासमं भ्रमणं समीक्रियते । गोलज्ञाने नैतदपि न शक्यते वक्तुम् । यतो नियता ग्रहगतिः अन्यथा संख्याया अनुपलब्धिरेव स्यात् । तस्मात् गोलारंभप्रयोजनकथनपरमिदमार्यासूत्रमसंबद्धमिव शक्यते । नैष दोष अयम-भिप्रायो भट्टब्रह्मगुप्तस्य यथा दूरविप्रतिपन्ना भुवनकोशविदोऽन्यथा सर्वमेव व्या-वर्णयंति । भू......मंहाप्रमाणत्वं दर्पणोदराकारतां च कथयन्ति मेरोश्च महा-प्रमाणत्वं शवाकारतां च । तत्पृ......सक्तो ध्रुवश्च ग्रहनक्षत्राणि चावलंब-मानानि । मेरोरधोभागेऽस्माभिरुपरिस्थितानीवोप.........तद्वशेन वार्कादीनां प्रतिदैवासिकावुदयास्तमयौ सर्वेषां यत्र तत्र स्थितानां द्रष्टृणां । तुल्ये......मक-रादिदिव्यदिवसस्य सौम्यमपमण्डलार्धमेषां द्यमित्यादिना निकारणमित्येव-मादिवक्ष्यमाणग्रन्थपर्यालोचनयाचार्येणोक्तम्, तद्विज्ञानं गोलादित्यतः सुष्ठु

उच्यमानं शोभनं प्रपंचेन। तत्र तत्रायां सूत्रे व्यावर्णयिष्यामोऽत्रालं भवतित्रति विरतरेण प्रकृतमभिधीयत इति। इदानीं गोलस्वरूपपत्तिपादनायार्यामाह—

शशिबुधकुजार्कसितगुरुशनिकक्ष्यावेष्टितो भकक्ष्यांतः।
भूगोलः सत्त्वानां श्रुताश्रुतैः कर्मभिरुपात्तः ॥२॥

वास०—शशीबुधश्चेत्यादिद्वन्द्वः-तेषां कक्ष्याः शशिबुधसितार्ककुजगुरुशनिकक्षाः, कक्ष्यशब्देनात्र मध्यग्रहभ्रमणप्रदेशवृत्तमुच्यते ताभिर्वेष्टतः, तासां मध्ये भूगोल इत्यर्थः। अयमर्थः भूगोलमध्यं मध्ये कृत्वा स्वयोजनकर्णेन 'यद्वृत्तमुत्पाद्यते तत्कक्षामंडलं तच्च भूगोलाद्बहिः शशिनः ततो बुधस्य। ततोऽपि शुक्ररविभौमगुरुशनीनां क्रमेण कक्ष्याः सप्त ताभिर्वेष्टितोऽयं भूगोलो भकक्ष्यांतः, तानि ज्योतींषि। तेषां कक्षागोलनक्षत्रविशेषः सर्वगणितगम्यः क्षेत्रत्वात्। यथा वैयाकरणाः प्रकृतिप्रत्ययागम लोपवर्णविकारागमादिभिः साधुत्वं शब्दस्य प्रतिपद्यन्ते। याज्ञिकाश्चतुद्योदिभिर्यज्ञादीन्। विप्रवराश्चेत्युत्पलानालादिभिः सिरादिवेधात्प्रतिपद्यते। एवमिहापि सांवत्सरा ज्याधनुः शरभुजकोटिकर्णविलंबकशलाकावृत्तादिभिः क्षेत्रगणितविशेषैश्च, सत्यपूर्वकैः सत्यं ग्रहभ्रमणधरित्रीसंस्थानादिकं गोलातत्त्वं प्रतिपद्यते। गोलकलक्ष्यैः लक्षणैः क्षपितपरमतैः वृत्तात्वदेववृत्तत्वं च। गोलभगोलयोरुत्तरार्यायां निराधारत्वं च। मेरोर्महत्त्वं निराकारणं व स्वल्पत्वाद्भूमेवासक्तिः, कक्षोन्नात्य निर्धार्यंते ग्रहनक्षत्रावलम्बनं भपंजरं भ्रमविशेषैर्भिन्नदेशजनितैश्च मेरुवशेनोदयास्तमयनिवृत्तिः भिन्नार्कोदयप्रतिपादनेन महर्दिदोरावरणमित्यादि न राहुनिवृत्ति भूगोलस्य समुद्रपरिधेरन्यो महान् परिधिर्नास्तीति शेषसमुद्राणां महत्त्वनिराकरणं मण्डलमुदयमण्डलमुन्मंडलमित्यादि विज्ञेयं लब्धार्थः। ततोऽपमंडलप्रमाणमेवान्यद्वृत्तम्। षष्टिशतत्रयांकितं मेषादेरारभ्य यावति प्रदेशं चन्द्रपातो वर्तते। तत्र बध्वा ततोऽर्धचक्रांतरप्रदेशे द्वितीये बंधः कार्यः। यथा च प्रथममर्धमपमंडलादुत्तरेणावतिष्ठते, द्वितीयमर्धं दक्षिणेन तथा च तिर्यग्निदध्यात्। यथा तदपमंडलयोरंतरे विक्षेपभागा भवन्ति। नवतितमे भागे बंधाभ्यामुभयतोऽपि तद्विमण्डलमेव। एवमियं चन्द्रकक्ष्या बुधादीनामपि स्वयोजनकर्णप्रमाणानुपातेन स्वकक्ष्यापंजरः कार्यः। ते पंजराद्बहिर्बुधस्य ततोऽपि तस्येत्यादि तावद्यावदष्टमो भपंजरः। सर्वेषां पंजराणां दक्षिणोत्तरंतकयो वोधौकृत्वा ततो या शालाकां सुदीर्घां समस्तपंजर स्वस्तिकार्धर्त्तेदिनीमुभयपार्श्वं विनिर्गताग्रां दक्षिणोत्तरा यतौ पंजरभार सह प्रवेशयेत्। अपमंडलानि सर्वेषां पूर्ववत्। अपमंडलाच्च विमंडलानि चन्द्रवत्, इयांस्तु विशेषः स्वपठितविक्षेपभागा यथा नवतितमे भागे बंधाभ्याममंडलयोरंतरं भवति तथा निदधात् शेषं सामान्यम्। रविकक्षायां मण्डलं नास्ति यतः तद्गत्यवधित्वेन सर्वेषामेवग्रहाणां गतयो दक्षिणोत्तराः कल्पिताः तद्गतिश्चापमंडलमेव भकक्षायां

प्रति नक्षत्रं भिन्नो विक्षेपः। पाताभावात्तत्रापि न प्रदशाम्। स्वाहोरात्रवृत्तानि क्रान्त्यग्रेषु मेषादीनां ग्रहाणां च प्रदर्शयितव्यानि ततः सर्वकक्ष्यामध्येयाः। शालाकायां भूगोलाकारामृदान्येन वा प्रदर्शयितव्या। एवमयं भूगोलः कक्षापरिवेष्टितो भकक्षांतस्ततः पूर्वस्वस्तिके सूत्रस्यैकमग्रं बद्ध्वा द्वितीयमग्रं भुवं भित्त्वा परस्वस्तिके बध्नीयात्। तत उपर्यधः स्वस्तिकयोर्भू भेदिसूत्रं बध्नीयात्। ततो भूगोलस्योपरि यत्र सूत्रेण कृतो भेदस्तत्र भूप्रदेशे लंका। यत्राधः तत्र सिद्धपुरम्। यत्र पूर्वेण भेदस्तत्रयम···कोटी यत्रापरतः सूत्रभेदस्तत्ररोमकं पत्रोत्तरेण यः शलाकाभेदो भूगोले तत्र मेरुर्यत्र। दक्षिणेन तत्र वडवामुखम्। विनिगतशलाकाग्रयोश्च ध्रुवौ प्रदर्श्यौ लंका यमकोटी सिद्धपुरी रामकानामवगाहीयः परिणाहो भुवः ससर्वो निरक्षो देशश्च। सर्वत्र चिह्नानि कारयेत्, एवमयं लंकायां गोलः समरावावतिष्ठते। अथायमेवैकोभपंजरः प्रदर्श्यते सर्वग्रहविशेषस्तत्रैव। यतो भिन्नकक्ष्यागता अपि नक्षत्रगता एव भकक्ष्या गता इवोपलभ्यन्ते। तस्मादेक एव कार्यः अस्माभिश्च वस्तुदर्शनं कृतम्, तत्र लंकास्थस्य द्रष्टुर्विषुवन्मंडलमेव सममण्डलं प्राच्यपरं येन द्वितीयं तद्यादेवाः भूगोलमेरुवडवामुखस्थानां ध्रुवयोश्चोर्ध्वस्थानप्रदर्शनार्थमार्यामाह—

खे भूगोलस्तदुपरि मेरौ देवाः स्थितास्तले दैत्याः।
खे भगणाक्षाग्रस्थावुपर्यधश्च तौ ध्रुवौ तेषाम्॥३॥

वास०—खे वियति भूगोलस्तदुपरि मेरौ देवाः स्थिताः तस्मिन् भूगोले उपरि मेरुः तत्र देवाः स्थिताः तले दैत्याः तस्यैव भूगोलस्याधो दैत्याः वडवामुखवासिनः खे भगणाक्षाग्रस्थौ खे आकाशे भगणस्याक्षौ भगणाक्षौ तयोरग्रे स्थितौ भगणाग्रस्थौ उपर्यधश्च ध्रुवौ। एकमुपरि द्वितीयोधस्तेषां देवदैत्यानां यो देवानामुपरि दैत्यानामधो दैत्यानामुपरि यः स देवानामधः स्थित इत्यर्थः। नत्विदमत्याश्चर्यमुच्यते खे भूगोल इति। यावदल्पस्थायि मूर्तिमत्पदार्थ स्याकाशे न स्थितिर्दृश्यते। किमुत महाप्रमाणिकया भुवो नगनगरसमुद्रद्वीपगजतुरगरथाद्यनेकाश्चर्याकुलाया नैतच्चोद्यम्। स्वरूपत्वात् यथाग्निर्दहनात्मको वायुश्च प्रेरणात्मकः उदकं वक्रेदनात्मकं न तेषां कश्चित्स्वविषये प्रयोजकः एवमियमपि भूधारणात्मिकानधार्यमाणा तस्मात् खे स्थिरेयं सर्वं धारयति। अथ पतंत्येव तिष्ठतु कानः क्षतिरिति चेत्। तदापि न यतो लोष्ठादयः शिशुभिरुपरिक्षिप्ता भुवमाससादयन्तो दृश्यन्ते। मन्दक्षितिः पततीव। असाध्यमेवैतदतिगुरुत्वाद्भूमेः अथवावश्यं पतति, तथापि क्व पततु अध इति चेत्। किमिदमधोनामप्रतियोगि सापेक्षश्चाधः शब्दः यथा सत्व विशेषणानामस्मदादीनामधो भूरुपरिवियदेवमस्याः सर्वाधोभूताया भुवः किमधः स्वमिति चेत्। तर्हि सर्वतो युगपत्पतनप्रसंगः, तत्रोपरि पार्श्वपतने न नस्तोदृष्ट विरोधात्। अधश्च निरस्तसम्बाधः पतनादाधारविशेषः

परिकल्पते इत्यभिप्रायेण तदपि न शक्यते वक्तुम् । तस्यापि मूर्तत्वादन्यस्तस्यान्य इत्यनवस्थाप्रसङ्गः, अथोच्यते स्वशक्त्यासौ तिष्ठतीति तत्प्राथम्यादेव सा शक्तिः कथं भुवो न परिकल्पते । भूमेश्चावश्यं शक्तिः परिकल्पयितुं बुध्यते । अन्यथा सर्वतोऽपि परस्परमधो तावेन सत्त्वानां भवस्थितेरेव न स्यात् । समुद्रादीनामपि च तस्मान्मूर्तिमदाधाररहितो विशिष्टशक्तियुतो भूगोलः खेऽवतिष्ठते इत्युपपन्नम् । अथ मूर्तं परिकल्पते । कश्चिदाधारस्तत्सिद्धसाध्यताचार्येणैवोक्तत्वात्प्रागार्याया-मस्माभिरपि धर्माधर्मनिबन्धनी स्थितिर्वाय्वादीनामत्युपगम्यते । नवास्माक-प्रमाणभागेव प्रावीणम् । यतो वैयाकरणाना कर्मधारय समासोदाहरणीभूता वयं चतुर्वेदत्वात् केवलं शास्त्रदृष्टया परीक्षध्वम् । युक्तिमदयुक्तिमद्वाद्याख्यात-मार्यासूत्रम् । अत्र वलायचार्य क्षितिगोलः समवृत्तः खे किल तिष्ठति समंतत-स्त्वपदे सामान्यैः सत्वानां शुभाशुभैः कर्मभिरुपात्तः । तथा वसिष्ठसिद्धान्ते-जगदण्डखमध्यस्था महाभूतमयो क्षितिः भवाय सर्वसत्वानां वृत्तगोल इव स्थितेति गोलवासनयाधुना प्रदर्श्यते । तद्यथा स्वदेशाक्षाग्रादुत्तरतोयः शलाकाग्रहमपकृष्य स्वगोलोकोपरि स्वस्तिकवेधे प्रवेशयेत् । तद्दक्षिणाग्रादधखगोलो स्वस्तिकवेधे द्वितीयमग्रं न्यसेत् । एवं स्थिते गोले स्वयमेवार्यार्थावगतिर्भवति । भूगोलस्योपरि यत्रायं शलाकाभेदस्तत्रमेरुर्देवनिवासः यत्राधस्तत्र दैत्यनिवासो वडवामुखमेको ध्रुवो मेरोरुपरि शलाकाग्रे द्वितीये वडवामुखस्योपरि शलाकाग्रे असुरसुराश्च परस्थमधो मन्यन्ते । अत्र चार्यभटः सुमेरुः स्थलमध्ये तदधो वडवामुखं जलमध्ये । असुरसुरा मन्यन्ते परस्परमधः स्थितानियतम् । अन्यथा पञ्चसिद्धान्तिकायाम्-तरुनगनगर न रामसरित्समुद्रादिभिः चितः सर्वः विबुधनिलयः सुमेरुस्तन्मध्येऽधः स्थिता दैत्याः सलिलतटासन्नानां वाडवमुखी दृश्यते यथा छाया तद्वद्गतिरसुराणां मन्यन्ते तेऽप्यधो बिबुधान् । तथा लङ्कासिद्धपुरयोर्यमकोटी रोमकयोश्च परस्पर-मध्ये भावः, एवं प्रतिपदमप्यधो भागकल्पना । न च परमार्थतया भूमेरुपर्यधो भागकल्पना शक्यते वक्तुम् । यतः सर्वतोऽपि सत्वानां स्थितिः, यतो भूगोलो त्रिचतुष्पदकीटजलधरनगनगरतरु जलधारादिभिः कदंबपुष्पग्रन्थिरिव केसरैः प्रचितः । अत्र त्वार्यभटः-यद्वत्कदंबपुष्पग्रन्थिः प्रचितः समन्ततः, कुशमैः तद्वद्धिसर्वं सत्त्वैर्जलजैः स्थलजैश्च भूगोलः । तथा चार्यालाटदेवः । पर्वतनदीसमुद्रैः पुरराष्ट्र-द्रुमचतुष्पदाश्वाद्यैः प्रचितः कदंबपुष्पग्रन्थिरिव समन्ततः कुसुमैः यच्चाचार्येण तदुपरीत्यादि, तदपि धर्माधर्मप्रदेशापेक्षया सर्वतः सर्वेषामधोभूरुपर्याकाशमेत-त्प्रदर्शितं च भवति मूर्तिमदाधारनिरासायवा । यैश्चोक्तं मध्ये मेरुः तैः समुद्रा-वस्थितिर्न ज्ञाता जलात्स्थलभागापेक्षया यच्च निरक्षदेशोपरि विषुवन्मण्डलं षष्टि-घटिकांकितं प्रदर्शितमासीत्तन्मेरुस्थितानां क्षितिजम् । यच्चोन्मण्डलं तत्सममण्डलं पूर्वापरयोः क्षितिजे ग्राक्षयोश्च तस्य लग्नत्त्वाद्वडवामुखवासिनामपि एवमेव मुद्रोपि परिकरवदुभयेषां मेषाद्यपमण्डलार्धं क्षितिजादुपरिस्थिति दृश्यं स देवानां तुला-

द्यार्धं तद्वद्दैत्यानां मेषतुलाद्योरादित्वं विषुवदुपलक्षणार्थं लंकासमोत्तरे......रवावासिनां दक्षिणतो लंकोत्तरतो मेरुः यमकोटीसमुत्तरस्थानां दक्षिणतो यमकोट्युत्तरतो मेरुः सिद्धपुरसमोत्तररेखास्थानां दक्षिणतः सिद्धपुरमुत्तरतो मेरुः रोमकसमोत्तरस्थामासुत्तरतो मेरुदक्षिणतो रोमकम् । मेरुस्थानां पुनः सर्वतोऽपि । सर्वा एव दिशो यतो दिक्परिकल्पना सवितृवशा यत्र विवस्वानुदेति सा प्राची । यत्रास्तमेति सा प्रतीची न तत्राथोच्यते यत्र दिनादौ प्रथमं दृश्यते सा प्राची, यत्र दिनार्धं सा दक्षिणा, यस्यामदृश्यो याति सापरा यस्यां रात्रार्धं सोत्तरा विषुवति मेरुस्थानां पुनः सकृदुदित एव । सर्वास्यपि दिक्षूपरि भ्राम्यन्ननेकशो दृश्यते । अतो दिग्विभागकल्पना । न तत्राथोच्यते यत्र दिनादौ प्रथमं दृश्यते सा प्राची तदपि न यतः स्फुटं सौरसावनयोर्युगपद्दिनादिनं भवति । कदाचिद्भवतीति चेत् तथापि न नियते प्रदेशे, एवं मेरुवडवामुखरेखास्थानां गोलन्यासः प्रदर्शितः । तदन्तरस्थानां देशान्तरकर्मणा पूर्वापरत्वं भिद्यते । तत्प्रदर्शनायाध्वतुल्येऽतरे भूगोलं भ्रमयेत् । यदि पूर्वेण स्वदेशस्तदा पश्चिमतः । अथ यतो परदेशस्तदा पूर्वेण भ्रमयते । शलाकाग्रनिवेशेवतुल्यार्धेऽर्धममीष्टदेशे गोलविन्यासः इत्येवं दिशात्र मे तत्प्रदर्शितं स्वबुद्ध्या कालसमसूल्यमिति । एवं मेरुवडवामुखस्थानां ध्रुवयोः संस्थानमभिधायेदानीं भचक्र भ्रमणादि प्रतिपादनायाह —

ध्रुवयोर्बद्धं सव्यगममराणां क्षितिजसंस्थमुदवक्रम् ।
अपसव्यगमसुराणां भ्रमति प्रवाहानिलाक्षिप्तम् ॥४॥

वास०—ध्रुवयोर्बद्धं ध्रुवतारयोर्नियमितं, सव्यं गच्छतीति सव्यगमः, प्रदक्षिणगमित्यर्थः, अमराणां मेरुस्थानां क्षितिजसंस्थं क्षितिजवेशेषाज्जातं यन्मण्डलं तत्क्षितिजम् । यत्राकाशं भूम्या सहैकवद्भूतं लक्ष्यते । परितोऽपि तत्र स्थितं तदा सकुमुद्रुवक्रं नक्षत्रचक्रं विषुवन्मण्डलमित्यर्थः । अपसव्यगमसुराणां तदेवोदचक्रं अप्तदक्षिणगं दैत्यानां क्षितिजासक्तमेव भ्रमति क्षणमपि स्थिरं न भवति । प्रवाहानिलाक्षिप्तं नित्यं प्रवहणेन पश्चाद्गतिना मारुतेन प्रेरितमिति यावत् तदेतद्भचक्रं तद्देवानां भूलोकोपरिस्थितानां क्षितिजासक्तं यतो विषुवन्मण्डलमेव भचक्रं तच्च मेरुस्थानं क्षितिजमेव व्याख्यातम् । तत्रस्था भ्राम्यते प्रवाहानिलेनतदेवैः प्रदक्षिणगं सदृश्यते । दैत्यैश्च प्रदक्षिणगं यतस्तेषां परस्परमधोभावः यथा कश्चित्किमपि दक्षिणे हस्ते कृत्वा यदासन्नो भवति, तदा तत्प्रति रूपकारस्य वामे हस्ते तत्र लक्ष्यते, इत्येवं सव्यापसव्यसिद्धिः, एतच्च खगोलोपर्यधः स्वस्तिकयो शलाकाग्रे प्रवेश्य सर्वं प्रदर्शयेत् । गोलो ध्रुवयो बद्धमिति व्याप्तिप्रदर्शनार्थम् । ध्रुवाभ्यां यावद्भचक्रस्य द्वादशराश्यात्मकस्य व्याप्तिमुरुजबंधानामिव मध्यावभूगोलमध्यं यावत् । अयमभिप्रायो द्वादशराशि व्यतिरिक्तो भपंजरे सकक्षे सभूमिके कश्चित्प्रदेशे नास्तीत्यर्थः । अन्ये तु पुनरन्यथा व्याचक्षते । भूगोल एव प्राङ्मुखो भ्रमति

भपंजरः, सोडुचक्रं स्थिर एवमपि सव्यापसव्यसिद्धिः तुल्यैव, न चैवं, यदि भूगोलो भ्रमति तद्वायसादयो न स्वं निलयं खात्पुनरासादयेयुर्वारिमुचोऽपि नैकत्र बहुवारिमुचः स्युः तस्य तस्य प्रदेशस्याग्रतो गतत्त्वात् । ध्रुवादयो नित्यं प्रत्यगतयः स्युः, भूगोलवेगजनितप्रभंजना क्षिप्ताः तरु शिखार्यादयोऽपि विदीर्येरन् । अत्र वाराहमिहिरः यद्येवं शयनाद्या नखात्पुनः स्वनिलयमुपेयुरित्यादि तस्मात् भूभ्रमति भचक्रमे च भ्रमति प्रवाहानिलाक्षिप्तम् । तथा चाचार्यवराहमिहिरः मेरोः समोपरि वियत्यक्षोव्योम्नि स्थितो ध्रुवोऽधोऽन्यः तत्र निबद्धा मारुता प्रवहेन भ्राम्यते भगणः । तथाचार्यभटः, उदयास्तमय निमित्तं नित्यं प्रवहेन वायुना क्षिप्त लंकासमपश्चिमगो भपंजरः सग्रहोभ्रमति मेरु वडवा मुखस्थानां क्षितिजासकं एवार्यसूत्रार्थः । तथावयौ लिषे सिद्धान्ते । तस्योपरि ध्रुवः खं तद्बद्धं पवनरश्मिभिश्चक्राम । पवनाक्षिप्तं भानामुदयास्तमिषं भ्रमति । तथा च वसिष्ठे सिद्धान्ते । तत्राग्रे ग्रहनक्षत्रतारागण समावृतः । अजस्रं भ्रमति व्योम्निज्योतिर्गणः प्रदक्षिणम् एतेषु सर्वनाम्ना मेरुपरामर्श इति एवं मेरू परामर्श इति एवं मेरु वडवामुखवासिनां ध्रुवं न वक्रं संस्थानभ्रमणमभिधायाधुना परिशेष देशार्थमाह—

अन्यत्र सर्वतो दिशमुन्नमति भपंजरो ध्रुवोनमति ।
लंकायामुडुचक्रं पूर्वापरगं ध्रुवौ क्षितिजे ॥५॥

वास०—अन्यत्रान्यस्मिन् देशे मेरु वडवामुखवर्जिते, सर्वतोदिशं सर्वास्वपि दिक्षु उन्नमति भपंजरः क्षितिजाद्विप्रकृष्टो भवति । भानां पंजरो भपंजरः नक्षत्र चक्रं विषुवन्मण्डलमित्यर्थः ध्रुवो नमति, ध्रुवः खमध्यात्तिर्यग्भवत्युत्तरेण स्थलभागे मेरोरन्यत्र वडवामुखादेवं जलभागे लङ्कायामुडुचक्रं पूर्वापरगं लंका ग्रहणं निरक्षदेशोपलक्षणार्थं तत्रोडुचक्रं पूर्वा परगमुपर्यधोगमित्यर्थः । ध्रुवे क्षितिजे तत्रैव निरक्षदेशे स्थितस्य द्रष्टुरुत्तरदक्षिणयोर्ध्रुवो क्षितिजासंक्तौलक्षेते इत्यर्थः । अयमभिप्रायो भूगोल काकाराभपंजरमध्यस्थिता च तदवबोधाय ध्रुवतारायां बध्नीयात्, एवं पूर्वस्वस्तिकाद्यमकोटी भूरोमकार्धभेद्यपरस्त्रस्तिके बध्नीयादेवं दक्षिणस्वस्तिकालंका भूसिद्धपुरार्धभेद्युत्तरस्वस्तिके बध्नीयात् । ततो भूगोलयोः तुल्ययोर्विभागकल्पनया तुल्यत्वमुपपद्यते । लघवोऽल्पे वृत्ते महति महांतो राशिभागादयः कल्पाः कल्पिताश्च भभूगोलयोः सतुल्या भवन्ति । तेन यावति रामध्रुवादिषु वृत्तावति मेरोर्निरक्षदेशे, एवं शेषेष्वपि योज्यम् । सर्वाण्येव केन्द्राणि परस्परं भभूगोलयोश्चतुर्भागे भवन्ति, चतुर्भागाश्च नवतिर्भागाः भचक्रांशानाम् । द्रष्टुश्च यत्रतत्रावस्थितस्यातिभूगोलोपरि । स च द्रष्टा भूगोलार्धं पश्यति, द्वितीयमर्धं भूव्यवहितं न पश्यति तेन मेरोर्यावद्भिः भूगोलाशैः कश्चिद्दक्षितो भवति, तावद्भिस्तस्य भूगोलान्शैः ध्रुवो नमत्युत्तरेण । एवं वडवामुखादपि तावद्भिरेवांशैर्निरक्षदेशोपरि विषुवत्स्वस्तिकौ भवतः एतच्च स्वदेशाक्षाग्रे सोन्मण्डलं सध्रुवं

गोलं विन्यस्य प्रदर्शयेत्। यावन्निरक्षदेशं तत्रोडुचक्रं पूर्वापरगं ध्रुवौ क्षितिजे भवतः। निरक्षदेशं दक्षिणस्थं भूगोलार्धं देवा न पश्यंति, भूम्यर्धवत्तद्वदुत्तरस्थं दैत्या अपि एवं निरक्षादुत्तरस्था दक्षिणं ध्रुवं न पश्यंति, दक्षिणस्थाश्चोत्तरमिति। यदि पुनः समा भूः स्यात्तन्मेषाद्यपमंडलार्धं सदादृश्यं स्यात्, समुद्रादुत्तरस्थानां ध्रुवश्च भूम्यासक्तो न स्यादेतच्च प्रत्यक्षविरोधान्नभपंजरस्य तुच्छग्राकारतायां कल्पमानायां द्वादशस्वपिराशिषु, स्थितोऽर्कः सदादृश्यः स्यादस्माकं। यतो मेरोर्व्यवधायकत्वं निराकृतं। पूर्वमेवास्माभिरथ गोलकाकारायामेव भुवि तच्छत्राकारम्, तन्मेरुस्थानां सदादृश्यं नित्यमदृश्यं च वडवामुखवासिनां भूव्यवधानाद्यतः सकलमेवापमंडलं तच्छत्रं तथा लग्नादीनामवलंबकाक्षादीनां चानुपलब्धेः पापीयानपपक्षः तस्माद्भूगोलकाकारा भपंजरश्चात एव विषुवति निरक्षदेशेषु व्यासार्धमवलंबको मेरुवडवामुखयोर्लंबकाभावः, अक्षश्च निरक्षे नास्ति लंबश्च नवतिर्भागाः, यतो ध्रुवोन्नतिरेवाक्षः एवमन्तरेऽपि योज्यमिति। अत्र लाटाचार्यः तस्मात्क्षेत्रोद्देशाद्यथा सर्वतो दिशम्, तथा उन्नमति भगणचक्रं ध्रुवः खमध्यं परित्यजति। भित्वा क्षितितलमुत्तिष्ठतीव मेघः प्रकृष्टस्थः। सैवान्येषां तिष्ठत्युपरि ज्योतिर्गणोऽप्येवम्। एवं तावद्देशभेदाद्भूचक्रदर्शनभ्रमणे भेदान्प्रतिपाद्येदानीं भगवतो भास्करस्य तानेव प्रतिपादयन्नाह—

देवाः सव्यगमसुराः पश्यंत्यपसव्यगं रविं क्षितिजे।
विषुवति समपश्चिमगं निरक्षदेशे स्थिताः पुरुषाः ॥६॥

वास०—पश्यंतीति सर्वत्र योज्यम्। देवा मेरुवासिनः सव्यगं प्रदक्षिणगं असुरा वडवामुखवासिनोऽपसव्यगमप्रदक्षिणम्, कमित्याह रविं क्व? क्षितिजे मंडले। भूम्यासक्तमिति यावत्, कदाविषुवति विषुवद्वृत्तस्थं विषुवदिवसे इत्यर्थः समं पश्चिमगं निरक्षदेशे स्थिताः पुरुषा तत्रैव विषुवति समोपर्यधोभागगं लंकादि निरक्षदेशस्था द्रष्टारः पश्यन्ति रविमिति सूत्रार्थः। एतच्च खगोलोपर्यधः स्वस्तिकवेधयो खः शलाकाग्रे प्रवेश्य गोले प्रदर्शयेत्। विषुवत्स्वस्तिके चार्कोपलक्षितं चिह्नं कृत्वा भगोलं भ्रमयेत्। देवासुरप्रतिपादने निरक्षदेशप्रतिपादने च खगोलंदक्षिणोत्तरस्वस्तिकयोरथः। शलाकाग्रे कृत्वा शेषं सामान्यमिति। अत्र च लाटदेवः—दृग्वरिजे स्वे विषुवति पश्यंत्यमराः प्रदक्षिणगमर्कम्। अपसव्यगतिदैत्याः समरेखस्थं बुधाश्रमिणः निरक्षदेश वासिनो बुधाश्रमिणस्तस्य, तथा च वराहमिहिरः प्रोद्यन्नविरमराणां भ्रमत्यजादौ कुवृत्तगः सव्यम्। उपरिष्टाल्लंकायां प्रतिलोमश्चामरारीणाम्, इदानीमपमण्डलार्धं दर्शनात्—द्वारेण देवासुरादि वासयोः प्रतिपादनार्थमाह—

सौम्यमपमण्डलार्धं मेषाद्यं सव्यगं सदा देवाः।
पश्यन्ति तुलाद्यर्धं दक्षिणमपसव्यगं दैत्याः ॥७॥

वास०—सौम्यमुत्तरमपमंडलार्धं चक्रार्धं मेषाद्यामजाद्यं सव्यगं प्रदक्षिणगं देवा नित्यं मेरुवासिनः पश्यन्त्यवलोकयन्ति, तुला ऊर्ध्वं दक्षिणमप्रदक्षिणगं दैत्या वडवावासिनः सदा पश्यन्तीति वाक्यशेषः, अत्रार्यभटः देवाः पश्यन्ति भगोलार्ध-मुदङ्मेरुसंस्थिताः सव्यम्। अपसव्यगं तथार्धं दक्षिणवडवामुखे प्रेताः अत्र मेषतुलाद्योर्ग्रहणं विषुवदुपलक्षणार्थं तेन खगोलोपर्यधः स्वस्तिकयोः शलाकाग्रे निधाय सर्वं प्रदर्शयेत्, तत्रापमंडलविषुवन्मंडलयोर्यत्र संपातो मेषादौ तत्र विषुवति रविर्भवति, तत्रस्थश्चार्धछत्रबिंबो मेरुस्थैर्दिनमेकं वडवामुखवासिभिश्च परितो भ्राम्यन्मेथीवलीवर्दवद्दृश्यते, ततोपमंडलगत्योदगुत्तमं दृश्यते प्रतिदिनं तद्दिन-क्रान्तितुल्येनान्तरेण यावन्मिथुना तं तत्रस्थश्चतुर्विंशत्या भागैर्विप्रकृष्टः क्षितिजो मेरुवासिभिर्दृश्यते परितो भ्राम्यन् ततश्चापमंडलागत्या प्रतिदिनं नमन् लक्ष्यते। यावत्तुलादावपमंडलविषुवत्स्वस्तिकसंपातम्। तत्र पुनः खछत्रबिंबो देवासुरैः पूर्वस्वस्तिकावस्थित इव लक्ष्यते, परितो भ्राम्यन् तदधो देवैर्न दृश्यते। यतस्तेषां विषुवन्मंडलमेव क्षितिजं। ततश्चापमंडलगत्या दक्षिणादुन्नमन्दैत्यैर्दृश्यते यावद्धनुषोंऽते तत्र चतुर्विंशत्या भागैः। उन्नमनं कृत्वा पुनर्नतिक्रमेण मेषादि-स्वस्तिकं या दृश्यते परतोऽस्तं याति क्षितिजवशादतो मेषादौ देवानामर्कोदयः। तुलादौ अस्तमयो दैत्यानां विपरीतं चन्द्रादीनामव्यवक्षिप्तानां दर्शनमेवं योज्यम्। विक्षेपवशान्नतोन्नतकल्पना स्वधिया योज्या एवं मेषादिराशिषट्कः। सदोदितं देवानां तत्रस्थोऽर्कश्च सदोदित एव त्र्यशीत्यधिकं शतं परिवर्तानां ददाति किंचि-न्न्यूनं भचक्रवश्यात्तद्वत्तुलादिराशिषट्कं सदोदितदैत्यानां तत्रस्थश्चार्कः, सदोदित एव अपरं साशीतिशतं अधिकं किंचिन्न्यूनं परिवर्तानां ददाति, भचक्रवशादेव अतो मेषादिराशिषट्कस्थेऽर्के दिव्यो दिवसः तुलादौ राशिषट्कस्थेऽर्केऽदिव्यो दिवसः। तुलादौ राशिषट्कस्थेऽर्के रात्रिः, अन्यथा दैत्यानां ये पुनर्मकरादिस्थो दिव्यदिनं कर्कादौ रात्रिमिच्छंति, तेषां प्रायेण मेरौ देवानां स्थिता इति यदि मेरौ स्थितास्त-त्कथंमकरादिराशित्रयं पश्यंति, कथं च कर्कादिराशित्रयं न पश्यंति। अर्कस्य चापमंडलादन्यत्रावस्थितिभ्रंमणं वा न शक्यते वक्तुं भवद्भिरतिपंडितैरपि। अत्र वराहमिहिरः मेषवृषमिथुनसंस्थे दिवसोऽर्के कर्कटादिके रात्रिः यैरुक्ता विबु-धानां मेरुस्थानां नमस्तेभ्यः येप्यवोचन्मेषाद्यादिस्थानेषु संनिवृत्तोऽपि एव कथं दृश्यः, पुनर्न दृश्यश्च तत्रस्थः एतत्सर्वं गोले प्रदर्शयेत्, इदानीममुमेवार्थं स्पष्ट-यन्नाह—

पश्यन्ति देवदैत्या रविवर्षार्धमुदितं सकृत्सूर्यम्।

वास०—रवेर्वर्षं रविमंडलभोग इत्यर्थः, तदर्धदेवाः पश्यंति। दैत्याश्च सकृदुदितमेव सूर्यं मेषादिराशिषट्के चरंतो देवाः पश्यंति सौरेण मासान् षड् यावत्। तुलादिराशिषट्के चापरान् षण्मासान्दैत्याः पश्यन्तीत्यर्थः। अत्रोपपत्तिः

प्रागार्यायां व्याख्याता। तथैवं स्थिते गोले सर्वं प्रदर्शयेत्। अत्र च वराहमिहिरः सकृदुदितः षण्मासान् दृश्यार्को मेरुपृष्ठसंस्थानाम्। मेषादिषु षट्सु वरन् परतो दृश्यः। सदैत्यानाम् अत्रलाटश्च संवत्सरार्धममरैः सकृदुद्गत एव दृश्यते सूर्य इति तथार्यभटः रविवर्षार्धदेवाः पश्यंत्युदितं रविं तथा प्रेताः इति। दिव्यानि दिनानि रविभगण इति, यदुक्तं मध्यगतावाचार्येण तदिहार्यया सार्धया प्रतिपादितं दिव्यमानं, इदानीं द्वितीयेनार्याधेन शशिमासाः पितृदिवसा इत्यस्य पितृदिवसस्य च प्रतिपादनमाह—

शशिगाः शशिमासार्धं पितरो भूस्था नराः स्वदिनम् ॥८॥

वास०—शशिनं गच्छन्तीति शशिगाः कर्मिणः पितृसंज्ञिता इत्यर्थः। शशिनो मासः शशिमासः त्रिंशत्तिथयः, तदर्थं पंचदशतिथयः कृष्णाष्टम्यर्धा शुक्लाष्टम्यर्धा यावत्पितरः पश्यंति सकृदुदितं सूर्यमित्यनुवर्तते पितृदिवसः स च भूस्थाः नरा अस्मदादयः स्वदिनमिति स्वदिनम्। स्वदिनं दिनशब्देनैव सिद्धात्। स्वग्रहणं प्रतिदेशं दिक्सभेदप्रतिपादनपरं स्वोदयात्स्वास्तमयं यावन्नराः सकृदुदितं सूर्यं पश्यन्तीत्यर्थः। न त्वहोरात्रम्, दृष्टविरोधात्तुल्यत्वाच्च। सर्वत्रैवं दिव्यपितृमानयोरपि तदत्र पितृदिवसोपपत्तिः अविक्षिप्ते चन्द्रे सितप्रति५दादौ भूमध्याद्यत् सूत्रं रविगोलमध्यं यावन्नीयते तच्चन्द्रगोलमध्यार्धभेदोऽपि भवति तुल्यत्वात्तयोः यत्र चन्द्रगोलोपरि सूर्यभेदः तत्र पितरस्तेषां तथा मध्याह्नकालतोऽपि चन्द्रगोलस्योपरितनमर्धं पश्यंति, वयमधस्तनमर्धंचन्द्रगोलार्धं सूर्यभेदकेन्द्रकल्पनया पश्यामोऽन्योन्यवच्छादनेन तेन। तेन तदा वयं न मनागपि चन्द्रगोलमुपालभामहे। यतोऽर्करश्मिपातवशाच्चन्द्रस्य शौक्ल्यम् उक्तं च सुषुम्लः सूर्यरश्मिरिति वेदे भूगोलवत् चन्द्रगोलेऽपि षष्टिशतत्रय भागकल्पना कार्या, तत्रस्त्रिशद्भावे न द्वादश भागाः भवन्ति। तावांश्च तिथिभोगश्चन्द्रोपरि केन्द्रात्तिथौ द्वादश भागा रविकेन्द्रं पश्चादवलंबते। तेनैव क्रमेणास्मद्दृश्येऽर्धे रविरश्मिपातः, तावच्चास्माभिः, सितमुपलभ्यते चन्द्रमसि एवं तावद्यावन्नवत्या भागैः पितृणामस्तमेति। अस्माकं पुनरर्धसितो भवत्येतच्च शुक्लाष्टम्यर्धोऽतः परं पितृरात्रिरस्माकं सितवृद्धिः पितृणां पौर्णमास्यंते अर्धरात्रः परासितवृद्धिश्चास्माकं चक्रार्धांतरं ततो पररात्रक्रमेण कृष्णाष्टम्यर्धे। तेषामर्कोदयः तेनैवासितापचयेनास्माकं पुनरर्धसितो रात्रिनवके ततस्तेषां पूर्वाह्णक्रमेणामावास्यांतं दिनमध्यं सितादर्शनमस्माकं च अत एव अमावस्यांतादुभयतोऽपि द्वादशकालांशा यावच्चन्द्रमा नोपलभ्यते, पौर्णमास्यां तच्च संपूर्णोऽर्कसंनिकर्षविप्रकर्षात्। ये तु प्रतिपदादि पितृदिवसादिमिच्छंति। तेषाम् सर्वमेवं न घटते, तस्मान् मासग्रहणं त्रिंशतिथ्युपपललक्षणार्थम्। यथा कश्चिदाह—मासेन ग्रामादहमागत इति, न च तत्र प्रतिपदादिमासगणना तद्वदिहापि चन्द्रोपरि केन्द्रे पितरः तेषां वासना प्रदर्शितेयम्,

ये तु कदंबपुष्पग्रन्थौ केसरसंस्थाना इव सर्वतोऽपि चन्द्रगोले पितरः तेषां नतोन्नत्यादिकभूगोलस्थानामिव योज्यम् । ते च न्यूनाधिकमप्यर्धमासांते मनुजाहोरात्रार्धवदेतत्सर्वं यथास्थितं गोले प्रदर्शयेत् । अनयैव वासनया शशिष्टं गोत्रतिद्धिरति पितृदिवसोपपत्तिश्च एकदिनं च क्वापि त्रिंशद्घटिकायामन्यत्र षष्टिघटिकामन्यत्र दिनाभाव एव । ततोस्त्यन्मासैः दिनमेकं षण्मासं यावदन्यत्रैतत्सर्वमुन्मण्डलविन्यासे दिनरात्रौ क्षयवृद्धिप्रतिपादने व्यावर्णयिष्यामः । अत्रार्यभटः—शशिमासार्धं पितरः शशिगाः कुदिनार्धमिह मनुजा ये तु दक्षशाणयाक्षयवृद्धी रवेश्चोपरि चन्द्र इत्यादि कथयंति । तेषां नित्यमधःस्थस्येंदोरित्यादिकया गोलवासनया वराहमिहिरोक्तयातिप्रकटया निरास इति रविशशिकक्षाद्वयेन गोलवासनयात्र प्रदर्शिता । इदानीं कस्मिन् भू प्रदेशे लंका ध्रुवोज्जयिनी तत्प्रदर्शयन्नाह अवन्ती भूपरिधेः पंचदशभागे । भूमस्तक शब्देनात्रमेरुरुच्यते । क्षितितलशब्देन च वडवामुखम् । लंकाग्रहणं निरक्षदेशोपलक्षणार्थं, तेनायमर्थः—मेरोर्वडवामुखाच्च भू चतुर्भागे निरक्षदेशः परितोऽपि तदन्तः पातिनो लङ्कायमकोटी सिद्धपुररोमकादयस्तत्रैव तच्चास्माभिः पूर्वमेव व्याख्यातम्, लंकायास्तु पुनः समोत्तरेणावन्ती । अवन्तीशब्देन उज्जयिनीत्युच्यते । किल तत्र चतुर्विंशतिरक्षांशाः षष्टिशतत्रयस्य चतुर्विंशतिभागः पंचदश भवन्त्येतच्छोभनमुक्तम्—

भूपरिधितुर्यभागे लङ्का भूमस्तकात् क्षितितलाच्च ।
लङ्कोत्तरतोऽवन्ती भूपरिधेः पंचदशभागे ॥९॥

वास०—भूपरिधिश्च खखखशराः ५००० अस्य चतुर्भागाः १२५०, एतावद्भिर्योजनैर्मेरोर्दक्षिणेन लंका पुनः भूपरिधिः ५००० । अस्य पंचदशभागाः गुणाग्निवह्नयः सत्रिभागाः ३३३ त्रि १३ एतावद्भिर्योजनैर्लंकात उज्जयिनी समोत्तरतः एतानि भूपरिधिचतुर्भागयोजनेभ्यः खशरार्क संख्याभ्यः १२५० शंसोध्याशेषं रसेदुनंदाः त्रिभागद्वययुताः ९१६ त्रि २।३। उज्जयिनी त एतावद्भिर्योजनैरुत्तरेण परिधिगत्या मेरुः सर्वं गोले प्रदर्शयेत् । परमोत्तरक्रान्त्यग्रे रविस्तत्रोपरि मध्याह्नं करोत्यन्योथ विक्षिप्तश्चन्द्रादिकः उज्जयिनी ग्रहणमपि चतुर्विंशति भागाक्षदेशोपलक्षणार्थम् । तेन निरक्षदेशात्सर्वतोऽपि भूपरिधिपंचदशे भागे । स देशो यत्र चतुर्विंशतिरक्षांशा । एवं निरक्षदेशा दक्षिणेनापि योज्यम् । द्वितीयध्रुवतारापेक्षया वडवामुखाद्यपेक्षया च योजनादिकं योज्यम् इति एवमुज्जयिनीनिरक्षदेशयोरंतरपरिज्ञानमभिध्यायेदानीमभीष्टदेशनिरक्षदेशयोरंतरपरिज्ञानमाह—

अक्षांशकुपरिधिवधान्मण्डलभागाप्रयोजनैर्विषुवत् ।

वास०—अक्षांशैः कुपरिधिवधः अक्षांशकुपरिधिवधः स्वदेशाक्षभागा कुपरिणाहम् । परस्परगुणनेःत्यर्थं, तस्माद्वधान् मण्डलभागैः आप्तं लब्धं षष्टिशतत्रया-

प्तमिति यावत् । यदाप्तं तानि योजनानि तै विषुवत्तनो देशात्तावद्भिर्योजनैर्यो देशस्तस्योपरि विषुवन्मण्डलं तावद्भिर्योजनैर्निरक्षदेश इत्यर्थः, तद्यथा कान्यकुब्जे-क्षभागाः २६।३५, एतैर्भूपरिधिरयम्, ५००० गुणितो जातः रसेन्दु नवयमगुण-चन्द्राः सद्विभागाः १३२९१६ (२/३) अतः षष्टिशतत्रयेण भागे हृते लब्धानि कान्य-कुब्जनिरक्षदेशांतरयोजनानि । नवाङ्गनयो द्विनवभागाधिकाः ३६६ (२/६) लब्धयोजनानि भूपरिधिचतुर्भागयोजनेभ्यो विशोध्य शेषं खाष्टव सवः सप्त-नवभागा ८८० । परिधिगत्या एवावन्ति योजनानि, कान्यकुब्जमेरुरेवमन्यत्रापि यथास्थिते गोले त्रैराशिकवासनं (१/६) यं प्रदर्श्य । इदानीममेवार्थं प्रचोदन्नाह—

नतभागयोजनैरेवमुपरि सूर्योऽन्यदनुपातात् ॥१०॥

वास०—दिनमध्याह्नक्रान्त्यक्षभागयोगांतरं समान्यदिशामिति येऽभीष्ट-दिनार्धनतांशा भवन्ति, तेऽत्र गृह्यंते । तैर्नतभागैरेवं यथा प्रागार्यार्धेऽभिहित-मेतदुक्तं भवति । इष्टदेशादिनार्धनतांशे भूपरिधिं संगुण्य्य षष्टिसूत्रचयेन विभजेत्फलं योजनानि तैश्च योजनैरुपरि सूर्यस्तस्माद्देशात्तावद्भिर्योजनैर्यो देशः समदक्षिणोत्तरस्थदेशस्योपरि तद्दिनमध्याह्ने सूर्यो भवतीत्यर्थः, एवं स्वनतभागै-श्चन्द्रादीनामपि योज्यम् । यद्युत्तरनतांशास्तदुत्तरेणाथदक्षिणास्तदा दक्षिणेन सदेशश्चतुर्विंशत्यक्षकादेशादुत्तरेण कदाचिदप्युत्तरा नतांशा न भवन्ति रवेरन्य-दनुपातादिति । अन्यदप्यान्तरमेवं त्रैराशिकात् । अभीष्टयोरपि समदक्षिणोत्तर-स्थयोरन्तराद्योजनान्येवमित्यर्थः । तद्यथा कान्यकुब्ज दक्षिणनतादौ नतभागाः ।२।३।५, एतैर्भूपरिधिगुणितो भांशैर्हृतश्च जनः ३६, एतावद्भिर्योजनैः कान्य-कुब्जदक्षिणातो यो देशस्तत्र नष्टाछायस्तदा मध्याह्नकालः । अभीष्टदेशयोरपि तद्यथास्था एव ईश्वरेक्षभागाः ३।१२। उज्जयिन्यां ।२४। एषामन्तरं ।६।१२। अनेन भूपरिधिर्गुणितो भांशैर्हृतश्च ८६, १/६ एतावन्ति योजनानि तयोरन्तरमेवमन्य-त्रापि । अत्र यथाक्षांशैर्नतभागैश्च योजनानयनम् । एवं विपरीतकर्मणाक्षभागा-नयनं सिद्धम्, त्रैराशिकवासना पूर्ववत्प्रदर्श्या । निरक्षदेशदक्षिणतोऽप्येवमेव योज्यम् । वडवामुखं यावत् । अधुनाकाशकक्षानयनमाह—

अंबरयोजनपरिधिः शशिभगणाः शून्यखख जिनाग्निगुणाः ।

वास०—योजनात्मकः परिधिः योजनपरिधिः अंबरस्य योजना परिधिरंबर-योजनपरिधिः कथमित्याह-शशिभगणाः पंचांबराणि, गुणराम पंचसप्तस्वरेषव इति किंभूताः शून्यखखजिनाग्निगुणाः लक्षत्रयेण चतुर्विंशत्या ज सहस्रै-र्गुणिताः शशिभगणाः आकाशकक्षयोजनानि भवन्तीत्यर्थः । तद्यथा शशिभागाः ५७७५३३०००००० शून्यखखजिनाग्निभिरमीभिः ३२४००० गुणितजाताः शून्याष्ट-कयमनंदरसखाश्विरूपनगाष्टचन्द्राः १८७१२०६९२००००००० एतावंति खकक्ष्या-

परिधियोजनानि, कल्पे च ग्रहाणां गतियोजनानि। एतावंति वक्ष्यत्येकैकस्य नत्वनतस्य कालगस्य कथमुच्यते नियतपरिधिः, अत्र केचिद्दिनकरकरनिकरविधूस्ततमसो व्योम्नं परिधिरयं परतो निबिडमंधकारं यदस्माभिर्नीलमिवोलभ्यते। अपरे त्वंडस्य यस्य मध्ये सकक्षे भूगोलात्मवत्स्थितस्तथायं परिधिस्तत्कोशं च नीलमिवास्माकं प्रतिभाति, उभयथापि न कश्त्चिप्रक्रियाविरोधः यतो भकक्ष्याया ऊर्ध्वगतिनिरोध एव अत्रार्थे ग्रहणकमस्मदीयम्। द्विछिद्रषट्कांबर तेऽत्र चन्द्रशैलाष्टरूपाणि गुणानि कोटयाः व्योम्नः सधाम्नः परिधि दशध्रकल्पे ग्रहाणां सच योजनाध्वः यदुक्तं वासिष्ठ सिद्धान्ते॥ जगदण्डखमध्यस्था महाभूतमयी क्षितिरित्यादिः, तदण्डाभ्युपगमे घटत एव आर्यभट्टः शिष्यैश्च व्याख्यातं खपरिधिदशनद्वारेणार्करश्मिप्राप्तस्य नभसः प्रमाणं प्रदर्शितम्। भवत्याचार्येण ननु चेष्टग्रह् स्वकक्ष्याभगणवधः षपरिधिरित्येतावतैव सिद्धेः शशिभगण इत्यादि ग्रंथगौ रवकरणमसं बद्धमिव नः प्रतिभाति। यतः शून्य खखाजिनाग्नयश्चन्द्र कक्षा प्रमाणं नैष दोषो यतः खपरिधे रेव ग्रहकक्ष्या आनयिष्यति तदपरिज्ञानात्तद्भगणवधः कथं शक्यते कर्तुम्, तर्त्तहि तुल्यं शशिकक्ष्या परिज्ञानेऽपि न तुल्यम्। अत्रोच्यते रविचन्द्रयोरन्येनैव प्रकारेण कक्ष्यानयनासिद्धेः कोसौ प्रकार इति तदुच्यताम्, तद्यथा चन्द्रभूयोगाच्चन्द्रबिबं मध्यमं लिप्तागतं साधयेत्। तच्चोदयतोऽस्तमयतो वा बिंबस्य कियंत्यो विनाड्यः प्राणाश्च भवन्तीति चन्द्रभगणभोगं यावत्साधयेत् दिनं प्रतिदिनं स्वधिया स्वदिनोदयस्यैकत्र कृतस्य तदह्निश्च स्वैर्दिनैर्विभक्तस्यार्कदिनोदयबिंवकालो मध्यमो भवति। सच प्राणी कृतः शशिमानमध्यमलिप्तो भवति, ताश्चाब्दा विंशतिशतम्। रवेरप्येवमेव समप्रदेशस्थस्य द्रष्टव्यम्, मानप्रसाधनं चन्द्रमसोर्योजनमानं च वक्ष्यति शून्यवसुवेदा इति ४८०, ततो लिप्तामानेन योजनमानस्य भागे हृते लब्धपंचदश।१५। एतावंति योजनान्येकैकस्याः कलायाः प्रमाणम्। चन्द्रकक्ष्या प्रदेशे कक्ष्या च सर्वस्य खखषट्कन संख्याः लिप्ताः, यतो लब्धवोऽल्पराश्याम् इति वक्ष्यति। तेन पंचदशगुणिताः खखषट्कन संख्याजातं प्रमाणं योजनात्मकं। चन्द्रकक्ष्याया शून्यखखजिनाग्नयः। ३२४००० एवं रवेरपि यत उक्तम्। मानोदयाद्रवींद्वो र्घटिकार्धमर्धेन (भोक्ष्य) इति छायाध्याये त एवार्येण चन्द्रकक्ष्या मूलत्वेन सर्वकक्ष्याणामानयनमभिधातुं शोभनमारब्धम्। तत्रानि शेषत्वा दृगणितकर्मणः शेषग्रहाणां योजनमानानि न पठितानि अत एवात्र खपरिधिद्वारेण सर्वमेव वक्तुमुद्यत आचार्यः भवतु नामेहृक् तया सिद्धया शशियोजनमानं सिद्धमेव अभ्युपगतमस्माभिश्च तत्कक्ष्याभ्युपगमतुल्यत्वात् न कश्चिद्विशेषः। सत्येवं यदप्युक्तमस्माभिः शशिभूयोगादस्तमयोदयकाले चन्द्रमानसाधनं तदपि मानुषमात्रेण ग्रहीतुं न शक्यते विघटिककादिकोऽपि कालः किमुत प्रमाणावयवादिकः अस्माभिः प्रसंगेन वसुदर्शनं कृतं भुवश्च निम्नोन्नतत्वान्महाद्रिवनांतरितत्वाच्च। अशक्यं सर्वं किंत्वागम एव प्रमाणमस्माकं

भगणपरिधिः कक्ष्यामानयोजन कर्णादिषु मेरूलंकावडवामुखादिषु तेषामगम्यत्वात्। यत एवाभितपोबलेन विमलमनसवसिष्ठगर्गादयो ऽभियुक्ताश्च तत्प्रणीतेभ्यो ग्रन्थेभ्यो लेशज्ञा विदामो वयं सदिदमसच्चेदं परगृहभोजनेषु छात्रा इव एवं स्व-कक्षाप्रमाणमुक्त दानीयं तत एव सर्वग्रहकक्ष्यानयनमाह—

यस्य भगणैर्विभक्तास्तत्कक्ष्यार्को भषष्ठ्यंशः ॥११॥

वास०—खपरिधिरित्यनुवर्तते यस्य ग्रहस्य भगणैः खपरिधिर्विभज्यते तस्यैव कक्षा योजनमानात्मका लभ्यते। तद्यथा खपरिधिरयं द्विछिद्रषट्कम्मवर-नेत्र चन्द्रशैलाष्टरूपाणि शून्याष्टकैकहतानि १८७१२०६९२०००००००० अस्य कल्परविभगणैरमोभिः ४३२००००००० भागे हृते रवि कक्ष्याप्रमाणे सप्तनवकृत-रूपाग्निगुणवेदाः सार्धाः। ध ३३१४९७½ तथा शशिभगणैः शशिकक्ष्यायोजनानि शून्य। खखजिनाग्निसंख्यानि ३२४००० एवं सर्वेषां कक्षानयनमस्माभिरुदा-हरणीयं सिद्धा एव लिखन्ति। स्वैः श्लोकैः सार्धनन्दकृतरूपगुणाग्निवेदाः कक्ष्या प्रमाणमिह भानुमतः प्रदिष्टम्, चन्द्रस्य शून्यखखवेदयमाग्निसंख्यकौजं रसेन्दु नवषण्णवोष्टकान्तं रुद्राश्विलोककृतपंक्तिकृतं बोधं कक्षप्रमाणमिह देवगुरोरतश्च द्यश्वाष्टलोकैर्वेदनगलोकशशांकबाणास्त्रिशद्रसाष्टकृतिषट्ककरा तु शौक्रम्। सप्ताष्टशैलवसुषट्करसागसूर्याः ख्यातं शते विविकलाः कथितास्तु सर्वाः खेष्विदु-पूर्णशशिशीतकरैर्विहीनाकोद्योरसाश्च विमिताः कथिता भकक्ष्याः अर्को भषष्ठ्यंश इति। भानि नक्षत्राणि तेषां यः षष्ठ्यंशः तत्रार्कः, एतदुक्तं भवति भूमध्या-द्यावति प्रदेशे रविः तावति षष्टिगुणे प्रदेशे नक्षत्राणि भूमध्यादेव ननु वास्मिन् कक्ष्या प्रतिपादनपरसूत्रे। किमनेन प्रयोजनमिति चेत् अस्ति प्रयोजनं नाम नक्षत्रकक्षापरिज्ञानं। यदेवोक्तमर्कात्षष्टिगुणे नक्षत्राणि तदेवार्ककक्ष्या षष्टिगुणे नक्षत्रकक्षेत्युक्तम्। एतच्चार्ककक्ष्यामण्डलपरिमण्डलसंपातापेक्षया अन्यथा परि-मण्डलेऽर्के कथं षष्ठांशे भानां वक्तुं शक्यते प्रतिमण्डलमध्यं यतो भूमध्ये न भवति एतच्चस्फुटगत्युपपत्तौ ज्ञास्यथेति तद्यथा रविकक्षा सार्धाग्निनंदकृतरूप गुणाग्निवेदा ४३३१४९७½ इयं षष्टिगुणा नक्षत्रकक्षा जाता सा चः शून्या ख सुनववसुनन्देषु यमाः २५९८८९८५० पूर्वमेवास्माभिरियं पठिता। शीघ्रं मद-पाताश्च। स्वग्रहाकक्षाप्रमाणेपमण्डले भ्रमन्त्यतस्तेषां ते पृथक् एतच्चोत्तरत्र प्रति-पादयिष्यामः स्फुटगति वासनायामिति। इदानीं ग्रहाणां योजनरूपायागतेः तुल्यत्वमाह—

भपरिधिसमानि षष्ट्या ख परिधितुल्यानि कल्परविवर्षैः।
गच्छन्ति योजनानि ग्रहाः स्वकक्षासु तुल्यानि ॥१२॥

वास०—स्वकीयाः कक्षाः स्वकक्षाः तासु तुल्यानि योजनात्मकोध्वा सर्व-ग्रहाणां तुल्य इत्यर्थः। तद्यथा स्वकक्ष्यायोजनानि, खेष्विदं पूर्णशशिशीतकरै-

विहीनाकोद्योरसाश्च विमिता प्रथिता भकक्ष्याः २५८८९८५० रविवर्षाणां षष्ट-योजनान्येतावन्ति । स्वकक्ष्यास्थो ग्रहः प्राङ्मुखं याति......देवरवितुल्यानि...... (रविवर्षाणां) याति ग्रहः खपरिधियोजनानि १८७१२०६९२००००००० कल्पे नैतावन्ति योजनान्येकैको ग्रहो याति स्वकक्षास्थः अत्रार्कसावन कल्प दिनैरनुपातादिव सभुक्तिः यदि कल्पसावन दिनैः खपरिधि योजनानि तदेकेन सावनदिनेन कियन्तीति लब्धा दिनभुक्तियोजनात्मिकाष्टशखसुरुद्राः ११८५८ योजनांशाश्च ११३५९३३५९००००० अनया दिन योजनानिभुक्त्या त्रैराशिक

१५७७९१६४५०००

द्वयं भुक्त्या ग्रहानयनं तदयथा यदि कक्ष्या योजनैरेक भगणो लभ्यते तद्दिनगगतियोजनैः किमित्येकदिनभुक्तिफलं प्रथमत्रैराशिके एकैको गुणकारः द्वितीये भागहारः तुल्यत्वात् नष्टयोरहर्गणस्य दिनभुक्तियोजनात्मिकाः गुणकारः खकक्ष्यायोजनाभागहारः फलमिष्टग्रहः । तथा चार्यभट्टः षष्ट्या सूर्याब्दानां प्रपूरयन्ति ग्रहाभपरिणाहम् । दिव्येन नभः परिधिसमं भ्रमन्तः स्वकक्ष्यासु ननु योजनगत्या सर्व एव ग्रहाः समगतयः तत्किमिति भिन्नगतयोऽस्माभिरुपलभ्यते इत्येतदाशंक्योपपत्यर्थमार्याद्वयमाह—

भगणस्याधः शनिगुरुभूमिजरविशुक्रसौम्यचन्द्राणाम् ।
कक्षाक्रमेण शीघ्राः शनैश्चराद्याः कलाभुक्त्या ॥१३॥
लघवोऽल्पे राश्यंशा महति महांतोल्पवृत्तमल्पेन ।
पूरयतींदुर्महता कालेन महच्छनैश्चारी ॥१४॥

वास०—भानां गणो भगणः नक्षत्रपंजर इत्यर्थः तस्याधः शनिगुरुभूमिजरविसौम्यचन्द्राणाम् । कक्षा क्रमेणायमर्थोऽस्माभिः भूगोलस्वरूपप्रतिपादने प्रपञ्चेन व्यावर्णितः शीघ्राः शनैश्चराद्या इति कक्ष्याक्रमेण शनेर्गुरुः शीघ्रः गुरोर्भौमः एवं शशी यावत् । यदि प्रागातपः स्वगताग्रहाः अथवा शीघ्राः शनैश्चराद्याः अतिशीघ्रा शनिः ततो मन्दो गुरुः गुरोर्भौम इत्यादिना क्रमेणाति चन्द्रमाः यदि सर्वदा पश्चाद्गतयो ग्रहाः स्युः, इयं च शीघ्रं मन्दकल्पना कलाभुक्त्या लिप्ता रूपया भुक्तेत्यर्थः, अन्यथा योजनभुक्त्या तुल्या गणिता एव गतिश्चादि न भोगः तस्याश्चोभयथा सम्भवः । प्रथमपक्षे नक्षत्रा भुक्तिलिप्ता तुल्येनाध्वेनापूर्वेण ग्रहो गतः । द्वितीय पक्षे, तावानेव ग्रहो नक्षत्रात्पश्चादवलम्बितः सोप्यवलम्बमानः पूर्वेणैवावतिष्ठते । इत्येवमुपरिस्थितो ग्रहोऽधःस्थितग्रहेण सहयोजनः यस्मादुपरिस्थितस्य महती कक्षाधः स्थितस्य स्वल्पा महत्यः कक्ष्याः या राशयो राश्यवयवाश्च महान्तः । यत एवोक्तं लघवोऽल्पे राश्यांशाः लघवः सूक्ष्मा अल्पे वृत्ते राश्यवयवाः महति वृत्ते महान्ति यस्मादेवं तस्मादल्पं वृत्तं स्तोकेनैव कालेन पूरितं चन्द्रः शनिरस्तु पुनः महवृत्तं महता कालेन पूरयति यतश्चन्द्रशनीतुल्या गती कक्ष्यभे-

दाद् भुक्तिभेदः, चन्द्रः कक्ष्यायां पंचदशो योजनानि लिप्ता प्रमाणं सति कक्ष्यायां पुनः षड्भिर्योजनसहस्रैः सप्तन्यूनैर्लिप्ता भवति अयं द्वितीयाया मथ उभयोरपि गतिपक्षयोः तुल्य एव। प्रागार्योक्तोर्थश्च विचार्यं ते शीघ्राः शनैश्चरोद्याः कलाभुक्ते ति अत्रैकपक्षः भूस्थिरा भपंजरस्तु सग्रहः प्रभंजाक्षिप्तप्रतिक्षणं पश्चाभिमुखं भ्रमति। तद्वशेन प्रतिदिवसिकावुदयास्तमयौ सर्वग्रहनत्राणां तत्र भवति स्वगणो भोगेन। अत एव प्राग्गतयो ऽस्याभिरूपलभ्यते। देशान्तरप्राप्तेः द्वितीयः पक्षः भूः स्थिरैव नक्षत्रग्रहाः सर्व एव पश्चाद्गतयो प्रत्यक्षतो ऽस्माभिरूपलभ्यन्ते। तस्मादत्रातिशीघ्रोक्तिनक्षत्राणि ग्रहेभ्यो यतो भूगोलकादति दूरस्थितानि, तेषामधिका प्रेरणानित्यं प्रवाहानिलजनिता तेभ्योऽधः शनिः स एव तदपेक्षया पश्चाद्गतित्वे मंदः तस्य न्यूनवायुप्रेरणया भूमेरासन्नो यतः स एवं ततोऽपि मंदक्रमेणाधोऽधोतिमंदता चन्द्रस्य। ततोऽपि श्येनादयो मंदस्तेभ्योऽपि मन्दा वयं साक्षाद्भूमिस्पर्शिणः एवं च स्थिते शनिं हित्वा नक्षत्रं पश्चाद्यात्यतो भूस्थैरुच्यते प्रगतिः शनैश्चरो नक्षत्रांतरं प्राप्तः एवं सर्वग्रहाणां योज्यम्। अन्यथा नक्षत्रग्रहाः सर्व एव खस्थाः पदार्थाः तत्र ग्रहाणां युगपद्गतिद्वया संभवस्यात्। यतो गतिर्नाम वपु व्यापारः पूर्वापरयोश्च विरुद्धौ वायू एकस्यैव पदार्थस्या काशस्थितस्य तुल्यकालं प्रेरणाद्वयं कुरुत इत्येतदपि न शक्यते वक्तुम्। य एव बलवान् स एव स्वस्थायां दिशि नयति। मूर्तिमदाधारवर्जितत्वाप्तदार्थस्य ग्रहादेः अस्ति मूर्तिमदाधारो यत्रासौ स्थितो यातीति चेत्तदपि न। यदि स्यात्तदस्यावयवे व्यवधायकः स्यात्। दृश्यन्ते च ज्योतिष्मंतः। पदार्थाः तस्मात्प्रथमपक्षे यदुक्तं कुलालचक्रा स्थिताः कीटा इव महानदीप्रवाह पतिताः पुरुषा इवेति तदुक्तमाधाराभावादयंह पूर्वेण च देशान्तरप्राप्तिरस्मात्पक्षे च युज्यत एव नैवं भवत्पक्षेपि दोषा विद्यंते तत्रैको वक्रासम्भवात्। यतो नक्षत्रेभ्योर्वाग्यो ग्रहः स्थितः स तावत्प्राग्गतिः स च नक्षत्रादवलंबितः पश्चाद्गतिः सवक्री कथं भवत्युभयताम्। अथैवं भणसि यदा नक्षत्रेभ्य उपरिग्रहो भवति। तदा तेन नक्षत्राणि जीयंते जितानि चावलंबंते पूर्वेण स च पश्चादुपलभ्यते इति। तदपि न शक्यते वक्तुम्। यतो नक्षत्रेभ्य उच्चतरो ग्रहः कदाचिदपि न भवति। नियतत्वाद् ग्रहभ्रमणप्रदेशस्य अन्यच्च वक्रीग्रहो भूमेरत्यासन्नो भवति। योजनकर्णेऽपि तस्यातिलघुर्भवति, मानमपि बिंबस्य महद्भवति अतः परमवक्रे स्थितो ग्रहः, अन्यकालाद्भूमेर त्यासन्नो भवति, न वैवमस्मिन्सदा पश्चात्गतिक्षे प्रतिपादयितुं शक्यते। अतोऽयमपि सदोषः पक्षः अपरो ऽपि दोषः, त्वया तावदस्योपर्यधो भावेन ग्रहाणां स्थितिरभ्युपगता। तत्कथं तुल्यावलंबनम्। योजनगतं प्रदेशभेदाद्वायुभेद स्वोक्त एव। स च नेह यस्त्वबलंबनभेदः स लिप्तागतो यतो वृत्तगत्याग्रहाः परिवर्ता कुर्वते। तच्च वृत्तं दूरस्थस्य महद्भवति निकटस्थस्याल्पं तस्माद्द्वितीयोऽपि दोषः परिहार्यः। अन्येऽपि दोषा अनया दिशायोज्याः इत्यनयोः पक्षयोः प्रथमः पक्षः शोभनोऽप्यतो लघुकाराग्रहणगतिरुपलभ्यते।

तस्माभिरूपर्यध: पूर्वापरदक्षिणोत्तरेषु गतिः षट्पक्षाः उत्पद्यंते तेषां षण्णां गति पक्षाणां पूर्वगमन एव ग्रहाह्लंबनयुक्तिः, नान्येषु उपलभ्यन्ते च सर्वा एव गतय: ताश्च गमनक्रियामंतरेण न सम्भवति। तस्मात्स्वव्यापारकृता ग्रहाणां गतिः प्राची। अपरा च प्रवाहानिलजनिता भूम्यावर्तजनिता वा भपंजरस्य तुल्यरूपत्वान्नबोध्यम्। यथा च परमार्थिकाग्रहस्य गतिः तया स्फुटगतिवासनायां नीचोच्चमंद शीघ्रवृत्तद्वारेणाचार्यं एव वक्ष्यति। कक्ष्यामण्डलमध्यं भूमध्य इत्यादिना ग्रन्थेन वयमपि तत्रैव विस्तरेण प्रतिपादयिष्याम इति। इदानीमयं भगणकलापरिणाहस्य व्यासार्धानयनमाह—

यन्मूलं तद्वचसो मण्डललिप्तकृते र्दशहृताया।
तस्यार्धं व्यासार्धं मण्डलकर्णं प्रमाणार्थम् ॥१५॥

वास०—मण्डललिप्ता भगणलिप्ताः खखषध्वना इत्यर्थः। तासां कृतिवर्गः तस्याः कृतेः किं भूतायाः दशहृतायाः यन्मूलं तद्ध नुः तस्य व्यासस्यार्धं; भगण परिणाहेति। स्वयोजनकर्णप्रमाणार्थः तेन स्फुटयोजनकर्णानयने त्रैराशिक विधिरित्यर्थः। तद्यथा मंडललिप्ता २१६०० आसां कृति दर्शभक्ता ४६६५६००० तस्याः पदं ६८३० एष व्यासस्यार्ध ख ३४१५ योजनाकर्ण स्फुटी करणार्थं न

७१०० ३५५०
१३६६० १३६६०

नुच भगणकालानां (र्ध ख) एतदेव व्यासमुनिरदा इति युक्तमित्युक्तभिति। आशकां परिहरति—

भगणकला व्यासार्धं भवति कलाभिर्यतो न सकलाभिः।
ज्यार्धानि न स्फुटानि च ततः कृतं व्यासदलमन्यत् ॥१६॥

वास०—भगणकलाभ्यो यद्व्यासार्धं तत्सविकलं ततश्च ज्यार्धानि कल्पमानानि वा न स्फुटानि कल्पयितुं यांत्यतः फलनाशभयादन्यद्व्यासार्धं मयाकल्पितम्। फलं चापगतं तुल्यमेत्र योजनकर्णाश्च स्वकक्षा भगणकल्पनया कल्पिताः ते च भगणव्यासार्धेन सह सम्बध्यंते। शेषं गणितकर्म चाभीष्ट व्यासार्धेनापि न नाशं याति। गताज्या अपि तदनुसारेणेत्यर्थः। सामान्य गोलप्रकरणम्।

अधुना स्फुटगतिवासना प्रदर्श्यते। तत्र तावन् ज्या प्रदर्शनार्थमार्याद्वयमाह—

राश्यष्टांशैर्ष्णांकान् पदसंधिभ्यः क्रमोत्क्रमान् कृत्वा।
बध्नीयात्सूत्राणि द्वयोर्द्वयोर्ज्यास्तदर्धानि ॥१७॥

ज्यार्धानि ज्यार्धानां ज्याखंडान्यन्तराणि तान्येव।
व्यस्तान्यन्त्या दथवेषुरुत्क्रमज्या धनुस्ताभ्याम् ॥१८॥

वास०—राशोनामष्टांशा राश्यष्टांशाः भचक्रस्य षण्णवतितमा अंशा इत्यर्थः। तेषां कान्कृत्वा क्रमोत्क्रमान् दशसंधिभ्यः पदानां संधयः पदसंधयः तेभ्यो राशित्रयाद्राशित्रयादित्यर्थः ततो बन्धीयात्सूत्राणि द्वयोर्द्वयो रेवं कृते ज्या भवन्ति, एतदुक्तं भवति। समायामवनौ खमुनि रदांगुलसंख्येन कर्कटकेण वृत्तमालिखेत् तत्र पूर्वापरादक्षिणात्तरा च द्वे अपिःरेखे समे कुर्याद्यथा तच्चतुर्धा भवन्ति तानि चत्वारि तत एकैकस्मिन्पदे राशित्रयं परिकल्प्यचिह्नानि कुर्यात् तदेकैकस्मिन् राशौ राशावष्टावष्टौ चिह्नानि कुर्यात्। एवं षण्णवति चिह्नानि सकले वृत्ते भवंति। ततः पूर्वस्मिन् भागे पूर्वपरायाम्योत्तररेखाया उभयपार्श्वस्थयोश्चिह्नयोः सूत्रं प्रसार्य रेखां कुर्यात्, सा प्रथमा ज्या भवति। मनुयमला द्विगुणा भवंतीत्यर्थः, एवं तदनन्तरोभय पार्श्वचिह्नयोः सूत्रं प्रसार्य रेखां कुर्यायावच्चतुर्विंतिश्चतुर्विशे सूत्रे खमुनिरदा द्विगुणा भवति। तत उक्तोत्क्रमेणांनंतरं चिह्नयोरूभयपार्श्वस्थयोस्तावत्सूत्राणि प्रसार्य रेखाः कुर्याद्यावदपरा दिक्। एवमष्टचत्वारिशंज्जीवा भवंति। तदर्धानि ज्यार्धानीति तासां ज्यानामर्धाति भवंनि। सप्तचत्वाशिंरता रेखाभिः मध्यमायाः साधारणत्वादर्धज्यामनुयमला मुनियमवेदा इत्यादीनि एवं षण्णवतिर्ज्यार्धानि सकले वृत्ते भवंति, ज्यार्धानां ज्याखण्डान्यंतराणि तेषां ज्यार्धानां प्रत्येकमेकैक स्यानंतरज्यार्धे सहांतरे कृते यद्भवति। तज्याखंडकं भवति एवं सर्वज्यार्धानानां चतुर्ष्वेपिप्रदेशेषु षण्णवतिर्ज्याखंडकानि भवंति। क्रमोत्क्रमेण यथा प्रथमं ज्यार्धमनुययलाः २१४ द्वितीयं च मुनियमवेदाः ४२७ अनयोरंतरं २१३ एतज्ज्याखंडकमेवं यावत्सर्वत्रां ज्याखण्डकं सप्त व्यस्तानां तावदथवेषुरूत्क्रमज्या तान्येव ज्याखंड़ानि व्यस्तानि यिपरीतानि। जीवातः प्रभृति यच्चतुर्विंशत्या ज्यायाः सम्बंधिज्याखंडं तदुक्तमज्याकरणे प्रथमं भवत्येवं त्रयोविंश द्वितीयमित्यादि तावद्यावत्प्रथममंयं भवति। अथवा क्रमेण प्रथमज्यामापः शरस एवं प्रथमज्यार्धमुक्तमज्याकरणे द्वितीया द्वितीयं तृतीयास्तृतीययित्यादि तावद्वचा सार्धं धनुस्ताभ्यां तस्या क्रमज्याया उक्तमज्यायाश्च चापं तुल्यमेव। यत एवमुत्तर दिग्भागा दक्षिणदिग्भागं यावदष्टाचत्वारिंशज्याः' तदर्धानि ज्यार्धानितेषां मंतराणि ज्याखंडकानि क्रमणैव योज्यम्। एवं भूमौ दृग्गोले च अपमण्डलेः तु मेषतुलादौ क्रमेण ज्या कर्कटमकरादावुत्क्रमेण। एव ज्यास्वरूपं प्रदर्श्याधुना अष्टादशषोडश ज्यार्धानामुत्पत्तिं प्रदर्शयन्नाह—

एकद्वित्रिगुणाया व्यासार्धकृतेः पृथक् चतुर्थभ्यः।
मूलान्यष्टद्वादश षोडशखंडान्यतोऽन्यानि ॥१९॥

वास०—एकगुणाया व्यासार्धकृतेश्चतुर्भागान्मूलं···अष्टक्रमज्याखंडं भवति, द्विगुणायाः व्यासार्धकृतेश्च······मूलं···द्वादशज्याखंडकं भवति। त्रिगुणायाश्च अनेनैव विधिना षोडशं ज्यार्धं भवति। अत्रेयं वासना अष्टमी जीवराशिद्वयस्य भवति सा च व्यासार्धतुल्या, यतो वृत्तक्षेत्रमध्ये यावत्षट्समत्राश्च क्षेत्राण्याख्यंते, तावद्राशिद्वये व्यासार्धतुल्या ज्या भवति सर्वमेतद्यथा लिखिते वृत्तक्षेत्रे प्रदर्श्य वक्ष्यति च ज्यार्धानि वृत्तपरिधेः षष्ठचतुर्थत्रिभागानामिति। उक्तं च परिधेः षट्भागज्याविष्कंभार्धेन सा तुल्येति। तदत्र यैव व्यासार्धकृतिः, सैवाष्टम्या जीवायाः कृतिः ज्यार्धानयने च कृतेश्चतुर्भागमूलं गृह्यत इत्युपपन्नम्। यतः समचतुरश्रो वर्गः, उक्तं च वर्गः समचतुरश्रः फलं च सदृशद्वयस्य संवर्ग इति अथवाष्टमे समुत्पन्ने षोडशं ज्यार्धकोटिः, यतस्तदवलंबाकर्णस्थित व्यासार्धं तुल्ये भुजे भूमेश्च स्वाबाधावर्गोनाद्भुजवर्गान्मूलमवलंब इत्यनेन तत्प्रमाण ज्ञान व्यासार्धकर्णः कृतेः कोटिकृतिं विशोध्य मूलं भुजः अष्टमं ज्यार्धः यः स तत्र क्षेत्रमयनचतुरश्रं भवति द्वादशी च जीवा राशित्रयस्य भवति। सा च परिधि चतुर्भागज्यातया समचतुरश्रं क्षेत्रमुत्पद्यते। तत्र च व्यासतुल्यः कर्णद्वादशी जीवा तुल्ये कोटिभुजे तयोश्च वर्गयोगः व्यासवर्ग समः कर्णयोगः, उक्तञ्च। यश्चैव भुजावर्गयुतः कोटिवर्गश्च कर्णवर्गः स इति कर्णवर्गात्कोटिवर्गमपास्य व्यासवर्गस्य व्यासवर्गस्यार्धमवशिष्यते। व्यासार्धकृतिश्च द्विगुणा तावतैव भुजवर्गोऽपि तावानेव द्वादशी जीवावर्गश्च ज्यार्धानयने ज्यावर्गचतुर्भागान्मूलं गृह्यत इत्युपपन्नम्। षोडश्या अपि जीवाया भुजरूपाया व्यासः कर्णः अष्टमी जीवा कोटिरेवमेतदायतचतुरश्रं क्षेत्रमष्टमी जीवा कोटिव्यासार्धं तुल्यातस्य एव वर्गंव्यासवर्गादपास्य त्रिगुणव्यासार्धकृतेरवशिष्यते। पादोनः कर्णवर्गः षोडशी जीवनवर्गश्च स एवेत्यतश्चतुर्भाग मूलं षोडशं ज्यार्धं भवत्येवं पूर्वलिखितः वृत्तक्षेत्रे ज्यार्धं रेखाभिः सार्धं प्रदर्शयेत्। अतोऽन्यानि अत उक्तात्प्राकारादन्यानि शेषाणि ज्याखंडानि भुजकोटिकर्णकल्पनया प्रदर्शयितव्यानि। कथमिति चेत्प्रतिपादनायार्यात्रयमाह—

तुल्यक्रमोत्क्रमसमज्याखंडकवर्गयुतेश्चतुर्भागम्।
प्रोह्यानष्टं व्यासार्धवर्गतस्तत्पदे प्रथमम् ॥२०॥
तद्दलखंडानि तदूनजिनसमानि द्वितीयमुत्पत्तौ।
कृतयमलैक दिगीशेषु सप्तरसगुणनवादीनाम् ॥२१॥
एवं जीवाखंडान्याल्पानि बहूनि वाद्यखंडानि।
ज्यार्धानि वृत्तपरिधेः षष्ठचतुर्थं विभागानाम ॥२२॥

वास०—तुल्यस्य धनुषः क्रमोत्क्रमाभ्यां ये समज्याखंडके द्वितीयचतुर्थादिके। तयोः खंडकयो वर्गात्तुल्यक्रमोत्क्रमज्याखंडकवर्गौ तयोर्वर्गयोर्युतिः तस्यायुतेश्च-

तुर्भाग:, तं प्रोह्यानष्टं कुत इत्याह साधं वर्गत: तत्पदे ताभ्यां पदे तत्पदे। प्रथम-मेकं पदमनष्टाद्राशे: अनष्टोनाद् व्यासार्धवर्गद्वितीयं पदं प्रथमं तद्दलखंडानि अनष्टं पदं यत्तद्यावत्संख्याया: ज्याया: क्रमोत्क्रमज्ञातं तदर्धं संख्यं ज्यार्धं भवतीत्यर्थ:। यदि द्वादशेन क्रमज्याखंडेन कर्मकृततत्प्रथमं भवत्येवं सर्वत्र समखंडककर्म-नियोज्यम्। अत एव तत्र खंडानीति बहुवचननिर्देश: कृत:। द्वितीयं यत्पदं तदून-जिनसमानि प्रथमपदाद्यत्खंडकमुत्पन्नं तत्संख्या चतुर्विंशतेरपास्या शेषसंख्या समखंडकस्योत्पत्तिर्भवतीत्यर्थ:। एवं प्रथमेनोत्पन्नेन द्वितीयोत्पत्ति: सर्वत्र ज्ञेया बहुवचनात्तदूनजिनसमानीति द्वितीयं पदं योज्यम्। उत्पत्तौ कृतयमलैकदिगी-शेषु सप्तस्य गुणवादीनाम्। अयमर्थ: स्पष्टतरो विवृते तद्यथाक्रमेणाष्टमज्याखंड-कोटि: रसश्च स एवाष्टम्याजीवायास्ततो भुजकोटिवर्गयोगेन तु भागमूलं कर्णार्धं भवति। तदेव पंचदशानां भागानां ज्याखंडको भवति। चतुर्थज्यार्धमि-त्यर्थ: पुनरपि तद्भुजकोटि वर्ग योग चतुर्भागं व्यासार्धकृते: संशोध्य शेष पदं तदून-जिनसमं विंशतितमं ज्याखंडकं भवति। यतश्चतुर्थज्याखंडकं भुजाविंशतितमं कोटि: व्यासार्धकर्णस्तस्मादुपपन्नम्। एवं यथाष्टमे ज्ञाते चतुर्थ साधितं विंशं च। एवं चतुर्धा द्वितीयं द्वाविंशं च द्वितीयं प्रथमं त्रयोविंशं च। एवं विंशाद्दशमं चतुर्दशमं च एकादशं त्रयोदशं द्वाविंशत्। दशमात्पंचमं च एकोनविंशतितमं च चतुर्दशात्सप्तमं सप्तदशं च एवं चतुर्दशज्याखंडकान्यष्टमात्। तथा द्वादशात् एवम-ष्टादशं च अष्टादशान्नवमं पंचदशं च षष्टात्तृतीय मेवं विंशं च। एतानि षट्ज्या-खंडानि द्वादशात्। एवं विंशतिपूर्वाणि अष्टम द्वादश षोडशानि व्यासार्धं चेत्येवं चतुर्विंशतिर्ज्या खंडकानि प्रदर्शितानि तत: उक्तम्, कृतयमलैक दिगीशेषु सदा गुणरस नवादीनाम्। कृताद्य: यमलौ एक: १ दिक् १० ईशा: ११ इषव: ५ सप्त ७ गुणा: ३ रसा: ६ नव ९ तथा चतुर्थे उत्पन्ने द्वितीयं द्वितीये च प्रथमं चतुर्थे विंशतितम्। ततश्च दशमं द्वितीये द्वाविंशं ततश्चैकादशमित्यादि प्रदर्शितमा-चार्येणास्माभिरपि विस्तरतो व्याख्यातम्। एवं जीवखंडानि अनेन प्रकारेण ज्याखंडान्युत्पाद्यानि स्वल्पानि च बहूनि वा। अथवाऽनया वृत्तक्षेत्र वासनया चतुर्विंशति खंडान्युपपाद्यानि स्वल्पानि बहूनि वा। अथ यानि च खण्डानि यत: अष्टम द्वादशानि यान्युक्तानि, तानि ज्यार्धानि वृत्त: परिधे: षड्भागस्य ज्यार्ध-मष्टमखण्डकम्। चतुर्भागस्य द्वादशं ज्यार्धं त्रिभागस्य षोडशं ज्यार्धं एतच्चास्मा-भि: पूर्वमेव प्रदर्शितम्। उदा० व्यासार्धकृति: खशून्यनवयमनवरसांवरशशिनः १०६९२९०० एक द्वित्रिगुणा: १०६९२९००।२१३८५८००।३२०७८७०० पृथक् क्रमेण चतुर्भागा मूलानि ।१६।३५।२३१६।२८३२। एतान्यष्टद्वादशषोडशखण्डानि। शेषाणां तद्यथाष्टमम्। ज्याखण्डक्रमेण उत्क्रमेण। ४३८। अनयोर्वर्गयोग चतुर्भागोनष्टसंज्ञ: ७१६२६७ अस्मान्......मूलं ८४६। इदं चतुर्थं ज्याखण्डमनष्टं व्यासार्धवर्गादपास्य शेषं ९९५६६३३ अस्य मूलं ३१५९ इदं विंशं ज्याखण्डमेवं

सर्वत्र। इदानी मष्टाद्वादश षोडखण्डैः सिद्धैः शेषाणामानयनं प्रकारां तरेण प्रवर्शन्नार्यामाह—

उत्क्रमसम खंडगुणाद्व्यासादथवा चतुर्थभागाद्यत् ।
कृत्वोक्तखण्डकानि ज्यार्धानयनं लघ्वस्मात् ॥२३॥

वास०—उत्क्रमेण समसंख्यं खंडं तदुत्क्रमसमखंडम् ॥ तेन व्याप्तं खवेदशररस संख्यं सगुणज्या ततस्तस्माच्चतुर्भागो ग्राह्यः। स च तुल्य क्रमोत्क्रम समज्या खंडकवर्गयुतिचतुर्भागेन तुल्यो भवतीत्यर्थः। एतदुक्तं भवति। अष्टमस्य क्रमज्याखण्डस्यभूताग्निरसशशांक तुल्यस्योत्क्रमेण समसंख्यमष्टममेव खंड वसुगुणवेदसख्यम्। ४३८ अनेनायं व्यासः ६५४० गुणितो यातः २८६४५२० अस्य चतुर्भागा ७१६१३० एतदनष्टं व्यासार्धवर्गादपास्य शेषं खमुनिनगरसागनवनंदा ९९७६७७० प्रथमान्मूलं चतुर्थज्याखंडं ८४६ द्वितीयातपदं विंशं ज्याखंडं ३१५९ एतच्च कृत्वाष्ट द्वादशषोडशा खंडानि कर्मकर्तव्यं यतश्चतुर्भागाद्यं यत्कर्म तत्प्रागुक्तेन समं कार्यमित्युक्तम् अथवानेन प्रकारेण ज्यार्धानयनम्। एवं द्वादश षोडशयोरपि ज्ञेयं ज्यार्धानयनं न लघ्वस्मादिति बहुभिरप्याचार्यैं ज्यार्धानयनानि बहुप्रकाराण्युक्तानि किंत्वतोऽन्यल्लघुतरं नास्तीत्यर्थः। अत्रेयं वासना उत्क्रम खंडेन यदा व्यास ऊनीकृतः तेनैव निहन्यते। तदोत्क्रमखंडसमस्या क्रमज्यावोत्क्रम खंडसमस्य क्रमज्या खंडस्य च वर्गो भवति खंडस्य तत्रच वर्गो भवति। ···तत्र चो···मखंडं वर्गा योज्यचतु···ग्रहीतुं यु...अतओ···ण सकल···व्यासः सं···णितः उत्क्रम···खंडने···वर्ग युति स्तयो भवति क्रमोत्क्रमखंडयोः यस्माद्येनैवोनस्तेनैव यदा व्यास संगुण्यते तदा गुणकारो न। व्यासार्धगत्या हीनो व्यासार्धवर्गो भबति, गुणकारकृतिश्चात्रोत्क्रमखण्डककृतिः सा च पुनरपि योज्या भविष्यतीति कृत्वा क्रमज्यार्धकृतेः सकल एव व्यास। संगुणित उत्क्रमखण्डेन ततश्चतुर्भागेन पूर्ववत्सर्वमुपपन्नम्। उत्क्रमखण्डेन गुणो व्यासश्च क्रमज्याखण्डस्य वर्गः कथं भवतीति चेत्तत्रायं परिहारः राशेरिष्टयुतोनाद्वध इति वर्ग प्रकारः। सर्वमेतद्वृत्ते यथा लिखिते प्रदर्शयेदिति। ज्याप्रकरणम् ॥

इदानीं सर्वग्रहाणां मन्दशीघ्रफलसंस्कारेण यत्स्पष्टीकरणं स्फुटगतौ प्रदर्शितम्। तत्रकारणमार्याः प्रदर्शन्नाह—

कक्षामंडलमध्यं भूमध्ये मध्यमः स्वकक्षायाम् ।
अनुलोमं मंदोच्चात्प्रतिलोमं भ्रमतिशीघ्रोच्चात् ॥२८॥
नीचोच्चवृत्तमध्यं मध्ये तद्भ्रमति मध्यमः स्वोच्चात् ।
तत्परिधौ प्रतिलोमं मंदोच्चाद्भ्रमति शीघ्रोच्चात् ॥२५॥
अनुलोमं मध्यसमं भूस्थः पश्यति यतो न कक्षायाम् ।
स्पष्टं तन्मध्यान्तरमृणं धनं वा ततो मध्ये ॥२६॥

वास०--कक्षाया मंडलं कक्षामंडलमथवा कक्षैव मंडलं कक्षामंडलं तस्य मध्यः मन्त्र। तद्भूमध्ये स्वकक्षया यदंतरोक्त कक्षामंडलं तत्र मध्यमो भवति। अनुलोमं मंदोच्चार मंदोच्चभागावधेरनुलोमे न भ्रमति मंदोच्चं जित्वाग्रतौ यातीत्यर्थः, प्रतिलोमं भ्रमति शीघ्रोच्चात्। शीघ्रोच्चभागावधेः तु पुनः प्रतिलोमेन भ्रमति। शीघ्रात्पश्चादवलंबते इत्यर्थः। नीचोच्चवृत्तमध्यं मध्ये तद्भ्रमति नीचोच्चं च नीचोच्चेति यत्र वृत्ते गृहस्योत्पद्येते। तन्नीचोच्चवृत्तं कक्षामंडलं प्रति मंडलयोरन्तरतुल्येन व्यासार्धेन यद्वृत्तमुत्पद्यते तदित्यर्थः। तच्चैकं मंदनीचोच्चवृत्तं द्वितीयं शीघ्रनीचोच्चवृत्तं तयोर्मध्यं नीचोच्चवृत्तमध्यं तद्भ्रमति मध्ये यदुक्तं कक्षामंडलोमं मध्यम इति। प्रागार्यायां नीचोच्चवृत्तमध्यं मध्ये स्थितं तद्भ्रमति न तु पुनः ग्रह इत्यर्थः। ग्रहस्तु पुनः स्वोच्चतत्परिधौ प्रतिलोमं मंदोच्चात्स्वोच्चावधेस्तस्यैव परिधौ मंदवृत्तस्य प्रतिलोमं विपरीतं भ्रमति स्वप्रतिमंडले च प्रदेशान्मंदोच्च नींचवृत्तं यावद्ग्रहाभिमुखं नीयते। कक्षामंडले यावन्मध्यं कृत्वा तावन्मंदनीचोच्चवृत्तपरिधिस्थितोऽवलंबायमानः प्रतिलोमं दृश्यते भ्रमति शीघ्रोच्चात्तु पुनरनुलोमं यदुक्तं कक्षामंडले प्रतिलोमं शीघ्रोच्चतच्छीघ्रनीचोच्चवृत्तमध्यं न ग्रहो ग्रहस्तत्परिधौ भ्रमत्यनुलोमं। स्वप्रतिमंडलोच्चप्रदेशा कक्षा मंडले मध्यं कृत्वा शीघ्रोच्चनीचवृत्तं ग्रहाभिमुखं प्रतिलोमं यावदानीयते तावत्तत्परिधिस्थितो ग्रहोऽनुलोमो दृश्यते। यत एवं मध्यमे संग्रहं भूस्थो द्रष्टा स्वकक्षायां स्पष्टं न पश्यति, ततो मध्ये ग्रहे धनमृणं वा क्रियते। यस्मात्परमार्थिको ग्रहः कक्षामंडले न भ्रमतीति। अयमर्थोतिप्रपंचेन मया व्याख्यायते। तत्र तावत्समायामवनौ व्यासार्धं कल्पितेन कर्कटकेन वृत्तमालिखेत्ततः कक्षामंडलं तत्केन्द्रं च भूगोलमध्यं तस्यं मंडलस्यार्धावगाहिन्यौ पूर्वापर दक्षिणोत्तररेखे कुर्यादेवं च कृते चत्वारि पदानि भवन्ति। तत एकैकस्मिन्। पदे राशित्रयं (राशित्रयं) प्रकल्पचिह्नानि कुर्यादेकैकस्मिन्। राशौ त्रिंशद् भागकल्पनां कृत्वा सर्वत्र चिह्नानि कारयेत्। एवं पदराशिभागकल्पते कक्षामंडले पूर्वतः केन्द्रान्मेषादयो राशयस्ततो मेषादेरारभ्य यत्र यत्र राशौ भागे लिप्तायां च स्वमंदोच्चं वर्तते। तत्र चिह्नं कृत्वा तस्मात् चिह्नाद्भूमध्यप्रापिसूत्रं नीत्वा रेखां कुर्यात्। यतो भूमध्यात्तस्यामेव रेखायां प्रतीपं स्वमंद परमफलज्यया कक्षाव्यासार्धपरिणतया मितं सूत्रं निदध्यात्। यतस्तावत्स्वमंदोच्चनीचवृत्तव्यासार्धं यत्र सूत्रं समाप्तं तत्र केन्द्रं विरचय्य कक्षामंडल तुल्यव्यासार्धेन वृत्तमालिखेत्। तन्मंदप्रतिमंडलं यत आचार्येणैवोक्तम्। स्फुटगत्युत्तरे कक्षामंडलतुल्यं प्रतिमंडलमध्यमवनिमध्यात्खे तत्स्वोच्चनीचवृत्तव्यासार्धेऽभिमुखमुच्चस्य। अभिमुखमुच्चस्येत्यस्यार्थः। अत एव मंद प्रतिमंडल केन्द्रात्पूर्ववदुत्तर रेखानुसारेण व्यासार्धतुल्यं सूत्रं नीत्वा प्रतिमंडलपरिधिं प्रापयेत्तत्र प्रदेशे प्रतिमंडलस्य परमोच्चता तत्रोच्चव्यपदेशः अनया रेखया कक्षामंडले यः प्रदेशः स्पष्टः पूर्वमेव मंदोच्च-

चिह्नतस्तत्र प्रदेशे मंदनीचोच्च चिह्नवृत्तमध्यं तत्प्रतिमंडल चिह्नांतर व्यासार्धेन-वंशशलाकया तद्वृत्तं निर्माप्य तथा निदध्याद्यथा कक्षामंडले तद्वृत्तमध्यं भवति तत्सुदीर्घया प्रतिमंडलोच्चभूमध्यप्रापिण्या वंशशलाकया युक्तं कल्पयेत्। एवं मन्द प्रतिमंडलनीचोच्चवृत्तयोः संस्थानं ततो मेषादेरारभ्य कक्षामंडले यत्र देशे स्वशीघ्रं वर्तते राशिभागादिके तत्र चिह्नं कृत्वा तस्माच्चिह्नाद्भूमध्यप्रापि सूत्रं प्रसार्य रेखां कृत्वा ततो भूमध्यात्तथैव रेखया पुनः। स्वशीघ्र परमफलज्या-तुल्यं तद्वृत्तपरिणतं सूत्रं प्रतीपं निःसार्याग्रे चिह्नं कुर्यात्। तच्छीघ्र प्रतिमंडल-मध्यं तन्मध्यं कृत्वा कक्षामंडलव्यासार्धेन वृत्तमालिखेत् तच्छीतप्रतिमंडलं, ततः शीघ्रप्रतिमंडलमध्यात्पूर्ववदत्र रेखानुसारेण व्यासार्धं तुल्यं सूत्रं प्रतिमंडलपरिधि-प्रापयेत्। तत्र शीघ्रप्रतिमंडलस्य परमोच्चता तत्कक्षामंडलांतरं शीघ्र परम फलज्या तत्तुल्येन व्यासार्धे वंशशलाकया शीघ्रनीचोच्चवृत्तं निर्मापयेत् सुदीर्घज्यावंशं-शलाकया भूमध्यप्रतिमंडलोच्चप्रापिण्या युक्तं कल्पयेत्। ततः कक्षामंडले पूर्वमेव यत्र शीघ्रोच्चचिह्नं कृतमासीत्तत्र तस्य मध्यं वृत्तपंचकमपि षष्टिशतत्रयांकितं च कुर्यात्। कक्षामंडलमध्यं प्रतिमंडलशीघ्रप्रतिमंडलानि वंशशलाकाभिः छेदकेन वा कल्पानि नीचोच्चवृत्ते तु पुनः नरवशं वंशशलाकामये दीर्घ शलाकया युक्ते च कार्ये यतस्तयोश्चलनात्फलव्यक्तिरेवं स्थिते फलोपपत्तिदर्शनार्थमार्याद्वयमाह—

कोटिफलं व्यासार्धात्पदयोराद्यंतयोर्भवत्यु परि।
द्वितृयीयोर्यतोऽधस्तद्यु क्तोनं ततः कोटिः ॥२७।
कर्णस्तद्भुज फलकृतिसंयोगपदं तदुद्धृता त्रिज्या।
भुजफलगुणिताप्तधनुर्गुणितेनैवं फलं शीघ्रे ॥२८॥

वास०—कोटि फलशब्देन नीचोच्चवृत्तकोटिरुच्यते। त्रैराशिकसिद्धा तद्गुणिते ज्ये भांशैर्हृतेत्युक्तां यत्कोटिफलं व्यासार्धात् कक्षामण्डलत्पदयोराद्यं तयोर्भवत्युपरिवतः प्रथमचतुर्थपदे कक्षामण्डल परिस्थिते द्वितृतीये च पदे कक्षामंड-लांतः प्रविष्टतो व्यासार्धादधिकाकोटिराद्यं तयोर्नीचो वृत्तकोट्या द्वितृतीययो व्यासार्धान्न्यूना कोटिः तयैव सा प्रतिमण्डलकर्णस्य कोटिः भंवतीत्यर्थः। तद्युक्तोनं ततो व्यासार्द्धं कोटिः मन्दशीघ्रकर्मणोरपि भवतीति यावत्प्रतिमण्डलकर्णस्तु पुनस्तद्भुजफलं कृतिसंयोगपदंतदिति। स्फुटकोटेः परामर्षः तस्याः कृति भुजफल-शब्देन नीचोच्चवृत्तभुजज्योच्यते। तस्याश्च कृतिः तयोः संयोगपदं कर्णं भूमध्यपार-मार्थिक ग्रहयोरंतर तित्यर्थः तदुद्धृता त्रिज्या भुजफल गुणितेति। अत्र त्रैराशिक वासना यदि स्फुटकर्णस्यैक इति भुजो व्यासार्धस्य तावत्कक्षा मण्डलप्रदेशे ग्रह-फलज्या भवतींत्यर्थः। आप्तस्य धनुर्लब्धस्य चापं कार्यं तच्छीघ्रफलं भवति, गणितेनैवं फलं शीघ्रे, फलं केवलं वासनयाभिधीयते यावद्गणितेनैवोक्तमेवं मये त्यर्थः। ननु यैव शीघ्रं कर्मणि वासना, सैव मन्दकर्माणि तत्किमुच्यते। गणितेनैवं

फलं शीघ्रे इति मन्दकर्मण्यपि स्फुटकर्णेन फलानयनं युक्तं चात्राचार्येणोक्तमेतदाशंक्य परिहारार्थमार्यामाह—

त्रिज्याभक्तः कर्णः परिधिगुणो बाहुकोटि गुणकारः ।
असकृन्मांदे तत्फलमाद्यसमं नात्र कर्णोऽस्मात् ॥२६॥

वास०—त्रिज्याभक्तः कोऽसौ कर्ण इति किं भूत इत्याह-परिधिगुणः किं भवति बाहुकोटि गुणकार- मन्दप्रतिमण्डलप्रदेशे स्फुटपरिधिर्भवतीत्यर्थः। असकृन्मांदे मन्दकर्मणि तत्फलमाद्यसमं मध्यपरिधिकृतफलतुल्यमत्र त्रैराशिकद्वये यदि व्यासार्धमंडलस्यार्धं मन्दपरिधिः स्फुटकर्ण मण्डलस्य कइति ततो लघुंस्फुटपरिधिः तेन फलमानीय। ततो द्वितीयं यदि स्फुटकर्णप्रदेशे एतावत्फलं कक्षामण्डलप्रदेशे कियदित्यत्र प्रथमत्रैराशिके व्यासार्धं भागहारो द्वितीये गुणकारः स्फुटकर्णोऽपि प्रथमे गुणकारो द्वितीये भागहारः एवं सर्वेष्वेव नष्टेषु मध्यमपरिधिरेव गुणकारो भुजकोटिज्ययोः स्थित इत्यस्मात्कारणान्मंदकर्मणि कर्णो मया न कृत इति। तद्यथोक्तवत्कक्षामंडलमंदप्रतिमण्डलशीघ्रप्रतिमण्डलानां विनाशं कृत्वा ततो नीचोच्चवृत्ते स्वे स्वे स्थाने कक्षामण्डले च विन्यस्य ग्रहस्फुटीकरणवासना प्रदर्श्य मेषादेरारभ्य यत्र राशौ भागे लिप्तायां ग्रहो वर्तते तत्र चिह्नं कार्यम्। ततो मंदोच्चप्रदेशान्मंदनीचोच्चवृत्तग्रहाभिमुखं नयेत्। तथा च नयेद्यथा तद्वृत्तमध्यं कक्षामण्डलपरिधिममुं च गत्वा ग्रहचिह्नित प्रदेशेति। तत्र स्थितस्य नीचोच्चवृत्तस्त तदुपरि केन्द्ररेखातस्यत्परिधिश्च पूर्वेणोच्चाद्यत्र संपातस्तत्र मन्दफलस्फुटोग्रहस्तत्र च तुल्या एव राशिभगणादयो भवंति। नीचोच्चवृत परिधिप्रतिमण्डलयोः प्रतिलोमानुलमोकृतो विशेषः तावदेव ग्रहोच्चांतरं प्रतिमण्डले केन्द्रं भवति। तत आद्ये पदे भुक्तस्य भुजज्याभोग्यस्य कोटिज्या यतः प्रतिमण्डलोच्चापेक्षया सर्वदैव दक्षिणोत्तरा भुजज्या। प्राच्यपराकोटिज्या भवति॰ छेद्यको द्वितीय च पदे च विपरीतं प्रथमवत्तृतीये द्वितोय चतुर्थे यतोर्धचक्राच्चक्राच्च शेषभागानां भुजज्या भवति द्वितीयचतुर्थयोरेवं प्रति मण्डलभुजाकोटिज्ये निष्पन्ने त्रैराशिकेन नीचोच्चवृत्तेन कियत्याविति पृथग्भुजकोटि फले भवतः इष्टवृत्त इत्यर्थः। एवं स्थिते कोटिफलयुता त्रिज्या पदयोरित्यादिना स्फुटकर्णः प्राप्तः। तेन च शीघ्रकर्मवत्फलानयने प्राप्ते भुजफलमेवाचार्येण ग्रहफलमभिहितं तद्दोष परिहारा ये मयाचार्येण प्रणीता यतः प्रतिमण्डलानुसारेण परिधिः तेन प्रतिमण्डलभुजज्यागुणायितं युज्यते स च परिधिरसकृत्स्फुटकर्णं त्रैराशिकेन परिणमति। तत्कृतं फलं च पुनस्त्रैराशिकेन व्यासार्धेन परिणमत्यतः कक्षामण्डल परिधिनैव यद्भुजफलचापं तदेव ग्रहमन्दफलं भवति। मन्दस्फुटार्धं एव चन्द्रार्कौ पारमार्थिकौ दृक्समौ भवतः, भौमादीनां पुनर्मंदस्फुटग्रहशब्देन नीचोच्चवृत्तमध्यमुच्यते। अन्यथा स्थानद्वये ग्रहसम्भव एव तुल्य-

कालं स्यात्। एवं मन्दकर्माणि सर्वग्रहाणां ततः स्वस्थानाच्छीघ्रनीचोच्चवृत्तं प्रतिलोमकक्षामण्डलपरिधिममुं चतुर्मध्यं यथा गच्छति तथानीय कक्षामण्डले मन्दफलसिद्धे प्रदेशे तन्मध्यं निदध्यात्। एवं स्थिते शीघ्रनीचोच्चवृत्तं प्रदर्शयेत्। तथा स्थितस्य शीघ्रनीचोच्चवृत्तस्य यत्र परिमण्डलेन सह संतापः स्वोच्च प्रदेशादपरतो नीचोच्चवृत्ताच्च पूर्वतः तत्र ग्रहः पारमार्थिकः यतः प्रतिमण्डले परिधौ मध्यम भुक्तस्फुट ग्रहो भ्रमतीति ततः प्रतिमण्डलभुजकोटि ज्ये कृत्वा ग्रहो भ्रमति, स्फुटगत्युत्तरे आचार्येणोक्तं प्रतिमण्डलस्य त्रैराशिकेन नीचोच्चवृत्ते परिणमय्य। ततः कोटिफलयुता त्रिज्येति वासनया स्फुटकर्णमानीयोक्तवद्ग्रहफलं कार्यम्। कक्षामण्डले एवं कृते दृक्तमो ग्रहो भवति। क्षयधनोपपत्तेश्च खेर्मंदोच्चनीचोच्चवृत्तशलाकया कक्षामण्डले यः प्रदेश स्पष्टस्तत्र मध्यमो ग्रहः तद्वृत्तेन च प्रतिमण्डलपरिधिः यत्र स्पष्टः तत्र पारमार्थिको रविः। यतो मन्दप्रतिमण्डलोच्चरेखया यत्र प्रदेशे कक्षामण्डलं स्पष्टं तस्मादारभ्य नीचोच्चवृत्त शलाका स्पष्टदेशं यावद्यावंतो भागादयस्तावंत एव प्रतिमण्डलोच्चप्रदेशात्तत्परिधि नीचोच्चोवृत्तपरिधि संपातं यावत्। अतः स्फुटग्रहाद्यत् सूत्रं भूमध्यान् प्रति प्रसार्यं ते। तन्मध्यग्रहात्प्रथमे पदे पश्चिमेन याति, तत्रस्थं रवीन्द्वोः भूस्थो द्रष्टा पश्यत्यतः प्रथमे प्रतिमण्डले केन्द्रपदं तदंतरं विशोध्य। यतस्तत्रोपरि प्रतिमण्डल कक्षामण्डलात्तृतीये तु विपरीतं कक्षामण्डल स्योपरि स्थितत्वात्। द्वितीये च वासना। प्रथमवदर्धचक्रात् विशोध्य यतो भुजकोटिज्ये चतुर्थं पदे तृतीयवच्चक्रार्धं।शेषस्य यतो भुजकोटिज्ये, एवं चन्द्रस्यापि यथोपदृष्टैर्वृत्तैः सर्वं प्रदर्शयेत्। भौमादीनां पुनर्मंदकर्मणा यः प्रदेशः सिद्धो भवति। कक्षामण्डले तत्रशीघ्र नीचोच्चवृत्तमध्यं कृत्बा शेषं प्रदर्शयेत्। तत्र प्रथमे प्रतिमण्डल पदे धनं भवति, प्रतिमण्डलोच्चत्वं यतः पुरतस्तिष्ठति, अतः शेष पदेष्वपि वैपरीत्यं योज्यम्। मन्दवासना तु मन्दकर्माणि युक्ता केवलमुच्यते। एवं तत्त्वतो गणिते तु कक्षामण्डलाश्रयमेव केन्द्रः, तत्र च राशित्रये परमफलमागच्छति, युक्ता च नोपपद्यते, शीघ्रफलतुल्यवासनत्वात्। स्वल्पांतरत्वात्तु तथा न कृतमित्युक्तं शीघ्रफले तु कक्षामण्डल पदं व्यवस्थापयित ऋणधन रूपं प्रतिमण्डल पदं प्राप्तं यावत्स्वतः एव वर्धंते ताभ्यांतरत्वात्। प्रतिमण्डलभुजकोटिज्ये दर्शिते यथा न्यस्तवृत्तेषु सर्वं दर्शमान स्वयमेवावगम्यते। मन्दकर्माणि प्रतिलोम मन्दनीचोच्चवृत्तपरिधिकेन्द्र भगणभोगेन ग्रहः पूरयति शीघ्र कर्माणि चानुलोमे न शीघ्रनीचोच्चवृत्तपरिधिः केन्द्रभगणभोगेन ग्रहः पूरियति। शीघ्रकर्माणि वानुलोमेन शीघ्रचोच्चवृत्तपरिधिकेन्द्रभगण भोगेन ग्रहः पूरयत्यतः सर्वं एवोदयास्तमयचक्रात्तु चक्रादयः प्रदर्श्याः। यदा रविसमसूत्रस्थो ग्रहः स्थितः तदापरमास्तमयप्रदेशात्प्रवेशनिर्गमौ स्वकालांशैर्योज्यौ। अर्धचक्रांतरितश्च परमे वक्रे ग्रहो यतः शीघ्रनीचोच्चवृत्तपरिधिवाधोवती भवत्यानुलोम्येन। तत्र प्राग्गति-

रिव लक्ष्यते। प्राग्गतिवासनापि तत्र घटत एव यत स्वगतितुल्येनाध्वना ग्रहः प्राग्गच्छन्नुपलभ्यते, ततोऽपि स्वगतेर्यद्येकदैवसिकमृणफल प्रतिमण्डलग्रहभूमध्य-प्राप्ति सूत्रवशात्कक्षा मण्डले महदुपलभ्यते ततः स्वभुक्तेः प्रतिमण्डलकक्षा मण्डलादभेदस्य यदांतरं सा तु वक्रभुक्ति शीघ्र- नीचोच्चवृत्तेः प्रदर्श्यम्। सर्वमन्द-नीचोच्चवृत्तेः पुनः प्रतिलोमो ग्रहो भ्रमति। तत्राधोवंत्यपि प्राग्गतिरुपलभ्यते ततो रविचन्द्रयोर्वक्राभाव इत्येवं स्वधिया नीचोच्चवृत्तयोर्धनर्णादिका वासना योज्या।

तत्रस्थग्रहभूमध्यप्राप्तिसूत्रवश्यात्तत्र च यदुक्तं। त्रिज्याभक्तः कर्ण इत्यादि प्रतिमण्डल कक्षामण्डलयोर्भुजफलस्य स्वल्पांतर प्रतिपादनपरं मन्द कर्माणि अन्यथा पुनः पुनः शीघ्र कर्मण्येतदेव स्यात्। न चैवं तत्र क्रियते, यदि क्रियते तद्‌बहुभागांतरं भवत्यतः स्वल्पांतर तत्कर्णो मन्द कर्मणि न कार्यं इति। न तु चैक एव ग्रहः क एते मन्दोच्चशीघ्रोच्च पाताः। यदि परमाधिका तत्कथं ग्रहवन्नोपभ्यते, असत्यञ्चेत्काभुक्तिकल्पना तेषामित्यत्र परिहारमाह—

प्रतिपादनार्थमुच्चं प्रकल्पितं ग्रहगतेस्तथा पातः।
भुक्तेरूनाधिकता मानस्यं भवति कर्णवशात् ॥३०॥

वास०—प्रतिपादनार्थमुच्चं प्रकल्पितं ग्रहगतेः शिष्याणां पारमार्थिग्रहगत्य-वगतये। नीचोच्चादिका कल्पना यतस्तद्वशात्पूर्वापरगतिर्द्रष्टुं सिद्धा भवति। तथा पात इति प्रतिपादनार्थमेव पातः प्रकल्पतो यद्वशाद्दक्षिणोत्तरा गतिः सिद्धा भवत्यतः परमार्थतया ग्रहण एव केवल इत्यर्थः। कथं चेत्कल्पत इत्याह—भुक्ते-रूनाधिकतामानस्य च भवति कर्णवशात्। अयमभिप्रायोभीष्टदिनेऽभीष्टकाले यद्यादियंत्रेण ग्रहं विद्यात्, द्वितीयदिने तावत्येव काले विद्यात्। तत्रांतरमाक-लय्य तत्परिधिना स्फुटभुक्ति कल्पयेत्। मध्यभुक्तिश्च स्वभगणभोगार्कसावन-दिनैर्भपरिधिं खखषट्‌क न संख्यं विभज्य भवति ततो यदि स्वमध्यगते ऋणात्त-दैव सिकी भुक्तिः तदा कक्षामंडलादुपरिग्रहः अधिका चेत्तदधोरविचंद्रयोः कर्णश्च ग्रहभूमध्यांतरं यतस्तद्वशादवगम्यते। एवं परमाल्पतां भुक्तेः परमधिवतां व लक्षयेत्। भगणभोगं यावद्‌गणभोगगत्यैव भवत्यतोवगम्यते। यद्यपि भुक्ति-भेदात्कक्षामंडले न ग्रहः तथापि तत्तुल्ये मंडले ग्रहो भवति। भगणभोगयोः तुल्यत्वात्। मंद कर्णश्चात्यल्पभुक्तावति महान्। अतिवृहद्भुक्तावत्यल्पः परमंद-कर्णं व्यासार्धांतरं परम फलतश्च मंदनीचोच्चवृत्त व्यासार्धं तद्वशादर्धांतरे फल-भेदस्तत उच्चकल्पना युज्यते रविचन्द्रयोः कुजादीनां पुनः स्फुटमध्यभुक्तोरंतरं मंदशीघ्रकर्णवशाद्भिद्यते तत्र मंदकर्णेन रविवदंतरकल्पना सावाध्या शीघ्र-कर्णवशान्महत्यंतरकल्पना सा च वैपरीत्येन योज्या अतस्तत्र शीघ्रोच्च मंद-स्फुटग्रहयोरंतरं साध्यं कक्षामंडले। तच्च महति कर्णे स्वल्पं भवति। अल्पे च

महदतो मध्यभुक्तेरथाधिकं तत्रांतरं भवति। यस्माद्वक्रादय उपलभ्यंते, इत्यादि स्वधिया योज्यम् तत्कलोत्पत्तिवशाच्चकेंद्र भुक्तिरुपलभ्यते। तां ग्रहभुक्तौ संयोज्य शीघ्रोच्चभुक्तिर्भवति। मंदकेंद्र भुक्तिग्रहभुक्तयोरंतरं मंदोच्चभुक्तिर्न च शीघ्र-मंदोच्चनीचे वस्तुभूत इत्यर्थः। एवं परमविक्षेपाद्यंते दक्षिणोत्तरयोर्विमंडल-सिद्धिः। ततः परम विक्षेपस्यान्यात्रान्यद्दृष्टत्वीत्यातगते कल्पना यथा कर्णवशा-द्भुक्ति कल्पना, एव मानवशादपि, तुल्यैवमत्राप्युच्चादि कल्पना युक्तावसाना तुल्यत्वात्। मंदशीघ्रकर्णयोरपि न केवल मुच्चादयः कल्पिता यावद्भूपंजरभ्रमणं कल्पितमेव नः प्रतिभाति, ग्रहस्य युगपद्गतिद्वयासंभवात्। यदा तु पुनर्भुव आवर्तनं कल्पते। तदा भपंजरे स्थिरेपि प्रतिदैवसिकावुदयास्तमयौ संभवेतां ग्रहाश्चापमंडलविमंडलगतयः प्रागगतय एवं विमंडलवशाद्दक्षिणोत्तरापि गतिः सिद्धा भवति, भूयश्चावर्त्तावर्त्यहोरात्रेण क्षितिजे रविणा सह युज्यते। ग्रहश्चाग्रतोऽग्रतो याति वक्रादिवासना तुल्यैव, आचार्यार्यभट्टेनापि भू भ्रमण-मभ्युपगतम्। यतो दशगीतिकासूक्तम्। प्राणेन कलां भूरिति, तथार्याष्टशते, अनु-लोमगतिर्नैस्थः पश्यत्यचलं विलोमगं यद्वत्। अचलानि भानि तद्वत्समपश्चिमगानि लंकायामिति। लोकभयाद्भास्करादिभिरन्यथा मत्वा इयमार्या व्याख्याता। न चात्र तत्त्वमवगन्तुं शक्यतेऽस्मदादिभिः किंतु स्वाभिप्रायो लिंगनाकृतेत्येवं स्फुटगतिबसने द्विशतः प्रदिशता तत्रैव प्रत्यार्यासूत्रं प्रदर्शयिष्याम इति स्फुट-गतिवासना।

इदानीं रविचन्द्रग्रहणयोर्वासना प्रदर्श्यंते। तत्र मानयने योजनकर्णा-भ्यां प्रयोजनं तत्प्रसंगेन सर्वग्रहाणां योजनकर्णायिनमाह—

कक्षाव्यासार्धगुणा मंडला लिप्ता विभाजिता कर्णः।

वास०—कक्षेति जात्यपेक्षयैकवचनं व्यासार्धं ग्रहणेन भगणकला व्यासार्धं गृह्यते नखमुनिरदायत उक्तं योजनकर्णप्रमाणार्थं भगणकलाकर्णः तेनेष्टग्रह-कक्षाव्यासार्धेन गुणमण्डललिप्ता गणकलाः ताभिर्विभाजिता किं भवति कर्णः भूमध्यं तत्कक्षामण्डलांतरे योजनात्मकं व्यासार्धं भवतीत्यर्थः। अत्र त्रैराशिकं यदि भगणकला तुल्ये परिणाहे रसचन्द्रकृततुल्यं व्यासार्धं तदिष्टग्रह कक्षातुल्ये किं भविष्यतीति फलं योजनकर्णम्। सर्वेषां कक्षाकर्णानियनम्। मया सिद्धा एव योजनकर्णलिखांते कर्णद्वयेन तद्यथा अर्केषु खेषु वसुषट्क मितोऽर्कः कर्णः चन्द्र-खवेदयमचन्द्रशरैश्च कौजः। शून्यद्विवेदवसुवस्विनतुल्यसंख्योबोधस्तुनेत्रवसुरंध्र-कृताष्टिसंध्या॥

रामाग्निमगलकृतार्कवसुप्रसंख्यं जैवः सितस्य रसखाब्धिशशिद्विवेदाः।

अश्व्यष्टबाणखनवेंदुखनेत्रसंख्य: सौरोखे विनिहित: स्वरसैस्तु भानाम्। एते योजनकर्णा मध्यमा ग्रहनक्षत्राणामिति।

इदानीं योजनकर्णानांस्फुटीकरणार्थं द्वितीयमार्यार्धमाह—

स्वकलाकर्णेन गुण: कर्णस्त्रिज्याहृत: स्पष्ट: ॥३१॥

वास०—स्वश्च सौकलाकर्ण: स्वकलाकर्ण: तेन गुण: को सो कर्णेनांतर-प्रक्रांतौ मध्यमयोजनकर्ण इत्यर्थ:। त्रिज्याहृत: स्पष्ट: व्यासार्धभक्त: स्फुटयोजन-कर्ण:। प्रतिमण्डलस्थ ग्रहभूमध्यप्रापी भवतीत्यर्थ:। एवं सर्वेषां कर्णपुटीकरणम्। वासना चात्र त्रैराशिकोक्ता इदानीं भूरविशशिना योजन[illegible]बप्रमाणदर्शनार्थं खरूपप्रतिपादनाय चार्यामाह—

मृद्दहनजलमयानां विष्कंभो योजनै: क्विनेंदूनाम्।
शशिवसुतिथिभिर्यमपक्षशररसै: शून्यवसुवेदै: ॥३२॥

वास०—मृद्दहनजलमयानां यथासंख्यं क्विनेंदूनाम्, कु: पृथिवी इनो रवि: इंदुश्चन्द्र:, कुश्चेनश्चेंदुश्चेति द्वंद्व:। तेषां विष्कंभो योजनै: मृन्मयी भू: प्रत्यक्षत एवास्माभिरुपलभ्यते। अग्निमय: सूर्य: सोऽप्यस्माभि: तादृगेवोपलभ्यते। यतोऽर्क-दीधिति प्रतिबिंबत्वेन चन्द्रदीधितयो यथान्यत्रापि जले पतिता अर्करश्मय: तदपि जलं रश्मिवत्कुर्वते तद्वदिहापि तेषां क्विनेंदूनां योजनैरेतावत्संख्यैर्विष्कंभ: भूगोल-व्यास: शशिवसुतिथिभि: शतैरेकाशीत्यधिकै: १५८१। रविगोलस्य व्यासोपमपक्ष-शररसै: षड्भि: सहस्रै: पञ्चभि: शतै:द्वाविंशत्यधिकैरित्यर्थ:—६५२२। चन्द्रोगोल स्य व्यास: शून्यवेदैश्चतुर्भि: शतैरशीत्यधिकैरित्यर्थ: ॥४८०॥

इदानीं चन्द्रप्रदेशे भूछाया विष्कुंभस्य योजनात्मकस्यानयनार्थमार्यामाह—

कर्कव्यासांतरगुणमिंदुस्फुट कर्णमर्ककर्णहतम्।
प्रोह्य भुवो भूछाया विष्कंभश्चन्द्रकक्षायाम् ॥३३॥

वास०—कुश्चार्कश्च कर्कौ तयोर्व्यासौ कर्कव्यासौ व्यासयोरंतरं न्यासेत्। रविभूयोजन व्यासयोर्विशेष इत्यर्थ:। तेन गुण इंदो: स्फुटकर्णचन्द्रमस: स्फुट-योजनकर्ण इत्यर्थ:। अर्ककर्णेन हतोर्ककर्णहत: रविस्फुटयोजनकर्णेन विभक्त इत्यर्थ:। अत: कर्कव्यासांतरगुण मिंदु स्फुटकर्णमर्क कर्णहतम्। स तं प्रोह्य कुत इत्याह भुवो भूव्या सहभूछाया द्रिष्कंभश्चन्द्रकक्षायां चन्द्रकक्षाग्रहणेन चंवस्थान-प्रदेशंदर्शयति। तेन चन्द्रपतिमण्डलप्रदेशे योजनात्मकी भूछाया व्यासो भवति इत्यर्थ:। यतस्ततोधो महानुपरि च सूक्ष्म भूछाया व्यासो भवतीत्यर्थ:। तद्यथा

भूव्यासा शशिवसुतिथयः १५८१ रविव्यासो यमपक्षशररसा ६५२२ अनयोरंतरं रूपकृतनववेदाः ४९४१ अनेनाभीष्ट दैवसिकं चन्द्रफुटयोजनकर्णं संगुणय्य रवियोजनकर्णेन विभज्यावाप्तं भूयासादस्माच्चन्द्राष्ट शरेंदुसंख्यात् ।१५८१। विशोध्य भूछायाविष्कंभो भवति। चन्द्रकक्षाप्रदेशे तत्प्रतिमण्डल इत्यर्थः। अत्र दीपछाया गणितवासना रविव्यासार्धेन प्रदर्श्या तद्यथा । यदि रवियोजनकर्णं-तुल्यछायया रविव्यासार्धभूव्यासार्धांतर तुल्या छाया कोटिर्लभ्यते । तत्स्फुट-शशियोजनकर्णतुल्यया कियतीतिलब्धं भूव्यासार्धस्य चन्द्रप्रदेशजभू छाया विष्कंभार्धस्य चांतरं तद्भूव्यासार्धादपास्य द्विगुणं कृत्वा चन्द्रकक्षाप्रदेशे भूछाया विष्कंभो भवतीत्यर्थः । आचार्येण भूव्यासार्धोनं रविव्यासार्धं द्विगुणं कृत्वा निबद्धं ततश्च यत्फलं तदपि सकलमेव भूव्यासाच्छोध्यते इति च निबद्धम् । अतः सूत्रार्थो वासनायां घटक इति अत्रार्यायां चन्द्रमन्दप्रतिमण्डलोपलक्षणार्थं-यतः स्फुटयोजन कर्णे कर्म प्रदर्शितम् । इदानीं भूछाया विष्कंस्य योजनात्मकस्य लिप्तीकरणमाह—

तद्गुणितं व्यासार्धं शशिकर्णहृतं तमः प्रमाणकलाः ।

स्वास०—तदित्यनंतरोक्तभूछायाविष्कंभस्य परामर्शः । तेन गुणितं तद्-गुणितं व्यासार्धंतसचन्द्रकृतगुणसंख्यभगणकला व्यासार्धमित्यर्थः । शशिकर्ण-हृतं चन्द्रमध्ये योजनकर्णेन हृतं तमः प्रमाणकला भवंति । अत्र त्रैराशिक द्वयं यदि चन्द्रमध्ययोजन कर्णस्य व्यासार्धतुल्याः लिप्ता भवन्ति । तच्चन्द्रस्फुटयो-जनकर्णस्य कियत इति फलं स्फुटकला, कर्णः ततो यदि चन्द्रस्य स्फुटयोजनकर्णस्य चन्द्रस्फुटकला कर्णतुल्या लिप्ता भवन्ति। तदस्य स्फुटभूछाया विष्कंभस्य कियत्य इति। स्फुटयोजनकर्णप्रथमे गुणकारः द्वितीये भागहारस्तुल्यत्वान्नष्ट यो भूछाया विष्कंभस्य त्रिज्या गुणकारो मध्येन न कर्णभागहारः फलं लिप्ता रूपं तमः प्रमाणं चन्द्रमन्दप्रतिमण्डलप्रदेशे। अधुना रवि चन्द्रयोजनमानयोर्लिप्ता-नयनमाह—

एवं त्रिज्यारविशशि विष्कम्भगुणा स्वकर्णहृता ।।३८।।

वास०—त्रिज्यारविशशिविष्कम्भगुणा रवियोजनमानेन मध्यमेनैकत्रगुणिता-न्यत्र चन्द्रयोजनमानेन स्वकर्णाभ्यां हृता स्वस्फुटयोजनकर्णयो पृथक् पृथग्विभजनी-येत्यर्थः। एवं रविशशिनोर्माने लिप्ता रूपे निरूपते इत्यर्थः। अत्र त्रैराशिकद्वयं यदि मध्ययोजन कर्णतुल्यैर्योजनैः व्यासार्धतुल्या लिप्ता लभ्यन्ते तन्मध्यममानयोजनैः कियत्य इति लिप्तारूपं मध्यमानं लभ्यते। ततो द्वितीयं यदि मध्ययोजनकर्णे एता स्फुटयो योजनकर्णे कियन्मानं द्वितीयं व्यस्तत्रैराशिकं महति स्फुटकर्णे यदल्पं मानमल्पे च महत्तदात्र प्रथमे मध्यमयोजनकर्णो भागहारो द्वितीये गुणकारस्तु-

ल्यान्नष्टयोर्मध्यमयोजनविष्कंभस्य त्रिज्यागुणाकारः स्फुटयोजनकर्णो भागाहारः फलं स्फुटमानलिप्ता रवे चन्द्रस्य चैवं मानान्यभिधायेदानीं रविचन्द्रग्रहणयोः स्वरूप प्रतिपादनार्थमार्यामाह—

भूछायेन्दुं चन्द्रः सूर्यं छादयति मानयोगार्धात् ।
विक्षेपो यद्यूनः शुक्लेतरपंचदश्यन्ते ॥३५॥

वास०—छादयतीति उभयोरपि सम्बध्यते । तेन नायमर्थः । भूछायेन्दुं छादयति । चन्द्रश्च सूर्यं छादयति । यथा संख्या शुक्लेतरपञ्चदश्यन्ते । किं सर्वदैव नेत्याह मानार्धयोगार्धाद्विक्षेपो ग्राह्यग्राहकयोर्लिप्तामानयोगार्धात् । तात्कालिको विक्षेपोय द्यूनः । तदाग्रासस्म्भवः अत्रेयं वासना । रवेर्भार्धान्तिरिता सर्वदा भूछाया भ्रमति पौर्णमास्यन्ते चन्द्रोऽपि भांतरित एव तत्रस्थाश्चासौ यद्यतिविक्षिप्तोपमण्डलान्न भवति । तदा भूछायां प्रविशति यतश्चन्द्रकर्णछायादैर्घ्यमधिकं भूछाया चापमण्डले भ्रमति चन्द्रस्तूपातासन्नो विमण्डलस्थोऽपि भूछायां प्रविश्य महत्त्वाभूछायाः सूर्यरक्तचन्द्रमसश्छाद्यते । उपरिरविरधश्चन्द्रः स च शीघ्रगतिः सन्छाद्य प्रागच्छति मेघखण्डवत् । अमावस्यायाः अन्ये च एकसूत्रगतौ द्वावपि भवतः तव स्फुटविक्षेपवशाद्यद्यति विक्षिप्तश्चन्द्रो न भवति । तदा रविग्रहणं यतो बिम्बयोः केन्द्रान्तरालं स्फुटविक्षेपः स च यदि मानार्धादधिको भवति । तदा बिम्बयोर्युतिरेव न भवति । अथोनस्तदा परस्परमनुप्रवेशो भवति, इत्येवं सर्वं गोले प्रदर्शयेत् ननु च राहुकृतग्रहणं रविचन्द्रयोः तत्किमुच्यते । भूछायेन्दुं चन्द्रः सूर्यं छादयत्येतदाशङ्क्य राहुकृतं ग्रहणं निराचिकीर्षुरादौ तावद्ग्राहकद्वयप्रतिपादनार्थं माह—

महद्विंदोरावरणं कुण्ठविषाणो यतोऽर्धसंछन्नः ।
अर्धच्छन्नो भानुस्तीक्ष्णविषाणस्ततोऽस्याल्पम् ॥३६॥

वास०—स्पष्टाथयमार्या । अन्येन रविः छाद्यते अन्ये न च शशी यतो छन्नस्येन्दोः कुण्ठविषाणत्वादवगम्यते महान् कश्चिद्ग्राहक इत्यस्य । रवेश्चावछन्नस्य विषाणयोः तैक्ष्ण्यादवगम्यते, अल्पोस्य ग्राहक इति तौ च भूछायाचन्द्रमसौ युक्तौ नान्यैर्नियुक्तिकौ कल्पयितुं शक्येते इति राहुकृतग्रहणस्यान्यदूषणद्वयमाह—

यदि राहुः प्राग्भागाविन्दुं छादयति किं तथा नार्कम् ।
स्थित्यर्धं महदिन्द्वोर्यथा तथा किं न सूर्यस्य ॥३७॥

वास०—इयमपि स्पष्टार्था। मण्डलप्राग्भागे यथा चन्द्रमा छाद्यमानो-दृश्यते। अर्कश्च मण्डलापरभागे छाद्यते तद्राहो रेकत्वात्किमेतत्। भूछायां तु पुनः चन्द्रः प्रागाछन्निव पूर्वभागेनैव प्रदेशं करोतीत्येतस्य प्राच्यां दिशि प्रग्रहण-मुपपद्यते। रवेस्तु शीघ्रगश्चन्द्रः स च पूर्वाभिमुखो गच्छन्निव बिंबं पश्चाद्भागे प्रग्रहणमुपपादयति। अतो ऽन राहुकृतं ग्रहणमित्यर्थः। अन्यच्च स्थित्यर्धं मह-द्यथा चन्द्रग्रहणे किं तथा नार्कग्रहणे ग्राहकसामान्यात्। भूछाया च महती ततः स्थित्यर्थैर्धमहदुपपद्यते एव अतो न राहुकृतं ग्रहणमिति। राहुकृतग्रहणस्य दूषणांतरमाह—

किं प्रतिविषयं सूर्यो राहुश्चान्यो यतो रविग्रहणे।

ग्रासान्यत्वं न ततो राहुकृतं ग्रहणमर्केन्द्वोः ॥३८॥

वास०—सुगमार्थेयमार्या—सूर्यस्तावदेक एव सर्वत्र राहुश्च तत्किमिति क्वापि खण्डग्रहणं—अन्यत्रग्रहणाभाव एव रविग्रहणे चन्द्रग्रहणे च सामान्यः सर्वत्र ग्रासः। तत्किमेतदेकत्वात्स्वर्भानोः चन्द्रस्तु यदा रवेः छादकः तदा तस्याल्पत्वादव-नतिविक्षेपाक्षदेशांतरादिति ग्रासभेदः उपपद्यते। एवं यथाम्बुदखंडछन्नोर्कः क्वापि न दृश्यते, अन्यत्र दृश्यते। अन्यत्राव छन्नो दृश्यते। एवमिहापि। चन्द्रस्य भूछा-याछादिका सा चैकरूपया सर्वत्र धूमवर्ताकारी, तत्र प्रविशति चंद्रः सर्वतोऽपि छन्न एवेत्यतश्चंद्रग्रहणं सर्वसामान्यमेवोपपद्यते। तस्मादुपसंहरति, न ततो राहुकृतं ग्रहणमर्केद्वोरिति। यथास्थिते गोलवासना प्रदर्श्या अनंतरोक्तार्याणां भूछाया वासना यत्रापि मण्डले रवेः स्थितः तत्समभूभागादुभयतो नवतितमे-भूभागे सूत्रद्वयं बद्धा तदग्रे एकत्र कृत्वा रविक्रान्तापमण्डलभागादर्धं चक्रांतरिते-पमण्डल भाग एव बन्धीयात्। एवं स्थिते सूत्रांतरसंस्था भूछाया भवति ग्रहणा-ध्याययोश्च प्रतिसूत्रप्रपंचेन वासनां प्रतिपादयिष्याम इति। अत्र चाचार्यवराह-मिहिरः—सूर्यात्सप्तमराशौ यदि चोदग्दक्षिणाभिगतः चन्द्रः, पूर्वाभिमुखछायामौर्वी तदा विशतिः चन्द्रोऽधः स्थः, स्थगयति रविमंबुदवत्समागतः पश्चात् प्रतिदेश-मतश्चित्रं दृष्टवसाद्भास्करग्रहणम्। यदुक्तं भूछाया चन्द्रं छादयति। रविमिंदु-रिति वराहमिराद्यैः तेषां धर्मफलाशास्त्रायो ग्राह्यत्वप्रतिपादनायार्याद्वयमाह—

एवं वराहमिहिरः श्रीषेणार्यभट्टविष्णुचन्द्राद्यैः।

लोक विरुद्धमभिहितं वेदस्मृति संहिताबाह्यम् ॥३९॥

ग्रहणफलं गर्गाद्यैः संहितासु यदभिहितम्।

तदभावो होमजपस्नानादिफलस्य चाभवः ॥४०॥

वास०—गतार्थम् । राहुकृतं ग्रहणमेवेत्याह—

राहुकृतं ग्रहणद्वयमागोपालांगनादिसिद्धमिदम् ।
बहुफलमिदमपि सिद्धं जपहोमस्नानफलमत्र ।।४१।।

वास०—इष्टार्थेयमार्या । अमुमेवार्थं स्मृतिवाक्यैरनुमोदयति ।

स्मृतिषूक्तं न स्नानं राहोरन्यत्र दर्शनाद्रात्रौ ।
राहुग्रस्ते सूर्ये सर्वं गंगासमं तोयम् ।।४२।।

वास०—गतार्था । अत्रार्थे वेदवाक्यं प्रदर्शयति—

स्वर्भानुरासुरिरिनं तमसा विव्याध वेदवाक्यमिदम् ।

वास०—स्पष्टार्थमार्यार्धम् । ननु भूछायां चन्द्रः प्रविशति । स्वग्रहणे रविमपि छादयति चन्द्रोऽर्कग्रहण इत्युक्तं प्राग्युक्तिमत्परित्यज्य लोकप्रसिद्धराहुकृतं ग्रहणं किमित्यङ्गीक्रियते यतः प्रसिद्धिरन्यथा दृश्यते यथाशुक्लपक्षान्तरे मासो बहुष्वपि देशेषु प्रसिद्धः रवेरुपरि चन्द्रः तस्य क्षयवृद्धी दक्षशापादित्यादिना चैतद्विचार्यमाणं न सम्भवति । यदापि स्मृतिवाक्यं तद्रात्रिस्नानस्य निषेधपरम् । यच्च वैदिकं वाक्यं तत्सौमारोद्रीयवरोरश्वेतायाः श्वेतवत्सायाः पयसः श्रयणं परमर्थवादतया तत्र पठ्यते । ऐतिहासिकान्यपि वाक्यानि ग्रहणफलप्रतिपादनपराणि । य एव रविचन्द्रयो खण्डतां करोति स एव तेषां राहुः गर्गादीनामपि संहिता वाक्यानि दिग्वर्णचलनादिलक्षणैः शुभाशुभप्रतिपादकानि, तेषामपि यो ग्रसते स एव राहुः पुनर्यावत्पारमार्थिको ग्राहः को न ज्ञायते तावत्कालग्रासप्रमाणं स्थितिचलनादयो दृक्समाः कथं ज्ञातुं शक्यन्ते । तस्मात्सवासनिकं यत्प्रागुक्तं तच्छोभनम् । लोकविरुद्धोऽपि नवकृत्य इत्यतोऽर्थमार्यार्धमाह—

श्रुतिसंहितास्मृतीनां भवति यथैक्यं तदुक्तिरतः ।।४३।।

वास०—गतार्थमिदमार्यार्धम् । इदानीं तदैक्यमार्याद्वयेन प्रदर्शयति—

राहुश्छादयति प्रविशति यच्छुक्लपंचदश्यंते ।
भूछाया तमसोंऽदोर्नरप्रदानात्कमलजस्य ।।४४।।
चन्द्रोम्बुमयोधः यदग्निमय भास्करस्य मासांते ।
छादयति शमितताप्पो राहुश्छादयतिं तत्सवितुः ।।४५।।

वास०—गतार्थम् । आगमप्रामाण्यात्सोऽपि तत्राधः स्थो भवत्वित्यर्थं भवति नामराहोरधोवस्थितिस्तथापि तस्यैकत्वात्कथं रविशशिग्रहणयोर्मान-

प्रमाणं भिन्नं भवतीत्यत्राप्येकवाक्यतां योजयति—

भूछायाव्याससमः स्थितः शशिग्रहणे ।
राहुश्छादयतींदुं सूर्यग्रहणेऽ र्कमिन्दुसमः ॥४६॥

वास०—गतार्थेयमार्या । अथैवं कश्चिद्भणति महाप्रमाणो राहुभूछाया चन्द्रप्रमाणाभ्यां यदधिकं तत्किमिति नोपलभ्यते, इति संप्रत्याह—

यत्तदधिकं तमोमयराहुव्यासस्य सूर्यदृष्टत्वम् ।
न पश्यति भूछायेंदौ व्याससमोऽस्माद्भवति राहुः ॥४७॥

वास०—निष्प्रयोजनेयं गतार्था च इदानीमेकवाक्यतापक्षमुपसंहरति—

भूछायेन्दुमतो हि ग्रहणे छादयति नार्कमिंदुर्वा ।
तत्स्थस्तद्व्याससमो राहुश्छादयति शशिसूर्यौ ॥४८॥

वास०—स्पष्टार्थेयमार्या । ग्रह स्वरूप वासना ।

इदानीं गोलबन्धं प्रदर्शयति तत्रादौ सममण्डलयाम्योत्तर क्षितिजमण्डलानां विन्यासार्थमार्यामाह—

प्राच्यपरं सममण्डलमन्यद्याम्योत्तरं क्षितिजमन्यत् ।
परिकरवत्तन्मध्ये भूगोलस्तत्स्थित द्रष्टुः ॥४९॥

वास०—प्राच्यपरमुन्मण्डलं तत्सममण्डलमन्यद्यामोत्तरं द्वितीयं दक्षिणोत्तरं तदित्यर्थः, क्षितिजमन्य परिकरवद्यत्तृतीयं समपार्श्वस्थं मण्डलं तत्क्षितिजमुच्यते । मन्मध्ये भूगोलकाकारा सर्वतः स्थितस्य द्रष्टुरेतानि त्रीणि खगोलवृत्तान्येव कल्प्यानीत्यर्थः ।

तत्स्थितं द्रष्टुतित्युत्तरत्र समस्तमण्डलविन्यासे सम्बन्धो भविष्यतीति तत्र गोले स्वदेशस्थितस्य द्रष्टुः कीदृगुन्मण्डलं तत्र प्रतिपादनायार्यामाह—

पूर्वापरयोर्लग्नं याम्योत्तरयोर्नतोन्नतं क्षितिजात् ।
स्वाक्षांशैरुन्मण्डलमहर्निशोवृद्धिहानिकरम् ॥५०॥

वास०—पूर्वा चापरा च पूर्वपरेतयोर्लग्नं पूर्वापरयोः स्वस्ति कयो रासक्त मित्यर्थः, याम्या चोत्तरावद्याम्योत्तरे नतोन्नतं कुत इत्याह । क्षितिजादिति क्षितिजमण्डला द्दक्षिणखगोल स्वस्तिकान्नसूत्तरात् चोन्नतमित्यर्थः कियद्भिरक्षांशै रित्याह । स्वाक्षांशैरिति स्वदेशाक्षभागैरिति यावत् । किं तदुन्मण्डलमुदयमण्डल

मुन्मन्डल स्वदेश समदक्षिणनिरक्षदेशे क्षितिजमित्यर्थः। अहर्निशोवृद्धि हानि करणम्। निरक्षदेशज दिनरात्रोः स्वदेशे क्षयवृद्धिजनकं तद्वशात्प्रति देशं दिनरात्रि-प्रमाणे भिन्ने भवत इत्यर्थः, यतो निरक्षस्यैव स्वाहोरात्रार्धवृत्तसार्धं क्षितिजादु-परिस्थितं द्वितीयमर्धमतस्तत्र सर्वदा दिनरात्रि प्रमाणे तुल्यो क्षितिजोन्मण्डलयो रेकत्वा दन्यत्रोत्तरेणान्यक्षितिजमन्यदुन्मंडलमक्षवशादत उन्मण्डलास्वःरात्रार्धमण्ड-लस्यार्धमुपरि द्वितीयमधः तच्चोमण्डलस्वदेशक्षितिजादुत्तरेणोन्नतं दक्षिणेनाव-नतं समम् मण्डलार्धेधः स्वक्षितिजे द्रष्टा रव्युदयास्तमयौ पश्यति। स्वहोरात्रार्ध-मण्डलार्धन्यूनाधिकमपि पश्यति। तस्मादुपपद्येते क्षयवृद्धी दिननिशोर्यावच्चोत्तरेण द्रष्टा भवति। तावस्योत्तरगोलके सूर्यो महान्दिवसो भवत्यल्पा रात्रिः दक्षिणगोल-स्थे रवौ विपरीतमेवं षटषष्टिरक्षांशास्तत्र षष्टिघाटिको दिवसो रात्रेरभावः। दक्षिणायनादौ यतस्तत्र दिने ऽर्कोदयकालेपमण्डलमेव क्षितिजं दिवसस्याथभावः। उत्तरायणादौ षष्टिघटिका रात्रिः यतः क्षितिजा तत्र मिथुनांता होरात्रतुल्या परमक्रान्ति ज्या तुल्योवलंबकः। चरदलं च पंचदश घटिकास्ततोप्युत्तरेणास्मा द्दिनानि बहूनि यावत्सदुक्कद्गत एव दृश्यते सूर्यः। परतः परतो यावन्मेरुस्तत्र षड्भिमोसैर्दिवस उत्तरगोलके रवौ यावद्दिनप्रमाणं तत्र तावद्रात्रिप्रमाणं तत्रैव दक्षिण गोलस्थे इत्यादि योज्यमिति। इदानीं स्वदेशस्थस्य द्रष्टुः विषुवन्मंडल-प्रतिपादनायाह—

विषुवन्मण्डलमूर्ध्वं सममण्डलतः स्थितं स्वकक्षांशैः।
याम्येनोत्तरतोऽधः क्षितिजे प्राच्य परयोर्लग्नम् ॥५१॥

वास०—विषुवन्मण्डलं विषुवद्वृत्तं तत्कथं स्थितमूर्ध्वं सममण्लत उपरि। सममण्डलमध्यस्थितं । स्वकक्षांशैः याम्येन स्वदेशाक्षभागतुल्यैर्भागैर्दक्षिणेन तमित्यर्थः, उत्तरतोऽधः उत्तरेण चाधः गोलकभागे तावद्भिरेव भागैः। स्थितं क्षितिजे प्राच्यपरयोर्लग्नं पूर्वापरयोश्च दिशोः क्षितिजासन्नमित्यर्थः यतो निरक्ष-देशो परिविषुवन्मण्डलं तच्च स्वदेशाक्षभागे..............ले यथोक्तमेव दृश्यते। इदानीमपक्रम मण्डलप्रदर्शनार्थमिदमाह—

विषुवन्मंडललग्नं मेषतुलादावुदक् कुलीरादौ।
जिनभागैर्याम्येन मृगादावपमंडलमिहार्कः ॥५२॥

वास०—विषुवन्मण्डल लग्नं.........इत्याह। मेषतुलादौ विषुवत्खस्वस्ति-कयोरित्यर्थः। उदककुलीरादौ जिनविभागैरुत्तरत कर्कटादौ.........चतुर्विंशत्या-लग्नं याम्येन मृगादौ दक्षिणेन भागचतुर्विंशत्या मकरादौ लग्नमित्यर्थं एवम-पक्रममण्डलं सममण्डलं। मया च समण्डलादीनां विन्यासे पूर्वभेव। प्रदर्शितमिहार्कं

इत्यस्मिन्नपमण्डलेर्को भ्रमति। यतोर्कगतिरेवापमंडलं।
के तत्रापमण्डले भ्रमंतीति तदर्थमार्यार्धमाह—

पातश्चन्द्रादीनां भ्रमति भाऽर्धे रवेश्च भूछाया।

वास०—न केवलमिहापमण्डलेऽर्को भ्रमति। यावत्पाताश्चन्द्रादीनां संबंधिनो भ्रमन्ति भार्धे चक्रार्धे। रवेश्च भूछाया तत्रैव भ्रमन्तीति वासना पूर्वमेव प्रदर्शिता। इदानीं विमण्डलानां विन्यासप्रदर्शनायाह—

पातादपमण्डलवद्विमण्डलानि स्वविक्षेपैः ॥५३॥
सौम्यं विमण्डलार्धं प्रथमं याम्यं द्वितीयमेतेषु।

वास०—पातात्पातभोगवर्धेऽपमण्डलवदपमण्डलसंस्थाने च विमण्डलानि बध्नीयादिति अर्थः। अयं विशेषः स्वविक्षेपैर्यथापठितस्वविक्षेपैस्तयोरपमण्डलविमण्डलयोरंतरं भवति। मध्ये याम्योत्तरयोरपमण्डलयोस्तथा बध्नीयादित्यर्थः। तत्र चापमण्डले सौम्यं प्रथमं यथा विमण्डलार्धं भवति द्वितीयमर्धं च यथा दक्षिणं भवति तथा बध्नीयादित्यर्थः एतच्च पूर्वमेवास्माभिः प्रदर्शितमेतेष्वित्युत्तरायर्यार्धे सम्बध्यते। एतेषु विमण्डेषु तदर्धं द्वितीयमार्यार्धमाह—

चन्द्रकुजजीवमन्दाः भ्रमंति बुधशुक्रौ च भ्रमतः ॥५४॥

वास०—किं तु तौ शीघ्रेणायमर्थः। कुजगुरुशशिचन्द्राः स्वे स्वे विमंडले मंदस्फुटगत्या भ्रमंति। बुधशुक्रौ तु पुनर्विमंडले शीघ्रगत्या भ्रमत इत्यर्थः। एतदुक्तं भवति। शीघ्रनीचोच्चवृत्तमध्यं स्वे विमंडले भ्रमति। कुजगुरुसौराणां तद्वशाच्च तत्परिधिस्थितो ग्रहोपि तावत्येवांतरेऽपमंडलाद्विप्रकृष्टो भवति। तेन मंदस्फुटाग्रहाद्विक्षेपादानयनं समागमाध्याये वक्ष्यति। बुधशीघ्रयोस्तु न केवलं शीघ्रनीचोच्चवृत्तमध्यवशेन विप्रकृष्टो यावत्स्वशीघ्रयोश्च प्रतिमंडलवशेन च यतोतः स्वशीघ्राद्विक्षेपानयनं तयोर्वक्ष्यति अने…लब्धिः…दि कारणं शक्यते वक्तुं परिध्यादिष्विवेति। इदानीं दृङ्मंडल प्रतिपादनायाह—

दृङ्मंडलार्धं मूर्ध्वं यत्तत्परिधिस्थितं ग्रहं द्रष्टा।
पश्यति यतः क्षितिस्थस्तद्भ्रमति ततो ग्रहाभिमुखम् ॥५५॥

वास०—दृष्टिमंडलं दृङ्मंडलं यष्टिं क्षिप्त्वा ग्रहो दृश्यते। तद्दृङ्मंडलं तस्यार्धमूर्ध्वं तस्य दृङ्मंडस्य यदर्धं क्षितिजादुपरिस्थित…परिधिस्थितपश्यति द्रष्टाग्रहं। यतस्तावद्भ्रमति ग्रहाभिमुखम्। तत् दृङ्मंडलस्यार्धमुपरित…ग्रहाभिमुखमत एव भ्रमति ग्रहं न त्यजतीत्यर्थः। खगोलवृत्तानां प्रमाणेन अन्यद्वृत्तं निर्मायत

दृङ् मंडलं न्यसेत् । उदयकाले क्षितिजग्रहोदयप्रदेशे यथा परिधिनासक्तो भवति । समंडलस्योपर्यधः स्वस्तिकयोश्च सर्वथा परिधि यथासक्तो भवति तथा तद्वृत्तं निदध्यात् । मध्याह्ने च याम्योत्तरमंडलवद्भवति । अस्यमयक्षितिजप्रदेशासक्तश्चास्तमये तत्परिधिर्यथा भवति, तथा निदध्यादित्येवम् । यथाग्रहो भ्रमति तथा तथा तद्वृत्तं भ्रामयेदेवं, तत्परिधौ सर्वदैव ग्रहो भवति । तत्र मंडले शंकुरुन्नतज्या दृग्ज्या नतज्या तदर्धं सर्वदा क्षितिजादुपरि भवति । द्वितीयमर्धमधो यथास्थिते गोले विन्यस्य शंकुछायादिवासना प्रदर्श्या । इदानीं दृक्क्षेपमंडलप्रदर्शनार्थमाह— क्षितिजापमण्डलप्रदर्शनार्थमाह—

क्षितिजापमण्डलयुतौ लग्नं लग्नाग्रया दिशावलग्नम् ।
दृक्क्षेपमंडलं दक्षिणोत्तरं वित्रिभविलग्ने ॥५६॥

वास०—क्षितिजापमण्डलयोर्युतिर्यत्रापमण्डलस्योदयः क्षितिजेन सहैकत्वं लक्ष्यते, तत्र प्रदेशे क्षितिजापमण्डला युतिर्लग्नव्यपदेशः । तस्य प्रदेशस्य लग्नाग्रया दिशावलग्नम् । लग्नस्याग्रा लग्नाग्रा क्षितिजे सममण्डलापमण्डलांतरांशानां ज्येत्यर्थः । सा लग्नाग्रा तस्या अग्रायायादिक्तयादिशावलग्नम् सापमण्डलपूर्वा । तद्दक्षिणोत्तरं दृक्क्षेपमण्डलं वित्रिभविलग्ने । एतदुक्तं भवति यदि लग्नाग्रा सममण्डलरेखा उत्तरेण भवति । तदा वित्रिभलग्नमपि याम्योत्तरमण्डलात्पूर्वेण भवति । मध्यज्यावृत्ते यतस्तत्र परमोच्चतापमण्डलार्धस्य क्षितिजादुपरिस्थितस्य विषुद्रवापमण्डललग्नं·····सममण्डलरेखातो दक्षिणेन भवतीत्यर्थः । यत एव स्वतो दृक्क्षेपमण्डलं वि······विलग्न······णोत्तरं प्रदर्श्यम् । यस्मान्मध्यज्या- संभवे विषुवदिनं वर्जयित्वा···याम्योत्तर······दृक्क्षेपमण्डलं न भवति दृष्टिः क्षिप्यते मण्डलदक्षिणोत्तरेण यत्र तद्दृक्क्षेपमण्डलभवन······यथावत् । यथा सममण्डलोपर्यधः स्वस्तिकयोर्यंतो वित्रिभलग्नावगाहि भवति तदा दृक्क्षेप······ गोले निधाय रविवासनां प्रदर्शयेत् । यतो मण्डलगत्या पूर्वापरं लंका······दृक्क्षेप- मण्डलं·····दक्षिणोत्तरावनतिरिति । स्वाहोरात्र प्रदर्शनार्थमार्यामिमामाह—

विषुवदुदग्बध्नीयात् क्रान्त्यंशसमान्तरेष्वजादीनाम् ।
वृत्तत्रितयं व्यस्तं कर्क्यादीनां तुलादीनाम् ॥५७॥
विषुवद्दक्षिणतोऽन्यन्मकरादीनां तदेव विपरीतम् ।
स्वाहोरात्राण्येषां व्यासाः पृथगेव मिष्टमपि ॥५८॥

वास०—विषुवदुदग्बध्नीयात् किं तत् वृत्तत्रितयं केषामजादीनां कियत्स्वं- तरेषु क्रान्त्यं शेष्वजादीनां क्रान्तेरंशाः क्रान्त्यंशाः विषुवत् उत्तरेण यावद्भिः यावद्भिः स्वक्रान्त्यंशैः मेषवृषमिथुनाः स्थितास्तैरित्यर्थः । विपरीतं कर्कटादीनां तुलादीनां विषुवदुदक् एवं तुलादीनां विषुवद्दक्षिणेन वृत्तत्रितयं मकरादीनां तदेव

विपरीतं यद्धनुषस्तन्मकरस्य यद्वृश्चिकस्य तत्कुम्भस्य यत्तुलायास्तन्मीनस्येत्यर्थः। स्वाहोरात्राण्येषां वृत्तानां व्यासाः पृथगेव शिष्टमपि। यथा मेषादीनां स्वाहोरात्र-व्यासतुल्यानि वृत्तानि स्वक्रान्त्यग्रेषु प्रदर्शितानि। एवं स्वाहोरात्र प्रमाणेना-भीष्टस्य ग्रहादेः स्वक्रांत्यग्रात्स्वाहोरात्रवृत्तं बध्नीयादित्यर्थः। स्वाहोरात्रवृत्तानि कक्षागोले बध्नीयादित्यर्थः, न खगोले एतच्चास्माभिः पूर्वमेव व्याख्यातम्। स्वाहो-रात्रवृत्ते दिनगतशेषादयः प्रदर्श्या गोले। इदानीं त्रिप्रश्नाध्यायवासना प्रदर्श्यंते। तद्यथा निरक्षदेशे भपंजरः सम एवावतिष्ठते। तत्रराश्युदयात्किमिति भिन्ना। तदुपपत्त्यर्थमार्याद्वयमाह—

लङ्कासमपश्चिमगं प्राणेन कलां भमण्डलं भ्रमति।
अपमण्डलस्य राशिर्द्वादशभागः क्षितिजलग्नात् ॥५९॥

यान्त्युदयं मेषाद्या यतस्तदुदया न कालसमाः।
क्रान्तिवशाल्लंकायां तदूनताधिक्यमक्षवशात् ॥६०॥

वास०—लकाग्रहणं निरक्षदेशोपलक्षणार्थं लंकायाः समपश्चिमगं निरक्षदेश उपर्यधोगमित्यर्थः। किं तत् भमण्डल······क्ष······विषुवन्मण्डलमित्यर्थः। प्राणेन कलां भमण्डलं भ्रमति। प्राणतुल्येन कालेन यस्य मण्डल ·····भ्रमति। उन्मण्डलं तत्। न तदपमण्डलम्। रविस्तु पुनरपमण्डलस्य द्वादशभागः राशयः······क्षितिज-लग्ना उदयं यांति। यतो यस्मात्ततस्तस्मात्तेषामुदयास्तदुदयाः न कालसमाः ······काल समान भवंति तस्माद्धेतोः क्रांतिवशाद्यतो विषुमंडलापमंडलयोरंत ······क्रांतिः त··· दपमण्डलं च तिर्यग्भवति। यदि विषुवन्मन्डले राशयः स्यु-स्तत्पंचघटिका राश्युदया अपि भवेयुः। निरक्षे वा साक्षे देशे वायावच्चापमण्डले राशयः तच्चापमण्डलं लंकायामपि तिर्यक् स्थितं क्रांतिवशादस्तत्रापि तदूदनता-धिक्यं तेषां मेषादीनां न्यूनाधिकता सम्भवति। स्वदेशे तु पुरक्षवशात्तदूनताधिक्यं भवत्येवं किमत्रोच्यते। निरक्षदेशे साक्षे चगोले सर्वं प्रदर्शयेत्। अक्षवशादित्येतदु-त्तरार्धे सम्बन्धं भविष्यतीति। चरप्रदर्शनार्थमार्यामाह—

क्षितिजोन्मण्डलयोर्यत्स्वाहोरात्रांतरं चरदलं तत्।

वास०—क्षितिजं चोन्मण्डलं च क्षितिजोन्मण्डले तयोरंतरं यत्स्वाहोरात्र-वृत्ते तत्स्वदेशाक्षोन्नतिवशाच्चरदलं यतो निरक्षदेशक्षितिजोन्मण्डलयोरंतरं नास्त्ये-कत्वात्तत्र चरदलमपि नास्ति, सर्वदा तेन तुल्ये दिन रात्रिप्रमाणे ऽन्यत्राक्षवशा-दुन्मण्डलमुन्नतं नतं भवति। स्वाहोरात्रस्याक्षादधिकमूनं वा दृश्यते। अतः तत्रा-क्षवशादुपपद्येते क्षयाधिके। सर्वं गोले प्रदर्शयेत्। इदानीमग्राप्रदर्शनार्थमाह—

क्षितिजेऽग्रा प्राच्यपरा स्वाहोरात्रांतरज्या ॥६१॥

वास०—क्षितिजमण्डले अग्रा प्राच्यपरा सममण्डलं स्वाहोरात्रं स्वाहोरात्रार्धवृत्तांतयोरंतरं ये तु त्रयोंशाः तेषामंशानां या ज्या साग्रेत्युच्यते । यतस्तदग्रे ग्रहोदयास्तमयौ भवत इत्यर्थः । सममंडलादुत्तरतो दक्षिणतो वा क्षितिजे यत्र ग्रहहोदयस्तत्र सूत्रस्यैकमग्रं बद्ध्वा द्वितीयमग्रं सममण्डलादन्यस्यां दिशि तावत्येवांतरे बध्नीयाद्दक्षिणोत्तरायतं क्षितिज एव तदर्धमग्रा सा च निरक्षे क्रान्तितुल्या साक्षादेशे क्रमेणोपचीयते । तावद्यावद्यत्र षट्षष्टिरक्षांशस्तत्र त्रिज्या तुल्या भवतीत्येतद्गोले प्रदर्शयेत् । शंकुछाया कालानां प्रदर्शनार्थमाह—

स्वाहोरात्रे क्षितिजाद्दिनगतशेषोच्चता रवेः शंकुः ।
तस्माद्दिनगतशेषं शङ्कुकुमध्यान्तरं दृग्ज्या ॥६२॥

वास०— स्वाहोरात्रे स्वाहोरात्रार्धवृत्ते क्षितिजा······र्थः । दिनगतस्य शेषस्य वा यावत्युच्चता वा सा दिनगतिशेषोच्चता रवेः रविग्रहणम्······न्यास्यापि ग्रहस्य स्वाहोरात्रार्धवृत्तेषु दिनगतशेष योज्ययोश्च योज्यम् । यावदुच्च······तस्माद्दिनगतशेषं तस्माच्छंकोः दिनगतः शेषं यथा दिनगत शेषाल्पस्याह्न इत्यादि······नीनः ततश्शंकुरानीतः । ततश्छाया एवं छायाकर्णविभक्ता विषुवत्कर्णेन संगुणाः त्रिज्येत्यादिना का······नीयते इत्यर्थः । यत उभयोरप्येकैव वासना अतः पृथक् नोक्ता दृग्ज्या तु पुनः शंकुकुमध्यांतरं । शंकुमूलस्य भूमध्यस्य यदंतरं सा दृग्ज्या तस्य शंकोः सा छाया एतद्गोले प्रदर्शयेत् । तद्यथा स्वाहोरात्रार्धवृत्ते घटिकाचिह्निते यावत्यो दिनघटिकाविघटिकाश्च गतास्तावति प्रदेशे रव्युपलक्षते चिह्नं कार्यम् । तत्र सूत्रं बद्ध्वालंबयेत् गुरुणाग्रहबद्धेन केनचिल्लोष्टादिना ततो भूमध्यादन्यदवलंबकसूत्रस्पृक् सूत्रं नीत्वा क्षितिजे बध्नीयात् । एवं स्थिते ग्रहचिह्नित प्रदेशे क्षितिजयोरंतरसूत्रप्रमाणाच्छंकुः शंकुमूलाच्च भूगोलमध्यं यावत्तावत्प्रमाणा दृग्ज्या भूमध्यग्रहचिह्नितप्रदेशांतरं कर्णव्यासार्धतुल्यः एवं सर्वत्र योज्यम् । वयं च तत्रैव प्रयात्यार्यासूत्रे वासनां प्रतिपादयिष्याम इति दृङ्मण्ले शंकुदृग्ज्ययोः प्रतिपादनसूत्रमाह—

दृङ्मण्डले नतांशज्या दृग्ज्या शंकुरुन्नतांशज्या ।

वास०—दृङ्मण्डले पूर्वप्रदर्शितया नतभागानां ज्या सा दृग्ज्या या तु पुनरुन्नतभागानां ज्या सा शंकुः भवति । एतच्च गोले प्रदर्शयेत् । यतो ग्रहोपलक्षितप्रदेशे स्वाहोरात्रदृङ्मण्डयोः सर्वदैव संपातो भवत्यास्मात्प्रदेश क्षितिजं यावदुन्नतभागा दृङ्मण्डल स्योपरि सममण्डलमध्यं यावन्नता तस्मादुपपन्नं मध्याह्नेऽपि दृङ्मण्डलोत्र तज्ज्या शंकुः न तज्ज्या दृग्ज्या अत एवोन्मण्मडल नतज्या क्रमेण क्रियत इति । शंकुतलप्रदर्शनार्थमाह—

अर्कोदयास्तसूत्राद्दिनशङ्कोर्दक्षिणेन तलम् ॥६३॥

वास०—अत्राप्यर्क ग्रहोपलक्षणार्थं तेन सर्वोदयास्तस्वदिनशंकोर्दक्षिणतः शंकुः तलग्रहणमुपयोगित्वात्। वार्कग्रहणं स्वाहोरात्रादुत्तरत्र निरक्षदेशे यतः शंकुतलं नास्ति शंकुतल··· ···कत्वात्तत उत्तरेणाक्षवशात्तिर्यग्गोलस्थितो दक्षिणेनात एव दक्षिणे शंकुतलं भवति।·········· मिव भूमौ यस्माच्छंकुतल-मुच्यते। यावच्चादृश्यं स्वाहोरात्रवृत्तस्य तदुदयास्तसूत्रादुत्तरेण······ ···गोले प्रदर्शयेत। छेद्यके वा तद्यथा समायां व्यासार्धकल्पितेन कर्कटकेन वृत्तम्········· कल्पयेत्। ततः प्रागपरयोरग्रे प्रसार्य चिह्नितद्वयं ततः, चिह्नितद्वयं शिरः········· तदुदयास्तसूत्रं ततो मण्डलमध्यान्मध्याह्ननतज्यां दक्षिणोत्तरेण वा निधाय। तदग्रे·········ग्र स्थितचिह्निन पूर्वदत्ताग्रचिह्नाभ्यां मत्स्यस्य विधानेन छाया-भ्रमवृत्तवद्यद्वृत्तमुत्पद्यते तदेकं·········भ्रमवृत्तं शंकु मूलवृत्तमित्यर्थः। एवमिष्ट-ग्रहस्य वा स्वोपकरणे खे तद्वृत्तपरिधौ भ्रमतो ग्रहशंकुमूलस्य यावाद्यावदंतुर-मुदयास्तसूत्रेण सह तावच्छंकुतलं स्वाहोरात्रवृत्ते छायावृत्ते तु विषुवच्छायातुल्यं सर्वदा भवतीति योज्यम्। इदानीं लंबनावनत्योः सम्भवप्रतिपादनायाह—

दृश्यादृश्यं दृग्गोलार्धं भूव्यासदलविहीनयुतम्।
द्रष्टा भूगोलोपरि यतस्ततो लम्बनावनती ॥६४॥

वास० दृग्गोलस्यार्ध दृग्गोलार्धं तद्भूव्यासदल विहीनयुतं। तद्यथासंख्यं दृश्यमदृश्यं च भवति। यदि भूमिः समा स्यात्तद्वृत्तगोलार्धं सर्वदैव सकलं दृश्यं द्वितीयमदृश्यं स्यात्। यावद्भूगोलाकाराः अत एव भूव्यासार्धो न दृग्गोलार्धं द्रष्टा पश्यति तद्युक्तं च। द्वितीयं दृग्गोलार्धं न पश्यति क्षितिव्यासार्धोछितत्वाद् द्रष्टु-रनयैव वासनया लम्बनावती सम्भवत इत्याह। द्रष्टा भूगोलोपरियतस्ततो लम्ब-नावती या विग्रहणेऽर्कोदयकाले तिथ्यंतः। तदा भूमध्यविनिर्गतक्षितिजमण्डल प्रापितसूत्रगतौ द्रष्टा च भूगोलोपरि। स च यदा रविचन्द्रौ पश्यति तदा भिन्नवर्णं-गतिभ्यां पश्यति। रविदृक्कर्णसूत्रा च अधः स्थितो भवति। यस्माद्रवेर्महती कक्षा चन्द्रस्य चाल्पा अतस्तिथ्यन्तात्पूर्वमेव ग्रहणमध्यमुपपद्यते। पूर्वेण वित्रिभलग्नाद-परतस्त्वन्यथा। एवं लम्बनसम्भवो वनेतरपिदक्षिणोत्तरक्षितिजापेक्षया। यत-स्तद्वशाद्विक्षेपस्योनाधिकत्वं ततश्च ग्रासस्याधिकोनता सम्भवतीति। तस्मादवनते-रपि सम्भव उपपद्यते। इत्येतद्गोले प्रदर्शयेत् कियत्ययो ते लंबनावनती सम्भवत इति तत्प्रतिपादनार्थमार्यामाह—

क्षितिजे भूदललिप्ताः कक्षायां दृग्गतिन्नभोमध्यात् ॥
अवनतिलिप्ता याम्योत्तरा रविग्रहवदन्यत्र ॥६५॥

वास०—क्षितिजे भूदललिप्ता वासार्धोत्थालिप्ता भूव्यासार्धवशाद्या लिप्ता उत्पद्यन्ते ता इत्यर्थः। कक्षार्थं·· तावत्य एव लम्बनलिप्ता भवन्तीत्यर्थः, एतदुक्तं भवति भूगोलमध्यक्षितिजस्थं रवि······कर्णप्रमाणभूव्यासार्धं कोटिः द्रष्टृभूमध्यांतरं द्रष्टुः सूत्रं रविप्रापिततिर्यक्कर्णं एवं स्थि······भूव्यासदलोत्पन्नाः सर्वा एव दृग्गतिर्लिप्ताः स्युः तावच्च रविभुजायां······चन्द्रमाः स्थितः अतस्त्रैराशिकेन भूदललिप्ता उत्पाद्याः तद्यथा रवि···· भूजायाभूव्यासार्धयोजनतुल्या कोटिः तच्चन्द्रयोजनकर्णेन रवियोजनकर्णतुल्याय······च चन्द्रकक्षाप्रदेशे कोटिरूपा दृग्गतिर्भवति। योजनात्मिका सा च पंचदशा विभक्ता लिप्ता······अथवा व्यासार्धहृता चन्द्रमध्ययोजनकर्णहृता गव दृग्गतिलिप्ता कक्षायामुत्पद्यते। तावतीभिर्लिप्ताभिश्चन्द्रोनतो भवति द्रष्टृ रविसूत्रादित्यर्थः। सा चावनतिर्नभोमध्यात्सममंडलमध्याद्यदा वित्रिभलग्नसममंडलमध्यं भवति। तदा सा दृग्गतिः—परिपूर्णा भवति। न ते तु रवि सममंडलवशान्न्यूना सा भवति इत्यर्थः। अवनतिलिप्ता याम्योत्तरा यथा दृग्गतिलिप्ता तद्वदवनतिलिप्ता उत्पद्यंते।······याम्योत्तरास्ते यथा पूर्वापरयोः क्षितिजे दृग्गतिः वासना एवं दक्षिणोत्तर सममंडले क्षितिजे च वासना—एवं दक्षिणोत्तरसममंडलक्षितिजेव वासना योज्या सापि नभोमध्या दृक्क्षेप मंडले पूर्वे न्यस्ते दृश्यमानाश्चावनति लिप्ता······यत्र देशे तत्र भूदलोत्थ लिप्ता तुल्याः उत्पद्यंते। मिथुनतार्कोद्वयेन, ततो दक्षिणतो रवेः चन्द्रस्य च विक्षेपवशाद्दक्षिणतोऽपि यथेह रविग्रहणे लंबनावनती। एवमन्यत्रापि ग्रहयोः परस्परच्छादने नक्षत्रग्रहयोरपि लंबनलिप्तानामवनतिलिप्तानां वेयमेव युक्तिरिति लंबनलिप्ताश्चषष्टिहृताभुक्तांतर भाजिता घटिका भवंति चक्रिणोरचक्रिणोर प्यंतरयाश्चैकस्मिन् चक्रिणि भुक्तियोगेन भाग इत्येवं दिङ्मात्रं प्रदर्शितम्। तत्रैवं विस्तरतः प्रतिपादयिष्याम इति। अथवा दृक्कर्मद्वयोपपत्त्यार्थमार्यामाह—

सत्रिग्रहक्रान्ति रुदग्दक्षिणयोस्त्रिज्यया हृतंवलनम्।
विक्षेपगुणमृणधनं ग्रहेऽन्यद्दृक्कर्म चरदलवत्॥६६॥

वास०—सत्रिभिगृहैर्वर्तते इति स त्रिगृहः, त्रिराश्यधिकोग्रह इत्यर्थः। तस्य क्रान्तिः सत्रिगृहक्रान्तिः उदग्दक्षिणयो······तयोरित्यर्थः त्रिज्ययाहतं वलनं विक्षेपगुणसत्रिगृहस्योत्क्रमजीवया या क्रांतिः······हता सतीववलनं भवतीत्यर्थः। अयमभिप्रायः मकरराशौ स्थितस्य ग्रहस्य कक्षा······निरक्षक्षितिजोन्मंडलवत् मेषतुलादौ च पर क्रान्तिज्यातुल्येन वलनेन······तरे त्रैराशिके यदि व्यासार्धे एतावती कोटिः तद्विक्षेपतुल्यव्यासार्धवृत्तेयाकोटि सा चापमंडलीकृता ग्रहफलं भवति। उत्तरायणा विक्षिप्तेग्रहे···यत्र ग्रहस्तस्य प्रदेशस्य यावन्नोदयो भवति। तावद्ग्रहो दृश्यते······नीतोदक्षिणविक्षिप्तश्चोत्तरायणे। एवं यतः प्रथममंडल प्रदेशे उदेति······यने विक्षेपवशाद्विपरीतं योज्यम्। अतो दक्षिणोत्तरायण

वशाद्युज्यते दृक्कर्मप्रथम······निरक्षदेशेऽपि तत्संभवतीति । द्वितीयं तु दृक्कर्मचर-दलवत् । अक्षवशात्तिर्यग्···मपमंडलविमंडलयोरति तत्र पूर्वा नीता कोटिः अपचीयते वाक्षे छायवशात् । तद्यथा यदि लंबज्याकोटेरक्षज्या तुल्या भुजा तद्विक्षेपकोहे: कियती भुजा भवति सा च क्षितिजा भवतीत्येतत्पूर्वं गोले प्रदर्शयेत् । इदानीं स्वदेशे गोलविन्यासे पंचवृत्तानिस्थिराणि तानि प्रदर्शयति—

कक्षामण्डलतुल्यं प्राच्यपरं दक्षिणोत्तरं क्षितिजम् ।
उन्मण्डल विषुवन्मंडले स्थिराणि ग्रहार्क्षाणाम् ।।६७।।

वास०—कक्षामंडलतुल्यं प्राच्यपरं दक्षिणोत्तरं तुल्यमेव तृतीयं क्षितिजं तत्तुल्यमेव यत्रोन्मंडलविषुवन्मंडले, तत्तुल्ये एव एतानि पंचवृत्तानि स्वदेशे सर्वदैव स्थिराणि ग्रहाणां नक्षत्राणां चास्माभिरपि तथैव प्रदर्शितानि । इदानीं चलवृत्तानि प्रदर्शयत्येकपंचाशत्—

मंदोच्चानि सप्तोच्चनीचवृत्तानि पंचशीघ्राणाम् ।
प्रतिमंडलानि चैवं प्रत्यैकं भास्करादीनाम् ।।६८।।
दृङ्मंडल दृक्क्षेपामंडलानि क्षपापकरादीनाम् ।
षट्कं विमंडलानां चलवृत्तान्येकपंचाशत् ।।६९।।

वास०—मन्दनीचोच्चवृत्तानि सप्तानां ग्रहाणां सप्तभौमादीनां पंचशीघ्रोच्चनीचवृत्तानि । एवं द्वादश प्रतिममंडलानि चैवं द्वादशानां द्वादशैव······चतुर्विंशतिः तथा भास्करादीना प्रत्येकं दृङ्मण्डले दृङ्क्षेप मण्डलमपमण्डलम् ।।

सप्तानामे··· ······वतिः पूर्वैः सह पंचचत्वारिंशत् । तथा क्षपाकरादीन षण्णां षट्क विमंडलानामेव वृत्तानि स्थिराणि पंचैव षट्पंचाशत् । एतैर्विना किमपि न ज्ञायते । ततः······ मण्डलसंख्यैव न शक्यते वक्तुं स्वाहोरात्राधविवयवक्रान्ति विक्षेपादिमण्डलानां तथा ध्यायस्य च आर्यासंख्या प्रदर्शयति ।

यत्स्पष्टीकरणाद्यं गोलादुत्प्रेक्ष्य तत्कृतं सर्वम् ।
गोलाध्यायः सप्तत्यार्याणामेकविंशोऽयम् ।।७०।।

वास०—गोलाध्याये वदिह मया स्वसिद्धान्ते स्फुट गत्यादिकं कृतमुपनिबद्धं ततः सर्वं गोलाद···एवं मया गोलाध्याय एकविंशतितम आर्याणां सप्तत्या निवद्धमिति गोलविदा······मध्याद्यमिह यदुक्तं तत्प्रत्यक्ष मिव दर्शयति यस्मात् । तस्मादार्यत्वं गोलविदा·····स्पष्टार्थेयमार्या । मध्याद्या मिह यदुक्तं तत्प्रत्यक्षमिव दर्शयति यस्मात् तस्मादाचार्यत्वं गोल विदो भवति नान्यस्य । स्पस्टार्थेयमार्या । स्वकृतस्य गोलस्य प्रशंसार्थमाह आचार्येन ज्ञातः श्रीषेणार्यभट्ट विष्णुचन्द्राद्यैः गोलो

यस्मात्तस्माद् ब्रह्मो गोलः कृतः स्पष्टः, गतार्थेयमार्या। गोलज्ञो गणितज्ञो ग्रहगतिं विजानाति। यो गणितगोलबाह्यो जानाति ग्रहगतिं स कथं गणितक्षेत्रविशेषैर्गोलो ज्ञातुं शक्यते। तस्माद् गोलोज्ञेय इत्यर्थः इति श्रीभट्टमधुसूदनसुतचतुर्वेदपृथुस्वामिकृते ब्राह्मस्फुटसिद्धान्त वासनाभाष्ये गोलाध्ययः समाप्तः॥ शुभम्॥

अध्यर्धेन सहस्रेण मया गोलो वर्णितः, अत ऊर्ध्वं समस्नेहं सिद्धान्ते भाष्यमारभे। एवं गोलाध्यायं व्याख्यायाधुना सकलसिद्धान्तो व्याख्यायते।

समाप्तं वासनाभाष्यम्

अकारादिक्रमेण श्लोकानुक्रमणिका